

**Program of the 83rd Annual Meeting of the
American Association of Physical Anthropologists
April 8-12, 2014**

To be held at the

Hyatt Regency Calgary and Telus Convention Center
700 Centre Street SE and 120 9th Ave SE
Calgary, Alberta CANADA

AAPA Scientific Program Committee:

Susan C. Antón, Chair

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Message from the Program Chair

Welcome to the 2014 AAPA conference!

We have a great meeting with many new and exciting events! AAPA events start Wednesday afternoon with a **Committee on Diversity Mid-Career Women's Mentoring Workshop** (12-5pm) a **Student Committee Panel** (4-5pm) on *How to Get Into Grad School* followed by the annual **Committee on Diversity Undergraduate Research Symposium** (6-8pm) and our **Opening Reception** (8-11pm). We end Saturday evening with a new and expanded **Closing Reception with Student Awards** (6-9 pm - check your registration pack for a drink ticket for the closing reception!) Please note: the **AAPA Luncheon** featuring Dr. Emőke Szathmáry is Saturday and the **AAPA Business Meeting & Awards Ceremony** is Friday at 5:45 pm. Join us!

The 2014 program includes 975 scientific presentations, 13 invited poster symposia, 7 invited podium symposia, and a wealth of special events. Schedules can be found in this program (p. 6-9) and in our online schedule (at physanth.org).

Contributed poster and some podium sessions will be held in the Telus Convention Center. Posters are on display all day with authors present once in the morning and once in the afternoon. Invited half-day poster symposia and other podium sessions meet in the Hyatt. The "+15 walkway" connects the venues.

I look forward to the scientific interchange at these sessions and those facilitated by our fellow organizations also meeting in Calgary this year: the *Paleopathology Association*, the *Paleoanthropology Society*, the *Human Biology Association (HBA)*, and the *American Association of Anthropological Genetics (AAAG)*. This interchange includes: a co-sponsored session with the *AAAG* on Saturday morning, "**Beyond the Genome: Anthropological investigations of transcriptomes, epigenomes, telomeres, and microbiomes,**" organized by Geoff Hayes; a co-sponsored session with the *HBA* on Friday morning, "**Female Mate Choice in Non-Human Primates and Humans,**" organized by Constance Dubuc and James Higham, and the Wiley-Blackwell symposium Thursday afternoon "**Evolutionary Developmental Anthropology: An evo-devo approach to understanding evolution**", Julia Boughner and Campbell Rolian, co-organizers.

Thursday Evening includes, a **Plenary Poster**

Session highlighting research from across Biological Anthropology (be sure to check in for some 'treats' at each poster) and a **Plenary Panel Discussion** on *Open Access Publishing: What it is & what it may mean for you*, organized by Dr. Mark Teaford. Don't forget to join the annual **AAPA Auctions** Thursday Evening – the Silent auction starts at 4:30, the Live at 7. In 2013, we made \$10k for the Pollitzer Student Travel Awards! *So please come, bid, & contact me if you have a donation!*

On Friday, a tandem set of panels on funding starts at noon with the **Career Development Committee's** "*How to Write a Grant Proposal*" with Drs. Leslie Aiello (Wenner Gren) & Carolyn Ehardt (NSF), followed at 2:30, by the **Committee on Diversity's** "*Strategies for Making and Implementing Effective Broader Impacts Plans*" in which Dr. Ehardt leads a panel of scientists with successful BI plans from education to community outreach.

I continue to be amazed by and grateful to the small army of volunteers who help plan and organize all of this. Ed Hagen re-designed and re-coded the online registration and submission system this year. We can now gather your ideas for the meetings as well as review abstracts *and* symposia and view schedules online. I can't begin to repay Ed for his efforts. The Program and Executive committees reviewed symposia proposals and abstracts with care. Program assistants, Emily Middleton and Myra Laird, assisted with alacrity in all tasks of the 'Imperial We'. A multitude of volunteers planned the workshops, symposia, and development sessions. I am profoundly grateful to them all. And as I write, the Calgary local arrangements committee continues to work tirelessly to organize an impossible number of details unseen and unappreciated by most of us. I am especially grateful to their Chair, Annie Katzenberg. Please give each of them a hearty thanks when you see them in Calgary.

As you see, AAPA is a volunteer organization and we need you! Most standing and ad hoc committees meet during the AAPA meetings (see p. 6-9). Please come and get involved with your AAPA!

I look forward to seeing you in Calgary - recently voted a "hot-spot" destination for 2014 - but in early April, don't forget your (cowboy) boots and mittens!

Susan Antón

AAPA Vice President and Program Chair

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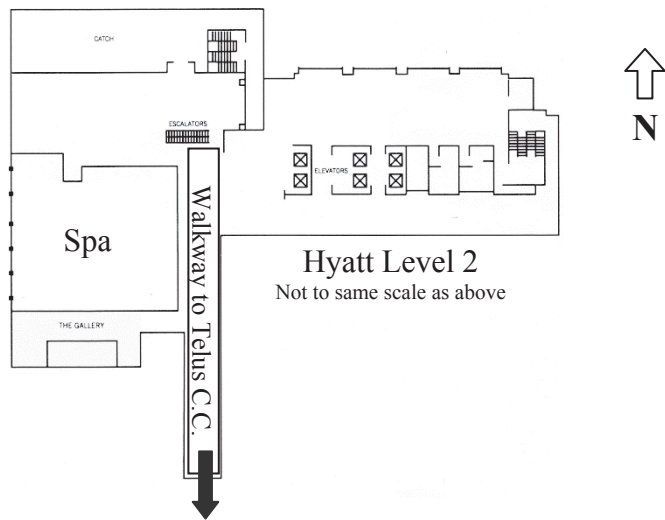
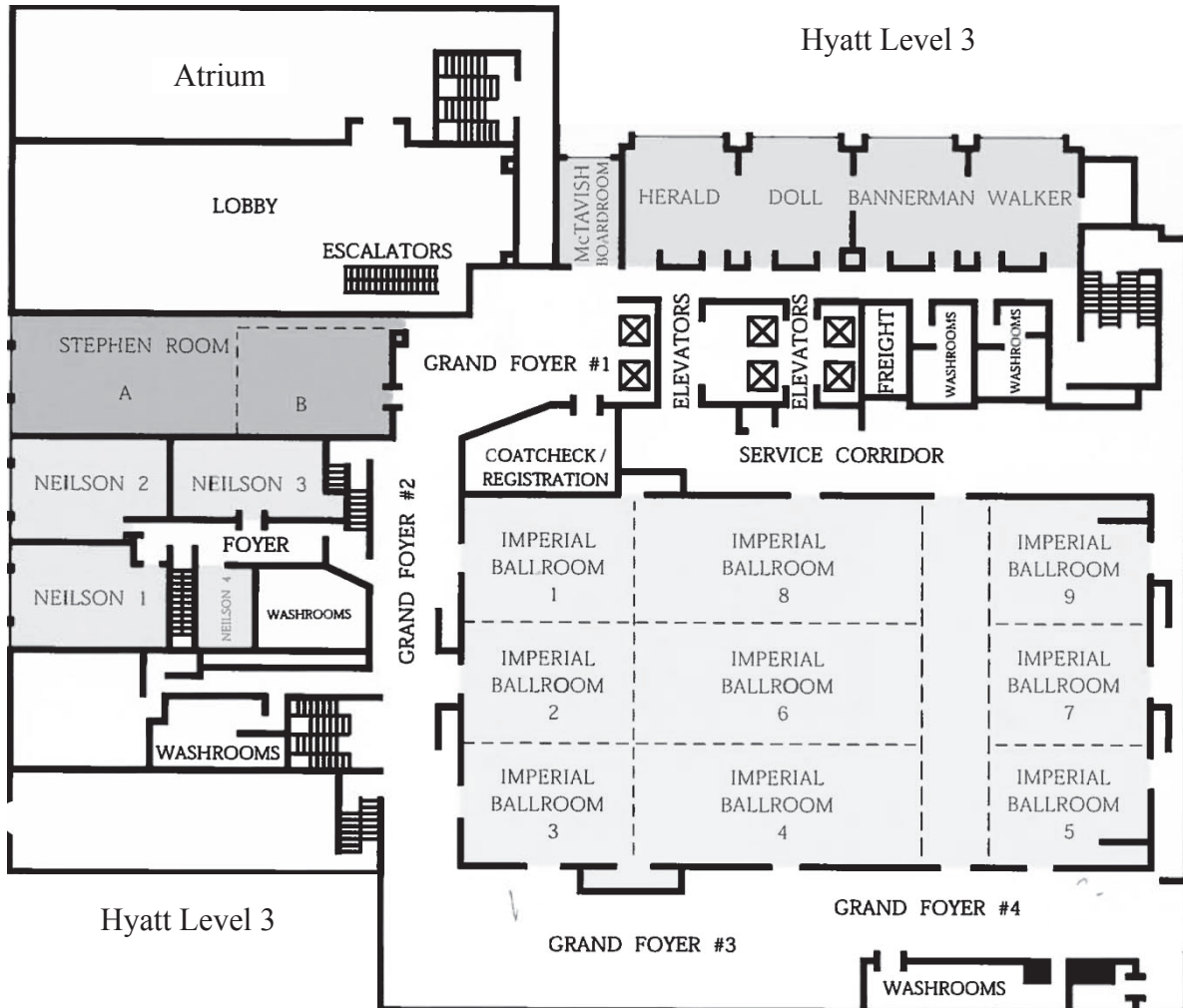
On the cover: The Calgary Skyline.

Supplement 58 was mailed the week of February 17

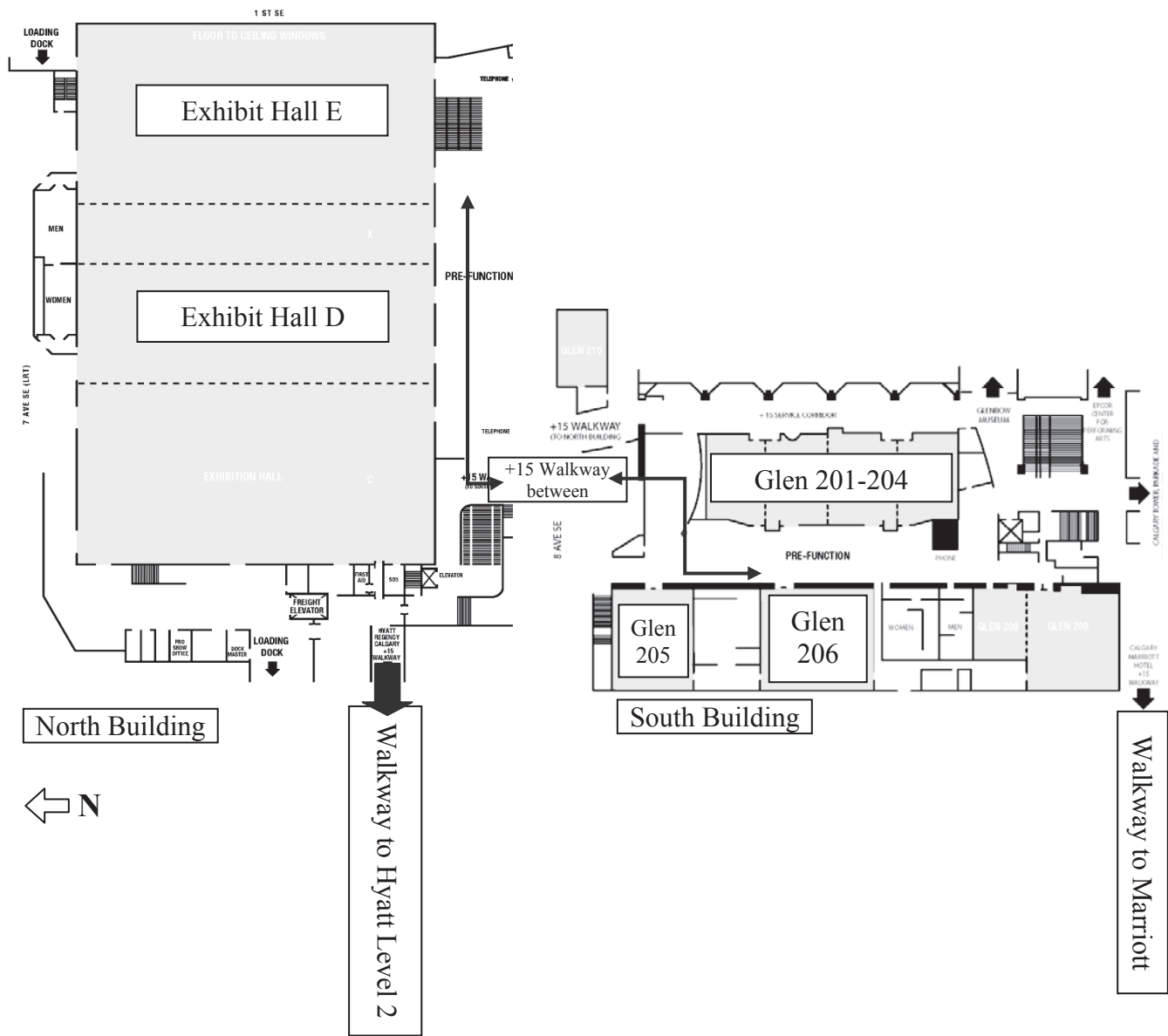
KEY TO ACRONYMS:

AAAG – American Association of Anthropological Genetics
AAPA – American Association of Physical Anthropologists
ADA – American Dermatoglyphics Association
AJHB – <i>American Journal of Human Biology</i>
AJPA – <i>American Journal of Physical Anthropology</i>
BANDIT – Biological Anthropology Developing Investigators Troop
COD – AAPA’s Committee on Diversity
DAA – Dental Anthropology Association
HB – <i>Human Biology</i>
HBA – Human Biology Association
JHE – <i>Journal of Human Evolution</i>
PAWMN – AAPA COD’s Physical Anthropology Women’s Mentoring Network
PAS – Paleoanthropology Society
PPA – Paleopathology Association

Hyatt Regency Floor Plan – Level 3 (Walkway to the Telus CC is on Level 2, see lower diagram)



Telus Convention Center Floor Plans – Upper Level (north and south buildings not to same scale)



Monday Evening

Paleopathology Association Registration	Hyatt Lobby	6 p.m.-9 p.m.
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Tuesday All Day

Family Respite Room	Hyatt Nielson 3	7:30 a.m.-11 p.m.
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Human Biology Association

Human Biology Association Registration	Hyatt Grand Foyer	5 p.m.-8 p.m.
Human Biology Association Executive Committee Dinner	Hyatt Herald	6 p.m.-10 p.m.

Paleoanthropology Society

Paleoanthropology Society Registration	Hyatt Grand Foyer	7 a.m.-5 p.m.
Paleoanthropology Society Podium Presentations	Hyatt Imperial Ballroom 4/6	8 a.m.-3 p.m.
Paleoanthropology Society Posters	Hyatt Stephen AB	3 p.m.-6 p.m.

Paleopathology Association

Paleopathology Association Registration	Hyatt Grand Foyer	8 a.m.-5 p.m.
Paleopathology Association Workshop 1	Hyatt Imperial Ballroom 1/2	8:30 a.m.-11:30 a.m.
Paleopathology Association Workshop 2	Hyatt Stephen AB	8:30 a.m.-11:30 a.m.
Paleopathology Association Podium Presentations	Hyatt Imperial Ballroom 5/7	1:30 p.m.-5 p.m.
Paleopathology Association Student Action Meeting	Hyatt Imperial Ballroom 5/7	5:15 p.m.-6:15 p.m.
Paleopathology Association Banquet	Hyatt Imperial Ballroom 1/2/3	6:30 p.m.-9 p.m.

Wednesday All Day

AAPA

Family Respite Room	Hyatt Nielson 3	7:30 a.m.-11 p.m.
AAPA Executive Committee Meeting	Hyatt Nielson 1	8 a.m.- 5 p.m.
<i>AJPA</i> Editorial Board Lunch	Hyatt Herald	noon-2 p.m.
AAPA Committee on Diversity Women's Mentoring Workshop	Hyatt Stephen AB (pre-registration required)	noon-5 p.m.
AAPA Student Committee Panel: <i>How to get into Grad School</i>	Hyatt Bannerman	4 p.m. – 5 p.m.
AAPA Registration	Hyatt Grand Foyer	5 p.m.-9 p.m.
AAPA Committee on Diversity Mixer	Hyatt Stephen AB	5 p.m.-6:30 p.m.
AAPA Teacher's Liaison Mixer	Hyatt Herald	6 p.m.-6:30 p.m.
AAPA Committee on Diversity: Undergraduate Research Symposium and Reception	Telus CC Exhibit Hall E	6 -8 p.m. (set up 5 p.m.; closed reception 5:30; open to all 6:00 p.m)
AAPA Welcome Reception	Telus CC Exhibit Hall D/E	8 p.m.-11 p.m.

Other Groups

EVAN Geometric Training Day (pre-registration required)	Hyatt Imperial Ballroom 3	10 a.m. – 6 p.m.
Dental Anthropology Association Executive Committee	Hyatt Herald	2 p.m.-5 p.m.

Human Biology Association

Human Biology Association Registration	Hyatt Grand Foyer	7:30 a.m.- 5 p.m.
<i>American Journal Human Biology</i> Editorial Board Breakfast	Hyatt Herald	7:30 a.m.-9 a.m.
Human Biology Association Posters (up for viewing until 5pm)	Telus CC Exhibit Hall E	8 a.m.-11 a.m. (authors present)
Human Biology Association Plenary Session	Hyatt Imperial Ballroom 4	1 p.m.-6 p.m.
Human Biology Association Dinner	Hyatt Imperial Ballroom 5/7/9	6:30 p.m.-9:30 p.m.

Paleoanthropology Society

Paleoanthropology Society Registration	Hyatt Grand Foyer	8 a.m.-5 p.m.
Paleoanthropology Society Podium Presentations	Hyatt Imperial Ballroom 6/8	8 a.m.-noon; 1- 6 p.m.

Paleopathology Association

Paleopathology Association Registration	Hyatt Grand Foyer	8 a.m.- 5 p.m.
Paleopathology Association Podium Presentations	Hyatt Imperial Ballroom 1/2	8 a.m.- noon; 2-5 p.m.
Paleopathology Association Posters	Telus CC Exhibit Hall E	8 a.m.- 5 p.m.

Thursday Morning

<u>AAPA Activity</u>	<u>Room</u>	<u>Time</u>	<u>#</u>	<u>Session type</u>
Building Bones: Studies of Bone Growth in Anthropology	Hyatt Imperial Ballroom 1/2/3	8 a.m.-noon	1	Invited Podium
BIOARCHAEOLOGY: Diet, Identity and Age	Hyatt Imperial Ballroom 4/6	8 a.m.-noon	2	Podium
PRIMATOLOGY: Behavior and Ecology	Hyatt Imperial Ballroom 5/7/9	8 a.m.-noon	3	Podium
PALEOANTHROPOLOGY: Primate Evolution	Telus CC Glen 201-204	8 a.m.-noon	4	Podium
A Change of Scene: Group takeovers and alpha male replacements	Hyatt Bannerman/Walker	8 a.m.-noon	5	Invited Poster
Neglected Infectious Diseases in Palaeopathology and Clinical Medicine: Leprosy. Dedicated to the memory of Donald J. Ortner	Hyatt Herald/Doll	8 a.m.-noon	6	Invited Poster
<u>Human Biology Association</u>				
Human Biology Registration	Hyatt Grand Foyer	8 a.m.-11:30 a.m.		
Human Biology Association Podium Presentations A & B	Hyatt Stephen AB	8 a.m.-11:30 a.m.		

Thursday All day

AAPA Registration	Hyatt Grand Foyer	7:30 a.m.- 5 p.m.		
Press and Interview Room	Hyatt Nielson 1	7:30 a.m.- 5 p.m.		
Family Respite Room	Hyatt Nielson 3	7:30 a.m.- 11 p.m.		
Speaker Ready Room	Hyatt Nielson 4	7:30 a.m.- 6 p.m.		
Exhibitors	Telus CC Exhibit Hall E	8 a.m.-5 p.m.		
PALEOANTHROPOLOGY: Primate Evolution	Telus CC Exhibit Hall E1	8 a.m.-5 p.m.	7	Poster
DENTAL ANTHROPOLOGY: Nonhuman Primates	Telus CC Exhibit Hall E2	8 a.m.-5 p.m.	8	Poster
PRIMATOLOGY	Telus CC Exhibit Hall E3	8 a.m.-5 p.m.	9	Poster
BIOARCHAEOLOGY: Childhood, Population and Cranial Change	Telus CC Exhibit Hall E4	8 a.m.-5 p.m.	10	Poster
BIOARCHAEOLOGY: Mobility, Activity, Stature	Telus CC Exhibit Hall E5	8 a.m.-5 p.m.	11	Poster

Thursday Afternoon

<i>Yearbook of Physical Anthropology</i> Editorial Board Meeting	Hyatt Atrium	noon-2 p.m.		
AAPA COD PA WMN Lunch (reservations required)	Telus CC 205	noon-1 p.m.		
Evolutionary Developmental Anthropology: An evo-devo approach to understanding evolution	Hyatt Imperial Ballroom 1/2/3 <i>Wiley-Blackwell Symposium</i>	1 p.m.-5 p.m.	12	Invited Podium
PRIMATOLOGY: Foraging and Energetics	Hyatt Imperial Ballroom 7/9	1 p.m.-5 p.m.	13	Podium
BIOARCHAEOLOGY and PALEOPATHOLOGY	Telus CC Glen 201-204	1 p.m.-5 p.m.	14	Podium
Beyond the Obstetric Dilemma: How New Studies of the Pelvis are Redefining our Approach to Hominin Evolution	Hyatt Bannerman/Walker	1 p.m.-5 p.m.	15	Invited Poster
Ring-Tailed Lemurs: A Species Re-imagined	Hyatt Herald/Doll	1 p.m.-5 p.m.	16	Invited Poster
AAAG Network Event (pre-registration required)	Hyatt Nielson 1	4 p.m.-6 p.m.		
<u>Human Biology Association</u>				
Human Biology Association Podium Presentations C and D	Hyatt Stephen AB	1:30 p.m.-5 p.m.		

Thursday Evening

AAPA Auction - Silent 4:30-7; Live 7-9:30 – Benefits student travel	Hyatt Imperial Ballroom 4/6/8	4:30 p.m.-10 p.m.		
AAPA Plenary Posters (We have treats!)	Hyatt Grand Foyer and Imperial 5	5 p.m.-7 p.m.	17	Poster
AAPA Plenary Panel - <i>Open Access Publishing: What it is and what it might mean for you.</i>	Hyatt Imperial Ballroom 1/2/3	5 p.m.-7 p.m.		
AAPA COD PA Women's Mentoring Network Happy Hour	Telus CC 206	5 p.m.-6:30 p.m.		
Teaching Bioanthropology in the 21st Century	Hyatt Nielson 1	6 p.m.-9 p.m.		
Wiley-Liss Reception	Hyatt Grand Foyer	8 p.m.-10 p.m.		
AAPA Committee on Diversity LGBTQ interest group	Hyatt Nielson 2	8 p.m.-11 p.m.		
<u>Human Biology Association</u>				
Human Biology Association Business Meeting	Hyatt Stephen AB	5 p.m.-6:30 p.m.		
HBA Student Reception (members only)	Telus CC 206	7 p.m.-9 p.m.		

Friday Morning

Female Mate Choice in Non-Human Primates and Humans	Hyatt Imperial Ballroom 1/2/3 <i>HBA and AAPA Symposium</i>	8 a.m.-noon	18	Invited Podium
BIOARCHAEOLOGY and GENETICS	Hyatt Imperial Ballroom 4/6	8 -10:15 a.m.	19	Podium
ANTHROPOLOGICAL GENETICS: Non-human Primates	Hyatt Imperial Ballroom 4/6	10:15 -noon	20	Podium
HUMAN ADAPTATION: Climate, Altitude, Latitude	Hyatt Imperial Ballroom 5/7/9	8 -10:15 a.m.	21	Podium
FUNCTIONAL MORPHOLOGY: Foods, Force and Function	Hyatt Imperial Ballroom 5/7/9	10:15 -noon	22	Podium
PALEOANTHROPOLOGY: Early Homs – Diet,Teeth, Locomotion	Telus CC Glen 201-204	8 a.m.-noon	23	Podium
From the Ground Up: Integrative research in primate locomotion	Hyatt Bannerman/Walker	8 a.m.-noon	24	Invited Poster
Forgotten People in Forgotten Places: The Erie County Poorhouse	Hyatt Herald/Doll	8 a.m.-noon	25	Invited Poster
Evo-Devo Studies in Bio-physical Anthropology	Hyatt Stephen AB	8 a.m.-noon	26	Invited Poster

Friday All day

AAPA Registration	Hyatt Grand Foyer	7:30 a.m.-5 p.m		
Press and Interview Room	Hyatt Nielson 1	7:30 a.m.-5 p.m		
Family Respite Room	Hyatt Nielson 3	7:30 a.m.-11pm		
Speaker Ready Room	Hyatt Nielson 4	7:30 a.m.-6 p.m		
AAPA Fossil Cast Comparison Room	Telus CC Glen 205	8 a.m.-5 p.m.		
Pearson Focus Group	Telus CC 206	8 a.m.-5 p.m.		
Exhibitors	Telus CC Exhibit Hall E	8 a.m.-5 p.m.		
ANTHROPOLOGICAL GENETICS	Telus CC Exhibit Hall E1	8 a.m.-5 p.m.	27	Poster
BIOARCHAEOLOGY GENETICS	Telus CC Exhibit Hall E2	8 a.m.-5 p.m.	28	Poster
BIOARCHAEOLOGY and PALEOPATHOLOGY: Insights from congenital conditions, infectious disease, trauma and arthritis	Telus CC Exhibit Hall E3	8 a.m.-5 p.m.	29	Poster
HUMAN SKELETAL BIOLOGY and FORENSIC ANTHROPOLOGY: Validation studies, age, sex, climate & methods	Telus CC Exhibit Hall E4	8 a.m.-5 p.m.	30	Poster
FUNCTIONAL MORPHOLOGY: Postcranial	Telus CC Exhibit Hall E5	8 a.m.-5 p.m.	31	Poster
PALEOANTHROPOLOGY: Environment, Taphonomy, Dating	Telus CC Exhibit Hall E6	8 a.m.-5 p.m.	32	Poster

Friday Afternoon

AAPA Ethics Committee	Hyatt Nielson 2	noon-2 p.m.		
AAPA Membership and COD Contingent Faculty Working Group	Hyatt Stephen AB	noon-2 p.m.		
AAPA Career Development Panel: <i>How to Write a Grant Proposal</i>	Hyatt Imperial Ballroom 8	noon-2 p.m.		
AAPA Committee on Diversity Panel: <i>Strategies for Making and Implementing Effective Broader Impacts Plans</i>	Hyatt Imperial Ballroom 8	2:30-4:30 p.m.		
Monkey Business: Developments on the evolution of OW monkeys	Telus CC Glen 201-204	1 p.m.-5 p.m.	33	Invited Podium
ANTHROPOLOGICAL GENETICS: Human History and Prehistory	Hyatt Imperial Ballroom 1/2/3	1 p.m.-5 p.m.	34	Podium
PRIMATOLOGY: Hormones, Fitness, Life History and Reproduction	Hyatt Imperial Ballroom 4/6	1 p.m.-5 p.m.	35	Podium
PRIMATOLOGY: Primates and People	Hyatt Imperial Ballroom 5/7/9	1 p.m.-3:15 p.m.	36	Podium
PRIMATOLOGY: Surviving for the Longterm - Sustainable Funding	Hyatt Imperial Ballroom 5/7/9	3:15p.m.-5 p.m.	37	Podium
Physical Anthropology of Living and Skeletal Maya Populations	Hyatt Bannerman/Walker	1 p.m.-5 p.m.	38	Invited Poster
Isotopic Advances in Primate Foraging Ecology	Hyatt Herald/Doll	1 p.m.-5 p.m.	39	Invited Poster

Friday Evening

AAPA Business Meeting and Lifetime Awards	Hyatt Imperial Ballroom 5/7/9	5:15-7:15 p.m.		
<i>Journal of Human Evolution</i> Editorial Board Meeting	Hyatt Atrium	7 p.m.-11 p.m.		
American Dermatoglyphics Association Business Meeting	Hyatt Herald	7 p.m.-9 p.m.		
Primate Interest Group	Hyatt Imperial Ballroom 1/2/3	7 p.m.-9 p.m.		
<i>Human Biology</i> Editorial Board Meeting	Hyatt Nielson 2	7 p.m.-10 p.m.		
Dental Anthropology Association Business Meeting	Hyatt Stephen AB	7 p.m.-8 p.m.		
AAAG Business Meeting and Reception	Telus CC Glen 201-204, 206	7 p.m.-9 p.m.		

Saturday Morning

AAPA Education Committee K-12 Teachers Training Workshop	Telus CC 206	8 a.m.-noon		
Beyond the Genome: Anthropological investigations of transcriptomes, epigenomes, telomeres, and microbiomes	Hyatt Imperial Ballroom 1/2/3 <i>AAAG and AAPA Symposium</i>	8 a.m.-noon	40	Podium
FUNCTIONAL EVOLUTIONARY MORPHOLOGY: Locomotion	Hyatt Imperial Ballroom 4/6	8 a.m.-noon	41	Podium
HUMAN BIOLOGY	Hyatt Stephen AB	8 a.m.-noon	42	Podium
PALEOANTHROPOLOGY: Later <i>Homo</i>	Telus CC Glen 201-204	8 a.m.-noon	43	Podium
The Bones and Behavior Project: Fostering integration in bioanthro	Hyatt Bannerman/Walker	8 a.m.-noon	44	Poster
A World View of (Bio)Culturally Modified Teeth	Hyatt Herald/Doll	8 a.m.-noon	45	Poster
Anatomy in Clay Workshop	Hyatt Imperial Ballroom 8	8 a.m.-noon		

Saturday All day

AAPA Registration	Hyatt Grand Foyer	7:30a.m.- 5 p.m		
Family Respite Room	Hyatt Nielson 3	7:30a.m.- 8 p.m		
Speaker Ready Room	Hyatt Nielson 4	7:30a.m.-6 p.m.		
Press and Interview Room	Telus CC 205	8 a.m.-12 p.m.; 2 p.m.-4 p.m.		
Exhibitors	Telus CC Exhibit Hall E	8 a.m.-2 p.m.		
HUMAN BIOLOGY	Telus CC Exhibit Hall E1	8 a.m.-6 p.m	46	Poster
PALEOANTHROPOLOGY	Telus CC Exhibit Hall E2	8 a.m.-6 p.m.	47	Poster
FUNCTIONAL CRANIAL ANATOMY: Mechanics, life history	Telus CC Exhibit Hall E3	8 a.m.-6 p.m.	48	Poster
SKELETAL BIOLOGY: Histology and Microstructure	Telus CC Exhibit Hall E4	8 a.m.-6 p.m.	49	Poster
BIOARCHAEOLOGY: Insights from the Dentition	Telus CC Exhibit Hall E5	8 a.m.-6 p.m.	50	Poster

Saturday Afternoon

AAPA Luncheon - Dr. Emőke Szathmáry “Searching for Ancestry: Has Biological History become Biological Destiny?”	Hyatt Imperial Ballroom 5/7/9	noon-2 p.m.		
NSF One-on-One's (contact cehardt@nsf.gov for appt)	Telus CC 205	noon-2 p.m.		
AAPA Committee on Diversity	Hyatt Imperial Ballroom 8	2 p.m.-3:30 pm		
The Role of Mosaic Habitats in Hominin Evolution	Hyatt Imperial Ballroom 1/2/3	2 p.m.-6 p.m.	51	Invited Podium
Cross-Disciplinary Research in the Genus <i>Chlorocebus</i> : Integrating Genomic and Phenomic Approaches from the Lab, Field, and Beyond	Hyatt Imperial Ballroom 4/6	2 p.m.-6 p.m.	52	Invited Podium
PRIMATOLOGY: Sociality, Social Networks, Agonism	Hyatt Stephen AB	2 p.m.-6 p.m.	53	Podium
HUMAN BIOLOGY: Energy, Cooperation and Life History	Telus CC Glen 201-204	2 p.m.-6 p.m.	54	Podium
Evolutionary Anthropology in Brazil: Celebrating Dr. Walter Neves	Hyatt Bannerman/Walker	2 p.m.-6 p.m.	55	Invited Poster
The Intersection of Hominin Fossil Studies, Human Variation and Life History: A symposium in honor of Alan Mann	Hyatt Herald/Doll	2 p.m.-6 p.m.	56	Invited Poster

Saturday Evening

AAPA Closing Reception & Student Awards (check your reg packet for your free drink ticket!)	Hyatt Imperial Ballroom 5/7/9	6p.m.-9p.m.		
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Thursday, April 10, 2014 - Morning sessions.

Session 1: Building Bones: Studies of Bone Growth in Anthropology

Invited Podium Symposium. Organizers and Chairs: Christopher J. Percival and Joan T. Richtsmeier.
Hyatt Imperial Ballroom 1/2/3.

Knowledge about patterns of, and factors underlying, normal growth and development of bone and tooth can be helpful for anthropologists working with paleontological, prehistoric, historic, and non-human primate samples. This symposium highlights 1) advances in the study of normal bone development from the prenatal period through adolescence and 2) the ways in which incorporating developmental information can improve our understanding of evolution, lifeways, functional morphology, and biological variation. Anthropologists use various approaches to study bone growth and development. Differences in life history characteristics and morphometrically defined growth trajectories are commonly studied with reference to the evolution of skeletal traits. Differences in behavior and associated skeletal stresses during early life have been associated with differences in skeletal characteristics between species or individuals of the same species. Experimental approaches to questions of development have begun to provide cellular and molecular information pertinent to mechanisms that underlie these differences. The recent integration of technological advancements into anthropological research provides further opportunities to pursue the developmental mechanisms that underlie differences in skeletal traits in many temporal and phylogenetic contexts. This symposium serves as the basis for dialogue among researchers with different perspectives on bone growth and development that the organizers hope will foster innovation and collaboration among a range of physical anthropologists with varied specialized interests.

- 8:00 **The generation of continuous phenotypic variation in skeletal morphology.** H.A. JAMNICZKY, M. PAVLICEV, N.M. YOUNG, R.S. MARCUCIO, B. HALLGRIMSSON.
- 8:15 **Advances in the study of intramembranous bone formation and growth.** C.J. PERCIVAL, J.T. RICHTSMEIER.
- 8:30 **Spatial association of the dermatocranium with the chondrocranium in early skull formation.** K. KAWASAKI, J.T. RICHTSMEIER.
- 8:45 **Building bones: Studies of bone growth in Anthropology.** S.E. FREIDLINE, C. MARTINEZ-MAZA, J. HUBLIN.
- 9:00 **Can ontogeny inform our understanding of homology? Unique patterns of growth and postorbital septation in tarsiers.** V.B. DELEON, A.L. ROSENBERGER, T.D. SMITH.
- 9:15 **Biorhythm variations underlying the evolution of human life history: Evidence from tooth and bone histology.** R.T. HOGG, T.G. BROMAGE, D.J. REID.
- 9:30 **Resolving Pliocene and Pleistocene hominin dental ontogeny with synchrotron virtual histology.** T.M. SMITH, A. LE CABEC, A. BONNIN, A. HOUSSAYE, J. POUÉCH, J. MOGGI-CECCHI, C.G. MENTER, F. MANTHI, C. WARD, P. TAFFOREAU.
- 9:45 **Discussant: James Cheverud, Loyola University Chicago.**
- 10:00 **BREAK.**
- 10:15 **It's all in the timing: Developmental basis of variation in vertebrate limb bone length.** A.S. DOWHANIK, C.B. KRUEGER, M. MARCHINI, L.M. SPARROW, M.N. COSMAN, C. ROLIAN.
- 10:30 **Out on a limb: Developmental rules for the evolution of primate segment proportions.** N.M. YOUNG.
- 10:45 **Making a 'short bone' short: Human pisiform reduction results from the loss of a growth plate.** K.M. KJOSNESS, J.E. HINES, C. LOVEJOY, P.L. RENO.
- 11:00 **Biomechanical perspectives on starvation and malnutrition in immature individuals.** L.W. COWGILL, R. JOHNSTON, M. HAMRICK, G. ROBBINS SCHUG.
- 11:15 **An ontogenetic framework linking locomotion and trabecular bone architecture with applications for reconstructing hominin life history.** D.A. RAICHLEN, A.D. GORDON, R.S. SCOTT, J. WEBBER, A.D. FOSTER, S.M. SUKHDEO, J.H. GOSMAN, T.M. RYAN.
- 11:30 **How much more would KNM-WT 15000 have grown? A case study in applying growth trajectories to fossil hominins.** C.B. RUFF.
- 11:45 **Discussant: Carol Ward, University of Missouri, Columbia.**

Session 2: BIOARCHAEOLOGY: Diet, Identity and Age

Contributed Podium Presentations. Chair: Andrea Waters-Rist. Hyatt Imperial Ballroom 4/6.

- 8:00 **Controlled diet experiments for diet reconstruction with stable isotopes of hair, muscle, bone collagen and bone apatite.** S.H. AMBROSE.
- 8:15 **Millet crop and consumption during the Late Bronze Age in Georgia: First human and animal isotopic evidence.** E. HERRSCHER, G. BEDIANASHVILI, M. CHKADUA, N. VANISHVILI, M. ABRAMISHVILI, E. MESSEGER, L. MARTIN.
- 8:30 **Urban and rural dietary patterns in early Medieval Central Europe (9th-10th century AD, Czech Republic).** S. KAUPOVÁ, E. HERRSCHER, P. VELEMÍNSKÝ, S. CABUT, B. JAROSLAV.
- 8:45 **Life before death in an Imperial Age necropolis: Multidisciplinary approach to understand life conditions.** F. DE

- ANGELIS, C. CALDARINI, R. MOSTICONE, L. PESCUCCI, F. PORRECA, F. ZAVARONI, G. SCORRANO, P. PREZIOSI, O. RICKARDS, P. CATALANO.
- 9:00 **The effects of the potato blight on a rural Dutch population: Demographic and osteological data on morbidity and mortality during a three-year subsistence crisis.** A.L. WATERS-RIST, M.M. HOOGLAND.
- 9:15 **Diet and trade in an Eighteenth Century British Colonial sample from Saint George's Caye, Belize.** J.R. PRINCE, E.J. BARTELINK, L. SPRINGS, J. GARBER, G. FOX.
- 9:30 **Glimpsing internal variation and inequality through bioarchaeology: A consideration of dental health and paleodiet in Larache (AD 400-1000), San Pedro de Atacama, Chile.** C. TORRES-ROUFF, M. HUBBE, W.J. PESTLE, K.J. KNUDSON.
- 9:45 **Long heads and jagged teeth: Expanding the northern frontier of prehistoric Mesoamerican identity.** J.T. WATSON, C. GARCIA.
- 10:00 **BREAK.**
- 10:15 **Population affinities of Early Holocene crania from Chile: A 3D morphometric study.** S.C. KUZMINSKY.
- 10:30 **Cranial morphology of the human skeletal remains from Lapa do Santo, Lagoa Santa, Brazil: Implications for the peopling of the New World.** W.A. NEVES, M. HUBBE, D.V. BERNARDO, A. STRAUSS.
- 10:45 **Geographic and diachronic variation among Amerindian crania: A 3D geometric morphometric test of settlement hypotheses.** M. GALLAND, M. FRIESS.
- 11:00 **Older age mortality in Medieval Denmark.** Š. JATAUTIS, N. LYNNERUP.
- 11:15 **Evaluating old and new skeletal age indicators - which ages of transition pass the "box test"?** G.R. MILNER, J.L. BOLDSSEN.
- 11:30 **Differences between biological and chronological age: Is it possible to measure the rate of aging in bones?** L.R. COUOH.
- 11:45 **Meet me in Coimbra: An international saga of interobserver error rates.** C.A. WILCZAK, C. HENDERSON, V. MARIOTTI, D. PANY-KUCERA, S. VILLOTTE.

Session 3: PRIMATOLOGY: Behavior and Ecology

Contributed Podium Presentations. Chair: Alison Behie. Hyatt Imperial Ballroom 5/7/9.

- 8:00 **Discriminating behaviors to measure personality traits in free-ranging Tibetan macaques (*Macaca thibetana*).** A.J. PRITCHARD, L.K. SHEERAN, K.I. GABRIEL, J. LI, R.S. WAGNER.
- 8:15 **"Seeing the world through their eyes": Analyses of the first National Geographic Crittercam™ deployments on macaques in Singapore and Gibraltar.** A. FUENTES, A. KLEGARTH, L. JONES-ENGEL, K. ABERNATHY, J. CORTES, M. GUMERT, B. LEE, G. MARSHALL, M. PIZARRO, E. SHAW.
- 8:30 **Covering the rock: GPS collar informed management of Barbary Macaques.** A.R. KLEGARTH, A. FUENTES, E. SHAW, D. HOLMES, D. LAGUEA, T. FEENEY, L. JONES-ENGEL, M. PIZARRO.
- 8:45 **Examination of the possible effects of collaring on the grooming behavior of female Black-handed Spider Monkeys (*Ateles geoffroyi*) on Barro Colorado Island, Panamá.** M.J. STRONG, C.J. CAMPBELL.
- 9:00 **Assessing the effects of a hurricane and forest fire on diet, activity and grouping patterns in spider monkeys (*Ateles geoffroyi*) at Runaway Creek Nature Reserve, Belize.** H.G. NOTMAN, J. CHAMPION, M.S. PAVELKA.
- 9:15 **Hurricanes and coastlines: The role of natural disasters in the distribution of Central American *Alouatta* species.** A.M. BEHIE, T.S. STEFFENS, T.M. WYMAN, M.S. PAVELKA.
- 9:30 **Black-handed Spider monkey (*A. geoffroyi*) density in a human altered landscape in Costa Rica: A comparison between national parks and private reserves.** H. WALTERS, N. ROBERTS.
- 9:45 **Changes in behaviour and association patterns in Black-handed Spider Monkeys (*Ateles geoffroyi*) from day to night.** M.R. BROWN, K.S. HARTWELL, H. NOTMAN, M.S. PAVELKA.
- 10:00 **BREAK.**
- 10:15 **Sex differences in the use of whinny vocalizations in Spider Monkeys (*Ateles geoffroyi*).** C.J. DUBREUIL, H. NOTMAN, M.S. PAVELKA.
- 10:30 **The recording and analysis of a behavioral vocal repertoire for the Red Ruffed Lemur, *Varecia rubra*.** D.R. HUDSON.
- 10:45 **Modeling the origins of mammalian sociality: Matrilineal signatures in mouse lemur vocalizations.** S.E. KESSLER, U. RADESPIEL, I. HASINIAINA, L.M. LELIVELD, L.T. NASH, E. ZIMMERMANN.
- 11:00 **Can't see the predators for the trees? Reconsidering the anti-predator benefits of sociality for rainforest primates.** B.C. WHEELER, C.H. JANSON.
- 11:15 **Primate camouflage as seen by felids, raptors, and conspecifics.** S. WINTERS, J.M. KAMILAR, T.H. WEBSTER, B.J. BRADLEY, J.P. HIGHAM.
- 11:30 **Gelada herds increase predation success of Ethiopian wolves on rodents.** V.V. VENKATARAMAN, J.T. KERBY, P.J. FASHING, N. NGUYEN, Z. TEFERA.
- 11:45 **Different diversity measures tell different primate community assembly stories.** K.H. BANNAR-MARTIN.

Session 4: PALEOANTHROPOLOGY: Primate Evolution

Contributed Podium Presentations. Chair: Frank L'Engle Williams. **Telus CC Glen 201-204.**

- 8:00 **Rates of homoplasy in the mammalian skeleton.** A.D. KEMP, W. BARR.
- 8:15 **Re-evaluation of promontorial arterial dominance in fossil adapiforms.** E.C. WELCH, D.M. BOYER, G.S. YAPUNCICH, G.F. GUNNELL, E.R. SEIFFERT, J.I. BLOCH.
- 8:30 **Primate postcrania from the early Eocene of India, and implications for the initial diversification of strepsirhines and haplorhines.** R.H. DUNN, K.D. ROSE, K. KUMAR, R.S. RANA, T. SMITH.
- 8:45 **A case of primate rafting and island hopping: Long distance dispersal and successful colonization over open ocean in a volcanic archipelago.** M. SHEKELLE.
- 9:00 **The evolution of dietary niche competition in early Eocene euprimate communities in North America.** L.K. STROIK.
- 9:15 **Testing a predictive model for identifying fossil vertebrate localities in the Eocene of Wyoming.** R.L. ANEMONE, C. EMERSON, B. NACHMAN, B. BOMMERSBACH.
- 9:30 **Changes in endocast shape precede encephalization in anthropoid evolution.** K.L. ALLEN.
- 9:45 **Comparative anatomy of ear ossicles in African apes and modern humans - Introducing a geometric morphometric measurement protocol.** A. STOESSEL, P. GUNZ, F. SPOOR.
- 10:00 **BREAK.**
- 10:15 **Tail length reconstructions of extinct primates using sacrocaudal functional links among living primates and other mammals.** G.A. RUSSO.
- 10:30 **Morphology of the humeral capitulum in primates: Three-dimensional morphology of the humeral capitulum and implications for reconstructing locomotor behavior in fossil catarrhines.** R.A. JOHNSTON, C.V. WARD, L.W. COWGILL, J. PLAVCAN.
- 10:45 **Comparing isotopes and dental microwear textural properties in *Parapapio* from Makapansgat.** F.L. WILLIAMS.
- 11:00 **The taphonomic and paleoenvironmental contexts of early Miocene catarrhines on Rusinga Island, Kenya.** K.E. JENKINS.
- 11:15 **Early Miocene catarrhine fossil localities at Napak, Uganda: Geologic, faunal, and isotopic analyses reveal contrasting paleoenvironments.** S. COTE, J. KINGSTON, L. MACLATCHY.
- 11:30 **The great ape-like patella of *Pierolapithecus catalaunicus* and the mosaic nature of the postcranium of Miocene hominoids.** M. PINA, S. ALMECÍJA, D.M. ALBA, M.C. O'NEILL, S. MOYÀ-SOLÀ.
- 11:45 **Another look at the Ngorora hominoids.** D.R. BEGUN.

Session 5: A Change of Scene: Group Takeovers and Alpha Male Replacements in Primates

Invited Poster Symposium. Organizers: Katharine M. Jack and Julie A. Teichroeb. **Hyatt Bannerman/Walker.**

In primate behavior, takeovers are often thought to be synonymous with the quick replacement of an alpha male in male-dispersed species that form unimale-multifemale groups. In reality, takeovers of an alpha male position can occur in several different ways, can vary in their timing and speed of completion, and commonly occur in species characterized by multimale-multifemale and even unimale-unifemale social groups. Moreover, male-biased dispersal is not a necessary precursor for such group turnovers. Indeed, if there is an alpha male, he can, and will, at some point be replaced. Group takeovers and alpha male replacements are associated with social (e.g., changing social networks), demographic (e.g., forced dispersal), and reproductive consequences (e.g., infanticide) thereby rendering these events significant for both sexes. It is therefore expected that both male and female strategies should serve to maximize reproductive success and minimize the costs of these important events. The purpose of this symposium is to examine the variation in, and evolutionary consequences of, group takeovers and alpha male replacements across a wide-variety of primate taxa. Symposium participants explore a wide range of topics associated with group takeovers and alpha male replacements and, in doing so, provide the first comprehensive examination of this topic in non-human primates.

7:30-8:00 am Poster set-up. 11:45-12:15 am Poster take-down.

10:00-10:30 am Even numbered poster authors present for discussion.

10:30-11:00 am Odd numbered poster authors present for discussion.

11:00-11:45 am Roundtable discussion Authors & Discussants: Katharine Jack, Tulane, and Julie Teichroeb, Duke University.

- 1 **Modes of alpha male change and reproductive success in Hanuman langurs at Ramnagar, Nepal.** C. BORRIES, R.F. PERLMAN, A. KOENIG.
- 2 **Bide your time: Method of alpha male replacement, infant deaths, and time to conception in *Cebus capucinus*.** K.M. JACK, L.F. BRASINGTON, K. RITCHOTTE, E.C. WIKBERG, S. KAWAMURA, L.M. FEDIGAN.
- 3 **Alpha male takeovers by immigrant males in crested macaques.** P. MARTY, K. HODGES, M. AGIL, A. ENGELHARDT.
- 4 **Male strategies for changing group membership in Verreaux's Sifaka.** K.G. LEIMBERGER, R.J. LEWIS.
- 5 **Coalition networks associated with alpha male replacements in chimpanzees at Ngogo.** D.P. WATTS.
- 6 **Factors affecting turnovers and takeovers in chacma and hamadryas baboon societies.** S. CHOWDHURY, L. SWEDELL.
- 7 **Female takeovers in Hamadryas baboons: Consequences and counter strategies.** A.L. AMANN, M. PINES, L. SWEDELL.
- 8 **Female dispersal post-takeover is related to male quality in *Colobus vellerosus*.** P. SICOTTE, J.A. TEICHROEB, J.V.

VAYRO, E.C. WIKBERG.

- 9 **Are takeover frequency and variability in male quality keys to solving the folivore paradox?** J. TEICHROEB, C. MARCO, C. COLIN.
- 10 **Demography, rank dynamics, and reproductive success of male Phayre's leaf monkeys.** A. KOENIG, E. LARNEY, A. DI FIORE, T.R. DISOTELL, C. BORRIES.

Session 6: Neglected Infectious Diseases in Palaeopathology and Clinical Medicine: Past, Current and Future Research on Leprosy. Symposium Dedicated to the Memory of Donald J. Ortner
Invited Poster Symposium. Organizers: Charlotte A. Roberts and Niels Lynnerup. **Hyatt Herald/Doll.**

Leprosy has plagued humans since prehistory, and remains with some geographic region of the world today, even though it has been claimed that it has been “eliminated”. This infection continues to attract stigma and has and does lead to marginalization of affected people. Research on this infection is naturally a focus for people working with those affected today, but it has also been explored in past human remains and documentary evidence for many years. Much of the research in archaeology, history and palaeopathology has been focused on documenting the evidence for leprosy in particular times and places, assessing the reasons for its decline in the past, and also the “treatment” of people with leprosy, including reflections on the purpose of leprosaria. This symposium aims to spotlight this infectious disease that is both neglected in the clinical sense, but also relative to other palaeopathological interests. This symposium is particularly timely with recent developments in the study of leprosy (the sequencing of the leprosy genome, both modern and ancient, recent increases in newly reported ancient evidence, and the re-evaluation of historical and bioarchaeological data). The genomic research has helped to develop management strategies for the control of leprosy, and the historical/bioarchaeological research that has focused attention on how it is much more likely that people with leprosy in the past were more accepted by their communities, and that segregation into a leprosarium was not as serious or devastating as once thought. The symposium ultimately aims to show how palaeopathological, biomolecular, archaeological and historical research on leprosy can contribute to understanding leprosy today, and what new information methodological advances can tell us about leprosy in the past.

This symposium is dedicated to the memory of Donald J. Ortner who had strong research interests in leprosy.

7:30-8:00 am Poster set-up. 11:45-12:15 am Poster take-down.

10:00-10:30 am Even numbered poster authors present for discussion.

10:30-11:00 am Odd numbered poster authors present for discussion.

11:00-11:30 pm Discussant: Jane Buikstra, Arizona State University.

- 1 **An overview of the global palaeopathological evidence of leprosy.** C.A. ROBERTS.
- 2 **How do we know that so many suffered from leprosy? A comparison of the pathological and the epidemiological approaches to estimating leprosy frequency in Medieval Denmark.** J.L. BOLDSSEN.
- 4 **Non-bony lesions and functional losses in leprosy.** C. PRIMEAU, N. LYNNERUP.
- 5 **Ill-Fated? Exploring bioarchaeological links between childhood non-specific indicators of stress and leprosy immunity in Medieval England.** K. FILIPEK-OGDEN.
- 6 **Using clinical evidence to infer lived experiences of individuals with leprosy in the past.** B.J. BAKER, K.L. BOLHOFNER.
- 7 **Molecular biomarker studies on the interrelation of ancient leprosy and tuberculosis.** H.D. DONOGHUE, M. SPIGELMEN, I. PAP, G. PÁLFI, E. MOLNÁR, O.Y. LEE, H.H. WU, G.S. BESRA, D.E. MINNIKIN.
- 8 **Defining the origins and spread of leprosy using molecular biomarkers.** D.E. MINNIKIN, G.M. TAYLOR, G.R. STEWART, T.A. MENDUM, S. ROFFEY, K. TUCKER, O.Y. LEE, H.H. WU, G.S. BESRA, S.T. COLE.
- 9 **The origins and evolution of *Mycobacterium leprae*.** T.P. HONAP, L. PFISTER, A.C. STONE.
- 10 **Validation of qPCR methods for the detection of *Mycobacterium* in New World animal reservoirs.** G. HOUSMAN, V. BOERE, A.D. GRATIVOL, J. MALUKIEWICZ, I. DE OLIVEIRA SILVA, C.C. RUIZ-MIRANDA, A. STONE.
- 11 **St Mary Magdalen, Winchester: A Medieval Leprosy Hospital in Context.** S. ROFFEY.
- 12 **The skeletal evidence for leprosy at St. Mary Magdalen hospital, Winchester.** K.E. TUCKER.
- 13 **Osteoarchaeological and paleomicrobiological evidence of leprosy in Hungary.** G. PÁLFI, A. MARCSIK, I. PAP, Á. KUSTÁR, H. DONOGHUE, D. MINNIKIN, O. LEE, H. WU, G. BESRA, Z. BERECZKI, O. SPEKKER, E. MOLNÁR.
- 14 **Begotten of corruption: Leprosy and high rates of infection at the end of the Indus Age, South Asia.** G.M. ROBBINS SCHUG, K. BLEVINS.
- 15 **Leprosy in Italy: Pathological aspects and palaeopathological perspectives.** M. RUBINI, P. ZAIO.
- 16 **Palaeopathological and biomolecular evidence for leprosy in Sweden: The evidence and its interpretation.** C.A. ARCINI, A.S. KJELLSTRÖM.
- 17 **Mycobacterial cross-immunity: A possible factor in the medieval decline of leprosy.** A.S. WILSON, K. MANCHESTER, N. LYNNERUP.
- 18 **Concepts of leprosy today in the western world - results of a survey.** A.C. CAINE, C.A. ROBERTS.

Thursday, All day sessions.

Session 7: PALEOANTHROPOLOGY: Primate Evolution

Contributed Poster Presentations. Chair: Michelle Singleton. Telus CC Exhibit Hall E1.

7:30-8:00 am Poster set-up. 4:30-5:00 pm Poster take-down.

Even numbered poster authors present for discussion - 10:00-10:30 am and 2:30-3:00 pm

Odd numbered poster authors present for discussion - 10:30-11:00 am and 3:00-3:30 pm

- 1 **The lemur syndrome: How does ancient climate affect our interpretations of lemur evolution?** L.R. GODFREY, M. LAFLEUR, J.R. ALI, M. OHBA.
- 2 **In the footsteps of giants: Deciphering the details of the demise of Madagascar's subfossil lemurs.** K.E. SAMONDS, L.R. GODFREY, B.E. CROWLEY, M.R. SUTHERLAND.
- 3 **Evidence of crocodile predation on the giant lemurs of Madagascar.** L.R. MEADOR, L.R. GODFREY.
- 4 **Jaw adductor muscles in treeshrews: Implications for Plesiadapiforms and Primate origins.** H.L. KRISTJANSON, J.M. PERRY.
- 5 **Plesiadapiform primates from the Chadronian of North Dakota.** M.A. TORNOW, A.J. KIHM.
- 6 **Identifying homologies among claws and nails: Implications for primate evolution.** S.A. MAIOLINO.
- 7 **New material of *Necrolemur* (Microchoerinae, Omomyidae, Primates) from the Middle Eocene of the Pyrennes (Northeastern Spain).** R. MINWER-BARAKAT, J. MARIGÓ, S. MOYÀ-SOLÀ.
- 8 **A phylogenetic approach to the evolution of anthropoid lumbar number.** E.L. FULWOOD, B.C. O'MEARA.
- 9 **Primate diversity at the close of the Paleogene: Perspectives from the late Oligocene Nsungwe Formation of southwestern Tanzania.** N.J. STEVENS, P.M. O'CONNOR, E.R. SEIFFERT, E.M. ROBERTS.
- 10 **New cranium of the endemic Caribbean platyrrhine, *Antillothrix bernensis*, from La Altagracia Province, Dominican Republic.** L.B. HALENAR, S.B. COOKE, A.L. ROSENBERGER, R. RIMOLI.
- 11 **Comparative morphometric analysis of a juvenile papionin fossil from Kromdraai A.** M. SINGLETON, C.C. GILBERT, S.R. FROST, B.C. SEITELMANN.
- 12 **New fossil remains of *Pliopithecus canmatensis* from Abocador de Can Mata, and their implications for the taxonomic validity and phylogenetic position of *Epipliopthecus* (Primates, Pliopithecidae).** D.M. ALBA, S. MOYÀ-SOLÀ.
- 13 **Research on East African catarrhine and hominoid evolution: Results from the first year.** K.P. MCNULTY, L. MACLATCHY, J.B. ROSSIE, D.J. PEPPE, A.L. DEINO, E.N. MBUA, F.K. MANTHI, I.O. NENGO, E.R. MILLER, N.J. STEVENS, S. COTE, T. LEHMANN, M. GUTIÉRREZ.
- 14 **Navicular remains of *Anchomomys frontanyensis* (Adapoidea, Primates) from the middle Eocene of Sant Jaume de Frontanya (Northeastern Spain).** J. MARIGÓ, D.M. BOYER, R. MINWER-BARAKAT, S. MOYÀ-SOLÀ.
- 15 **Tarsal morphology of *Caenopithecus*, a large adapiform primate from the middle Eocene of Switzerland.** E.R. SEIFFERT, D.M. BOYER, L. COSTEUR, J. PUENTE.
- 16 **Quantification of talar medial tibial facet variation among primates.** J.E. BUTLER, G.S. YAPUNCICH, D.M. BOYER.
- 17 **Morphometric and functional analyses of a new colobine tibia from Laetoli, Tanzania.** M.F. LAIRD, T. HARRISON, S. ZHOU, E. KOZMA, A. KWEKASON, D.F. SU.
- 18 **Exploring the relationship between anthropoid cuboid morphology and expressed locomotor behavior.** O.O. THOMAS, W.E. HARCOURT-SMITH, H. PONTZER.
- 19 **The Kromdraai "hominin" cuboid KB 3133: A new assignation based on comparative anatomical techniques and 3D geometric morphometrics.** W.E. HARCOURT-SMITH, O.O. THOMAS, J.M. DESILVA, S.R. FROST, B.A. PATEL, C.M. ORR.
- 20 **Hominoid cranial remains from the Vallès-Penedès Basin (NE Iberian Peninsula): Taxonomic and phylogenetic implications.** M. PÉREZ DE LOS RÍOS, D.M. ALBA, S. MOYÀ-SOLÀ.
- 21 **Relative enamel thickness and enamel-dentine junction morphology in the Vallès-Penedès hominoids: A 3D approach based on X-ray micro-computed-tomography.** J. FORTUNY, C. ZANOLLI, R. MACCHIARELLI, F. BERNARDINI, C. TUNIZ, D.M. ALBA.
- 22 **The standard Procrustes analyses may be inappropriate for applications to variation at large geometric scale.** F.L. BOOKSTEIN.
- 23 **Discrete dental traits differentiating *Gorilla* sexes, subspecies and species.** V.C. PILBROW.

Session 8: DENTAL ANTHROPOLOGY: Diets, Dentitions and Wear in Nonhuman Primates

Contributed Poster Presentations. Chair: Elissa Ludeman. Telus CC Exhibit Hall E2.

7:30-8:00 am Poster set-up. 4:30-5:00 pm Poster take-down.

Even numbered poster authors present for discussion - 10:00-10:30 am and 2:30-3:00 pm

Odd numbered poster authors present for discussion - 10:30-11:00 am and 3:00-3:30 pm

- 1 **Cercopithecoid molar size and shape variability in an evolutionary-developmental framework.** J.M. WINCHESTER, D.M. BOYER, J. JERNVALL.

- 2 **A test of the inhibitory cascade (IC) model on primate deciduous premolars.** E. DALY, K.K. CATLETT.
- 3 **Premolar lost, variation gained: Posterior dental proportions in anthropoids and testing adherence to a mammalian developmental model.** E.M. LUDEMAN, T. HARRISON, S. BAILEY.
- 4 **Does an extra premolar increase occlusal area: Comparison of Old and New World monkeys.** A.M. FRANKLIN.
- 5 **Environmental stress and molar wear in three populations of mantled howling monkeys (*Alouatta palliata*).** J.P. SPRADLEY, K.E. GLANDER, R.F. KAY.
- 6 **Canine bending strength and fracture in durophagous platyrrhines.** Z.S. KLUKKERT.
- 7 **A molar microwear texture analysis of pitheciid primates.** A.J. RAGNI, M.F. TEAFORD, P.S. UNGAR.
- 8 **Differentiating diets of New World Monkeys using dental topographic analysis.** C.A. HEALY, A. KARME, M. FORTELIUS, P.S. UNGAR.
- 9 **Dental macrowear analysis in Great Apes.** L. FIORENZA, S. BENAZZI, J. MOGGI-CECCHI, C.G. MENTER, O. KULLMER.
- 10 **Dental chipping in subfossil Lemurs.** M.S. SCHAEFER, P.J. CONSTANTINO.
- 11 **The role of grit and phytoliths in wearing primate teeth.** A.P. VAN CASTEREN, P.W. LUCAS, K. AL-FADHALAH, A.S. ALMUSALLAM, S. MICHAEL, A.G. HENRY, J. WATZKE, D.S. STRAIT, T.G. ATKINS.
- 12 **What's grit got to do with it: An analysis of grit accumulation in the canopy of a fragmented forest of Madagascar?** C.R. BENDER, M. IRWIN.

Session 9: PRIMATOLOGY

Contributed Poster Presentations. Chair: Michelle Rodrigues. **Telus CC Exhibit Hall E3.**

7:30-8:00 am Poster set-up. **4:30-5:00 pm** Poster take-down.

Even numbered poster authors present for discussion - **10:00-10:30 am** and **2:30-3:00 pm**

Odd numbered poster authors present for discussion - **10:30-11:00 am** and **3:00-3:30 pm**

- 1 **Dental processing of doum palm fruit by the Tana River mangabey (*Cercocebus galeritus*).** J. WIECZKOWSKI.
- 2 **Strongyloids in the soil: An exploration of gastrointestinal parasite load and geophagy in lemurs at Tsinjoarivo, Madagascar.** K.L. ALLDREDGE, Z.C. ROMER, M.C. FITZPATRICK, M.T. IRWIN.
- 3 **More fiber means more dirt? The role of geophagy in Diademeds Sifakas.** B.P. SEMEL, M.T. IRWIN, J. RAHARISON, C.A. CHAPMAN, J.M. ROTHMAN.
- 4 **Regrowth of timbered trees in Ranomafana National Park: Hope for rainforest recovery.** E. SPERLING, A.E. WRIGHT POSTON, G. RAKOTONIRINA, P.C. WRIGHT.
- 5 **Parasite prevalence in lemurs: Habitat disturbance and individual characteristics as explaining factors.** I.D. WINTER, I. HEITKÖNIG, P. WRIGHT, H. PRINS.
- 6 **Are eastern bamboo lemurs disturbance specialists? Preliminary indications of ecological stress in *Hapalemur griseus*.** M.C. FITZPATRICK, H. VOLOLONORO, M.T. IRWIN.
- 7 **Ecological correlates of diet and social structure in the greater bamboo lemur (*Prolemur simus*).** P. BOONE, C. FRASIER, E.E. LOUIS.
- 8 **Abundance estimates for the nocturnal lemur community of Mangevo forest in southern Ranomafana National Park.** S. CASSALETT, S.E. JOHNSON, P.C. WRIGHT.
- 9 **Female-female social relationships and feeding competition in Verreaux's sifaka (*Propithecus verreauxi*).** K.M. ORTIZ, R.J. LEWIS.
- 10 **Drivers of high infant mortality in *Propithecus edwardsi*: The role of resource availability.** M. LAUTERBUR, B.L. GREENE, P.C. WRIGHT.
- 11 **Pair-living and pair-bonding in the Red-Bellied Lemur, *Eulemur rubriventer*.** S.R. TECOT, B. SINGLETARY, E. EADIE.
- 12 **Population dynamics and evidence of polyestry in gray brown mouse lemurs, *Microcebus griseorufus*, in stressful habitats at Beza Mahafaly, SW Madagascar.** E. RASOAZANABARY, L. GODFREY.
- 13 **Preliminary analysis of habitat usage by sympatric greater and lesser galagos (*Otolemur crassicaudatus* and *Galago moholi*) in a montane environment.** K. FISH, M. SAUTHER, F. CUOZZO, M. STRINDEN.
- 14 **Development of feeding and social behavior in wild mantled howler monkeys (*Alouatta palliata*).** A.L. SCHREIER, M. MOSCOVITCH, N. MINEO, H. WILBANKS, N.L. BARRICKMAN.
- 15 **Using the parallel laser method to estimate body size in wild mantled howler monkeys (*Alouatta palliata*).** N.L. BARRICKMAN, A.L. SCHREIER.
- 16 **Activity budget, habitat use and diet of squirrel monkeys (*Saimiri oerstedii*) in Southern Costa Rica.** T.C. GALEY, L. KAUFFMAN.
- 17 **Evidence of behavioral plasticity in genus *Saimiri* via interactions with humans in Suriname and Costa Rica.** L. KAUFFMAN.
- 18 **Resource utilization and home range overlap in territorial owl monkeys of Argentina.** A. SAVAGIAN, A. TWITCHELL-HEYNE, M. CORLEY, V. DÁVALOS, M. ROTUNDO, A. DI FIORE, E. FERNANDEZ-DUQUE.
- 19 **The function of scent-marking in territorial owl monkeys.** M. CORLEY, A. SPENCE-AIZENBERG, K. MORUCCI, M. ROTUNDO, A. DI FIORE, E. FERNANDEZ-DUQUE.

- 20 Rethinking night monkey's nocturnality. F.M. CORNEJO, P.C. WRIGHT.
- 21 Another example of a chimpanzee-like Black-handed Spider monkey (*Ateles geoffroyi*) "raid" observed at La Milpa, Belize. E.R. BROWN-MEEKS, E.R. DAVIS, T. LILLEY, B. BENEFIT.
- 22 The effects of resource availability on the diet and activity budget of female Spider Monkeys (*Ateles geoffroyi*) on Barro Colorado Island (BCI), Panama. S.M. RAMIREZ, C.J. CAMPBELL, S.J. WRIGHT, T.Q. BARTLETT.
- 23 Adaptations of *Cebus nigrinus* and *Callithrix jacchus* to habitat changes and tourism in Rio de Janeiro, Brazil. J. THURMAN.
- 24 Discrimination between unwilling and unable helpers by capuchin monkeys (*Cebus apella*). K. REINA, J. SILK, L. SANTOS.
- 25 How 'semi' is the capuchin prehensile tail? A. MCNAMARA, N. MAZUMDAR, K. KURTZ, M. BEZANSON.
- 26 Friends, sex, and stress: Social behavior, reproductive condition, and cortisol levels of female Brown Capuchins in Suriname. E.E. EHMKE.
- 27 Urinary cortisol variation in redbills (*Cercopithecus ascanius*) and red colobus (*Ptilocolobus rufomitatus*) of Kibale National Park, Uganda: Hunting or habitat? G.P. ARONSEN, M.M. BEUERLEIN, D.P. WATTS, R.G. BRIBIESCAS.
- 28 A non-invasive methodology for monitoring physiological and endocrinological responses to stressors in correlation to skeletal protein breakdown in wild orangutans. A.M. MOLDAWER, R. UNGARO, T.M. SETIA, E.R. VOGEL.
- 29 Conservation of threatened primates in Dassioko Sud and Port Gauthier forest reserves: Use of field patrols to assess primate abundance and illegal human activities. S. GONDELE BI, E. BITTY, W. MCGRAW.
- 30 The impact of unrealistic primate management expectations on community support for a riverine corridor restoration project in western Uganda. E. CANCELLIERE, S. HSIAO, S. MUSEY, R. ATUGONZA.
- 31 Landscape ecology of fruiting trees in Kibale National Park, Uganda: Effects of logging history and implications for tree population genetics and primate seed dispersal. M.M. LYKE, A. DI FIORE, J.E. LAMBERT.
- 32 Democracy or despotism? How do baboons decide? M.C. CROFOOT, R. KAYS, S. ALAVI, M. WIKELSKI.
- 33 Consequences of a male take-over on the male mating skew of wild Sanje mangabeys (*Cercocebus sanjei*). D. FERNÁNDEZ.
- 34 Effects of high altitude on pygmy tarsiers (*Tarsius pumilus*) in the montane forest of central Sulawesi, Indonesia. N.B. GROW.
- 35 Population density survey of *Pygathrix cinerea* (the grey-shanked douc langur) in the An Toàn Nature Reserve, Vietnam. K. BAILEY.
- 36 Parasite ecology of black-shanked douc in Cat Tien National Park, Vietnam. J.A. O'BRIEN, J.E. LOUDON, R.B. ADAMS, K.E. ROBB.
- 37 Vocal survey of white-handed gibbons (*Hylobates lar*) in the Huai Kha Khaeng Wildlife Sanctuary, western Thailand. T.Q. BARTLETT, T. DAWRUENG, A. KAMJING, T. SAVINI.
- 38 Vocal recognition in ring-tailed lemurs. R.B. REDDY, R.C. ANDERSON, B. HARE.
- 39 Bonobos are xenophilic. J. TAN, B. HARE.
- 40 Re-evaluating the sisterhood: Are captive bonobos female-bonded? M.A. RODRIGUES.
- 41 The Holly Project: Continuing behavioral changes in a young adult female chimpanzee (*Pan troglodytes*) identified with sensory-integration difficulties. E.J. INGMANSON, T. MAY-BENSON, S. BRACCINI, I. PORTON, M.L. BAUMAN.
- 42 Increased preference for spatial association with adult males during adolescence in wild male chimpanzees (*Pan troglodytes*). D.K. ENIGK, M.N. MÜLLER, Z.P. MACHANDA, R.W. WRANGHAM, M. EMERY THOMPSON.
- 43 Fission-Fusion in chimpanzees: Feeding as a proximal mechanism at Gombe. A.B. BLACKBURN, W.C. MCGREW.
- 44 Orangutans: A study of activity and play. L.K. PENNINGTON, E. MCCOY, L. KAUFFMAN.
- 45 Nest type, structural variations, and tree species choice in wild Bornean orangutans (*Pongo pygmaeus wurmbii*). D. PRASETYO, S. UTAMI ATMOKO, J. SUPRIATNA, C.P. VAN SCHAİK, E.R. VOGEL.
- 46 The effects of sleeping platforms on next day cognition in captive orangutans (*Pongo spp.*). R.W. SHUMAKER, D.R. SAMSON, T.P. SCHOENEMANN.
- 47 Species differences in sleep quality between captive orangutans (*Pongo pygmaeus*) and baboons (*Papio papio*). D.R. SAMSON, R.W. SHUMAKER.
- 48 Circadian patterns for five species of lemurs at the Duke Lemur Center. K.E. GLANDER, M.G. FIGUEIRO, G.E. JONES, M.S. REA.
- 49 The evolution of primate pelage: Morphological analyses of museum research skins. B.J. BRADLEY, S. WALSH, A. NISHIMURA, J. KARLSSON, J.M. KAMILAR.
- 50 Historical contingency and the coevolution of terrestriality and genital skin coloration among Old World monkeys. J.D. PAMPUSH, J. CRAMER.
- 51 Does an increased ability to discriminate between red and green lead to decreased red pelage coloration in primates? A.N. SPRIGGS, A.D. GORDON.
- 52 Endocranial regions associated with deception in nonhuman primates. D.R. HURST, A.R. BRITTINGHAM, P. SCHOENEMANN.
- 53 Patterns of cultural nestedness in humans, chimpanzees, and orangutans. J.M. KAMILAR, Q.D. ATKINSON.
- 54 Associations between digit ratio and musculoskeletal stress markers in the hand in three species of ape. E. NELSON, L. CASHMORE.

- 55 Litter size as a selective pressure on group size in mammals? A.A. SANDEL, J. BRAY.
 56 Metabolism's influence on maternal energy transfer durations: Are primates unique? G. JACKSON, E. DUBMAN, A.Ø. MOOERS, M. COLLARD.
 57 Life history variables and vomeronasal groove length in primates. E.C. GARRETT.
 58 Facial trauma and female philopatry: Contrasting baboons and chimpanzees. C.A. KIRCHHOFF.

Session 10: BIOARCHAEOLOGY: Childhood, Population Dynamics, and Cranial Change

Contributed Poster Presentations. Chair: Karen Weinstein. **Telus CC Exhibit Hall E4.**

7:30-8:00 am Poster set-up. 4:30-5:00 pm Poster take-down.

Even numbered poster authors present for discussion - 10:00-10:30 am and 2:30-3:00 pm

Odd numbered poster authors present for discussion - 10:30-11:00 am and 3:00-3:30 pm

- 1 Craniometric analysis of the Howells Egyptian sample: The Greek connection. K. SANDERS, S. OUSLEY, J. ROSE, T. HANIHARA.
- 2 Assessing British cranial trends during the Norman and Medieval Periods: A geometric-morphometric approach. L.B. JONES.
- 3 Craniometric and genetic variation as a means of differentiating East Asian populations. K.I. HARRINGTON, K.R. TAYLOR.
- 4 Shared biology and culture of the first Americans: Data from submerged burials. M. FARALDO, L.L. TAYLOR.
- 5 Variation in cranial morphology of Mexican populations and its role for the human dispersion into the Americas. B.C. HERRERA, M.K. SPRADLEY, M. HUBBE.
- 6 Testing the Dual-Structure hypothesis for the colonization of the Japanese Archipelago: Evidence from southern Japan. B. DUDZIK, N. SEGUCHI.
- 7 Evidence in support of a two-prong colonization of Guam with data from the Naton Beach Site. C.K. WALTH.
- 8 Mid-Holocene population dynamics in eastern Africa: New dental evidence from megalithic "pillar sites" west of Lake Turkana, NW Kenya. E. SAWCHUK, S. PFEIFFER.
- 9 Social inequality and differential prestige in the prehistoric Atacama oases: The impact of foreign cultures on local lifestyle during the Middle Horizon. L. OLDERSHAW, M. HUBBE, C. TORRES-ROUFF.
- 10 Determining architectural function using human skeletons buried therein. L. KIRKPATRICK, D. KURIN.
- 11 Bio-archaeological comparison of medieval Icelandic and Irish remains from Haffjardarey and Alftanes, Skriduklaustur, and Augherkeá. H.C. DONOGHUE, M. MORGAN.
- 12 Duffy's Cut: A brief report of the bioarchaeological findings from a massacre of Irish immigrant railroad laborers from 1832. S.L. COX.
- 13 Preservation and weathering of the human remains from the battle of Stoney Creek during the War of 1812. L. CASACA, M. BRICKLEY.
- 14 The price of disobedience: Death by firing squad in the French and Indian War, Fort William Henry, NY, 1754-1756. J.D. RUNDLE, M.A. LISTON.
- 15 Superstorm Sandy's Halloween surprise: Initial inventory and assessment of colonial-era burials from the New Haven Green. K. WILLIAMSON, G.P. ARONSEN, N.F. BELLANTONI, G.J. CONLOGUE, N.A. PELLATIER, J. KRIGBAUM, L. FEHREN-SCHMITZ, Y. TONOIKE, J.A. SCHIFF, F. HOLE.
- 16 Morphological mismatch between the mandible and the lower dentition following the transition to agriculture in the Near East, Anatolia and Europe. R. PINHASI, N. VON CRAMON-TAUBADEL.
- 17 Changes in human brain morphometry following the transition to plant and animal domestication. S.S. SONG, R.L. HOLLOWAY, W. SONG, C.J. BAE.
- 18 Pastoralism, agriculture, and stress: A comparative analysis of two 19th century Qing Dynasty populations. B.J. BETZ.
- 19 Systemic stress in the Ohio River Valley during the early Contact period: Enamel hypoplasia and delayed growth at Neale's Landing, Blennerhassett Island, West Virginia. K.J. WEINSTEIN, D. EHRLICH, C. WOLFE.
- 20 Childhood at Orendorf: Stress and growth in the Mississippian period. A.M. WILLIAMSON, D.W. STEADMAN, J.J. WILSON.
- 21 Infant and child burials at a Formative Period site in the Lake Titicaca Basin, Peru. R. CAMPBELL, A. LEVINE.
- 22 Craniofacial asymmetry, subsistence behavior, and developmental stress: A comparison of facial form between hunter-gatherer and non-hunter-gatherer populations. S.F. MILLER.
- 23 Hazard Model estimation of prehistoric growth rates. K.D. WALLER, R.S. LANDER.
- 24 A bioarchaeological study of childhood mortality in 17th century Transylvania. J.D. BETHARD, A.J. OSTERHOLTZ, A. GONCIAR, Z. NYARADI.
- 25 Osteological analysis of juvenile skeletal remains: Tiber River Valley, Lazio Region, Vacone, Italy. D.L. WARD, M.D. CRISFIELD, G.D. FARNEY, D.M. BLOY.
- 26 Intrasite variability in subadult burial during the Iberian Copper Age. J. BECK.
- 27 Subadult ages and mortuary treatment at Non Nok Tha, Thailand: A contextual Analysis. K.M. HAMMOND.

- 28 Preliminary research on the age and sex distribution of Hanshu II culture burials (ca. 2250-2050 BP) in Houtaomuga site, China. X. XIAO, H. ZHU, L. WANG, D. YANG.
- 29 Paleodemography of human remains from Hamin Mangha Site in Inner Mongolia: Evidence of forensic anthropology of cause of prehistoric disaster. Y.W. ZHOU, H. ZHU.
- 30 A bioarchaeological study of human remains from Jinggouzi, a Bronze Age cemetery site in North China. Q. ZHANG, Z. SUN, M. LI, L. WANG, Q. ZHANG, H. ZHU.
- 31 Osteometric analysis of human skulls from the Shenmu-Dabaodang Eastern Han dynasty site: Evidence in physical anthropology for the Xiongnu secession. F. WANG.
- 32 The origin of the skeletal human remains from Dabaoshan site (2300-2200BP) in south central Inner Mongolia, China. X. ZHANG, H. ZHU, D. YANG.

Session 11: BIOARCHAEOLOGY: Mobility, Activity, Stature

Contributed Poster Presentations. Chair: Gail Hughes-Morey. **Telus CC Exhibit Hall E5.**

7:30-8:00 am Poster set-up. 4:30-5:00 pm Poster take-down.

Even numbered poster authors present for discussion - 10:00-10:30 am and 2:30-3:00 pm

Odd numbered poster authors present for discussion - 10:30-11:00 am and 3:00-3:30 pm

- 1 The study of Tuchengzi skeletal remains to examine stature change in ancient China. E.G. HARDY, H. ZHANG, X. XIAO, D. MERRETT, D. YANG, H. ZHU.
- 2 Testing stature equations on a medieval Upper Nubian skeletal sample. E. NIESPODZIEWANSKI.
- 3 How short is short? A possible case of dwarfism from Egypt's Third Intermediate Period from the Dakhleh Oasis, Egypt. C.L. KIRKPATRICK, E. MOLTO, C. VENET-ROGERS.
- 4 The individual-level "dual burden" of short stature and excess adiposity: Discounting a methodological explanation using tibia length. E. POMEROY, J.T. STOCK, S. STANOJEVIC, J. MIRANDA, T.J. COLE, J.C. WELLS.
- 5 Stature estimation from long bones in the Early Medieval population at Pohansko (Czech Republic): Applicability of regression equations. V. SLÁDEK, J. MACHACEK, C. RUFF, E. SCHUPLEROVA, R. PRICHYSTALOVA, M. HORA.
- 6 Testing the predictions of the developmental origins of adult health and disease (DOHaD) hypothesis on an identified human skeletal collection II: Age at death and femur length. A. AMOROSO, S. GARCIA, H.F. CARDOSO.
- 7 The influence of morbidity and socioeconomic status on the relationship between stature and mortality in industrializing London. G.M. HUGHES-MOREY.
- 8 Femoral and tibial cross-sectional morphology reflects complex change in sex roles, mobility, and division of labor across ~6200 years of agriculture in Central Europe. A.A. MACINTOSH, R. PINHASI, J.T. STOCK.
- 9 Preliminary investigations of habitual stress on femora from two economically different archaeological populations in China. Z. NIE, X. ZHANG, M. WANG, Y. NIE, D. YANG, H. ZHU, X. WU.
- 10 Skeletal variability of femoral robusticity in two human populations. S.E. CALCE, H.K. KURKI.
- 11 Paper Withdrawn.
- 12 Knock-kneed and bow legged: Identifying genu valgum in dry bone. K.E. TSCHINKEL, R. GOWLAND.
- 13 Lower limb posturing behavior of western Tennessee: An analysis of the knee and ankle joint. E.E. WILK, M.O. SMITH.
- 14 Scoring enthesal changes: A statistical analysis of two ordinal methods. K.N. WOODS.
- 15 Application of generalized linear models and generalized estimating equations in multifactorial conditions: The case of enthesal changes. E.P. NIKITA.
- 16 Musculoskeletal interpretation of labor induced stress on ancient Andean populations from Hualcayán (Ancash, Perú). J.O. STOKES, S.K. BECKER, J.J. LESNIK, R.E. BRIA.
- 17 Musculoskeletal stress markers in an Ancient Puebloan population. D.M. MULHERN.
- 18 Occupational markers and artifacts: The osteobiography of a weaver from ancient highland Peru. J.L. CARROLL, D.S. KURIN.
- 19 Basket cases: Temporal comparison of the patterns and prevalence of the acromio-humeral facet in samples from the Pre-Columbian Tennessee River Valley. D.L. NEIDICH.
- 20 Reconstruction of Neolithic and Iron Age human manipulative behavior using electromyography. M. HORA, K. FARKAŠOVÁ, V. SLÁDEK.
- 21 Differences in the effects of age and sex on musculoskeletal stress markers (MSM) development among historic Japanese populations. S. YONEMOTO.
- 22 Age and sex related cortical bone loss in two Imperial Roman skeletal populations: Exploring the interplay between gender, social status and the life course. P. BEAUCHESNE, S.C. AGARWAL.
- 23 Mapping activity patterns through Musculoskeletal Stress Markers: Vertebral anomalies of a Middle Horizon population in the north-central highlands of Peru. L.M. CALABRIA, S.K. BECKER, J.J. LESNIK, R.E. BRIA.
- 24 An investigation of mobility patterns in the late prehistoric communities of central Spain (Madrid) using ⁸⁷Sr/⁸⁶Sr isotope ratios. A.J. WATERMAN, J.T. THOMAS, P. DÍAZ-DEL-RÍO, S. CONSUEGRA, A. PÉREZ-VILLA, D.W. PEATE.

Thursday, Afternoon sessions.

Session 12: Evolutionary Developmental Anthropology: An Evo-Devo Approach to Understanding Primate and Human Evolution.

The Wiley-Blackwell Invited Podium Symposium. Organizers and Chairs: Campbell Rolian and Julia Boughner. Hyatt Imperial Ballroom 1/2/3.

Evolutionary developmental biology, or evo-devo, is a relatively young branch of biology concerned with how and why organismal development matters to evolution. Although the study of evolution and development in vertebrates is centuries old, evo-devo owes its existence primarily to advances in developmental genetics in the last quarter of the 20th century. One of these advances is the notable discovery that the morphology and behavior of complex organisms emerges from relatively few genetic "toolkits" that are not only used and re-used during organismal development, but are also highly conserved among taxa. Evo-devo draws upon this insight to reveal how morphological, and increasingly, behavioral diversity has evolved through relatively minor tweaking of such toolkits. As a discipline, evo-devo is primarily concerned with mechanistic aspects of the evolutionary process, in particular the specific developmental and genetic mechanisms that underlie past and present morphological and behavioral diversity in complex organisms. The relatively broad umbrella of evo-devo also includes the study of more general developmental phenomena that structure selectable variation at the population level (e.g. constraints), and influence the rates and directions of evolutionary change.

Given its enormous potential for explaining patterns of morphological and behavioral diversity within primates, evo-devo has also gathered significant traction in evolutionary anthropology. As evolutionary anthropologists, we are all interested in the traits that not only distinguish primates from other vertebrates, but also make humans unique among primates. Yet while many are concerned with *why* unique or novel traits ultimately evolved, others are increasingly asking questions relating to *how*, from a proximate mechanistic perspective, such evolutionary change and novelty are possible. This symposium aims to provide an overview of the breadth of questions asked, and tools used, in evolutionary developmental anthropology, as well as to build research momentum and catalyze future intellectual innovation in this burgeoning field.

- 1:00 **Evolutionary developmental anthropology: An introduction and historical overview.** J.C. BOUGHNER, C. ROLIAN.
 1:15 **The patterning of genetic variation in the collaborative cross and mutant mice.** B. HALLGRIMSSON, M. PAVLIVEV, P. MITTEROECKER, P. GONZALEZ, N. YOUNG, C. ROLIAN, H.E. JAMNICZKY, F. PARDO-MANUEL VILLENA, R. MARCUCIO, R. SPRITZ.
 1:30 **Morphometrics showing genetics: New approaches on evo-devo research.** N. MARTÍNEZ-ABADÍAS, R. MATEU, M. NIKSIC, L. RUSSO, J. SHARPE.
 1:45 **Hominin craniodental evolution and autonomy of mandible and tooth morphogenesis.** M.T. RAJ, J.C. BOUGHNER.
 2:00 **The genetics of hominin cranial base integration and evolution.** L. NEVELL, B. WOOD.
 2:15 **Genetic regulation of amelogenesis and implications for hominin ancestors.** R.S. LACRUZ.
 2:30 **Evo-devo sheds light on mechanisms of human evolution and parallelism in hominoids.** P.L. RENO.
 2:45 **Investigating the molecular mechanisms of evolutionary variation in hominin scapula shape.** T.D. CAPELLINI, N.M. YOUNG.
 3:00 **BREAK.**
 3:15 **Differing long bone lengths among hominoids can be achieved through changes in growth plate chondrocyte behavior.** C. ROLIAN.
 3:30 **Evolutionary developmental variation in primate musculature and implications for human medicine.** R. DIOGO, B. WOOD.
 3:45 **Directing new information and abilities into conserved brain architecture.** B.L. FINLAY.
 4:00 **The evolvability of conserved neurogenesis programs of the cerebral cortex.** C.J. CHARVET.
 4:15 **Quantifying the evolution of human brain development.** P. GUNZ, S. NEUBAUER, N. SCOTT, B. DREWS, J. HUBLIN.
 4:30 **So long after Darwin, do we know how complex developmental traits evolve?** K.M. WEISS, A.V. BUCHANAN.
 4:45 **Discussant: Gunter Wagner, Yale University.**

Session 13: PRIMATOLOGY: Foraging and Energetics

Contributed Podium Presentations. Chair: Katharine Amato. Hyatt Imperial Ballroom 7/9.

- 1:00 **Dichromacy in *Eulemur fulvus*: Implications for foraging ecology.** K. VALENTA, A.D. MELIN, M. EDWARDS, S.M. LEHMAN.
 1:15 **Nutritional quality and biological significance of foods consumed by Coquerel's sifaka (*Propithecus coquereli*) mothers during lactation.** A.C. ROSS, M.L. POWER.
 1:30 **An ateline foraging strategy: Nutritional intake of the black howler monkey (*Alouatta pigra*) in Palenque National Park, Mexico.** K.R. AMATO, P.A. GARBER.
 1:45 **Predictors of foraging behavior in white-faced capuchins (*Cebus capucinus*).** M.L. BERGSTROM, A.D. MELIN, N.A. PARR, L.M. FEDIGAN.
 2:00 **Strong group effects on energetic balance in redbtail monkeys (*Cercopithecus ascanius*).** M. BROWN, M. EMERY

THOMPSON.

- 2:15 **Flexibility in within-group spatial position, individual spacing and feeding success in the Sanje mangabey (*Cercocebus sanjei*).** E.K. LLOYD, C.L. EHARDT.
- 2:30 **Grips and hand movements of chimpanzees during feeding in Mahale Mountains National Park, Tanzania.** L.F. MARCHANT, M.W. MARZKE, W.C. MCGREW, S.P. REECE.
- 2:45 **Dietary ecology of the chimpanzees (*P.t. verus*) at the Tonkolili Site: Analyzing resource's chemical properties in proportion to their risk factor.** A.D. THORPE, A.R. HALLORAN.
- 3:00 **BREAK.**
- 3:15 **Do patterns of termite-fishing by Kasekela chimpanzees reflect patch depletion?** R.C. O'MALLEY.
- 3:30 **Do Bornean orangutans (*Pongo pygmaeus wurmbii*) in a peat-swamp habitat experience energetic stress during periods of fruit scarcity?** E.R. VOGEL, T.D. BRANSFORD, A.M. MOLDAWER, M.A. VAN NOORDWIJK, S. UTAMI ATMOKO, M. EMERY-THOMPSON, C.D. KNOTT.
- 3:45 **The influence of seasonal fruit variation on Sanje mangabey (*Cercocebus sanjei*) feeding ecology in a Montane Rain forest in Tanzania.** G. PAGES, C.L. EHARDT.
- 4:00 **Primate flower power: Flowers as a seasonally important food item for Central American spider monkeys.** N.C. GRIFFIN, M.S. PAVELKA.
- 4:15 **Influence of variation in arthropod availability on the foraging ecology of white-faced capuchin monkeys (*Cebus capucinus*).** E.K. MALLOTT.
- 4:30 **Did you hear that? Properties of deadwood that influence aye-aye (*Daubentonia madagascariensis*) extractive foraging.** K.E. THOMPSON, J.S. SOLOFONDRANOHATRA, E.E. LEWIS, G.H. PERRY.
- 4:45 **Falling short: Minerals as nutritional challenges in diademed sifakas (*Propithecus diadema*).** M.T. IRWIN, J. RAHARISON, C.A. CHAPMAN, R.E. JUNGE, K.E. SAMONDS, J.M. ROTHMAN.

Session 14: BIOARCHAEOLOGY and PALEOPATHOLOGY

Contributed Podium Presentations. Chair: Susan Kirkpatrick Smith. Telus CC Glen 201-204.

- 1:00 **Social constructs, health and burial strategy: Mortuary variation and skeletal analysis of First Intermediate Period Mendes.** A.M. LOPINTO.
- 1:15 **Enacting Egyptian colonialism: A comparison of enthesal changes between the C-Group and Pharaonic samples.** S.A. SCHRADER.
- 1:30 **Clumsiness or hard daily routine? Fractures of hands and feet in Bronze Age people from Northern Caucasus.** J. GRESKY, N. BEREZINA.
- 1:45 **Human skeletal remains from the Malliotaki Roman Cemetery Site in East Crete.** S. SMITH, S. APOSTOLAKOU.
- 2:00 **The antiquity of child abuse: A case of Battered Child Syndrome from the Agora of Athens.** M.A. LISTON.
- 2:15 **Where are the warriors? Trauma and violence in Roman Iron Age Denmark.** L.M. COLLIER.
- 2:30 **Death during the Scottish Wars of Independence: An osteological and isotopic analysis of Medieval individuals from Stirling Castle, Scotland.** J. BUCKBERRY, J. MONTGOMERY, J. LEE-THORP.
- 2:45 **Evaluating a reputation for violence: Paleopathological evidence for interpersonal violence in ancient Peru.** S.A. JOLLY, D.S. KURIN.
- 3:00 **BREAK.**
- 3:15 **Epidemic frequency and reproductive value in the Holocene.** R.R. PAINE, J.L. BOLDSSEN.
- 3:30 **Setting the stage for medieval plague: Pre-Black Death trends in survival and mortality (1000-1300 AD).** S.N. DEWITTE.
- 3:45 ***Mycobacterium tuberculosis* in prehistoric California: A review of evidence and paleoepidemiological comparisons of impacted and related populations.** J.C. AXELROD, R.E. VARGHESE, E.M. BURKE, J. DING, R.S. JABBOUR, G.D. RICHARDS.
- 4:00 **Marital status, maternal deaths and bone mineral density in the Coimbra Identified Skeletal Collection.** F. CURATE, E. CUNHA, D. NAVEGA, A. ALBUQUERQUE.
- 4:15 **The effect of caloric restriction on the rate and severity of age-related spinal osteoarthritis.** J.F. BAILEY, A.E. DUNCAN, R.J. COLMAN, J.A. MATTISON, P.A. KRAMER.
- 4:30 **Non-weight-bearing joint pain and body mass index: Data from the Osteoarthritis Initiative and their implications for understanding osteoarthritis etiology.** E. WEISS.
- 4:45 **Muscle, fat, and bone: How body size could revolutionize our understanding of past populations.** C.E. MERRITT.

Session 15: Beyond the Obstetric Dilemma: How New Studies of the Pelvis are Redefining our Approach to Hominin Evolution

Invited Poster Symposium. Organizer: Cara M. Wall-Scheffler. **Hyatt Bannerman/Walker.**

When paleoanthropology began to focus in on the importance of bipedality to the hominin lineage, it became a natural move to focus attention on better understanding the meaning behind sexual dimorphism of locomotor morphology. As such, a large amount of work on the functional morphology of the hominin postcrania focused on differences between the sexes in terms of pelvis shape. Much early interpretation focused on basic size differences and on the idea that females were likely selected away from a bipedal 'ideal' due to the constraints of childbirth.

Lately, a number of interesting and innovative investigations have started to approach the pelvis and pelvic variation from different perspectives, including developmental, demographic, and phylogenetic, as well as functional from the perspectives of tasks other than unloaded, level walking, like burden transport and a combination of arboreality and terrestriality. Additionally, as technology improves, we have begun the vast task of actually quantifying the variation of this complex 3-dimensional shape and comparing across and between populations. All of these different studies -functional, morphological, developmental- offer important clues towards a better understanding of hominin evolution, sexual dimorphism, morphological modularity, and development constraints. In this symposium, people at the forefront of work on the pelvis will be presenting their ideas so that we can begin to process our knowledge and explain the evolutionary mechanisms acting on pelvic morphology.

12:30-1:00 pm Poster set-up. **4:45-5:15 pm** Poster take-down.

2:00-3:00 pm Short Presentations by Authors

3:00-4:00 pm Roundtable Discussion

4:00-4:15 pm Discussant: Jeremy DeSilva, Boston University

4:15-4:30 pm Discussant: Karen Rosenberg, University of Delaware

- 1 **The patchwork pelvis: Evolution and variation in human pelvic size and shape.** B.M. AUERBACH.
- 2 **Pelvic shape variation: What does it tell us about obstetric adaptation?** H.K. KURKI, S. DECRAUSAZ.
- 3 **The pelvis in 3D: Shape differences in the modern human pelvic canal.** K.R. DRISCOLL.
- 4 **Pelvic inlet shape and sex determination from a fragmentary fossil pelvis.** E.A. MOFFETT, L.N. LEAKEY, M.G. LEAKEY, J.M. PLAVCAN, F. SPOOR, C.V. WARD.
- 5 **Evidence for a substantial effect of neutral microevolutionary processes in shaping human pelvic variation at a global scale.** L. BETTI, N. VON CRAMON-TAUBADEL, A. MANICA, S.J. LYCETT.
- 6 **Genetic variation in pelvic sexual dimorphism and its implications for human evolution.** M.W. GRABOWSKI, S.A. WILLIAMS, C.H. O'CONNOR, H.A. LAWSON, J.D. POLK, J.M. CHEVERUD, C.C. ROSEMAN.
- 7 **Variation in catarrhine os coxae morphology: Phylogenetic implications in a comparative context.** N. VON CRAMON-TAUBADEL, S.J. LYCETT.
- 8 **Putting the pelvis in its place: Distinguishing the 'phenomenon' of locomotion from the mechanisms that produce it.** J.E. BERTRAM, S. HASANEINI.
- 9 **Cephalopelvic disproportion: Assessing the possible role of asymmetry and developmental instability.** V.A. TOBOLSKY, H.K. KURKI, J.T. STOCK.
- 10 **The effects of anterior pelvic tilt on walking kinematics in modern bipeds.** K.K. WHITCOME.
- 11 **The balance between body size and task in assessing the meaning of pelvic width for human locomotion.** C.M. WALL-SCHEFFLER, M.J. MYERS.
- 12 **Neandertal and recent human female pelvis: Are they really different?** C. VANSICKLE.

Session 16: Ring-Tailed Lemurs: A Species Re-imagined

Invited Poster Symposium. Organizers: Michelle L. Sauther, Lisa Gould, Frank Cuzzo, and Teague O'Mara.
Hyatt Herald/Doll.

For over fifty years ring-tailed lemurs have been studied continuously in the wild. As one of the most long-studied primate species, the length and breadth of their study is comparable to research on Japanese macaques, baboons and chimpanzees. They are also one of the most broadly studied of all primates, with comprehensive research having been conducted on their behavior, biology, ecology, genetics, paleobiology and life history. However, over the last decade a new generation of lemur scholars, working in conjunction with researchers who have spent decades studying this species, have greatly enhanced our knowledge of ring-tailed lemurs. In addition, research on this species has expanded beyond traditional gallery forest habitats to now include high altitude, limestone spiny forest, and anthropogenically disturbed coastal forest populations. The focus of this symposium is to “re-imagine” the “flagship species of Madagascar”, bringing together three generations of lemur scholars from North America, Asia, Europe, and Africa.

12:30-1:00 pm Poster set-up. 4:45-5:15 pm Poster take-down.

1:00-2:00 pm Short Presentations by Authors

2:00-3:30 pm All Authors Present for Discussion

3:30-4:00 pm Invited Discussants: Robert Sussman, Washington University, and M. Teague O'Mara, University of Konstanz

4:00-4:45 pm Roundtable Discussion

- 1 **Effects of habitat fragmentation and isolation on the genetic diversity and structure of *Lemur catta* in south-central Madagascar.** T.A. CLARKE, O. GREY, M. RAVAOLAHY, K. SUNDERLAND, L. GOULD, A. BURRELL.
- 2 **Patterns of dental macro-wear in sub-fossil *Lemur catta* (~ 500 BP) from Ankilitelo, Madagascar: Indications of ecology and habitat use.** F.P. CUOZZO, M.L. SAUTHER.
- 3 **When ring-tailed lemurs find lemons and make lemonade: The dependency on *Opuntia* at Cap Sainte-Marie and the increasing use of *Opuntia* at Berenty.** E.A. KELLEY, H. RASAMIMANANA, A.S. MERTL-MILLHOLLEN.
- 4 **Anti-predator vocalization usage in the male ring-tailed lemur (*Lemur catta*).** L.M. BOLT, M.L. SAUTHER, F.P. CUOZZO.
- 5 **Beasts of the southern wild: *Lemur catta* feeding and nutritional ecology at three spiny forest sites in southern Madagascar.** L. GOULD, E.A. KELLEY, M. LAFLEUR.
- 6 **Individuality, territoriality and troop division in *Lemur catta* females: 20-year consequences of a bad choice.** A. JOLLY, T.D. WYNNDER, A. WALKER-BOLTON, L.H. WATCHMAN, G.E. WOOD.
- 7 **Seasonal ecology of ring-tailed lemurs: A comparison of spiny and gallery forest habitats.** M. LAFLEUR, M.L. SAUTHER.
- 8 **Tough times don't last, tough lemurs do: Using ¹³C and ¹⁵N to examine the responses of *Lemur catta* to natural disasters at the Beza Mahafaly Special Reserve.** J.E. LOUDON, M.L. SAUTHER, K. SCHWAGERL, F.P. CUOZZO, M. SPONHEIMER.
- 9 **Anchoring the clade: Insights from *Lemur catta* on primate-wide sex-typed behavioral development.** S.L. MEREDITH.
- 10 ***Lemur catta* mating behavior at Berenty Reserve Madagascar: Mating synchrony, indirect female choice and the operational sex ratio.** A.S. MERTL-MILLHOLLEN, K. BLUMENFELD-JONES, H. RASAMIMANANA, E. PALAGI, J.L. NEEDHAM, A. WALKER-BOLTON, R. PRIDE, A.T. KUYKENDALL, A. NIEMEYER, S. PETERSON.
- 11 **Ring-tailed lemurs and the evolution of the primate juvenile period.** T. O'MARA.
- 12 **Population demography of native ring-tailed and introduced brown lemurs at Berenty reserve.** J. RAZAFINDRAMANANA, A. JOLLY, G. DONATI.
- 13 **Should I stay or should I go now? How social, developmental and ecological factors influence patterns of male and female dispersal in a wild ring-tailed lemur population.** M.L. SAUTHER.
- 14 **Ecological distinctions among *Lemur catta* in different habitats: A comparison between two groups of ring-tailed lemurs in the northern and southern extremes of its range.** R.W. SUSSMAN, E.A. KELLEY.
- 15 **The impact of genetic variation at the Major Histocompatibility Complex in captive and wild ring-tailed lemurs (*Lemur catta*).** K.E. GROGAN, M.L. SAUTHER, F.P. CUOZZO, C.M. DREA.
- 16 **Paternity among ring-tailed lemurs from southwestern Madagascar.** J.A. PARGA, M.L. SAUTHER, J. PASTORINI, F.P. CUOZZO, I. YOUSOUF JACKY, R.W. SUSSMAN, L. GOULD, R.R. LAWLER.
- 17 **Examining the efficacy of visual measures of coat condition, body mass and health in wild ring-tailed lemurs at the Beza Mahafaly Special Reserve, Madagascar.** J.B. MILLETTE, M.L. SAUTHER, F.P. CUOZZO.
- 18 **Socially facilitated *E. coli* transmission in ringtailed lemurs (*Lemur catta*): Social relationships that promote and prevent the spread of disease.** G.C. SBEGLIA, D.E. DYKHUIZEN, P.C. WRIGHT, L.M. DÁVALOS.
- 19 **Age and habitat effects on hematology, plasma biochemistry, and urinalysis values in endangered, wild ring-tailed lemurs (*Lemur catta*) at the Beza Mahafaly Special Reserve, Madagascar.** C.L. SINGLETON, A.M. NORRIS, M.L. SAUTHER, F.P. CUOZZO, I. YOUSOUF JACKY.

Thursday, Plenary sessions.

Session 17: PLENARY POSTERS

Contributed Poster Presentations. Chair: Deborah Cunningham. **Hyatt Grand Foyer and Imperial Ballroom 5.**

- 1 **Cranial morphometric variation and human sacrifice at the Epiclassic site of Xaltocan, Mexico.** S.B. SHOLTS, S. BÁEZ-MOLGADO, C.T. MOREHART, A. MEZA PEÑALOZA.
- 2 **Investigation of skeletal remains from three mediaeval gallows hill sites in Estonia.** S.K. WÄRMLÄNDER, M. MALVE, L. VARUL, A. KIVIRÜÜT, E. PETERSONE-GORDINA, S.B. SHOLTS.
- 3 **United in death: The osteobiography of a Roman double burial at Çatalhöyük, Turkey.** S.E. NUGENT, C. KNÜSEL, S.D. HADDOW, C.S. LARSEN, J.W. SADVARI.
- 4 **Assessing cortical and trabecular bone loss as stress indicators in an archaeological sample using pQCT.** R.V. MOUNTAIN.
- 5 **Political ecology of the “Golden Liberty”: Elite diet in the Polish-Lithuanian commonwealth (16-18th c. AD).** L.J. REITSEMA, T. KOZŁOWSKI, R. JANKAUSKAS, A. DRAŹKOWSKA.
- 6 **The effect of fluctuating asymmetry and stature on risks of mortality in a documented skeletal collection.** K.E. WEISENSEE.
- 7 **Ancient DNA sequencing on the Ion Torrent PGM and Proton Platforms: Genetic diversity of haplotype D4b1a2a1a at Nuvuk, an ancient Thule Village.** J. TACKNEY, A.M. JENSEN, J. BRENNER-COLTRAIN, D.H. O'ROURKE.
- 8 **Inferring post-Peopling Amerindian population history from published and synthetic data.** A. ANTRIM, E. JASPER, A. KITCHEN.
- 9 **A comparison of craniometric and molecular genetic variation in a population of cotton-top tamarins (*Saguinus oedipus*).** E.K. DEW, A.H. ROSS.
- 10 **Skeletal evidence of infanticide in Virunga mountain gorillas (*Gorilla beringei beringei*) from Volcanoes National Park, Rwanda.** A.B. ERIKSEN, S.P. NAWROCKI, T.G. BROMAGE, M.R. CRANFIELD, T.S. STOINSKI, A. MUDAKIKWA, S.C. MCFARLIN.
- 11 **Comparative forelimb use during foraging in three cercopithecids from Côte d'Ivoire's Taï Forest.** N.T. DUNHAM, E.E. KANE, W. MCGRAW.
- 12 **Chimpanzee (*Pan troglodytes*) foraging behavior is mediated by food preference, competition avoidance, and social facilitation.** E.M. FINESTONE, K.E. BONNIE, L.M. HOPPER, V.M. VREEMAN, E.V. LONSDORF, S.R. ROSS.
- 13 **Using social network analysis to study the effects of a hurricane on association patterns in Spider monkeys (*Ateles geoffroyi*) in Belize.** K.S. HARTWELL, J.E. CHAMPION, H. NOTMAN, M.S. PAVELKA.
- 14 **Males who are potential sires show affiliation and tolerance towards infants in *Colobus vellerosus*.** S.A. FOX, J. VAYRO, E. POTVIN-ROSSELET, A. CROTTY, P. SICOTTE.
- 15 **When is a chirp more than a chirp? Characterization of a vocal call class in Ma's night monkey (*Aotus nancymae*).** A.J. ZAMORA, K. BOHN.
- 16 **Assessing the risks of maternal placentophagy: An analysis of environmental metals in human placenta capsules.** S.M. YOUNG, D.C. BENYSHEK.
- 17 **Exploring the human exception to maternal placentophagy among mammals: Assessing the visual and olfactory aversion to human placental tissue.** L.K. GRYDER, S.M. YOUNG, P. LIENARD, D.C. BENYSHEK.
- 18 **Growing a large, social brain: Tying together life history, behavior, and primate brain evolution.** A. MCGROSKY, J.B. SMAERS.
- 19 **Cusp 6 variation in the hominin clade: Insights and implications revealed at the enamel-dentine junction.** M.M. SKINNER, E.M. LUDEMAN, S.E. BAILEY, J. HUBLIN.
- 20 **New estimates of body mass in KNM-WT 15000.** D.L. CUNNINGHAM, R.R. GRAVES, D.J. WESCOTT, R.C. MCCARTHY.
- 21 **The many layers of cranial vault thickness: Cranial vault composition, but not thickness alone, may be autapomorphic in Pleistocene hominins.** L. COPES.
- 22 **Intrinsic shape variation in the human femur: Evidence from Late Pleistocene Eurasia.** V.T. HUTCHINSON.
- 23 **Acoustic characteristics of Neanderthal vowel-like sounds: A comparison with American English speakers.** R.C. MCCARTHY, N. BLUMENSTEIN, K. PARTYKA, M. ZULQARNAIN.
- 24 **Utilizing high impact educational practices to establish a new course in Biological Anthropology at the two-year college level.** J.C. REDMOND.
- 25 **A bigger role for physical anthropology in and outside the university.** J.C. STEVENSON, C.E. BARRETT, M. MOSHER, E.J. INGMANSON.
- 26 **Interaction of ACE, TPA, WNK-1, and GCGR Alu polymorphisms with hypertension within the context of racism in African-Americans.** A.C. BOULTER, N.L. TODD, A.T. MIRO-HERRANS, L.N. PEARSON, C.C. GRAVLEE, C.J. MULLIGAN.
- 27 **Assessment of skeletal muscle mass as a pathway linking early growth to adult diabetes risk in Cebu City, Philippines.** M. WORKMAN, L.S. ADAIR, J. BORJA, T.W. MCDADE, C.W. KUZAWA.

Friday, April 11, 2014 - Morning sessions.

Session 18: Female Mate Choice in Non-Human Primates and Humans.

HBA and AAPA Invited Podium Symposium. Organizers and Chairs: Constance Dubuc and James Higham.
Hyatt Imperial Ballroom 1/2/3.

Parental investment theory predicts that mate choice should be stronger for females than males because females are far more limited in their reproductive rate by gamete production and parental investment. This phenomenon should be particularly important in clades such as primates because of exceptionally high parental loads and low reproductive rates, with long highly female-biased investment periods of gestation and lactation, and extended offspring development. Yet several reviews published in the last decade have argued that there is little overall evidence for female mate choice among non-human primates. This has even led some to propose that females do not express direct mate choice in non-human primates altogether, with females usually too limited by male coercion and infanticide risk. In contrast, there is strong evidence for female mate choice in humans and in other clades such as birds. Evaluating the evidence for female mate choice in Primates is extremely important not only for testing the predictions of parental investment and sexual selection theories in general, but also for understanding the differing selective pressures that have acted within the Primate order, especially on our own species. Is female mate choice part of a long evolutionary history among non-human primates, or has it evolved relatively recently in our lineage in response to reduced dimorphism and social monogamy? Here, we bring together a number of researchers who have focused on female mate choice in primates, including humans. The objectives of the symposium are to: (i) review the current state of knowledge on primate female mate choice; (ii) identify methodological and theoretical issues that need to be considered by future studies; (iii) explore different hypotheses for why female mate choice may or may not be important in non-human primates; and (iv) develop ideas for future avenues of research that are likely to be productive.

- 8:00 **Reassessing Bateman: Sexual selection in strepsirrhine primates.** C.M. DREA.
- 8:15 **Female cryptic choice in primates.** A. ENGELHARDT.
- 8:30 **Understanding inter-specific variation in female mate choice.** J.P. HIGHAM, A. ENGELHARDT, C. DUBUC.
- 8:45 **Does female dominance facilitate female mate choice? An examination of mate choice in Verreaux's sifaka (*Propithecus verreauxi*).** L.A. ABONDANO, R.J. LEWIS, A. DI FIORE.
- 9:00 **Mate choice in monogamous Owl Monkeys (*Aotus azarae azarae*).** A.M. SPENCE-AIZENBERG, A. DI FIORE, E. FERNANDEZ-DUQUE.
- 9:15 **Male resource-control and female mate choice in tufted capuchin monkeys (*Cebus apella nigrinus*).** B. TIDDI, B.C. WHEELER.
- 9:30 **Male red skin ornamentation and female mate choice in free-ranging rhesus macaques.** C. DUBUC, J.P. HIGHAM.
- 9:45 **Mating behavior and female choice in wild northern pigtail macaques.** D. MAESTRIPIERI, C. CARLSON, U. REICHARD.
- 10:00 **BREAK.**
- 10:15 **Male versus female mate choice in primates.** C.L. FITZPATRICK.
- 10:30 **Female mate choice in mandrills (*Mandrillus sphinx*).** J.M. SETCHELL, M. ADAMS, L.A. KNAPP.
- 10:45 **Male sexual coercion and female mating preferences in wild chimpanzees.** M.N. MULLER, S.M. KAHLENBERG, M. EMERY THOMPSON, R.W. WRANGHAM.
- 11:00 **Sexual selection and female mate choice in human evolution.** S.A. WILLIAMS, J.P. HIGHAM.
- 11:15 **Penis size interacts with body shape and height to influence male attractiveness.** B.S. MAUTZ, B.B. WONG, R.A. PETERS, M.D. JENNIONS.
- 11:30 **Discussant: Joseph Manson, UCLA.**
- 11:45 **General Discussion.**

Session 19: BIOARCHAEOLOGY and GENETICS

Contributed Podium Presentations. Chair: K. Ann Horsburgh. Hyatt Imperial Ballroom 4/6.

- 8:00 **Molecular anthropological explorations of prehistoric herding.** K.A. HORSBURGH.
- 8:15 **Insights into the evolutionary history of leprosy.** V.J. SCHUENEMANN, A. HERBIG, K. NIESELT, J. KRAUSE.
- 8:30 **A preliminary evaluation of *Mycobacterium tuberculosis* genomes from the pre-contact New World using high throughput DNA sequencing.** K.I. BOS, K.M. HARKINS, A. HERBIG, S. GAGNEUX, J. BUIKSTRA, A.C. STONE, J. KRAUSE.
- 8:45 **Paleogenetic and paleopathological evidence for leishmaniasis in the New World.** K.M. HARKINS, A.C. STONE.
- 9:00 **Ancient Native American genomic diversity: Evolution, pathogens, and the environments of the Americas.** J. LINDO, R.S. MALHI.
- 9:15 **Assessing the demographic effects of Aztec Imperialism: Ancient mitochondrial and nuclear DNA evidence from Xaltocan, Mexico.** J. MATA-MÍGUEZ, L. OVERHOLTZER, E. RODRÍGUEZ-ALEGRÍA, B.M. KEMP, D.A. BOLNICK.
- 9:30 **First South American prehistoric mitogenome: Context, continuity, and the place of C1d haplogroup.** M. SANS, G. FIGUEIRO, C.E. HUGHES, J. LINDO, P.C. HIDALGO, R.S. MALHI.

9:45 **Mitochondrial Haplotype C4c Confirmed as a founding lineage through the whole mitochondrial genome sequencing of an Ancient North American sample (Norris Farms #36, Illinois).** F.L. PACK, B.I. HULSEY, G.S. CABANA.

10:00 **BREAK.**

Session 20: ANTHROPOLOGICAL GENETICS: Non-human Primates and Evolutionary History

Contributed Podium Presentations. Chair: Ryan Raaum. Hyatt Imperial Ballroom 4/6.

10:15 **Species identification and evolutionary history of slow lorises (genus *Nycticebus*) as inferred by nuclear introns.** L.C. MATTHEWS, M.D. LE, E.H. LÓPEZ, C.M. BERGEY, E.J. STERLING, M.E. BLAIR.

10:30 **Gene loss and protein evolution in *Propithecus verreauxi* detected using exome sequencing and *de novo* assembly.** T.H. WEBSTER, R.R. LAWLER, B.J. BRADLEY.

10:45 **Hybrid zone genomics: The structure of a baboon contact zone inferred from RAD tags.** C.M. BERGEY, J.E. PHILLIPS-CONROY, T.R. DISOTELL, C.J. JOLLY.

11:00 **Landscape genetics of western Black Crested Gibbons (*Nomascus concolor*) in China.** J.D. ORKIN.

11:15 **Phylogenetic variation in subcellular distribution and isoenzyme composition of energy metabolism enzyme, lactate dehydrogenase, in primate brain evolution.** T. DUKA, Z. COLLINS, S.M. ANDERSON, M. RAGHANTI, J.J. ELY, P.R. HOF, D.E. WILDMAN, L.I. GROSSMAN, C.C. SHERWOOD.

11:30 **Differential gene and protein expression in the human and chimpanzee brain: A comparison using high-throughput techniques.** A.L. BAUERNFEIND, E.J. SODERBLOM, M.E. TURNER, A.M. MOSELEY, J.J. ELY, P.R. HOF, C.C. SHERWOOD, G.A. WRAY, C.C. BABBITT.

11:45 **Dental evolution: Patterns of sequence evolution within the primate lineage suggestive of positive selection on genes involved in tooth growth and morphology.** J.L. BAKER, J.P. BIELAWSKI, T.M. MAYNARD, B. WOOD.

Session 21: HUMAN ADAPTATION: Climate, Altitude, Latitude

Contributed Podium Presentations. Chair: Cynthia Beall. Hyatt Imperial Ballroom 5/7/9.

8:00 **An assesment of phenotypic adaptation of the prehistoric Jomon hunter-gatherers and the Yayoi agriculturalists of Japan: A study of postcranial indices, ratios, and body mass versus eco-geographical variables.** N. SEGUCHI, C.B. QUINTYN, H. TAKAMUKU, S. YONEMOTO.

8:15 **Bergmann's rule in human females: A reassessment.** M. COLLARD, F. FOSTER, B. BOWSER, J. PATTON.

8:30 **Variation in human body form is not distributed along a latitudinal cline.** C.C. ROSEMAN, B.M. AUERBACH.

8:45 **Phenotypic patterns of rib and pelvis covariation in Old vs. New World human populations.** E.R. MIDDLETON.

9:00 **The importance of activity in cold climates: Using the allocation model to examine energy expenditure differences of highly active humans in natural environments.** C. OCOBOCK.

9:15 **Genetic responses to life at high altitude: Arterial oxygen saturation in Peruvian Quechua.** J.L. ISHERWOOD, A. BREIDENSTEIN, F. LEON-VELARDE, E.J. PARRA, M. KIYAMU, T. BRUTSAERT, A.W. BIGHAM.

9:30 **Genetic evidence for natural selection at the high-altitude candidate gene, *EGLN1*.** A.M. BREIDENSTEIN, K. MAGNAYE, M. BAMSHAD, M. SHRIVER, L.G. MOORE, T. BRUTSAERT, A.W. BIGHAM.

9:45 **Hemoglobin concentration does not explain significant variation in fertility and child survivorship of post-reproductive Tibetan women residing at high altitudes in Nepal.** C.M. BEALL, S.R. CRAIG, G. CHILDS.

10:00 **BREAK.**

Session 22: FUNCTIONAL MORPHOLOGY: Foods, Force and Function in Human and Nonhuman Primates

Contributed Podium Presentations. Chair: Siobhán Cooke. Hyatt Imperial Ballroom 5/7/9.

10:15 **How mechanically challenging are the foods eaten by black horned capuchins (*Sapajus nigritus*) of Carlos Botelho State Park, Brazil?** M.D. FOGAÇA, B.W. WRIGHT, P. IZAR.

10:30 **Fracture toughness and nutritional content as measures of food choice in ursine colobus (*Colobus vellerosus*) in Boabeng-Fiema Monkey Sanctuary, Ghana.** A.A. ELGART, E.M. JUEZAN, B.M. WHITMORE.

10:45 **Ecological variation in toughness and food selection in Virunga mountain gorillas.** H. GLOWACKA, E.R. VOGEL, G.T. SCHWARTZ, T.S. STOINSKI, F. NDAGIJIMANA, A. MUDAKIKWA, S.C. MCFARLIN.

11:00 **Demonstration of an image-based interpolation method for elastic constants in the human dentate mandible.** A.J. RAPOFF, S. MCGRAW, D.J. DA EGLING.

11:15 **Palate shape and diet in *Homo sapiens*.** S.B. COOKE, A. VILLASEÑOR, K.L. BOYD, C.M. ASTORINO, S.E. FREIDLINE, J. HUBLIN.

11:30 **In vitro sarcomere-length operating range of the masseter and temporalis muscles in *Macaca fascicularis*.** A.B. TAYLOR, C.E. TERHUNE, W.L. HYLANDER, C.J. VINYARD.

11:45 **Can we predict mandibular kinematics from patterns of EMG activity in primates?** J. IRIARTE-DIAZ, C.F. ROSS.

Session 23: PALEOANTHROPOLOGY: Early Hominin Evolution – Diet, Teeth, and Locomotion*Contributed Podium Presentations.* Chair: Rhonda Quinn. **Telus CC Glen 201-204.**

- 8:00 **The environmental context of *Australopithecus anamensis*: Pedogenic carbonate stable isotopic evidence for vegetation structure and climatic conditions at Kanapoi, Kenya.** R.L. QUINN, C.J. LEPRE, C.S. FEIBEL, R. BOBE, L. WERDELIN, J.M. PLAVCAN, F.K. MANTHI, C.V. WARD.
- 8:15 **Facial biomechanics of *Australopithecus afarensis* based on AL 444-2.** B.A. VILMOARE, J.A. LEDOGAR, A. SMITH, D. STRAIT, S. SENCK, G. WEBER, S. BENAZZI, M. SPENCER, P. DECHOW, I. GROSSE, C. ROSS, B. WRIGHT, Q. WANG, C. BYRON, D. SLICE, B.G. RICHMOND.
- 8:30 **Exploring C₄ plant foods and their potential as hominin dietary resources: The mechanical properties of savanna vegetation from the Cradle of Humankind, South Africa.** O. PAINE, M. SPONHEIMER, A. HENRY, A. HUTSCHENREUTHER, J. LEICHLITER, J. CODRON, D. CODRON, J. LOUDON.
- 8:45 **Constraints on feeding biomechanics in *Australopithecus sediba*.** J.A. LEDOGAR, A.L. SMITH, S. BENAZZI, G.W. WEBER, M.A. SPENCER, K.B. CARLSON, K.P. MCNULTY, P.C. DECHOW, I.R. GROSSE, C.F. ROSS, B.G. RICHMOND, B.W. WRIGHT, Q. WANG, C. BYRON, D.E. SLICE, K.J. CARLSON, D.J. DE RUITER, L.R. BERGER, K. TAMVADA, L.C. PRYOR SMITH, M.A. BERTHAUME, D.S. STRAIT.
- 9:00 **Dental development of the *Australopithecus sediba* juvenile MH1 determined from synchrotron virtual paleohistology.** A. LE CABEC, P. TAFFOREAU, T.M. SMITH, K.J. CARLSON, L.R. BERGER.
- 9:15 **Geometric morphometrics of second upper australopithecine molars at Sterkfontein Member 4 for taxonomic appraisal.** C. FORNAI, F.L. BOOKSTEIN, G.W. WEBER.
- 9:30 **Landmark-free 3D method for comparison of fossil hominins and hominids based on endocranium and EDJ shapes.** J. DUMONCEL, S. DURRLEMAN, J. BRAGA, J. JESSEL, G. SUBSOL.
- 9:45 **Modeling macroevolutionary trends in hominin postcanines through the inhibitory cascade.** K. SCHROER.
- 10:00 **BREAK.**
- 10:15 **Cervical lordosis and the orientation of the foramen magnum, implications to human evolution.** E. BEEN, S. SHEFI, M. SOUDACK, L. RAVIV ZILKA, A. BARASH, Y. RAK.
- 10:30 **The transition from thoracic to lumbar facet joint orientation at T11: Functional implications of a more cranially positioned transitional vertebra in early hominids.** M. HAEUSLER, N. FRATER, N. BONNEAU.
- 10:45 **Australopithecine lumbar vertebral morphology: Insights from *Australopithecus sediba*.** K.R. OSTROFSKY, S.A. WILLIAMS, S.E. CHURCHILL, L.R. BERGER, B.G. RICHMOND.
- 11:00 **The scapula of *Australopithecus sediba* in the context of orthograde climbing.** M.E. MACIAS, J.T. FELDBLUM.
- 11:15 **Using calcaneal morphology to predict medial longitudinal arch height in fossil hominins.** A.N. HEARD-BOOTH.
- 11:30 **An experimental functional analysis of the Laetoli hominin footprints.** K.G. HATALA.
- 11:45 **Comparing the pattern of cranial, postcranial, and size dimorphism in non-human primates, early hominins and modern *Homo*.** J. PLAVCAN.

Session 24: From the Ground Up: Integrative Research in Primate Locomotion*Invited Poster Symposium.* Organizers: Kristi L. Lewton and Tierra K. Nalley. **Hyatt Bannerman/Walker.**

Primate locomotor adaptation and evolution is a principal and thriving area of research by biological anthropologists. Research in this field generally targets hypotheses regarding locomotor kinetics and kinematics, form-function associations in both the soft and hard tissue components of the musculoskeletal system, and reconstructing locomotor behavior in fossil primates. A wide array of methodological approaches are used to address adaptive hypotheses in all of these realms. Recent advances in three-dimensional shape capture, musculoskeletal physiological measurements, and analytical processing technologies (e.g., laser and CT-scans, 3D motion analysis systems, finite element analysis) have facilitated the collection and analysis of larger and more complex locomotor datasets than previously possible. This symposium provides a forum to integrate these central branches of morphological locomotion research by posing a single, broad question to be addressed via symposium contributors: “How can integrative research in primate postcranial aid identification of locomotor adaptations?” The presentations gathered here will contextualize research from these varied perspectives and synthesize the current state of understanding in primate locomotor adaptation and evolution. The session will conclude with a roundtable discussion regarding how to support integrative research collaboration, and how to promote theoretical and methodological innovation moving forward.

7:30-8:00 am Poster set-up. 11:45-12:15 pm Poster take-down.

10:00 am - Introduction and mini-presentations by poster authors 1-6

10:30-10:45 am - Discussion by discussant Liza Shapiro, University Texas Austin

10:45am - Mini-presentations poster authors 7-12

11:10 - 11:25am - Discussion by discussant Matt Cartmill, Boston University

11:25- 11:45am - Roundtable discussion (open to audience)

1 **Heavy is the crown: Investigating form-function relationships among the head, neck, and posture during locomotion in primates.** T.K. NALLEY, N. GRIDER-POTTER.

2 **Pongo problems: Reconciling supraspinous fossa shape convergence among the hominoids.** D.J. GREEN, Y. SUGIURA, P.

GUNZ.

- 3 **Locomotor hand postures, carpal kinematics, and wrist morphology in anthropoid primates.** C.M. ORR.
- 4 **Emancipation of the forelimb: New experimental evidence on the different functional roles of grasping hands and grasping feet during arboreal quadrupedal locomotion.** B.A. PATEL, I.J. WALLACE, M. GRANATOSKY, D.M. BOYER, S.G. LARSON, J.T. STERN.
- 5 **The biomechanics of balance in common marmosets (*Callithrix jacchus*).** J.W. YOUNG, B.A. CHADWELL.
- 6 **Bipedality em natureza: Ground reaction forces during bipedal transport of heavy stones by wild bearded capuchins.** J.B. HANNA, Y. ESCHAR, D. FRAGASZY.
- 7 **Individual muscle function in chimpanzee bipedalism: I. EMG patterns.** S.G. LARSON, J.T. STERN JR., B. DEMES, M.C. O'NEILL, B.R. UMBERGER.
- 8 **Individual muscle function in chimpanzee bipedalism II: Musculoskeletal model predictions based on static optimization.** M.C. O'NEILL, L. LEE, S.G. LARSON, J.T. STERN, JR., B. DEMES, N. THOMPSON, B.R. UMBERGER.
- 9 **Hierarchical analyses of bone and muscle structural, material, and physiological properties improve our understanding of their integrated functions.** J. RUPERT, C. BYRON, K. CONDON, M. BUTCHER, J. ORGAN.
- 10 **Fossils, trabeculae and finite element modelling: A holistic approach to reconstructing behaviour in the past.** T.L. KIVELL, H. NGUYEN, Z.J. TSEGAI, T. GROSS, D.H. PAHR, J. HUBLIN, M.M. SKINNER.
- 11 **Reconstructing foot form and function in early hominins using modern human models.** J.M. DESILVA, C.M. GILL, Z. SWANSON, R. BONNE-ANNEE, S.V. GILL.
- 12 **Metatarsal structure and function in catarrhines.** M.S. DRAPEAU, R.E. WUNDERLICH.

Session 25: **Forgotten People in Forgotten Places: The Archaeology, History and Biology of the Erie County Poorhouse in Buffalo, NY**

Invited Poster Symposium.

Organizers: Joyce E. Sirianni, Douglas J. Perrelli, Jennifer L. Muller and Rosanne L. Higgins. **Hyatt Herald/Doll.**

Established in response to the growing problem of poverty in Buffalo, New York, the Erie County Poorhouse was relocated in 1851 from its original location in Black Rock to Main Street, occupying what is now the South Campus of the University of Buffalo. In the summer of 2012, major infrastructure improvements at the South Campus necessitated the salvage excavation of human skeletal remains associated with the Erie County Poorhouse Cemetery (1851-1909). Of the 480 burial locations excavated, 383 contain human remains. Some of the skeletal remains show evidence of autopsy and many were recovered with brain material intact. Archaeological analysis of associated artifacts and coffin alignment suggests a temporal boundary between the older and more recent sections of the cemetery.

Historical records associated with the Erie County Poorhouse are extensive and include municipal documents, inmate records, mortality records, period newspaper articles, death certificates, maps and photographs. These data are analyzed to help identify key policy changes in Poorhouse management with regard to sanitation, the quality and quantity of food and medical care, demographic trends and mortality. The analysis of death certificates confirms burial in the Poorhouse cemetery for approximately one third of those listed in the mortality records.

Cemetery samples of the institutionalized poor are not representative of a normal population distribution. The skewed demographic character of such samples reflects the larger social milieu in which the impoverished are embedded. Contributed research in this poster symposium focuses on the establishment of demographic patterns within the skeletal sample, interpretation of skeletal and dental pathologies, activity-induced changes, and assessment of ancestry. By using archaeological, historical and skeletal information, we present a critical analysis of the human biology of the Erie County Poorhouse inmates that contributes significantly to our understanding of the lives of the 19th and 20th century poor.

7:30-8:00 am Poster set-up. 11:45-12:15 am Poster take-down

10:30-11:00 am Discussant: Anne Grauer, Loyola University (All authors present).

- 1 **Erie County Poorhouse Cemetery Site (UB 2756) excavation methods and results.** D.J. PERRELLI, J.E. HARTNER.
- 2 **Erie County Poorhouse Site (UB 2756) artifact analysis and patterns.** J. HARTNER, D.J. PERRELLI.
- 3 **Confirming burial location in the Erie County Poorhouse Cemetery using death certificates and mortality records from 1880-1913.** R.L. HIGGINS, J.L. RAINES, N.L. MONTAGUE.
- 4 **The importance of documentary evidence in understanding demographic patterns at the Erie County Poorhouse (1851-1926).** J.L. RAINES.
- 5 **Dissection and surgery at the Erie County Poorhouse.** K.C. NYSTROM, A. MACKAY.
- 6 **The most vulnerable inmates: Age distribution and cause of death among Erie County Poorhouse infants.** J.L. MULLER.
- 7 **Paleopathology and the poor: Comparing historical records of morbidity and mortality to skeletal paleopathology in the Erie County Poorhouse Cemetery.** J.E. SIRIANNI, R.L. HIGGINS, J.F. BYRNES.
- 8 **Immigrants in America: Experiences with tuberculosis amongst Buffalo's poor.** K.G. ALLEN, R.L. HIGGINS, J.F. BYRNES.
- 9 **(Dis)Ability and traumatic injuries of the poor: An analysis of morbidity and mortality in the Erie County Poorhouse Cemetery.** J.F. BYRNES.

- 10 **The morphological differences in the size, shape and enthesal attachments of the clavicle from the Erie County Poorhouse Cemetery.** J. ODIEN, J.L. MULLER.
- 11 **The utility of GIS in analyzing patterns of osteoarthritis in the people of the Erie County Poorhouse.** E.N. CHAPMAN, C. STEWART.
- 12 **Vertebral pathologies and anomalies in the Erie County Poorhouse: An examination of clinical significance.** K.A. HANZLIAN.
- 13 **Pauper diet, pauper dentition: An analysis of oral health at the Erie County Poorhouse.** K.C. KNOWLES, J.E. SIRIANNI.
- 14 **Assessing ancestry through genetic sequencing of dental, osteological, and brain tissues recovered from the Erie County Poorhouse excavation.** M.M. MAYBERRY.

Session 26: Evo-Devo Studies in Bio-physical Anthropology

Invited Poster Symposium. Organizer: Evelyn J. Bowers. Hyatt Stephen AB.

Bio-physical anthropology has several major questions including the origin of bipedality, the reverse in proportions from long arms and short legs in the hominins, and the enlargement of the brain. All involve changes in development. Studies of the evolution of development, evo-devo studies, hold great potential for understanding variation, and so evolution, within and among species. They are significant to geographic variation, paleoanthropology, and primatology, so to evolution; and they are integral to ontogeny. Their study grows naturally from auxological studies of physical and biological anthropologists since our subfield's inception. They often show testable mechanisms of adaptation, since morphology can be seen as a literal reification of metabolism. Evo-devo studies offer a way of integrating adaptation, ontogeny, and natural selection, and so prompted the coherence of our discipline, while distinguishing our approach from those of genetics and genomics. Our interests started with phenotypes, and evo-devo studies explain how genotypes generate phenotypes. Ontogeny is a process that occurs at least in all vertebrates, and changes in development are central to evolution and speciation, as well as to practical problems in dimorphoogy and malformation. In recent years particular genes, products of which interact with exogenous chemicals, to turn a fertilized zygote into into a neonate/hatchling are becoming understood. Some of these act as "tool-kit" genes, used and re-used in multiple physiological roles and metabolic pathways. Auxolog as long known something of the roles of hormones in postnatal/post-hatching ontogeny. Evo-devo lets us test how these hormones and other metabolites arise and how they create morphology and its variation. This symposium presents a sample of such studies.

7:30-8:00 am Poster set-up. 11:45-12:15 pm Poster take-down.

10:15-10:45 - Roundtable Discussion. Solomon Katz, UPenn, discussion leader. Laurence Schell, SUNY Albany, recorder. (All authors present).

- 1 **Comparative analysis of craniofacial morphogenesis: Implications for developmental constraints and the origin of variation in craniofacial shape.** F.J. SMITH, N.M. YOUNG, C. PERCIVAL, R. GREEN, J.L. FISH, H.E. JAMNICZKY, R.S. MARCUCIO, B. HALLGRIMSSON.
- 2 **The specificity encoded within GDF5 regulatory elements and understanding skeletal traits in primates.** W.J. WOOD, T.D. CAPELLINI, H. CHEN, D.M. KINGSLEY.
- 3 **The role of FGF/FGFR signaling in cranial integration: Implications for primate evolution.** N. SINGH, Y. HEUZÉ, K. FLAHERTY, C. BASILICO, G. HOLMES, J.T. RICHTSMEIER.
- 4 **The LB1 individual from Flores is a result of disturbed evolutionary developmental homeostasis.** M. HENNEBERG, R.B. ECKHARDT.
- 5 **Testing the hypothesis of parology of jaws and limbs using biacromial diameters from children with cleft-lip-and-palate.** E.J. BOWERS.

Friday, All day sessions.

Session 27: ANTHROPOLOGICAL GENETICS

Contributed Poster Presentations. Chair: Timothy Weaver. **Telus CC Exhibit Hall E1.**

7:30-8:00 am Poster set-up. 4:30-5:00 pm Poster take-down.

Even numbered poster authors present for discussion - 10:00-10:30 am and 2:30-3:00 pm

Odd numbered poster authors present for discussion - 10:30-11:00 am and 3:00-3:30 pm

- 1 **Identification of genetic polymorphisms related to skin reflectance in the Japanese population.** K. YAMAGUCHI, A. KAWAGUCHI, C. WATANABE, H. ISHIDA, R. KIMURA.
- 2 **Global survey of PGA indicates high CNV variability in human populations.** K.L. DEROSA, R.S. SCOTT, H. HONG-SEOK, J. XING.
- 3 **Signatures of selection in immune response genes among Native Latin American populations.** O.A. GARCIA, K. ARSLANIAN, D. WHORF, M. SHRIVER, L.G. MOORE, T. BRUTSAERT, A.W. BIGHAM.
- 4 **Comparison of quantitative- and molecular-genetic differentiation in humans and chimpanzees.** T.D. WEAVER.
- 5 **Measuring mitochondrial DNA diversity and demographic patterns of tribal and caste populations from the Northeast Indian State of Assam.** P.H. REJ, R. DEKA, H.L. NORTON.
- 6 **Genetic variation among Native North Americans with complex ancestries: Implications for contemporary tribal diversity and recent population history.** R.W. SMITH, K. MANRRIQUEZ, J. MATA-MIGUEZ, D.G. SMITH, D.A. BOLNICK.
- 7 **Phylogenetic resolution with mtDNA D-loop vs. HVS 1: Methodological approaches in anthropological genetics utilizing four Siberian populations.** S.M. JOHNSON, L.A. TARSKAIA-NICHOLS, M.H. CRAWFORD.
- 8 **Y-chromosome analysis of ancient Native Americans from British Columbia.** A.C. OWINGS, C.E. HUGHES, M.P. ROGERS, R.S. MALHI.
- 9 **Genetic origins of central Asian populations: An examination of mtDNA sequence diversity.** B.M. CHRISTY.

Session 28: BIOARCHAEOLOGY GENETICS

Contributed Poster Presentations. Chair: Timothy Weaver. **Telus CC Exhibit Hall E2.**

7:30-8:00 am Poster set-up. 4:30-5:00 pm Poster take-down.

Even numbered poster authors present for discussion - 10:00-10:30 am and 2:30-3:00 pm

Odd numbered poster authors present for discussion - 10:30-11:00 am and 3:00-3:30 pm

- 1 **Study on the population affiliations of human remains from the Han cemetery in Xuecun, Henan, China.** L. SUN, L. ZHOU, S.J. GARVIE-LOK.
- 2 **Preliminary analysis of ancient DNA on a late Neolithic population in Northeast China.** Y. ZHANG, H. ZHOU.
- 3 **Ancient DNA analysis of human remains from Halahaigou, a Neolithic cemetery in China .** X. ZHAO, H. LI, A.T. RODRIGUES, T. LA, Y. ZHANG, D. YANG, H. ZHU, H. ZHOU.
- 4 **Mitochondrial DNA analysis reveals substantial population structure in Hecun, a shell mound in South China.** J. LI, W. ZENG, H. ZHOU, H. ZHU.
- 5 **Kinship analysis of ancient samples in the Noble Family cemetery of the Yuan Dynasty.** H. ZHAO, W. TANG, H. LI, D. WEI, H. ZHOU, Y. CUI.
- 6 **Testing the limitations of ancient DNA sampling in Bayesian coalescent analysis.** F. VILLANEA, B.M. KEMP, A. KITCHEN.
- 7 **Ancient DNA analysis of an infant from Sudanese Nubia (ca 500-1400 C.E.).** K.A. SIRAK, G.J. ARMELAGOS, D.G. BRADLEY, C. GAMBA, E.R. JONES, R. PINHASI.
- 8 **Mortuary genetics of the ancient Swahili sites of Manda and Mtwapa, Kenya.** L.G. PROCTOR, S.M. MOORMANN, C.M. KUSIMBA, S.R. WILLIAMS.
- 9 **Ancient DNA analysis of human skeletal remains from pre-Columbian Puerto Rico.** M.A. NIEVES-COLON, W.J. PESTLE, A.C. STONE.
- 10 **Ancient DNA from Early to Mid-Holocene Burials in Northwestern Argentina: Implications for understanding the colonization and early populations of South America.** D.A. BOLNICK, M. DÍAZ-MATALLANA, J. MATA-MÍGUEZ, E. PINTAR, J.G. MARTÍNEZ.
- 11 **Ancient domestic dog diversity in the Americas: A mitochondrial DNA analysis of pre-European contact dogs.** K.E. WITT, R.S. MALHI.
- 12 **Ancient DNA from the Schild site in Illinois: Implications for the Mississippian transition in the Lower Illinois River Valley.** A.W. REYNOLDS, J.A. RAFF, D.A. BOLNICK, D.C. COOK, F.A. KAESTLE.

Session 29: BIOARCHAEOLOGY and PALEOPATHOLOGY: Insights from congenital conditions, infectious disease, trauma and arthritis

Contributed Poster Presentations. Chair: Tina Jakob. **Telus CC Exhibit Hall E3.**

7:30-8:00 am Poster set-up. 4:30-5:00 pm Poster take-down.

Even numbered poster authors present for discussion - 10:00-10:30 am and 2:30-3:00 pm

Odd numbered poster authors present for discussion - 10:30-11:00 am and 3:00-3:30 pm

- 1 **Differential diagnosis of a unique pathological condition from the Ray Site in Illinois.** C.L. HALLING, E.A. NELSON.
- 2 **Evidence for skeletal fluorosis in Illinois: A pathological analysis of individuals from the Ray Site and discussion of environmental factors affecting community health.** E.A. NELSON, C.L. HALLING.
- 3 **Mortuary and paleopathological analyses of juvenile burials at the New Kingdom site of Tombos, Sudan.** M.R. BUZON, S.A. SCHRADER, S.T. SMITH.
- 4 **Possible prenatal and perinatal scurvy at Telekfalva, Romania.** A.J. OSTERHOLTZ, J. BETHARD, A. GONCIAR, Z. NYARADI.
- 5 **Culture change and the relationships between infection and stress in the middle Holocene Cis-Baikal.** S.L. PURCHASE, A.R. LIEVERSE, V.I. BAZALIISKII, A.W. WEBER.
- 6 **To die so far from Dixie: Confederate mortality in two Civil War prison camps.** R.S. LANDER, K.D. WALLER.
- 7 **Evidence for trachoma in historic and prehistoric human skeletal remains?** T. JAKOB, J.W. WALSER III.
- 8 **Multidisciplinary analysis of an osteosarcoma from the 11th-12th AD centuries of Hungary.** E. MOLNÁR, M. SCHULTZ, T. SCHMIDT-SCHULTZ, A. MARCSIK, K. BUCZKÓ, P. ZÁDORI, G. BIRÓ, Z. BERNERT, T. HAJDU.
- 9 **An Anglo-Saxon child burial with evidence of a brain tumour: A discussion of the pathology, unusual burial context and possible socio-cultural perspectives.** P.J. CROSS.
- 10 **Land of contrast: Osteological analysis of human remains from Salango, Ecuador and a comparison of paleopathologies between coastal and highland sites in Ecuador.** L.B. VAN VOORHIS, V. MARTINEZ.
- 11 **Spinal degenerative joint disease among the late Moche of San Jose de Moro, Peru: A study of social stratification.** M.C. GO.
- 12 **Osteoarthritis of the temporomandibular joint in the Chelechol ra Orrak skeletal assemblage, Republic of Palau.** J.H. STONE, G.C. NELSON, S.M. FITZPATRICK.
- 13 **Runs in the family: Osteoarthritis among biologically related individuals in Roman Turkey.** K.E. MARKLEIN.
- 14 **Degenerative joint disease among populations of northern China and Mongolia during the Bronze Age-Iron Age: Implications for the pastoral lifestyle and subsistence-related activities.** J.T. ENG.
- 15 **Osteoarthritis in three prehistoric Alabama populations.** B.H. ROBBINS.
- 16 **Implications of vertebral degenerative disease and vertebral ligamentous ossification in native populations of the Lower Tennessee River Valley.** S.A. BONCAL, M. OSTENDORF SMITH.
- 17 **Cranial modification among prehistoric groups of Patagonia and Tierra del Fuego, Chile.** M.P. ALFONSO-DURRUTY, F. MORELLO.
- 18 **Cranial modification and identity at Cusirisna Cave, Nicaragua.** K.L. PHILMON, C.T. BROWN.
- 19 **A morphometric approach to characterizing heterogeneity in cranial modification in the South-Central Peruvian Highlands.** V. BLACK, D. KURIN.
- 20 **Artificial cranial modification of human remains from two archeological sites in Xinjiang, China.** Y. NIE, D. YANG, H. ZHU.
- 21 **The interface between biology and culture: Description of a culturally deformed microcephalic cranium.** S. KOTESOVA, K.P. OELERICH, A.M. MCGOUGH, J. DING, R.S. JABBOUR, G.D. RICHARDS.
- 22 **Skull and brain anatomy of a trigonocephalic juvenile: Description of the first known prehistoric case.** A.M. MCGOUGH, L.E. CIRILO, J. DING, R.S. JABBOUR, G.D. RICHARDS.
- 23 **Geometric morphometric assessment of cranial shape change in trigonocephaly.** L.E. CIRILLO, A.M. MCGOUGH, J. DING, R.S. JABBOUR, G.D. RICHARDS.
- 24 **High rate of premature cranial suture closure at Nuvakwewtaqa (Chavez Pass), AZ.** C.R. GRIVAS, N. GRIDER-POTTER.
- 25 **Atresia of the external auditory meatus in an individual from pre-Columbian Venezuela.** M.E. MORGAN, A. VAN DUIJVENBODE, O.J. HERSCHENSOHN.
- 26 **You can trepan if you want to or you can leave your skull alone: Patterns in ancient cranial surgery at Kuelap, Chachapoyas, Peru.** J. TOYNE.
- 27 **Bone tapping at the Pearson Complex (33SA9), Ohio.** A. CURTIN, L.M. HOANG, J.T. WALBORN.
- 28 **There's a hole in my skull Dear Liza: Skull-based osteomyelitis.** K. DE LA PAZ- RODRIGUEZ, S. WADE, H. WALSH-HANEY.
- 29 **Malposition, circulatory deficiency and traumata - a multi-affected individual as a special case of Legg-Calvé-Perthes disease.** K. FUCHS, J. GRESKY.

Session 30: HUMAN SKELETAL BIOLOGY and FORENSIC ANTHROPOLOGY: Validation studies, Age, Sex, Climate and Methods

Contributed Poster Presentations. Chair: Chelsey Juarez. **Telus CC Exhibit Hall E4.**

7:30-8:00 am Poster set-up. 4:30-5:00 pm Poster take-down.

Even numbered poster authors present for discussion - 10:00-10:30 am and 2:30-3:00 pm

Odd numbered poster authors present for discussion - 10:30-11:00 am and 3:00-3:30 pm

- 1 **Determining the number of impact events to a pig skull: A means for assessing blunt force trauma.** C.B. YOAKUM, R.R. PAINE.
- 2 **A retrospective analysis of blunt force trauma in 22 cases of known circumstances of death.** H. CARDOSO, L. MARINHO, A. SANTOS.
- 3 **Factors affecting the accuracy of forensic photograph identifications: Case study of a jewelry store robbery.** R.A. HALBERSTEIN.
- 4 **Commingled human remains: A new approach of pair matching using *mesh to mesh* comparison of 3D surface models.** M. KARELL, H. LANGSTAFF, B. OSIPOV, C. MINGHETTI, M. FRELAT, E.F. KRANIOTI.
- 5 **Match it up: Reliability of the cervical vertebrae in positive identification in practice and theory.** S.A. WADE, H. WALSH-HANEY.
- 6 **Using a white light confocal profiler for cut mark analysis.** J.B. SCHNELLENBERGER, C.W. SCHMIDT.
- 7 **Creating the Mexican isoscape: Water isotopes, and human hair help identify region of origin for deceased undocumented Mexicans.** C.A. JUAREZ.
- 8 **To gelatinize, or not to gelatinize, that is the question.** C.M. HALFFMAN, E. DINNEEN, M. FISHER, S. LUXTON.
- 9 **Examining the effects of genetic ancestry on the accuracy of predicting hair color using the HirisPlex prediction tool.** C.E. HUGHES, P.T. VARGAS, A.C. OWINGS, L.H. BROWN, W. YAO, A.A. ZAIDI, M.D. SHRIVER, R.S. MALHI.
- 10 **Using GIS to visualize external taphonomic features on human remains inside chullpas: Marcajirca, Peru.** S.L. LININGER.
- 11 **Comparison of decomposition rates between autopsied and non-autopsied human remains in Central Texas.** L.N. BATES, D.J. WESCOTT.
- 12 **Radiological correlation of experimental and ancient Egyptian human mummification.** A.D. WADE, R. BECKETT, G. CONLOGUE, R. GONZALEZ, R. WADE, B. BRIER.
- 13 **Semi-automatic soft-tissue reconstruction of the human nose.** S. SCHLAGER.
- 14 **Nolla's longitudinal dental study revisited.** H.M. LIVERSIDGE, H. SMITH.
- 15 **The trajectory of human prenatal enamel growth slows through the trimesters.** P. MAHONEY.
- 16 **Validation study of the Ubelaker and London atlases.** C.A. FU, T. HENSON, J.D. BETHARD.
- 17 **New standards of dental formation for permanent mandibular teeth based on radiographic data from the Fels Longitudinal Study.** M. ŠEŠELJ, R.W. NAHHAS, R.J. SHERWOOD.
- 18 **Proximity of age-at-death estimates among aging sites of the pelvis.** M. MIRANKER.
- 19 **Intraskkeletal covariation of morphological and compositional traits.** S.H. SCHLECHT, K.J. JEPSEN.
- 20 **No chin left behind: The morphological integration and variation of the modern human mentum osseum.** A.K. TRAINER.
- 21 **Parallel climatic adaptation in the nasal anatomy of humans and bears.** T.R. YOKLEY.
- 22 **A preliminary 3D analysis of ecogeographical variation in modern human (*Homo sapiens*) maxillary sinus shape.** L.N. BUTARIC, S.D. MADDUX.
- 23 **Dental nonmetric traits and geography.** F. CANDILIO, J. HAWKS, A. CUCINA, A. COPPA.
- 24 **How can bioarcheology of early medieval Slavic populations in the Central Europe profit from 3D technologies?** P. URBANOVA, M. KRÁLIK, P. FOJTIK, A. HUPKOVA, M. JURDA.
- 25 **A novel method of estimating facial ancestry using 3D images.** A.A. ZAIDI, P. CLAES, K. DANIELS, W. YAO, C.E. HUGHES, R.S. MALHI, M.D. SHRIVER.
- 26 **Morphoscopic trait frequencies of Southeast Asians and Pacific Islanders.** M.D. RATLIFF.
- 27 **Biodistance analysis of Hispanic skeletons.** A.D. RODRIGUEZ CARRERAS, D.F. SIWEK, T.L. MOORE, E.F. CRESPO TORRES.
- 28 **Cranial sexual dimorphism in Hispanics using geometric morphometrics.** H.A. DUECKER, M. SPRADLEY.
- 29 **Evaluating the need for population-specific equations when assessing non-metric cranial sex traits.** C. LEWIS, H. GARVIN.
- 30 **The use of 3D GM methods to investigate sexual dimorphism in human foramen magnum shape: A preliminary analysis.** C.M. ASTORINO.
- 31 **Metric sex estimation in ancient Egyptian skeletal remains: A test of modern and population-specific methods.** E.J. MARLOW.
- 32 **A comparison of cranial trait and craniometric sexual dimorphism in a medieval Nubian sample.** R.E. MURPHY, H.M. GARVIN.
- 33 **Estimation of sex from the talus of prehistoric Southeast Native Americans.** B.D. PADGETT.
- 34 **A metric assessment of iliac crest curvature as a method for subadult sex determination.** R. PESHNIAK, K. BLAKE.
- 35 **A morphometric analysis of subadult sciatic notch shape.** A. LUCERA, K. BLAKE.
- 36 **Sex estimation from the greater sciatic notch of the human pelvis: A geometric morphometric approach.** A.L. HESSEY, M. SPRADLEY, A.H. MCKEOWN.
- 37 **A correlation between non-metric sex traits and hip bone shape.** H.I. ROBERTSON.
- 38 **The influence of thermal stress on sexual dimorphism.** E.B. WAXENBAUM, J.K. TIPTON.
- 39 **How travel time influences sexual dimorphism.** C.E. JONES, C. HOVE, J.M. WAGNILD, C.M. WALL-SCHEFFLER.

- 40 **Popularization of the modern cesarean section in the United States and its effects on pelvic morphology.** R.S. LEACH, A.C. DURBAND.
- 41 **Big-bodied, big scars? A investigation of the role played by body shape in the presence of parturition scarring.** S. DECRAUSAZ.
- 42 **Allometric outliers within a modern human reference sample.** N.M. UHL.
- 43 **Cross-sectional geometric properties of adult upper and lower limb bones: Adding strength to the argument of being big-boned.** N.M. REEVES.
- 44 **The utility of the first metatarsal for estimation of body mass and stature: Validation of De Groote and Humphrey (2011).** T.E. DUNN.
- 45 **From bone to muscle. Muscle cross-sectional area estimations for skeletal human remains.** A. SLIZEWSKI, K. HARVATI.

Session 31: FUNCTIONAL MORPHOLOGY: Postcranial

Contributed Poster Presentations. Chair: Craig Byron. **Telus CC Exhibit Hall E5.**

7:30-8:00 am Poster set-up. 4:30-5:00 pm Poster take-down.

Even numbered poster authors present for discussion - 10:00-10:30 am and 2:30-3:00 pm

Odd numbered poster authors present for discussion - 10:30-11:00 am and 3:00-3:30 pm

- 1 **Exploring the relationship between cross-sectional properties and external shape of the femur.** T.R. REIN, K. HARVATI.
- 2 **Sexual dimorphism of the femur: Biomechanical influence of pelvic morphology.** M.W. PURCELL, D.J. WESCOTT.
- 3 **Bilateral cortical bone remodeling in the human appendicular skeleton.** R.A. WALKER, P. HERBERT, G. HUSSION.
- 4 **3D morphometric analyses of human ulnae.** T.W. HOLLIDAY, W.M. KARRIGER.
- 5 **Adventures at the anthropology-anatomy interface: Palmaris longus agenesis (PLA) variation and evolution.** Z. THROCKMORTON, N. FORTH, A. SCHANDL, N. THOMAS.
- 6 **Arm swing length: Which is most predictive - step length or walking velocity?** Z. WANG, K.B. WORTHEY, P.A. KRAMER.
- 7 **Foot bones to footprints: Estimating skeletal and fleshy-foot lengths from isolated pedal elements.** S.G. LAUTZENHEISER, P.A. KRAMER.
- 8 **Interactions are important: Mass, velocity, burden, and gradient effects on walking energy expenditure.** S. VIJGEN, P.A. KRAMER.
- 9 **Tough terrain: The effects of incline walking on the human cost of transport curve.** J.M. WAGNILD, C.M. WALL-SCHEFFLER.
- 10 **Vertebral morphology, locomotion, and human spinal health.** K.A. PLOMP, U. STRAND VIDARSDOTTIR, D. WESTON, M. COLLARD.
- 11 **A new classification system for assessing morphological variation in lumbosacral transitional vertebrae.** C.R. SAVAGE, S.D. MADDUX, C.V. WARD, D.J. WESCOTT.
- 12 **Variation of proximal femoral angular orientation in human and non-human primates.** S. SWARTZ, C.V. WARD.
- 13 **Forelimb and hind limb articular scaling in cercopithecoids, hominoids, and modern humans.** N. SQUYRES, C. RUFF, J. JUNNO.
- 14 **Trabecular orientation of the proximal tibia covaries with orientation of the tibial condyles.** S.M. SUKHDEO, T.M. RYAN.
- 15 **Three-Dimensional quantification of basic multicellular unit-related resorption spaces using micro-CT: Do mechanics influence morphology?** K.D. HARRISON, S.A. TSUKAMOTO, D.M. COOPER.
- 16 **Effects of aging and nutrition on bone microstructure and gait.** K.N. RABEY, J. MCNEILL, C. WU, J. BORDAS, F. GUILAK, M.W. HAMRICK, D. SCHMITT.
- 17 **Leptin blunts the starvation-induced increase in bone marrow adiposity.** M.J. DEVLIN, C. CONLON, M. VAN VLIET, L. LOUIS, M.L. BOUXSEIN.
- 18 **Development of a new non-invasive method for kinematic analysis of animal locomotion based on the Structure from Motion algorithm.** E. HIRASAKI, W.I. SELLERS.
- 19 **Exercise-induced bone formation is poorly linked to peak strain magnitude.** I.J. WALLACE, B. DEMES, C. MONGLE, O.M. PEARSON, D.E. LIEBERMAN.
- 20 **Dynamic CT scanning as a tool for measuring thumb kinematics.** E.E. VEREECKE, F. KERKHOF, E. BRUGMAN, F. STOCKMANS.
- 21 **A 3D quantitative comparative analysis of wrist morphology among western and eastern gorillas.** A.E. KRALICK, M.W. TOCHERI.
- 22 **Functional morphology of the wrist joints of sloths and suspensory primates.** E. HODGES, M. NESS, P. LEMELIN.
- 23 **Morphometrics of the elbow relating to fine branch arboreality: Trochlear keel morphology and the proximal ulna.** M.S. SELBY, C.D. BYRON.
- 24 **The elbow morphology of a short-tailed platyrrhine (*Cacajao calvus*) and its bearing on the evolution of tail loss in early hominoids.** A.E. MACKENZIE, D.R. BEGUN.
- 25 **Morphologic integration in the hominoid shoulder and forelimb.** V.C. POWELL, M.W. GRABOWSKI, N.T. ROACH, B.G. RICHMOND.

- 26 **Bi-acromial and clavicular scaling in hominoids: Implications for locomotor behavior.** J. EYRE.
- 27 **Phenotypic integration and the evolution of suspensory behavior in primates.** J.D. POLK, S.A. WILLIAMS, M.W. GRABOWSKI, C.C. ROSEMAN.
- 28 **Suspension, brachiation, and the evolution of short torsos in atelines and hominoids.** L.A. PETRULLO, D.M. GOLDSTEIN, A.B. LEE, S.A. WILLIAMS.
- 29 **Covariation of locomotor behavior and vertebral shape in Cercopithecidae.** E.J. MAZELIS.
- 30 **The effects of fine branch arboreality on the tail musculature in a non-specialized climber.** C.D. BYRON, K. CONDON, J. ORGAN.
- 31 **Iliac orientation and locomotor behavior in anthropoid primates.** Z.J. WINKLER, C.V. WARD, A.S. HAMMOND.
- 32 **Significantly larger hip joint abduction and external rotation abilities increases the hindlimb spatial envelope in suspensory anthropoids.** A.S. HAMMOND.
- 33 **Covariance of the pelvis and distal limb morphology in anthropoids: A morphological integration study.** N.M. WEBB, W.E. HARCOURT-SMITH, O.O. THOMAS.
- 34 **Limb anatomy influences swing duration and angular velocity: Implications for understanding primate locomotor adaptations.** D. SCHMITT, P. LEMELIN, C.E. MILLER.
- 35 **Hind limb and dental ontogeny in *Propithecus coquereli* and *Lemur catta*.** K.D. JANKORD, V.B. DELEON, G.A. RUSSO, J.W. YOUNG, C.J. VINYARD, T.D. SMITH.
- 36 **Ontogenetic changes in inter-limb length and strength proportions in baboons (*Papio cynocephalus*) and vervet monkeys (*Cercopithecus aethiops*).** M. BURGESS, S.C. MCFARLIN, A.L. ZIHLMAN, C.B. RUFF.
- 37 **Developmental timing of heel-strike plantigrady in chimpanzees and gorillas.** A. ZEININGER, D. SCHMITT, R. WUNDERLICH.
- 38 **The ontogeny of heel-strike and impact transient.** J.T. WEBBER, A.D. FOSTER, D.A. RAICHLEN.
- 39 **Correlating form and function in the tali of catarrhine primates.** K.D. PUGH.
- 40 **Talar articular surface curvature decreases allometrically among primates.** G.S. YAPUNCICH, D.M. BOYER.

Session 32: PALEOANTHROPOLOGY: Climate, Environment, Taphonomy, Dating and Methods

Contributed Poster Presentations. Chair: Charles Musiba. **Telus CC Exhibit Hall E6.**

7:30-8:00 am Poster set-up. **4:30-5:00 pm** Poster take-down.

Even numbered poster authors present for discussion - **10:00-10:30 am** and **2:30-3:00 pm**

Odd numbered poster authors present for discussion - **10:30-11:00 am** and **3:00-3:30 pm**

- 1 **Do physical anthropology students have an edge for reasoning about human evolution? Comparisons with biology students.** E.P. BEGGROW.
- 2 **Assessing the real effects of X-ray imaging on recent fossils: Facts vs. speculations.** P. TAFFOREAU, A. LE CABEC, M. BONAZZI, V. SCHÜNEMANN, B. VIOLA, K. HARVATI, S. PÄÄBO, J. KRAUSE, J. HUBLIN.
- 3 **The removal of fossils from unstable decalcified breccia: An experimental model.** M.C. O'HARA.
- 4 **Taphonomic study of the fossil fauna from the Mursi Formation and Member A of the Shungura formation, Ethiopia.** L. DUMOUCHEL, M. DRAPEAU.
- 5 **Taphonomic histories and ecomorphological implications of fossil bovids limb elements in construction of hominin habitats at Pliocene Laetoli in northern Tanzania.** T. LANCASTER, C.M. MUSIBA, E. ABELLA.
- 6 **Regional diversity patterns in African bovids, hyaenids, and felids during the past 3 million years: The role of taphonomic bias and implications for the evolution of *Paranthropus*.** D.B. PATTERSON, J. FAITH, R. BOBE, B. WOOD.
- 7 **Examining the potential of dental microwear analysis for determining season of death.** A.N. GURTOV, H.T. BUNN.
- 8 **Identification of rodent microfauna using postcrania with implications for paleoenvironmental reconstruction.** T.L. CAMPBELL, T.J. DEWITT, D.J. DE RUITER.
- 9 **Developing a paleoenvironmental context for Middle Stone Age behavioral transitions: A multi-site approach.** J.R. ROBINSON.
- 10 **Stable isotopic paleoenvironmental reconstruction of the late Pleistocene Middle Stone Age sites on Rusinga and Mfangano Islands, Lake Victoria, Kenya.** N.D. GARRETT, D.L. FOX, K.P. MCNULTY, C.A. TRYON, J. FAITH, D.J. PEPPE.
- 11 **Carbon and nitrogen isotope analysis of modern fauna at Laetoli, Tanzania.** R. STUDER-HALBACH, J. LEE-THORP, P. DITCHFIELD.
- 12 **The use of Bayesian-inference stable isotope mixing models to infer niche breadth in the fossil record: An extant study from Kibale National Park.** M. HAMILTON, S. NELSON.
- 13 **Plant microremains in dental calculus and diet breadth.** C. LEONARD, L. VASHRO, J. O'CONNELL, A. HENRY.
- 14 **Plant biomarkers as climate proxies during early rice domestication.** R. PATALANO, Z. WANG, H. YANG, Q. LENG, W. LIU, Y. ZHENG, G. SUN.
- 15 **Lab contamination avoidance in molecular palaeontology: Starch grain analysis.** J. MERCADER, A. CROWTHER, M. HASLAM, N. OAKDEN, D. WALDE.

Friday, Afternoon sessions.

Session 33: **Monkey Business: Recent Developments on the Evolution of Old World Monkeys**

Invited Podium Symposium. Organizers: Stephen R. Frost and Leslea Hlusko. **Telus CC Glen 201-204.**

The last decade has seen a number of major advances in our understanding of the Old World monkey (Cercopithecoidea) fossil record, including new species and genera. This research has delivered great insights into the evolutionary history of the most speciose, ecologically diverse and recently evolved of primate radiations. The time is ripe to bring together researchers from across the field into one AAPA session that will facilitate synthesis and collaboration, as well as sharing of recent discoveries. To this end, we have invited speakers whose work represents the breadth of OWM paleobiology: from recent field discoveries to the rediscovery of old museum collections, from biochronology to paleoecology, from studies of form and function to studies of DNA. This symposium is designed to achieve three goals: 1) To bring students together with midlevel and senior scholars together in a facilitated dialogue; 2) To incorporate new information from the various realms of research, ranging from newly discovered fossils, through reassessments of old collections, to molecules; 3) To provide a single session in which non-specialist colleagues can update their understanding of what is currently understood about OWM evolution.

Chair: Stephen Frost

- 1:00 **Unique body proportions of *Microcolobus*.** M. NAKATSUKASA, E. MBUA, N. MORIMOTO, D. SHIMIZU, Y. KUNIMATSU.
 1:15 **Fossil Monkeys from Woranso-Mille, Ethiopia, and implications for the evolution of *Theropithecus*.** S.R. FROST, N.G. JABLONSKI, Y. HAILE-SELASSIE.
 1:30 **Cranial shape evolution in the *Theropithecus oswaldi* lineage compared to ontogenetic, allometric, and geographic variation.** E.A. SIMONS, S.R. FROST.
 1:45 **When, where and why did Old World monkeys evolve?** B.R. BENEFIT, N. STEVENS.
 2:00 **African Plio-Pleistocene biochronology: A reassessment using cercopithecoid taxa.** C.C. GILBERT, S.R. FROST, E. DELSON.
 2:15 **Fossil monkeys from South Africa in the University of California's Museum of Paleontology collections.** T. MONSON, M. BRASIL, S. GUTIERREZ, P. HOLROYD, K. ROTH, L.J. HLUSKO.
 2:30 **A reassessment of dental variation in the genus *Cercopithecoidea* and its implications for species diversity.** M. ANDERSON, S.R. FROST, C.C. GILBERT, E. DELSON.
 2:45 **The ecological roles of large-bodied monkeys in Plio-Pleistocene Africa.** N.G. JABLONSKI.
 3:00 **BREAK.**
Chair: Leslea Hlusko
 3:15 **Contextualising monkeys: Cercopithecoid community palaeoecology in the African Plio-Pleistocene.** S. ELTON.
 3:30 **Gene tree incongruence, molecular phylogenetic accuracy, and the case of the colobus monkeys.** N.D. SIMONS, M.J. RUIZ-LOPEZ, N. TING.
 3:45 **Reassessing locomotor signals from morphology in cercopithecoids with implications for fossils.** A.D. GOSSELIN-ILDARI.
 4:00 **Functional morphology of the talo-crural joint in Old World monkeys, and evaluation of locomotion in *Paracolobus*.** K. TURLEY.
 4:15 **New perspectives on cercopithecoid brain evolution based on microCT scans of the *Victoriapithecus* cranium.** L.A. GONZALES, B.R. BENEFIT, M.L. MCCROSSIN, P. GUNZ, F. SPOOR.
 4:30 **Genetic insights to the evolution of the cercopithecoid dentition.** L.J. HLUSKO, M.C. MAHANEY.
 4:45 **Discussants: Nina Jablonski, Penn State University; Eric Delson, CUNY, NYCEP; Nelson Ting, U Oregon.**

Session 34: **ANTHROPOLOGICAL GENETICS: Human History and Prehistory**

Contributed Podium Presentations. Chair: Theodore Schurr. **Hyatt Imperial Ballroom 1/2/3.**

- 1:00 **Canalization and facial morphogenesis in FGF8 hypomorphic mice.** R.M. GREEN, J.L. FISH, F. SMITH, R.S. MARCUCIO, T.J. WILLIAMS, B. HALLGRIMSSON.
 1:15 **Signatures of selection and convergent evolution at genomic loci associated with the pygmy phenotype in Batwa rainforest hunter-gatherers.** G. PERRY, N. DOMINY, L. BARREIRO.
 1:30 **Patterns of sequence variation at the pigmentation loci *ASIP* and *OCA2* in Melanesian and African populations.** H.L. NORTON, E. CORREA, E. WERREN.
 1:45 **Evolution of the *HERC2* eye color gene in Europeans using linkage disequilibrium analysis in four human populations.** M.S. SCHANFIELD, K.B. GETTINGS, D.S. PODINI.
 2:00 **How population growth affects linkage disequilibrium.** A.R. ROGERS.
 2:15 **Is lower DNA methylation along the leptin core promoter associated with increased metabolic risk profiles in SE Asians: A comparison of immigrants offspring from different continents.** M. MOSHER, M. SCHANFIELD.
 2:30 **Comparison of telomere length measurements from monochrome multiplex qPCR and Southern blot techniques in the Cebu**

- Longitudinal Health and Nutrition Survey.** D.T. EISENBERG, C.W. KUZAWA, M. HAYES, A. AVIV.
- 2:45 **Whole genome sequencing of Turkish genomes reveals functional private alleles and impact of genetic interactions with Europe, Asia and Africa.** O. GOKCUMEN, C. ALKAN, P. KAVAK, M. SOMEL, S. UGURLU, E. DAL, K. BUGRA-BILGE, T. GUNGOR, C. SAHINALP, N. OZEREN, C. BEKPEN.
- 3:00 **BREAK.**
- 3:15 **Genetic structure of island Carib populations.** M.H. CRAWFORD, C. KRAWCZAK, N.T. BOAZ, R.J. MITCHELL.
- 3:30 **A genetic history of indigenous American mitochondrial DNA lineages of the Caribbean.** J.P. BENN TORRES, M.G. VILAR, G.A. TORRES, J.B. GAIESKI, M. STEVESON, R. BHARATH HERANDEZ, Z. BROWNE, W. WALTERS, T.G. SCHURR, T. CONSORTIUM.
- 3:45 **Multi-locus genetic analysis of Circum-Caribbean populations and its implications for the prehistoric and historic peopling of the region.** M.G. VILAR, J. BENN-TORRES, J.B. GAIESKI, C. MELENDEZ, G. TORRES, M. STEVENSON, R.B. HERNANDEZ, Z.E. BROWNE, W. WATERS, T.G. SCHURR, G. CONSORTIUM.
- 4:00 **Analysis of Y-chromosome diversity in indigenous Mexican populations reveals complex paternal haplogroup structure in the New World.** T.G. SCHURR, R. GOMEZ, M.G. VILAR, M.A. MERAZ-RIOS, R. CAMACHO-MEJORADO, J.A. QUINTO MORA, G. NORIS, C. SANTANA, J.B. GAIESKI, A.C. OWINGS, G. CONSORTIUM.
- 4:15 **Understanding the colonization of the North American Arctic: Phylogenetic analysis of Y chromosome lineages from Iñupiat populations of the Alaskan North Slope.** J. RAFF, M. RZHETSKAYA, M. HAYES.
- 4:30 **The Horn of Africa has a long and complex history of admixture.** R.L. RAAUM, J.A. HODGSON, A. AL-MEERI, C.J. MULLIGAN.
- 4:45 **Bayesian analyses of >100 Yemeni mitochondrial genomes and implications for dispersals out of Africa.** D.N. VYAS, A. KITCHEN, A. AL-MEERI, C.J. MULLIGAN.

Session 35: PRIMATOLOGY: Hormones, Fitness, Life History and Reproduction

Contributed Podium Presentations. Chair: Linda Marchant. Hyatt Imperial Ballroom 4/6.

- 1:00 **Morphological diversity in cheirogaleid female genitalia.** S.W. FOLEY.
- 1:15 **An analysis of fitness and fitness components in a wild population of Verreaux's sifaka.** R.R. LAWLER.
- 1:30 **Prosimian primate life history profiles generated from the new Duke Lemur Center Database (coming soon to a URL near you!).** S.M. ZEHR, J. PARKS TAYLOR, R.G. ROACH, D. HARING, F.H. CAMERON, M. DEAN, A.D. YODER.
- 1:45 **Life history analysis for a population of *Colobus vellerosus* in Ghana, West Africa.** T.D. HOLMES, T.L. SAJ, J.A. TEICHROEB, E.C. WIKBERG, P. SICOTTE.
- 2:00 **In bonobos and chimpanzees age-related changes in urinary thyroid hormones indicate heterochrony in their development.** V. BEHRINGER, T. DESCHNER, R. MURTAGH, J.M. STEVENS, G. HOHMANN.
- 2:15 **Patterns of cortisol excretion and social behavior among juvenile chimpanzees (*Pan troglodytes schweinfurthii*) of the Kanyaware community at Kibale National Park.** K. SABBI, M. THOMPSON, M. MULLER, R. WRANGHAM.
- 2:30 **Hair plucking and cortisol levels in a captive group of bonobos (*Pan paniscus*): Evidence of a female-biased stress induced behavior.** C.M. BRAND, K.J. BOOSE, E.C. MIDTTVEIT, L.F. MARCHANT, F.J. WHITE.
- 2:45 **Urinary oxytocin, sociosexual behavior, and grooming in bonobos (*Pan paniscus*): Preliminary analyses.** K.J. BOOSE, E.C. MIDTTVEIT, F.J. WHITE, A. MEINELT, J.J. SNODGRASS.
- 3:00 **BREAK.**
- 3:15 **Application of non-invasive endocrine profiling methods in wild bonobos (*Pan paniscus*); Iyema Forest, DR Congo.** A.K. COBDEN, B.J. BARRETT, S. PRUETT.
- 3:30 **Rank effects on social stress in lactating chimpanzees.** A. MARKHAM, R.M. SANTYMIRE, E.V. LONSDORF, M.R. HEINTZ, I. LIPENDE, C.M. MURRAY.
- 3:45 **The toxin-reduction hypothesis for geophagy: Evidence from pregnant chimpanzees.** R.W. WRANGHAM, Z.P. MACHANDA, C. WEAVER, M.N. MULLER.
- 4:00 **Comparing the decline in ovarian follicle counts with age in chimpanzees (*Pan troglodytes*) and humans.** C.T. CLOUTIER, J.E. COXWORTH, K. HAWKES.
- 4:15 **Caring for a chronically ill offspring affects maternal behavior and reproduction in a wild female chimpanzee (*Pan troglodytes schweinfurthii*).** E.E. BOEHM, K. WELLENS.
- 4:30 **Patterns of nursing and allonursing in white-faced Capuchins (*Cebus capucinus*).** E.J. SARGEANT, L.M. FEDIGAN.

Session 36: PRIMATOLOGY: Primates and People

Contributed Podium Presentations. Chair: Michel Waller. Hyatt Imperial Ballroom 5/7/9.

- 1:00 **Socio-economic factors affecting the threat status of non-human primates.** M.T. WALLER.
- 1:15 **The impacts of "bottom-up" deforestation patterns on lemur geographic ranges.** T.S. STEFFENS, S.M. LEHMAN.
- 1:30 **Intra-annual variation in lemur hunting on the Masoala Peninsula of Madagascar.** C. BORGERSON.

- 1:45 **Preliminary study of the sustainability of primate hunting among indigenous Waiwai in the Kanashen Community Owned Conservation Area, Guyana.** C.A. SHAFFER.
- 2:00 **The Tonkolili Chimpanzee Project: Implications on chimpanzee conservation strategies in anthropogenic landscapes.** A.R. HALLORAN, C.T. CLOUTIER, P. BAI SESAY, S. MONDE.
- 2:15 **Primate tourism as a conservation tool: Towards a balanced view.** A.E. RUSSON, J. WALLIS.
- 2:30 **Integrating research into primate conservation: Insights from Uganda.** J.M. ROTHMAN, J. MAKOMBO, C. TUMWESIGYE, A. RWETSIBA, C.A. CHAPMAN.
- 2:45 **The effects of habituation on chimpanzees: Monitoring fecal glucocorticoid levels at a new field site.** B.F. LITMAN, A.R. HALLORAN, C.T. CLOUTIER.
- 3:00 **BREAK.**

Session 37: PRIMATOLOGY: Surviving for the Longterm - Sustainable funding for longterm primate field sites

Contributed Podium Presentations. Chairs: Susan Perry and Patricia Wright. **Hyatt Imperial Ballroom 5/7/9.**

- 3:15 **Patterns and predictions: What a long-term data base can tell us about the future of food availability in a Malagasy rainforest.** S.J. ARRIGO-NELSON, E. LARNEY, P. RAKOTONIRINA, J. RAMANTSOA, J. RAZAFIMAHAIMODISON, P.C. WRIGHT.
- 3:30 **Long term changes in primate social structure and population density: How important are climate change and non-equilibrium forest dynamics?** C.A. CHAPMAN, J.M. ROTHMAN.
- 3:45 **Collaborative long-term data sets and plans for the future: Thirty years of primate research in Costa Rica.** L.M. FEDIGAN, K.M. JACK, A.D. MELIN.
- 4:00 **The importance of long-term fieldwork for answering evolutionary questions: The Lomas Barbudal Monkey Project in Costa Rica as a case study.** S.E. PERRY.
- 4:15 **Long-term research without long-term funding: Studying white-handed gibbons at Khao Yai National Park, Thailand.** U.H. REICHARD, C. BARELLI.
- 4:30 **Long term research stations compound scientific value: Centre ValBio, Ranomafana National Park, Madagascar.** P.C. WRIGHT, A.L. BADEN, R. JACOBS, E. LARNEY, S. KARPANTY, S. TECOT, J. HERRERA, C. KARANEWSKY, S. ZOHDY, O. RAZAFINDRATSIMA.
- 4:45 **Efficacy of the use of small scale funding sources for long-term monitoring of the Sanje mangabey in Tanzania.** G.M. MCCABE, D. FERNÁNDEZ.

Session 38: Physical Anthropology of Living and Skeletal Maya Populations from the Yucatan Peninsula
Invited Poster Symposium. Organizers: Francisco D. Gurri and Allan Ortega-Muñoz. **Hyatt Bannerman/Walker.**

This session brings together scientists interested in the physical anthropology of populations from the Yucatan Peninsula. Most presentations, whether in skeletal or in living populations, address the relationship between living conditions and health. Studies in skeletal populations tell us the story of how well local populations adapted in pre-Columbian times. The studies with living populations speak of the ontogenetic effect of modern nutritional environments and their impact in future generations.

12:30-1:00 pm Poster set-up. 4:45-5:15 pm Poster take-down.

4:15-4:30 pm Discussant: Lourdes Márquez Morfin will comment on the skeletal posters

4:30-4:45 pm Discussant: Lynnette Leidy Sievert will comment on the posters on living populations.

- 1 **Population dynamics among the Classic and Postclassic period Maya in the Northern Maya Lowlands: The analysis of dental morphological traits.** E.M. MAGAÑA PERALTA, A. CUCINA.
- 2 **Intra-site variability as a mean to assess population dynamics using dental morphological traits.** A. CUCINA.
- 3 **Rare incisor variants are observed at relatively high frequencies in Mexico and the American Southwest.** A. O'DONNELL, C. RAGSDALE, C. WILLERMET, H. EDGAR.
- 4 **The nature of interaction at La Sufricaya, Guatemala: Evidence from stable isotope analysis of human tooth enamel.** V. FRIEDRICH, R. QUINN, F. ESTRADA-BELLI.
- 5 **Dental microwear and carbon isotope analysis of Maya elites from Cancuén, Guatemala.** A.A. WINBURN, T.A. TUNG, L.R. DESANTIS.
- 6 **Analysis and interpretation of health skeletal indicators from the ancient Mayas.** L. MÁRQUEZ, P. HERNÁNDEZ.
- 7 **Living conditions in Oxtankah site: a portuary settlement in the Classic Maya period.** K. GONZÁLEZ CADEÑANEZ, A. ORTEGA.
- 8 **Dental health and nutritional status among mayas of Quintana Roo: comparative study between coastal maya and inland maya, across Classic and Posclassic times.** A. ORTEGA, A. DEL ANGEL.
- 9 **Mayan paleodemographics: What do we know about Ancient Maya demography?** P.O. HERNÁNDEZ, L. MÁRQUEZ

MORFÍN.

- 10 **Association between linear enamel hypoplasias and body composition in rural youths from Yucatan.** F.D. GURRI.
- 11 **A new composite index of nutritional burden in adult women aged 22 to 41 years, their monthly family income and expenditure for food in Merida, Yucatan.** F. DICKINSON, F. GUTIÉRREZ, S. DATTA-BANIK.
- 12 **Changes in fat and muscle patterning among Maya groups in the context of the epidemiological, nutritional and behavioral transitions.** V. INES, H. AZCORRA, F. DICKINSON, B. BOGIN.
- 13 **Intergenerational changes in linear growth among adult Maya mothers and daughters from the city of Merida, Mexico.** H. AZCORRA, I. VARELA-SILVA, F. DICKINSON.

Session 39: Isotopic Advances in Primate Foraging Ecology

Invited Poster Symposium. Organizers: Brooke E. Crowley and Matt Sponheimer. **Hyatt Herald/Doll.**

Although isotopic ecology is a relatively young science, studies utilizing stable isotopes have begun to pervade the primatological literature, including several high profile publications in *Nature* and *Science*. Interest in this technique has grown tremendously over the last few years. In this symposium we introduce and critically evaluate recent advances in isotopic techniques and their application to foraging ecology of modern and extinct primates. There is still much to learn about this technical field and ambiguity remains about the interpretation of primate isotopic data. It is, therefore, important to discuss both successful applications as well as potential pitfalls with the broader anthropological community. Participants will either review the principles and practices of a particular technique or provide a case study based on their own research.

12:30-1:00 pm Poster set-up. 4:45-5:15 pm Poster take-down.

2:30-3:00 pm Even Numbered Poster Authors Present for Discussion

3:00-3:30 pm Odd Numbered Poster Authors Present for Discussion

3:30-4:00 pm Roundtable Discussion

- 1 **Calcium and carbon stable isotope ratios as paleodietary indicators.** A.D. MELIN, B.E. CROWLEY, G.L. MORITZ, A.D. JACOBSON, N.J. DOMINY.
- 2 **The stable isotope ecology of *Pan* and fossil hominoids.** J. LEICHLITER, J. LOUDON, P. SANDBERG, R. WRANGHAM, B. FAHEY, M. SPONHEIMER.
- 3 **Seasonality and niche partitioning among sympatric gorillas and chimpanzees in Loango National Park (Gabon) revealed by stable isotope analysis.** V.M. OELZE, J.S. HEAD, M.M. ROBBINS, M. RICHARDS, C. BOESCH.
- 4 **Isotopic variability and dietary flexibility of western lowland gorillas and sympatric chimpanzees in Cameroon: Implications for assessing behavioural ecology from a Museum collection.** J.A. LEE-THORP, G.A. MACHO.
- 5 **Consequences of habitat partitioning by *Pan* and *Gorilla* from Cameroon for life histories.** G.A. MACHO, J.A. LEE-THORP.
- 6 **Stable isotope ratios ($\delta^{13}\text{C}$ and $\delta^{15}\text{N}$) of hair reflect differences in foraging ecology and seasonal variation at two chimpanzee field sites (Gombe and Ugalla).** C.A. MOST, A.D. SOMERVILLE, J.J. MOORE, M.J. SCHOENINGER.
- 7 **Dietary ecology of wild chimpanzees (*Pan troglodytes verus*) inferred from a comparison of behavioural and bone carbonate ($\delta^{13}\text{C}$ and $\delta^{18}\text{O}$) and collagen ($\delta^{13}\text{C}$ and $\delta^{15}\text{N}$) isotopic analysis.** G.E. FAHY, C. BOESCH, J. HUBLIN, M.P. RICHARDS.
- 8 **Stable isotope canopy and dietary effects in sympatric monkeys from Tai Forest, Côte d'Ivoire.** J. KRIGBAUM, D.J. DAEGLING, W.S. MCGRAW.
- 9 **Elevation and intersite $\delta^{13}\text{C}$ variation between chimpanzee dietary niches at Ngogo and Bwindi Impenetrable National Park, Uganda.** B.A. CARLSON.
- 10 **Isotopic variation in Gibraltar Macaques: Further explorations of differences between and within sites, and over time.** M.R. SCHURR, A. FUENTES, A. KWIATT, J. CORTES, E. SHAW, L. JONES-ENGEL.
- 11 **Stable carbon and nitrogen isotope data offer novel opportunities for hypothesis testing in non-human primate weaning ecology.** K.A. PARTRICK, L.J. REITSEMA.
- 12 **Nocturnal predation and the isotopic niches of tarsiers and scops owls.** G.L. MORITZ, A.D. MELIN, F. TUH YIT YU, H. BERNARD, P.S. ONG, N.J. DOMINY.
- 13 **Can oxygen isotope values distinguish niche divergence in mammalian communities?** B.E. CROWLEY, A.D. MELIN, N.J. DOMINY.

Saturday, April 12, 2014 - Morning sessions.

Session 40: Beyond the Genome: Anthropological Investigations of Transcriptomes, Epigenomes, Telomeres, and Microbiomes in Human and Non-human Primates.

AAAG and AAPA Invited Podium Symposium. Organizer and Chair: Geoff Hayes. Hyatt Imperial Ballroom 1/2/3.

Since Watson and Crick's pivotal 1953 paper on the structure of DNA, genetics and DNA have been inextricably linked. Over the past several decades anthropological geneticists have been investigating the genomic sequences, or portions thereof, of human and non-human-primates to understand their genetic and biological variation, population and demographic history, and species evolution. Recent technological advancements and approaches now permit anthropological geneticists to focus on non-genomic or meta-genomic data to address these realms of inquiry. These may include the transcriptome (the collection of coding and non-coding RNA transcribed from the genome), the epigenome (the collection of modifications to DNA and histone protein molecules that plays a role in gene expression, development, and tissues differentiation, yet do not modify the genomic sequence itself), telomeres (a repeated DNA sequence that form the endcaps of chromosomes and which may inform us about epigenetic influences), and the microbiome (the collection of genomes from microbes living within the host species). Each of these is known to vary by tissue source and through time, and is transmittable to the next-generation. In this symposium, we bring together anthropological researchers focusing on one or more of these data types to investigate research question of interest and import to the field.

- 8:00 **Genome-wide patterns of placental methylation are predicted by the proxies of maternal nutritional history in Cebu, Philippines.** W.E. GUNDLING, J.N. RUTHERFORD, V.A. DEMARTELLY, N.R. LEE, C.W. KUZAWA, D.E. WILDMAN.
- 8:15 **Social and ecological predictors of DNA methylation in wild baboons.** J. TUNG, A.J. LEA, J. ALTMANN, S.C. ALBERTS.
- 8:30 **The effect of maternal stress on newborn birth outcome and methylation profiles.** C. MULLIGAN, N. RODNEY, D HUGHES
- 8:45 **Promise, challenges, and considerations of epigenetic analyses of early life adversity: A case study of institutionalized Romanian children** A. NON, B. HOLLISTER, A CHILDEBAYEVA, S ISMAILY, C ZEANAH, N FOX, C NELSON, S DRURY
- 9:00 **Gene expression and activity during primate pregnancies.** D.E. WILDMAN, J. CARAVAS, D. AGNEW, K. BENIRSCHKE, S. SAVAGE-RUMBAUGH, C. KIM, R. ROMERO, G.P. WAGNER, M.R. MCGOWEN.
- 9:15 **Dynamic patterns of gene expression in the human brain during postnatal development.** K.N. STERNER, H.T. CHUGANI, A.L. TARCA, C.C. SHERWOOD, P.R. HOF, C.W. KUZAWA, A. ABBAS, L. LIPOVICH, L.I. GROSSMAN, M. UDDIN, M. GOODMAN, D.E. WILDMAN.
- 9:30 **Functional characterization of Toll-like receptor signaling pathways in primates.** J.F. BRINKWORTH, J. KOHN, J. BOULAIS, R.E. LANFORD, Z.P. JOHNSON, L.B. BARREIRO.
- 9:45 **Investigating the molecular mechanisms underlying pelvic differences between humans and great apes.** S. KUNDU, T.D. CAPELLINI.
- 10:00 **BREAK.**
- 10:15 **Telomere lengths and attrition rates in our closest living relatives: A comparison of chimpanzee and human females.** K. HAWKES, J. TACKNEY, J.E. COXWORTH, R.M. CAWTHON.
- 10:30 **Association between blood telomere length in young adults and longitudinally-assessed adiposity and diet among a Filipino population.** H.J. BETHANCOURT, J.B. BORJA, C.W. KUZAWA, M. HAYES, D.T. EISENBERG.
- 10:45 **Comparative perspectives on primate microbiomes.** S.R. LEIGH, K.R. AMATO, A.D. KENT, C.J. YEOMAN, M. TORRALBA, M. GILLIS, B.A. WILSON, K.E. NELSON, A. GOMEZ, B.A. WHITE, R.M. STUMPF.
- 11:00 ***Omics insights from mother's milk.** K. HINDE, S. GUITERREZ, R.G. HOVEY, J.B. GERMAN, P. BARRY, L. TAO, C. LEBRILLA, D.G. LEMAY.
- 11:15 **A role for host-bacteria interactions in shaping patterns of genetic variation across human populations.** R. BLEKHMANN, J.K. GOODRICH, A. KEINAN, R.E. LEY, D. GEVERS, A.G. CLARK.
- 11:30 **Human microbiomes and non-traditional molecular archaeology.** C.M. LEWIS, C. WARINNER, A. OZGA.
- 11:45 **Discussant: Anne Stone, Arizona State University.**

Session 41: FUNCTIONAL EVOLUTIONARY MORPHOLOGY: Locomotion

Contributed Podium Presentations. Chair: Marcella Myers. Hyatt Imperial Ballroom 4/6.

- 8:00 **Functional implications of semicircular canal non-orthogonality in mammals.** E. KIRK, J.C. BERLIN, T.J. ROWE.
- 8:15 **Kinematic adjustments to substrate size and orientation during asymmetrical gaits in mouse lemurs (*Microcebus murinus*).** L.J. SHAPIRO, A.D. KEMP, J.W. YOUNG.
- 8:30 **Mechanical strategies in primate locomotor switching, and implications for the evolution of locomotor plasticity.** M.C. GRANATOSKY, D. SCHWARZ, D. SCHMITT.
- 8:45 **Get a grip: How does arboreal substrate orientation affect hand and foot use in primates?** K.A. CONGDON, M.J. RAVOSA.
- 9:00 **The use of pressure-sensing technology in the study of primate arboreality.** M.J. RAVOSA, K.A. CONGDON.
- 9:15 **Neutral and adaptive evolution of femoral morphology: A comparative study of developmental variation within and between *Pan* taxa.** N. MORIMOTO, M.S. PONCE DE LEÓN, C.P. ZOLLIKOFER.
- 9:30 **Torso shape and locomotor adaptation in anthropoid primates.** C.V. WARD.
- 9:45 **Vertebral body area profiles in primates and other mammals.** M. CARTMILL, K. BROWN.

- 10:00 **BREAK.**
- 10:15 **Ontogeny of bipedal traits in an animal model for the quadrupedal-to-bipedal transition.** A.D. FOSTER.
- 10:30 **Three-dimensional foot kinematics of chimpanzees and humans during bipedal locomotion.** N.B. HOLOWKA, M.C. O'NEILL, B. DEMES.
- 10:45 **A comparison of mediolateral ground forces in humans and chimpanzees.** M.R. DARR, H. PONTZER, D.A. RAICHLEN.
- 11:00 **The human calcaneus: A test case for models of bony resistance in impact forces.** B.J. ADDISON, M.J. SENTER-ZAPATA, D.E. LIEBERMAN.
- 11:15 **Foot function during barefoot and indigenously shod walking in populations from India, Northern Scandinavia, and Western Europe.** K. D'AOÛT, G. STASSIJNS, A. HALLEMANS, P. AERTS, C. WILLEMS.
- 11:30 **Differences in shod versus unshod walking: Implications for kinematic studies applied to extinct hominins.** K.B. WORTHEY, Z. WANG, P.A. KRAMER.
- 11:45 **Thermoregulatory and mobility consequences for reproductive age women carrying loads in an indigenous pack basket.** M.J. MYERS, M.R. LOVSTAD, A.P. KENNEDY, C.M. WALL-SCHEFFLER.

Session 42: HUMAN BIOLOGY

Contributed Podium Presentations. Chair: Ed Hagen. Hyatt Stephen AB.

- 8:00 **Dating and sexual behavior among single parents of young children in the United States.** P.B. GRAY, J.R. GARCIA, B.S. CROSIER, H.E. FISHER.
- 8:15 **Drug toxicity, not reward, explains large age and sex differences in substance use.** E.H. HAGEN, C.J. ROULETTE, R.J. SULLIVAN.
- 8:30 **More masculine 2D:4D predicts better biological condition, higher testosterone levels and higher number of children in men.** M. KLIMEK, A. GALBARCZYK, I. NENKO, L. ALVARADO, G. JASIENSKA.
- 8:45 **Seasonal fluctuation of men's testosterone levels and body composition in rural Poland.** L.C. ALVARADO, M.N. MULLER, M. EMERY THOMPSON, M. KLIMEK, I. NENKO, G. JASIENSKA.
- 9:00 **Testosterone mediates the association between phenotypic condition and low voice pitch in Bolivian adolescents: Implications for a costly-signaling model of male voices.** C.R. HODGES-SIMEON, M. GURVEN, S.J. GAULIN.
- 9:15 **Developmental predictors of testosterone levels in adolescent Dogon boys.** B.I. STRASSMANN, C. SMITH, C. VINCENZ.
- 9:30 **Variability in children's postnatal HPAA activity is associated with maternal cortisol levels during very early gestation.** P.A. NEPOMNASCHY, C.K. BARHA, K.G. SALVANTE, H. MA, J. ZHANG, L. ZENG.
- 9:45 **Flex heart rate measures of physical activity, but not scores on a widely used physical activity questionnaire, significantly predict BMI z-scores in a multiethnic sample of school children in Hawaii.** D.E. BROWN, P.T. KATZMARZYK.
- 10:00 **BREAK.**
- 10:15 **Maternal birth weight predicts placental nutrient transport characteristics thirty years later in Metro Cebu, Philippines.** J.N. RUTHERFORD, V.A. DEMARTELLY, D.E. WILDMAN, N.R. LEE, C.W. KUZAWA.
- 10:30 **"I breastfed, therefore I am": Infant feeding characteristics and early supplementation practices among Tibetan mothers living in the Nubri Valley, Nepal.** E.A. QUINN, G. CHILDS.
- 10:45 **Degrees of freedom: Quantifying the impact of apartheid residential segregation on exposure to toxic elements in urban South African adults.** C.A. HESS.
- 11:00 **Overimitation in the Aka and Ngandu of the Congo Basin.** R.E. BERL, B.S. HEWLETT.
- 11:15 **Evaluation of sickle cell hemoglobin and glucose-6-phosphate dehydrogenase deficiency genetic mutations in Haiti.** T.E. CARTER, M. VON FRICKEN, H. MALOY, J.R. ROMAIN, Y. ST. VICTOR, L. SCHICK, B.A. OKECH, C.J. MULLIGAN.
- 11:30 **Human vulnerability to Alzheimer's disease: An evolutionary perspective.** E.E. GRIFFITH.
- 11:45 **A geometric morphometric study of craniofacial variation in an East African Bantu population.** J.R. LARSON, M. MANYAMA, D.K. LIBERTON, K. LUKOWIAK, R.A. SPRITZ, B. HALLGRIMSSON.

Session 43: PALEOANTHROPOLOGY: Later *Homo*

Contributed Podium Presentations. Chair: Shara Bailey. Telus CC Glen 201-204.

- 8:00 **Modular architecture of human and chimpanzee brains. Implications for hominin evolution.** A. GOMEZ-ROBLES, W.D. HOPKINS, C.C. SHERWOOD.
- 8:15 **Shape analysis of endocranial asymmetry in humans and apes.** S. NEUBAUER, N.A. SCOTT, P. MITTEROECKER, P. GUNZ, J. HUBLIN.
- 8:30 **Do species with larger brains live in more complex niches?** S. GRABER, C. SCHUPPLI, K. ISLER, C.P. VAN SCHAİK.
- 8:45 **Manipulation complexity correlates with brain size and terrestriality across primate taxa.** S.A. HELDSTAB, Z.K. KOSONEN, K. ISLER, S.E. KOSKI, J.M. BURKART, C.P. VAN SCHAİK.
- 9:00 **The occipital lobes of Neandertal brains, orbit size, and cognition: What is the evidence for Neandertal cognitive inferiority?** R.L. HOLLOWAY, T.T. SCHOENEMANN.
- 9:15 **Assessing testability of brain-based hypotheses about Neandertal behavior.** J. SENJEM, A. GURTOV, S. TRAYNOR, J. HAWKS.

- 9:30 **Genomic reconstruction of Neandertal brain structure and function.** J. BLANGERO, E.E. QUILLEN, M.A. ALMEIDA, D.R. MCKAY, J.M. PERALTA, S. WILLIAMS-BLANGERO, J.E. CURRAN, R. DUGGIRALA, D.C. GLAHN.
- 9:45 **Inference of Neandertal quantitative gene expression profiles.** E.E. QUILLEN, M.A. ALMEIDA, J.E. CURRAN, M.P. JOHNSON, J.M. PERALTA, H.H. GORING, R. DUGGIRALA, S. WILLIAMS-BLANGERO, J. BLANGERO.
- 10:00 **BREAK.**
- 10:15 **Were Neandertal humeri adapted for spear thrusting or throwing? A finite element analysis study.** M.A. BERTHAUME, C.N. SHAW, C. JEWELL, J. HAMILL, T.M. RYAN, B.M. HOLT.
- 10:30 **The gape of *Homo neanderthalensis*.** Y. RAK, W. HYLANDER.
- 10:45 **Taxonomic differences in deciduous upper second molar crown outlines of *H. sapiens*, *H. neanderthalensis*, and *H. erectus*.** S.E. BAILEY, S. BENAZZI, C. SOUDAY, C. ASTORINO, K. PAUL, J. HUBLIN.
- 11:00 **The Qesem Cave mandibular premolars and molar from a morphometric perspective.** G.W. WEBER, C. FORNAI, A. GOPHER, R. BARKAI, R. SARIG, I. HERSHKOVITZ.
- 11:15 **Identification of features and trends associated with hybridization in the nasal cavity of baboon hybrids, *Papio anibus* x *P. cynocephalus*, as an analogue for Neanderthal and anatomically modern *Homo sapiens* hybrids .** K.A. EICHEL, M.A. LISTON.
- 11:30 **Exploring the relationship of Neanderthals and modern humans at various population levels through an analysis of body proportion indices.** J. MINETZ.
- 11:45 **Early human dispersal from Africa: A model-based test of two hypotheses.** G. BARBUJANI, F. TASSI, L. DE SANTI, S. GHIROTTI.

Session 44: The Bones and Behavior Project: Fostering Integration across Biological Anthropology

Invited Poster Symposium. Organizers: Felicia Madimenos, Emily Middleton, Susan Antón, J. Josh Snodgrass. Hyatt Bannerman/Walker.

Human biologists, evolutionary morphologists, and primatologists seek to understand patterns of variation and underlying adaptive processes and histories, yet each group of biological anthropologists tends to work in relative isolation. This is unfortunate given the interdependence at an organismal level of physiology, skeletal biology, and behavior. Although each sub-discipline might address similar “umbrella questions” such as life history patterns or adaptation to marginal environments, the field generally does so without attention to ensuring standardization and comparability of protocols across sub-disciplines. This isolation inhibits our ability to address certain key research questions, and makes it more likely that proximate rather than ultimate questions will be answerable.

Recognizing the risks and limitations of isolation within biological anthropology, the NSF funded Bones and Behavior Working Group was formed in 2007 with the main goals of: 1) developing a standardized measurement protocol that maximizes our ability to link behavioral, biological, and skeletal databases; and 2) fostering dialogue on questions of human and primate adaptation using integrated datasets. The resulting *Integrative Measurement Protocol for Morphological and Behavioral Research in Human and Non-Human Primates* has become the basis for application by Bones and Behavior Working Group members and others to research questions across biological anthropology sub-disciplines. With each dataset informing and enriching the other, the potential value of linking complementary datasets assembled by different groups of biological anthropologists could not be more profound.

This symposium showcases research that applies this integrative approach, and highlights the extent to which greater synthesis across biological anthropology can provide new insights onto questions concerning human and primate adaptation and evolution.

7:30-8:00 pm Poster set-up. 11:45-12:15 pm Poster take-down.

11:00-11:45 pm Discussants: Richard Sherwood, Wright State University; Sara Stinson, CUNY Queens, and Trudy Turner, University of Wisconsin.

- 1 **Integrating datasets in biological anthropology: An introduction to the Bones and Behavior Project.** S.C. ANTÓN, E.R. MIDDLETON, F.C. MADIMENOS, J.J. SNODGRASS.
- 2 **The Bones and Behavior Project protocol for the standardization of human skeletal measurements.** F.C. MADIMENOS, S.C. ANTÓN, J. SNODGRASS.
- 3 **Measurement protocol considerations for the cercopithecoid appendicular skeleton: Body mass and function.** A.R. ELLER, E. DELSON, E.H. GUTHRIE, S.R. FROST.
- 4 **Morphometrics of wild woolly monkeys: Implications of sexual dimorphism in body and canine size.** A. DI FIORE, C.A. SCHMITT, E. FERNANDEZ-DUQUE.
- 5 **Standardization issues for the measurement of mammalian body composition.** M.N. MUCHLINSKI, A.S. DEANE.
- 6 **Application of non-parametric tests to compare multiple differing measures of similarity and computed synthetic variables or indices.** F.J. WHITE, J. SNODGRASS, M.L. WAKEFIELD.
- 7 **An integrated focus for the anthropological deeded body program.** P.R. STUBBLEFIELD.
- 8 **Skeletal, cutaneous, and anthropometric measures of childhood changes in knee breadth.** D.L. DUREN, R.W. NAHHAS, E.R. MIDDLETON.
- 9 **Growth trajectories and infectious diseases during the peri-pubertal transition in Toba girls.** C.R. VALEGGIA, P. PHOJANAKONG.
- 10 **Measurement of short-term linear growth using knemometry among the Shuar.** S.S. URLACHER, M.A. LIEBERT, T.J. CEPON, J.J. SNODGRASS, T.E. GILDNER, A.M. COLEHOUR, P.T. ELLISON, L.S. SUGIYAMA.

- 11 **Secular trends in body size and proportions among indigenous Siberians: The role of developmental and adaptive environments.** J. SNODGRASS, W.R. LEONARD, L.A. TARSKAIA, T.M. KLIMOVA, V.R. BALU, V.I. FEDOROVA, M.E. BALTAKHINOVA, V.G. KRIVOSHAPKIN.
- 12 **Does head size influence metabolism: A test of the Expensive Tissue Hypothesis using data from the Indigenous Siberian Health and Adaptation Project.** S.B. LEVY, W.R. LEONARD, L.A. TARSKAIA, T.M. KLIMOVA, V.I. FEDOROVA, M.E. BALTAKHINOVA, V.G. KRIVOSHAPKIN, J.J. SNODGRASS.
- 13 **Getting a grip on phenotypic quality: Shuar Health and Life History Project analysis of grip strength as an indicator of phenotypic quality and health.** L.S. SUGIYAMA, F.C. MADIMENOS, M.A. LIEBERT, S.S. URLACHER, T.J. CEPON-ROBINS, A.D. BLACKWELL, T.E. GUILDNER, T.R. GANDOLFO, A. COLEHOUR, R.G. BRIBIESCAS, J.J. SNODGRASS.
- 14 **Cleaning and management of accelerometry data cleaning in free living populations.** H.J. WILSON, W.R. LEONARD, S. COSTA, J.J. SNODGRASS.
- 15 **Next steps and best practices in primatology, human biology, forensic anthropology, and paleoanthropology for the Bones and Behavior Project.** T.J. CEPON-ROBINS, S.C. ANTÓN, C.M. CROWDER, D.L. DUREN, E. FERNANDEZ-DUQUE, S.R. LEIGH, F.C. MADIMENOS, W.S. MCGRAW, E.R. MIDDLETON, C.W. RAINWATER, C.A. SCHMITT, R.J. SHERWOOD, S. STINSON, P. STUBBLEFIELD, T.R. TURNER, C. VALEGGIA, J.J. SNODGRASS.

Session 45: A World View of (Bio)Culturally Modified Teeth: Reason, Result, Response
Invited Poster Symposium. Chair: Joel D. Irish and Scott E. Burnett. Hyatt Herald/Doll.

Intentional alteration of human teeth dates to the Pleistocene and was practiced by more world populations than commonly assumed. Whether it is ablation, filing/chipping, incision, inlay, or something else - the practice is often pigeonholed under “cultural” modification. Moreover, with exceptions, including Romero’s and van Reenen’s regional overviews, simple case studies and examples of “typical” modifications predominate. Anthropological study of the practice is also beset with widely-accepted “truths” (e.g., simply a rite of passage).

The cultural aspect is important and will be discussed, but the intent here is to move beyond standard conceptions while exploring various biological factors. The most obvious factor is that alteration of living teeth constitutes a major step beyond adornment with manufactured items; modification may result in tooth pain, injury, and even death. With regard to *reason*, several motivations are clearly cultural, such as adolescent rites of passage, enhancement of beauty, group identification, and punishment; yet, these reasons have biological components. Others are wholly biological, like precautionary incisor removal among the Masai to nourish tetanus victims. Similarly, *result*, i.e., alteration of teeth, and *response*, i.e., of the individual and others, are biologically important. Diet may be affected, diseases treated or “cured” and reproductive fitness impacted. The researchers in this symposium present their interpretations of biocultural reason, result, and response in ancient through living peoples around the world, while beginning a dialogue on systematic recording and a move away from simple ad hoc observations.

7:30-8:00 pm Poster set-up. 11:45-12:15 pm Poster take-down.

11:00-11:45 pm Discussant: Clark Larsen, The Ohio State University

- 1 **Characterizing dental evulsion in the Maghreb.** I. DE GROOTE, L. HUMPHREY.
- 2 **Knocking, filing, and chipping: Following the paths of dental modification across sub-Saharan Africa.** J.D. IRISH.
- 3 **Identity marker or medicinal treatment? An exploration of the practice and purpose of dental ablation in ancient Nubia.** K.L. BOLHOFNER.
- 4 **Dental modification in modern day Cape Town, South Africa: A link to the past.** J. FRIEDLING.
- 5 **Non-ornamental dental modifications in Viking Age Denmark.** N. LYNNERUP, V. ALEXANDERSEN.
- 6 **Missing teeth in late Neolithic China: Intentional ablation or hereditary agenesis?** C. LEE, L. ZHANG.
- 7 **Tooth ablation in early Neolithic skeletons from Taiwan.** M. PIETRUSEWSKY, A. LAUER, C. TSANG, K. LI, M. DOUGLAS
- 8 **A biocultural perspective on Jomon dental ablation: Visage, identity, and social status.** A.R. HARVEY, G. SCOTT, E. PELLEGRINI, C.G. TURNER II.
- 9 **Carbon isotope analysis on tooth enamel to reveal relationships between diet and tooth ablation types of the Jomon in Japan.** S. KUSAKA, T. NAKANO.
- 10 **The biocultural context of dental modification in prehistoric Southeast Asia.** J. NEWTON, K. DOMETT.
- 11 **Teeth filing in Surabayan Javanese and Balinese: A change of tradition.** M.D. ARTARIA.
- 12 **An overview of intentional dental modification in Micronesia.** R. IKEHARA-QUEBRAL, E. RYAN, N. PARR, J. LISTON, M. PIETRUSEWSKY, M. DOUGLAS.
- 13 **Modified teeth: Cultural diversity and community building at Cahokia (AD 900-1400).** K.M. HEDMAN, J.A. BUKOWSKI, D.E. COBB, A.R. THOMPSON.
- 14 **A reassessment of intentional dental modification in the American Southwest.** S.E. BURNETT.
- 15 **Patterns of dental decoration and social identity among the Prehispanic Maya.** V. TIESLER, A. CUCINA.
- 16 **Decorative dental drilling techniques among the prehispanic Classic Maya** M RAMIREZ-SALOMON, V.TIESLER, A CUCINA
- 17 **Dental modification as a mirror for social constructs: A test case from Oaxaca, Mexico.** A. MAYES, S. BARBER, A. JOYCE.

Saturday, All day sessions.

Session 46: HUMAN BIOLOGY

Contributed Poster Presentations. Chair: Denise Liberton. **Telus CC Exhibit Hall E1.**
7:30-8:00 am Poster set-up. 5:30-6:00 pm Poster take-down.

Even numbered poster authors present for discussion - 10:00-10:30 am and 3:00-3:30 pm

Odd numbered poster authors present for discussion - 10:30-11:00 am and 3:30-4:00 pm

- 1 **Biocultural, archaeological, and linguistic too!:** Modelling an interdisciplinary Anthropology of Health in the classroom and laboratory. A.J. FOLEY.
- 2 **The evolution of teaching in humans and other animals: A new comparative approach.** M.A. KLINE.
- 3 **The humor gender gap: How gender and humor interact to influence social behavior.** C.M. HOVÉ, J.M. WAGNILD, C.M. WALL-SCHEFFLER.
- 4 **Testing theories of suicide in 245 cultures.** K.L. SYME, E.H. HAGEN.
- 5 **Diurnal blood pressure variability is uniformly narrower in healthy women classified as non-dippers.** G.D. JAMES.
- 6 **Do women experience menopausal-type hot flashes during the post-partum period?** L.L. SIEVERT, A. MASLEY.
- 7 **Parity and hemoglobin in US women (National Health and Nutrition Examination Survey, 1999-2002).** E.M. MILLER.
- 8 **The impact of diet composition on cross-national variation in prevalence of nausea and vomiting of pregnancy (NVP).** L.J. MCKERRACHER, M. COLLARD.
- 9 **Factors associated with spontaneous multiple pregnancies in a sample of women who delivered pre-term, low birth weight babies.** L. MADRIGAL, K.B. CLANCY, H. HUANG, Y. ZHU, C. BURHANCE, C. FLANSBURG.
- 10 **Preterm delivery as a predictor of diurnal cortisol profiles in adulthood: Evidence from metropolitan Cebu City, Philippines.** R.L. FRIED, J. LEE, Z.M. THAYER, J. BORJA, C.W. KUZAWA.
- 11 **Sociosexuality in Cebu (Philippines): Variation by life history status and paternal care but no correlation to testosterone.** L.T. GETTLER, S.S. AGUSTIN, A.B. FERANIL, T.W. MCDADE, C.W. KUZAWA.
- 12 **Nutrient intakes associated with serum C-reactive protein concentrations in normal to underweight breastfeeding women in northern Kenya.** M. FUJITA, E. BRINDLE, Y. LO, P. CAMEROAMORTEGUI, F. CAMEROAMORTEGUI.
- 13 **Discovering differences in dietary patterns between indigenous Madagascar ethnic groups.** A.M. VORSANGER.
- 14 **The importance of contact network assumptions in epidemic simulation models.** J. DIMKA.
- 15 **Life styles, health and frailty among elderly Slovenians.** G.R. SHARRON, M. VIDOVIC, D.E. CREWS.
- 16 **Comparative physical indicators of health in Mexican immigrant and Mexican children.** S.E. WALKER-PACHECO, T. CLEVELAND, D. PILAND.
- 17 **Socio-environmental influences on growth in a sample of Tanzanian children.** D.K. LIBERTON, M. MANYAMA, J.R. LARSON, A. NAGEL, W.M. WILSON, R.A. SPRITZ, B. HALLGRIMSSON.

Session 47: PALEOANTHROPOLOGY

Contributed Poster Presentations. Chair: Kristian Carlson. **Telus CC Exhibit Hall E2.**
7:30-8:00 am Poster set-up. 5:30-6:00 pm Poster take-down.

Even numbered poster authors present for discussion - 10:00-10:30 am and 3:00-3:30 pm

Odd numbered poster authors present for discussion - 10:30-11:00 am and 3:30-4:00 pm

- 1 **Daily water turn over in humans, apes, and fossil hominins.** H. PONTZER, D.A. RAICHLIN, B.M. WOOD, S.B. RACETTE, J.P. DELANY, A.Z. MABULLA, F.W. MARLOWE, K. ISLER, H.M. DUNSWORTH, K.K. SCHROEPFER-WALKER, B. HARE, R.W. SHUMAKER, E.V. LONSDORF, S.R. ROSS.
- 2 **Hamstrings, moment arms, and gait mechanics in early hominins.** E.E. KOZMA, H. PONTZER, N. WEBB, W. HARCOURT-SMITH.
- 3 **Hominin size, behavior, and ecology based on 1.5-million-year-old footprint assemblages from Ileret, Kenya.** B.G. RICHMOND, K.G. HATALA, A.K. BEHRENSMEYER, R. BOBE, D.R. BRAUN, H.L. DINGWALL, D.J. GREEN, P. KIURA, K. OSTROFSKY, N.T. ROACH, B.A. VILLMOARE, R.E. WUNDERLICH, J.W. HARRIS.
- 4 **The functional morphology of the seventh cervical vertebra in extant hominoids and early hominids.** N. FRATER, M. HAEUSLER, P. SCHMID.
- 5 **An analysis of *Homo erectus* vertebral canal morphology and its relationship to vertebral formula variation in recent humans.** C.I. VILLAMIL.
- 6 **Effects of physical activity on sex differences in lumbar lordosis development in rural and urban Kenyan populations.** E.R. CASTILLO, M. SANG, T. SIGEI, R. OJIAMBO, Y. PITSILADIS, D.E. LIEBERMAN.
- 7 **Hominin hypolordosis: A functional comparison of Neandertal and modern human lumbopelvic anatomy.** M.C. FOX, K.K. WHITCOME.
- 8 **Pelvic sexual dimorphism in the hominin fossil record.** N.D. REED, L. HAKKI, S.E. CHURCHILL.

- 9 **A three-dimensional quantitative analysis of subtalar and talonavicular joint morphology in Plio-Pleistocene hominins.** C. PRANG.
- 10 **Geometric morphometric and trabecular bone analysis of the Kalamakia Neanderthal navicular bone: A comparative study.** L.A. MCCARTY, T.R. REIN, H. SCHERF, A. DARLAS, K. HARVATI.
- 11 **Comparative morphology of the proximal hallucal phalanges of *Homo floresiensis*.** H.L. DINGWALL, M.W. TOCHERI, R. DUE AWE, T. SUTIKNA, E. WAHYU SAPTOMO, JATMIKO, S. WASISTO, W.L. JUNGERS.
- 12 **Post-Pleistocene gracilization and the effects of terrain on the lower limbs of modern humans.** A.J. ZACHWIEJA, L.L. SHACKELFORD.
- 13 **The evolution of trabecular bone density in humans.** H. CHIRCHIR, T.L. KIVELL, C.B. RUFF, J. HUBLIN, B.G. RICHMOND.
- 14 **Throwing and the reconstruction of the *Homo erectus* shoulder.** N.T. ROACH.
- 15 **Diaphyseal cross-sectional variation in extant hominoid humeri: Implications for incomplete hominid fossils.** C.S. MONGLE, I.J. WALLACE, F.E. GRINE.
- 16 **The effects of stone toughness on manual force distribution during stone tool production.** E. WILLIAMS, H. CHAI, B.G. RICHMOND.
- 17 **Sex differentiation in late palaeolithic hand silhouettes: A new methodology.** C.S. CHOPRA, R. WHITE.
- 18 **Managing 3D digital data sets of morphology: MorphoSource is a new project-based data archiving and distribution tool.** D.M. BOYER, S. KAUFMAN, G.F. GUNNELL, A.L. ROSENBERGER, E. DELSON.
- 19 **Evaluating causes of error in landmark-based data collection using scanners.** B.M. SHEARER, M. TALLMAN, S.B. COOKE, L.B. HALENAR, S.L. REBER, J. PLUMMER, E. DELSON.
- 20 **Estimating hominin body mass from cranial variables: An evaluation of current methods using three-dimensional computed tomography.** M. ELLIOTT, H. KURKI, D.A. WESTON, M. COLLARD.
- 21 **Contribution of virtual 3D reconstruction and printing (VIRCPAL®) to paleoanthropology: The case of the Neanderthal Subalyuk 2 child skull (Bukk Mountains, Hungary).** H. COQUEUGNIOT, A. TILLIER, G. PÁLFI, O.J. DUTOUR, B. DUTAILLY, P. DESBARATS, A. PALKÓ, I. PAP.
- 22 **Evaluating the potential of geometric morphometric analysis of mandibular shape to shed light on fossil hominin diet.** J.T. OWEN, K.M. DOBNEY, M. COLLARD.
- 23 **New evidence in an old debate: Computer-assisted extraction and identification of fossilized eggshell fragments from the Taung hominin locality, Taung, Northwest Province, South Africa.** K.J. CARLSON, B.F. KUHN.
- 24 **Further insights into the skull of *Australopithecus sediba*.** D.J. DE RUITER, K.B. CARLSON, K.J. CARLSON, K.P. MCNULTY, J.K. BROPHY, L.R. BERGER.
- 25 **Full sequence dating of South African early hominins units based on new cercopithecoid chronological markers.** A. BEAUDET, L. BRUXELLES, R. MACCHIARELLI, J. DUMONCEL, J. THACKERAY, L. BAM, J. HOFFMAN, F. DE BEER, J. BRAGA.
- 26 **Lower Pleistocene hominid paleobiodiversity in Southeast Asia: Evidence for a Javanese pongine taxon.** C. ZANOLLI, A. BACON, L. BONDIOLI, J. BRAGA, F. DEMETER, J. DUMONCEL, C. TUNIZ, R. MACCHIARELLI.
- 27 **New 1 Ma old human cranial remains from Mulhuli-Amo, near Uadi Aalad, Danakil (Afar) depression of Eritrea.** A. COPPA, L. BONDIOLI, F. CANDILIO, D.W. FRAYER, Y. LIBSEKAL, T. MEDIN, D. TESFAY, C. ZANOLLI, R. MACCHIARELLI.
- 28 **Does hominid dental microstructure carry a phylogenetic signal?** C. KUFELDT, B. WOOD.
- 29 **Comparing the molar proportions of *Sahelanthropus tchadensis* to australopiths and extant hominoids.** L.D. LUND, F.L. WILLIAMS.
- 30 **A reanalysis of fossil hominin phylogeny using a craniodental supermatrix.** M. DEMBO, N. MATZKE, A. MOOERS, M. COLLARD.
- 31 **Morphological affinity of the Balanica mandible (BH-1): Enamel-dentine junction morphology and enamel thickness.** D. DE VRIES, M. ROKSANDIC, P. GUNZ, J. HUBLIN, R. KLASSEN, M.M. SKINNER.
- 32 **Using an integration model to predict hominoid jaw shape.** S. STELZER, P. GUNZ, F. SPOOR.
- 33 **The effect of plastic remodeling on mandibular lingular morphology: Implications for paleoanthropological population studies.** K.M. LACY, S.J. CALDWELL, F.H. SMITH.
- 34 **Spatial determinants of mentum osseum morphology in recent and fossil *Homo sapiens*.** J.E. SCOTT.
- 35 **Genetic simulations of natural selection - Implications for hominin evolution.** J.K. MCKEE.
- 36 **Paleogenomic variation in a CC Chemokine Receptor Gene (CCR5).** K.C. HOOVER.
- 37 **Genomic identification and characterization of adaptive introgression from Neandertals.** A.J. SAMS, A. KEINAN.
- 38 **Effects of cold adaptation on the growth and development of the Neanderthal cranial base.** S.J. CALDWELL, K.M. LACY, F.H. SMITH.
- 39 **Occipital bunning and overall cranial shape in a longitudinal growth sample of extant humans.** M.E. UTZINGER, R.G. FRANCISCUS.
- 40 **Domestication and modern human evolution: A look at rats selected for tameness and aggression.** K. HARVATI, N. SINGH, I. PLYUSNINA, L. TRUT, S. PÄÄBO, F.W. ALBERT.

- 41 **Understanding variation in facial projection in anthropoid primates: Implications for modern human origins.** T.B. RITZMAN.
- 42 **Dating early modern human occupation in southern Tanzania.** A.R. SKINNER, P.R. WILLOUGHBY, K.V. SPILLER, T.A. COLBERT.
- 43 **Late Pleistocene modern humans east of Zhoukoudian Upper Cave? Morphometric perspectives of hominin fossils from Ryonggok Cave (Democratic People's Republic of Korea).** C.J. BAE, C.M. ASTORINO, P. GUYOMARCH, J.J. JIN.
- 44 **Periodontal disease and health in western Eurasian Late Pleistocene humans.** S.A. LACY.
- 45 **Resolving the pathological status of the Pleistocene Australian fossil WLH 50 with micro CT.** M.C. WESTAWAY, F. RUHLI, A. DURBAND.
- 46 **"Homo floresiensis" is LB1.** R.B. ECKHARDT, S. CHAVANAVES, A.S. WELLER, M. HENNEBERG.
- 47 **Does island dwarfing apply to relative brain size of Southeast Asian mammals?** L. YAO, M. WHITE, R.D. MARTIN.
- 48 **Analysis of lateral asymmetry in frontal, temporal, and occipital brain volumes in relation to right-frontal left-occipital petalia torque.** M.P. MASTERS, V.C. SIRAGUSA, J.K. RIESINGER.
- 49 **Functional correlates of structural asymmetries in the human brain.** L.M. KITCHELL, P. SCHOENEMANN.

Session 48: FUNCTIONAL CRANIAL ANATOMY: Mechanics, Brains, Ontogeny and Life History

Contributed Poster Presentations. Chair: Timothy Smith. **Telus CC Exhibit Hall E3.**

7:30-8:00 am Poster set-up. **5:30-6:00 pm** Poster take-down.

Even numbered poster authors present for discussion - **10:00-10:30 am** and **3:00-3:30 pm**

Odd numbered poster authors present for discussion - **10:30-11:00 am** and **3:30-4:00 pm**

- 1 **Inferences about prefrontal cortex size in humans from motor and premotor area scaling relationships.** P. SCHOENEMANN.
- 2 **Evidence for derived cellular organization in the ventral striatum of the human brain.** K.L. HANSON, K. SEMENDEFERI.
- 3 **Reorganization of cerebral cortical layers in primates compared to other mammals.** L.D. REYES, J.B. SMAERS, O. GRINKER, M.A. RAGHANTI, K. ZILLES, P.R. HOF, C.C. SHERWOOD.
- 4 **Meta-analysis of ontogenetic brain/body growth in primates and non-primate mammals.** D. HALLEY.
- 5 **The ontogeny of human and macaque prenatal brain and tooth growth.** N. TANG, N. JEFFERY, P. GRAHAM, S. WORTHINGTON, A. KATO, J. SIRIANNI, D. LIEBERMAN, P. TAFFOREAU, T.M. SMITH.
- 6 **Diet and the evolution of brain growth patterns in anthropoid primates.** C. KRUPENYE, M.C. GRANATOSKY.
- 7 **The ontogenetic influence of olfactory bulbs on orbital growth and facial form.** T.D. SMITH, E.S. KENTZEL, J.M. CUNNINGHAM, A.E. BRUENING, K.D. JANKORD, S.J. TRUPP, C.J. BONAR, S.J. REHOREK, V.B. DELEON.
- 8 **Biomechanics of the postorbital bar of *Eulemur fulvus* examined using finite element analysis.** D.S. STRAIT, D. PARISI, S. SOHNEN, A. GUNDEL, A.L. SMITH, K.H. TAMVADA, J.A. LEDOGAR, C.F. ROSS, T.M. RYAN.
- 9 **Developmental plasticity in craniodental structures: Assessing the response to systemic factors using rodent models.** P.N. GONZALEZ, V. BERNAL, L. D'ADDONA, F. LOTTO, B. HALLGRÍMSSON.
- 10 **Covariation in the human masticatory apparatus.** M.L. NOBACK, K. HARVATI.
- 11 **Is timing everything? Late versus early developmental effects of changes in dietary properties on jaw growth in an animal model.** J.E. SCOTT, K.R. MCABEE, M.M. EASTMAN, M.J. RAVOSA.
- 12 **The ontogeny of bite force: A test of the constrained lever model.** H.M. EDMONDS, H. GLOWACKA.
- 13 **Variation in age at M1 emergence and life history in wild chimpanzees.** J. KELLEY, G.T. SCHWARTZ, T.M. SMITH.
- 14 **Holey mandibles! The frequency of accessory mental foramina among the Hominoidea and its relationship to dental arcade length.** C.A. ROBINSON, A. HOLGUIN.
- 15 **Validation of a model for estimating sarcomere length operating range of the superficial masseter muscle in primates.** K. TAYLOR, C.J. VINYARD, A.B. TAYLOR.
- 16 **Computed fluid dynamics of the air-conditioning through the nasal passage in humans, chimpanzees, and macaques.** T. NISHIMURA, F. MORI, S. HANIDA, K. KUMAHATA, S. ISHIKAWA, T. MIYABE, M. HAYASHI, M. TOMONAGA, J. SUZUKI, T. MATSUZAWA, T. MATSUZAWA.
- 17 **Growing up gibbon.** D.R. BOLTER, A.L. ZIHLMAN.
- 18 **The condition of the divided zygoma in Orangutans.** Q. WANG.
- 19 **A branch-and-bound method for recognizing similarly-shaped anatomical features using landmark coordinate data.** T.M. COLE III.

Session 49: SKELETAL BIOLOGY: Histology and Microstructure*Contributed Poster Presentations.* Chair: John Skedros. **Telus CC Exhibit Hall E4.**

7:30-8:00 am Poster set-up. 5:30-6:00 pm Poster take-down.

Even numbered poster authors present for discussion - 10:00-10:30 am and 3:00-3:30 pm

Odd numbered poster authors present for discussion - 10:30-11:00 am and 3:30-4:00 pm

- 1 Age-dependent multiple regression analysis of trabecular bone morphology in the subadult human proximal tibia. Z.R. HUBBELL, J.H. GOSMAN, T.M. RYAN.
- 2 Evaluating age-related bone loss in the Eriksen femur collection. J.M. ANDRONOWSKI.
- 3 Patterns in resorptive spaces in elderly rib cortices. V.M. DOMINGUEZ, A.M. AGNEW.
- 4 Rib histomorphometry: Testing sampling and population errors on existing formulae. J. DUKE, J.G. GARCIA-DONAS, B. OSIPOV, E.F. KRANIOTI.
- 5 Histological variation in modern human robust and gracile femur. J.J. MISZKIEWICZ, P. MAHONEY.
- 6 Non-uniform osteocytic lacunae distribution across the femoral cortex. R.L. HUNTER, A.M. AGNEW.
- 7 Evidence for regional asymptotes of osteon population density from the femoral midshaft. T.P. GOCHA, A.M. AGNEW.
- 8 Sealed osteons: A pathological consequence or natural circumstance of extensive remodeling? T.R. HENRIE, M. DALTON, J.G. SKEDROS.
- 9 Histomorphology of endosteal lamellar pocket: Comparison of the second metacarpal in two genetically distinct populations. E. RAGUIN, M.A. STREETER, R. LAZENBY, M.S. DRAPEAU.
- 10 Current exclusion criteria for selecting osteons for circularity analysis are potentially problematic. J.G. SKEDROS, K.E. KEENAN, S.M. LITTON, G.A. SKEDROS, C.S. MEARS.
- 11 Recognizing and resolving inconsistencies and inaccuracies in determining osteon circularity: Can methods be standardized? C.S. MEARS, K.E. KEENAN, A.A. KITHAS, J.G. SKEDROS.
- 12 Use of osteon circularity to determine species affiliations can be confounded by habitual load complexity. K.E. KEENAN, S.M. LITTON, G.A. SKEDROS, J.G. SKEDROS.
- 13 Comparative histology of burned mammals using light microscopy: Examining heat-induced changes in femoral samples of deer, pig and cow. K. HOROCHOLYN.
- 14 Cortical and trabecular iliac crest histomorphometry in an ancient Andean population. L.E. MCCORMICK, S.D. STOUT, P.W. SCIULLI.
- 15 Lead in colonial Antigua revealed by cortical bone trace element spatial patterns. T.M. SWANSTON, T. VARNEY, I. COULTHARD, R. MURPHY, D.M. COOPER.

Session 50: BIOARCHAEOLOGY: Insights from the Dentition - Isotopes, Diet, Disease and Morphology*Contributed Poster Presentations.* Chair: Brian Hemphill. **Telus CC Exhibit Hall E5.**

7:30-8:00 am Poster set-up. 5:30-6:00 pm Poster take-down.

Even numbered poster authors present for discussion - 10:00-10:30 am and 3:00-3:30 pm

Odd numbered poster authors present for discussion - 10:30-11:00 am and 3:30-4:00 pm

- 1 The peopling of South America: Analysis of dental morphology. M.M. HUFFMAN, D. GUATELLI-STEINBERG, M. HUBBE, J. IRISH, S. BAILEY.
- 2 Investigating population structure and health in late prehispanic Peru using dental morphology. K. HAUTHER, D. KURIN, A. MCKEOWN.
- 3 The dental morphology of Yupik-speaking Eskimos in a broader Arctic and New World context. G. SCOTT, R. SCHOMBERG, C. MAIER, K. HEIM, P. EVERSON.
- 4 Nonmetric dental trait markers in prehistoric Polynesians: A descriptive analysis. C. STANTIS, H.R. BUCKLEY, N. TAYLES.
- 5 Passage to India: Do contemporary ethnic groups of northern Pakistan yield evidence of a Bronze Age introduction of Central Asians into South Asia? A dental morphology investigation. B.E. HEMPHILL, N. AKBAR, H. AHMAD.
- 6 Model-based clustering analyses reveal similar geographic structure in dental morphology and neutral genetic diversity. K. RUSK, H.J. EDGAR, K. HUNLEY.
- 7 The Black Sheep of Europe: Dental odontometrics in Medieval, Post Medieval, and Modern Basque populations from Vitoria, País Vasco, Spain. D. MALARCHIK, A. WILLIAMS, G. SCOTT.
- 8 Tracking interindividual biological proximity in the burial space through the analysis of enamel thickness and dental tissue proportions. M. LE LUYER, S. ROTTIER, P. BAYLE.
- 9 Premolar odontomes: A study of their frequency and familial occurrence in a Native American sample from Arizona. J. MULLINS, S.E. BURNETT.
- 10 Enamel defects as indicators of changing childhood stress: A comparative analysis of sites from the Bronze Age to the Byzantine Era in northern Jordan. T.V. WILSON.
- 11 Social change and dental health in Early Bronze Age southern Levant. J.M. ULLINGER, S.G. SHERIDAN.

- 12 **Health and hypoplasia: Lines from northeast China.** D.C. MERRETT, G. ZHANG, X. XIAO, Q. ZHANG, D. WEI, L. WANG, H. ZHU, D. YANG.
- 13 **Dental indication of health and stress of late Shang People in Anyang, China (ca. 1250 -1046 B.C.).** H. ZHANG, Z. JING, J. TANG, Y. HE, H. YUE, Z. YUE, M. SKINNER, D.C. MERRETT, D. YANG.
- 14 **The hierarchy in the grave: Investigating dental health of the owners and sacrificial victims in burials at the Imdang site, South Korea (A.D. 3rd -7th centuries).** E. WOO, J. LEE, H. JUNG, Y. JEONG, D. KIM, S. PAK.
- 15 **Sex, age and caries: Sex differences of caries frequency in Medieval London c. 1120-1250.** B.S. WALTER, S. DEWITTE, R. REDFERN, J. BEKVALAC.
- 16 **Nutritional deficiency in colonial Epidamnus, Albania.** K.A. DEVERS, B.K. MCILVAINE.
- 17 **Sweet (or meat) surrender? An examination of the frequency of dental abscesses in the highland Andes.** C.S. PRITCHARD, D. KURIN.
- 18 **Slaves at Stonebridge: Diet and health at the Stonebridge Site, Virginia.** B.A. HUNDMAN, C. YODER URISTA, D.C. BOYD, C. BOYD.
- 19 **After the earthquake: Dietary resource use at Helike, Greece.** C. MCCONNAN BORSTAD, S.J. GARVIE-LOK, D. KATSONOPOULOU.
- 20 **An exploration of the utility of dental calculus in the study of diet in the middle Holocene Cis-Baikal.** M.R. CLARKE, A.R. LIEVERSE, E.C. ROBERTSON, V.I. BAZALIISKII, O.I. GORIUNOVA, A.W. WEBER.
- 21 **Stable nitrogen isotopes in modern and archaeological human tooth enamel.** M.R. ZHU, L. REYNARD, N. TUROSS.
- 22 **Nutrition transition at the end of prehistory in the Paris Basin: Evidence from bone stable isotope analysis.** G. GOUDE, L. REY, S. ROTTIER.
- 23 **Isotopic evidence for the expansion of wheat consumption in Northern China: Not so fast.** L. ZHOU, S.J. GARVIE-LOK.
- 24 **Growing up in Medieval Alytus, Lithuania: Dietary reconstruction and biocultural analysis.** K.E. PAGE, T.L. DUPRAS, R. JANKAUSKAS, L.J. WILLIAMS, C.D. ELEAZER, J.J. SCHULTZ, S.M. WHEELER.
- 25 **Diet in Medieval Lithuania: Stable carbon and nitrogen isotopic analysis of bone and dentin collagen from the site of Alytus.** K.M. WHITMORE, T.L. DUPRAS, L.J. WILLIAMS, R. JANKAUSKAS, J.J. SCHULTZ.
- 26 **Variability in the dietary patterns in Bronze Age Italy.** A. VARALLI, J. MOGGI CECCHI, G. GOUDE.
- 27 **Heterogeneity in the dietary regimes of West Indian enslaved labourers as reconstructed from stable isotopes.** T.L. VARNEY, H. SPARKES, A. MURPHY, P. COURTAUD, T. ROMON, D.R. WATTERS.
- 28 **Isotopic analysis of diet among Archaic (10,000-2,000BP) and Early Ceramic (2000-1500BP) Prehistoric groups in North-Central Chile.** C. BECKER, M. ALFONSO-DURRUTY, N. MISARTI, A. TRONCOSO.
- 29 **Isotopic investigation of subsistence and residential mobility in the Lambayeque region of Northern Peru during the Spanish contact period.** D.S. JONES, C.J. GARLAND, H.D. KLAUS, B.L. TURNER.
- 30 **Strontium and oxygen isotopic evidence for migration to 19th century Grafton, Illinois.** E.C. FARBER, C. DERANGO, R. QUINN, A. GRAUER.
- 31 **Dental microwear, isotopes, and diet in Medieval Holbæk, Denmark (AD 1200-1573).** S.A. TURNER, N. LYNNERUP, M.S. JØRKOV.
- 32 **Dental microwear texture analysis of the people of Herculaneum.** A.J. REMY, C.W. SCHMIDT, R. D'ANASTASIO, G.A. REINHARDT.
- 33 **Incisor microwear textures point to status differences at Amarna, Egypt.** A.L. STONE, K.L. KRUEGER.
- 34 **Patterns of dental wear in prehistoric Palau.** G.C. NELSON.
- 35 **A comparison of premolar dental chipping patterns between two Icelandic assemblages.** L.T. LANIGAN.
- 36 **Regional pattern of dental chipping in two ancient populations (A.D. 3rd - 7th century) of Korea.** H. JUNG, E. WOO, Y. JEONG, S. PAK.
- 37 **Interproximal grooves reflecting habitual behavior and health in the Lepenski Vir culture (9500 - 5500 BC): Evidence from the Danube Gorges, Serbia.** R.B. MARIJA, S. SOFIJA.

Saturday, Afternoon sessions.

Session 51: The Role of Mosaic Habitats in Hominin Evolution

Invited Podium Symposium. Organizers and Chairs: Amy L. Rector and Yohannes Haile-Selassie.
Hyatt Imperial Ballroom 1/2/3.

Recent discoveries and reconstructions of hominin taxa have suggested that evolution of species and behaviors reflected mixed patterns of primitive and derived morphology. Habitat reconstructions of many hominin taxa using different lines of evidence have similarly been described as mixed or mosaic - regardless of location, age, or analytical technique employed. This symposium brings together an expertise in paleoecological analysis and hominin anatomy to explore the practical and theoretical fundamentals associated with this emerging theme of mosaicism: how do mosaic habitats compare to each other across space, time, and analytical methods? Are there modern analogs for this type of habitat, and how should they be appropriately interpreted? Most importantly, how do we interpret morphological changes in early hominins and adaptations within the context of habitats increasingly defined as "mixed"?

- 2:00 **African vegetation structure: Modern analogs and hominin habitat reconstructions.** K.E. REED, J. ROWAN, J.M. KAMILAR.
- 2:15 **Remote sensing and habitat heterogeneity: Quantifying modern analogues for African palaeoenvironments.** H.J. O'REGAN, S.C. REYNOLDS, C.G. MARSTON, J. LOUYS, D.M. WILKINSON.
- 2:30 **Toward defining "mosaic" in paleoanthropological contexts: Examples from Woranso-Mille, Ethiopia and La Senèze, France.** S.C. CURRAN.
- 2:45 **The changing landscape of Pliocene Baringo.** E.D. GOBLE EARLY.
- 3:00 **Mosaic habitats and refugia in the Plio-Pleistocene Omo-Turkana Basin, Ethiopia and Kenya.** R. BOBE.
- 3:15 **Habitat reconstruction of Laetoli, Tanzania and its implications for understanding mosaic environments.** D.F. SU, T. HARRISON.
- 3:30 **Hominin and cercopithecoid diet and niche partitioning at 3.8-3.2 Ma: New insights from Woranso-Mille, Ethiopia.** N.E. LEVIN, Y. HAILE-SELASSIE, S.R. FROST.
- 3:45 **BREAK.**
- 4:00 **Paleoenvironments of the Hadar and Shungura Formations: Synthesizing multiple lines of evidence using bovid ecomorphology.** W. BARR.
- 4:15 **Identifying trends in the environmental heterogeneity at *Australopithecus robustus* sites.** J.K. BROPHY, D.J. DE RUITER.
- 4:30 **Neanderthal diet and the patchy environments of Mediterranean Iberia.** D. SALAZAR GARCÍA, R. POWER, A. SANCHIS, V. VILLAVERDE, M. RICHARDS, A. HENRY.
- 4:45 **Stable isotope ecology of modern micromammals from the Sterkfontein Valley: Implications for habitat reconstruction in mosaic environments.** P.A. SANDBERG, J. LEICHLITER, O. PAINE, D. CODRON, B. PASSEY, K. CARLSON, M. BELMAKER, N. AVENANT, D. DE RUITER, M. SPONHEIMER.
- 5:00 **Shrew and rodent incisor microwear textures as a proxy for paleoenvironmental reconstruction.** S.S. CAPORALE, C.B. WITHNELL, P.S. UNGAR.
- 5:15 **Mosaics, mandible morphology, behavior and diet. Where's the variance?** C.F. ROSS, J. IRIARTE-DIAZ.
- 5:30 **Postcranial mosaicism in the hominin fossil record: Resolving locomotor adaptive signal from morphological noise.** K.L. LEWTON.
- 5:45 **Discussant: Yohannes Haile-Selassie, Cleveland Museum of Natural History.**

Session 52: Cross-Disciplinary Research in the Genus *Chlorocebus*: Integrating Genomic and Phenomic Approaches from the Lab, Field, and Beyond

Invited Podium Symposium. Organizers and Chairs: Jennifer Danzy Cramer, Christopher Schmitt, Trudy Turner.
Hyatt Imperial Ballroom 4/6.

Physical anthropology is cross-disciplinary by nature, but subfield specialization often leaves large conceptual and practical disconnects between research perspectives. The vervet monkey (Genus: *Chlorocebus*) has, over the last decade, benefitted from increased collaborative attention from a number of disciplines both within and outside of physical anthropology, culminating in a uniquely interconnected and international research community. In this symposium, we highlight this unprecedented shift in scale and practice. Using shared, universal protocols, these projects integrate long-term research from captive populations (the Vervet Research Colony and St. Kitts Biomedical Research Foundation), anthropogenically altered and transplanted populations (St. Kitts and Nevis), and wild populations in their native habitats across their known range (multiple field sites in Botswana, Cameroon, Ethiopia, The Gambia, Ghana, Kenya, South Africa, Tanzania, and Zambia), while also closely integrating several subdisciplinary pursuits in biomedicine, evolutionary biology, epidemiology, behavioral ecology, physiology, cognitive science, and more. With the imminent publication of the vervet reference genome and the whole genomes of over 900 captive and wild vervets already sequenced, the combined wealth of genomic and phenotypic data - the majority of which have been collected on sequenced individuals - has *Chlorocebus* poised to become one of the most important interdisciplinary model species in the coming years.

- 2:00 **Biological resources for genomic investigation in vervet monkey (*Chlorocebus*).** A.J. JASINSKA, C.A. SCHMITT, D. MA, Y.

HUANG, H. SVARDAL, J. WASSERSCHEID, P. GROBLER, M. JORENSEN, M. MULLER-TRUTWIN, M. ANTONIO, K. DEWAR, W. WARREN, G. WEINSTOCK, I. PANDREA, C. APETREI, M. NORDBORG, R. WOODS, D. JENTSCH, T. TURNER, N. FREIMER.

- 2:15 **The evolutionary history of the genus *Chlorocebus* inferred from whole genome sequencing.** H. SVARDAL, Y.S. HUANG, C.A. SCHMITT, A.J. JASINSKA, Y. JUNG, J. WASSERSCHIED, N. JURETICX, M. MULLER-TRUTWIN, B. JACQUELIN, M. ANTONIO, M. DIONE, P. GROBLER, R.K. WILSON, K. DEWAR, W. WARREN, G. WEINSTOCK, T. TURNER, M. NORDBORG, N.B. FREIMER.
- 2:30 **Genetic differentiation in South African vervet monkeys' Landscape features define routes of migration.** J. GROBLER, W.G. COETZER, C.A. SCHMITT, J. LORENZ, T.R. TURNER.
- 2:45 **Comparative developmental morphology within the genus *Chlorocebus*.** T.R. TURNER, C.A. SCHMITT, J. DANZY CRAMER, J. LORENZ, J. GROBLER, N.B. FREIMER.
- 3:00 **Patterns of variation in the static allometry of sexual and non-sexual traits in vervet monkeys.** J. DANZY CRAMER, R.L. RODRIGUEZ, C.A. SCHMITT, T.J. GAETANO, J. GROBLER, N.B. FREIMER, T.R. TURNER.
- 3:15 **Heritability of obesogenic growth trajectories during development in captive vervet monkeys (*Chlorocebus aethiops sabaues*).** C.A. SCHMITT, S. SERVICE, R.M. CANTOR, A.J. JASINSKA, M.J. JORGENSEN, J.R. KAPLAN, N.B. FREIMER.
- 3:30 **Pathogenesis of SIVagm infection in wild African Green Monkeys.** C. APETREI, D. MA, A. JASSINSKA, J. KRISTOFF, P.J. GROBLER, M. ANTONIO, Y. JUNG, C. SCHMITT, K. RAEHTZ, F. FEYERTAG, V. WIJEVARDANA, D.L. ROBERTSON, R. TRACY, I. PANDREA, N. FREIMER.
- 3:45 **BREAK.**
- 4:00 **The vervet microbiome: determinants of microbial community composition and insights into health and disease.** C. YEOMAN, S. YILDIRIM, S. LEIGH, B.A. WILSON, B. WHITE, A.J. JASINSKA, J. DANZY CRAMER, T. TURNER, G. CERDA, M.E. BERG MILLER, A. GOMEZ, M. CARR, M. TORRALBA, M. GILLIS, K.E. NELSON, R.M. STUMPF.
- 4:15 **Behavioural and physiological flexibility in vervet monkeys: potential adaptive responses to changing climates.** R. MCFARLAND, A. FULLER, R.S. HETEM, D. MITCHELL, S.P. HENZI, L. BARRETT.
- 4:30 **Novelty seeking in vervets: Genetic and environmental influences.** L.A. FAIRBANKS, M.J. JORGENSEN, J.N. BAILEY.
- 4:45 **Novel object exploration in wild vervet monkeys.** M.B. BLASZCZYK.
- 5:00 **Male participation in between-group conflicts in wild vervet monkeys: Testing the mate defence, hired guns and nepotism hypotheses.** T.M. ARSENEAU, A. TAUCHER, E.S. MÜLLER, C.P. VAN SCHAİK, E.P. WILLEMS.
- 5:15 **"The monkey problem" in St. Kitts: Integrating political ecology into ethnoprimateology.** K.M. DORE.
- 5:30 **Using stable isotopes to study vervet-human interactions.** M. SPONHEIMER, J.E. LOUDON, J. GROBLER, K. MOYER, T.R. TURNER.
- 5:45 **Discussant: Clifford Jolly, New York University.**

Session 53: PRIMATOLOGY: Sociality, Social Networks, Agonism

Contributed Podium Presentations. Chair: Lisa Corewyn. Hyatt Stephen AB.

- 2:00 **Infanticides during a socially stable period in wild white-faced capuchin monkeys (*Cebus capucinus*).** V.A. SCHOOF, E.C. WIKBERG, L.M. FEDIGAN, K.M. JACK, T.E. ZIEGLER, S. KAWAMURA.
- 2:15 **Within-group infanticide and infanticidal attempts by the alpha male chimpanzee at Gombe National Park, Tanzania.** D.C. MJUNGU, I. LIPENDE, K.S. WALKER, I.C. GILBY, C. MURRAY, E. WROBLEWSKI, M. RAMIREZ, B. HAHN, A.E. PUSEY, M.L. WILSON.
- 2:30 **Within and between group agonism in male mantled howlers (*Alouatta palliata*) living in a fragmented habitat at La Pacifica, Costa Rica.** L.C. COREWYN.
- 2:45 **Politics by other means: Social networks, community identification, and the "Four Years' War" in the chimpanzees of Gombe National Park, Tanzania.** J.T. FELDBLUM, S. MANFREDI, I.C. GILBY, A.E. PUSEY.
- 3:00 **Competing for space: Female chimpanzees are more aggressive inside their core areas than outside.** J.A. MILLER, A.E. PUSEY, I.C. GILBY, K. SCHROEPFER-WALKER, A.C. MARKHAM, C.M. MURRAY.
- 3:15 **Whom to trust? Social bonds and allegiance fickleness among the Gombe chimpanzees.** I.C. GILBY, C. KRUPENYE, H. LEE, J.T. FELDBLUM, A.E. PUSEY.
- 3:30 **Bonobo sociality in context: A critique of the self-domestication hypothesis.** N. MALONE, F.J. WHITE, K.J. BOOSE, M.T. WALLER.
- 3:45 **BREAK.**
- 4:00 **How sociality affects independent exploration: Evidence gathered in two populations of wild orangutans.** C. SCHUPPLI, S. FORSS, C.P. VAN SCHAİK.
- 4:15 **Causes and reproductive consequences of social network position and personality in free-ranging rhesus macaques.** L.J. BRENT, S. SEMPLE, A. MACLARNON, A. RUIZ-LAMBIDES, J. GONZALEZ-MARTINEZ, M.L. PLATT.
- 4:30 **Sex or Power? The function of male displays in rhesus macaques.** K.M. MILICH, D. MAESTRIPIERI.
- 4:45 **Social network dynamics of a group fission event in free-ranging rhesus macaques (*Macaca mulatta*).** S.M. LARSON, A. RUIZ-LAMBIDES, J. GONZALEZ-MARTINEZ, M.L. PLATT, E. FERNANDEZ-DUQUE, L.J. BRENT.

- 5:00 **Social network structure in female forest guenons (*Cercopithecus mitis*): Ecological and physiological correlates.** S. FOERSTER, N. ALL, M. CORDS, S.L. MONFORT.
- 5:15 **Social influences on longevity in blue monkeys.** N.A. THOMPSON, M. CORDS.
- 5:30 **Sex differences in the development of long-term association patterns among wild chimpanzees (*Pan troglodytes schweinfurthii*).** Z.P. MACHANDA, M. EMERY THOMPSON, M.N. MULLER, R.W. WRANGHAM.
- 5:45 **Ranging and association patterns of woolly monkeys (*Lagothrix poeppigii*) in lowland Ecuador.** K.M. ELLIS, E. PAIN, C.A. SCHMITT, A. DI FIORE.

Session 54: HUMAN BIOLOGY: Energy, Cooperation and Life History

Contributed Podium Presentations. Chair: Melissa Emery Thompson. **Telus CC Glen 201-204.**

- 2:00 **To every thing there is a season: Breast milk, infant growth, and birth seasonality in rural Gambia.** R. BERNSTEIN, S. MOORE, A. PRENTICE.
- 2:15 **Early childhood in Yucatec Maya subsistence agriculturalists.** A.J. VEILE, K.L. KRAMER, E.R. OTÁROLA-CASTILLO.
- 2:30 **A test of three hypotheses of pica and amylophagy among pregnant women in Tamil Nadu, India.** C.D. PLACEK, E.H. HAGEN.
- 2:45 **Trade-offs between reproduction and health: High reproductive effort is related to faster immuno-aging in women.** G. JASIENSKA, A. GALBARCZYK, M. KLIMEK, I. NENKO, L. ODRZYWOŁEK.
- 3:00 **Immunosenescence in Tsimane forager-horticulturalists.** M. EMERY THOMPSON, B.A. BEHEIM, A.D. BLACKWELL, J. STIEGLITZ, B.C. TRUMBLE, M. GURVEN, H. KAPLAN.
- 3:15 **Slow cardiovascular aging and rare infarcts among Tsimane forager-horticulturalists.** H.S. KAPLAN, M. GURVEN, E. CORTEZ, D. EID, B. BEHEIM, J. STIEGLITZ, C. ROWAN, K. TOLSRUP, A. ACHREKAR.
- 3:30 **Reciprocity and trade in food sharing and other services among Tsimane forager-horticulturalists.** A.V. JAEGGI, P.L. HOOPER, H. KAPLAN, M. GURVEN.
- 3:45 **BREAK.**
- 4:00 **Cooperative foraging networks and egalitarianism of Batek hunter-gatherers in Peninsular Malaysia.** T.S. KRAFT, V.V. VENKATARAMAN, K.M. ENDICOTT.
- 4:15 **Cooperative hunting for wasps, opportunistic gathering of grasshoppers: The behavioural ecology of insect consumption in rural Japan.** C.L. PAYNE, K. NONAKA.
- 4:30 **Women, worms and work: Implications of conservation management and declining biodiversity on subsistence practices and health of Aka populations in the Congo Basin.** C.A. JOST ROBINSON, M.J. REMIS, K.J. PETRZELKOVA, Z. HŮZOVÁ.
- 4:45 **Effects of honey consumption and latitude on hunter-gatherer nutritional profiles.** A.M. GLASGOW, H. PONTZER.
- 5:00 **Activity budgets and energy expenditure among hunter-gatherer children: Results from the Hadza of northern Tanzania.** G. WELLS, A.W. FROEHLE, A.N. CRITTENDEN.
- 5:15 **Assessing diet specialization of Hadza microbiota through activity and composition.** S.L. SCHNORR, K. VENEMA, A.N. CRITTENDEN, F. MARLOWE, A.G. HENRY.
- 5:30 **New insights on the role of tubers in hominin evolution: Data from the Hadza hunter-gatherers of Tanzania.** A.N. CRITTENDEN.
- 5:45 **Cooperative breeding and maternal energy expenditure among Ngandu farmers of Central Africa.** C.D. MALCOM, C.L. MEEHAN, R. QUINLAN.

Session 55: Evolutionary Anthropology in Brazil: Celebrating Dr. Walter Neves' Contributions to Modern Human Evolution, Archaeology, Bioarchaeology, and Human Ecology

Invited Poster Symposium. Organizers: Mark Hubbe and Barbara Piperata. **Hyatt Bannerman/Walker.**

Brazil, the largest nation in South America, encompasses a wide array of ecological habitats, including the majority of the Amazon Basin, and has a rich and diverse history of human occupation. The earliest archaeological sites in the country date to the end of the Pleistocene and include Lagoa Santa, one of the largest complexes of early archaeological sites on the continent, with hundreds of skeletons dated to the initial millennia of the Holocene. Morphological and bioarchaeological studies of these collections, including aspects of their life-style, diet, nutritional status and activity patterns have been extensively used to discuss the human dispersion across the continent, shedding light on the biological diversity that characterized South America during the Holocene. An example of such diversity is the remains of shell-mound cultures, specialized fisher-hunter-gatherers, who occupied the coast between 6 - 1 kyr BP. While the Amazon Basin is recognized as the most culturally and linguistically diverse region on the planet, our knowledge of its pre-history, and thus the origins of this diversity, is limited due to the paucity of skeletal collections from this zone. However, research in modern human ecology in the basin has made significant contributions to our understanding of human variation in this vast, bio-diverse and dynamic region, especially in terms of dietary ecology, growth and development, and health. Over the past several decades Dr. Walter Neves has made significant contributions to these sub-fields of evolutionary anthropology by pushing the standards of scientific work in Brazil to international levels of recognition and relevance and by supporting the scholarship of Brazilian and foreign researchers interested in studying in the country. This symposium celebrates Dr. Neves' career by bringing together scholars who have been influenced by his dedication to science and contributed to the understanding of human origins,

dispersion and adaptation in South America.

1:00 - 2:00 pm Poster set-up. 5:30-6:00 pm Poster take-down.

2:15-2:30 pm Introduction to the symposium: Hubbe and Piperata

2:30-3:00 pm Even numbered poster authors present for discussion

3:00-3:30 pm Odd numbered poster authors present for discussion

4:00-4:15 pm Discussant: Jane Buikstra, Arizona State University

4:15-4:30 pm Discussant: Darna Dufour, University of Colorado, Boulder

- 1 **The dance of bones: Concerns and thoughts about curatorial care of skeletal series.** V. WESOŁOWSKI.
- 2 **Oral health in the eastern-central Brazil: From past to present.** P. DA-GLORIA, W.A. NEVES, C.S. LARSEN.
- 3 **Dental decay on the Atacama oases during the period of the influence of the Tiwanaku Empire.** R.E. OLIVEIRA, W.A. NEVES.
- 4 **Morphological affinities of the shellmound populations: Testing models for the coastal occupation of SE Brazil.** M. HUBBE, M. OKUMURA, D.V. BERNARDO, W.A. NEVES.
- 5 **Modularity, covariance patterns and morphological integration in the human skull.** T.F. ALMEIDA, D.V. BERNARDO, W.A. NEVES, D.V. BERNARDO.
- 6 **Food intake, nutrition and ecology in Amazonian *Ribeirinho* populations: A multivariate analysis.** R.S. MURRIETA, M. HUBBE, M.S. BAKRI, W.A. NEVES, C. ADAMS.
- 7 **Nutrition in transition: Dietary strategies and health status of Ribeirinhos in the 21st century.** B.A. PIPERATA.
- 8 **Ecological anthropology of riverine populations from the estuary of the Amazonas: Revisiting Marajó Island two decades later.** H.P. SILVA.
- 9 **Walter Neves: His contribution for a better understanding of human cranial diversity in prehistoric Brazil.** D.V. BERNARDO, M. OKUMURA.
- 10 **Reevaluating Dr. Lund's ideas at the Lapa do Sumidouro, a classic paleoanthropological site of the American Quaternary.** L.B. PILÓ, A.S. AULER.
- 11 **Archaeological implications for the colonization of the New World by two distinct biological populations.** R. KIPNIS, D.V. BERNARDO.

Session 56: The Intersection of Hominin Fossil Studies, Human Variation and Life History: A Symposium in Honor of Alan Mann

Invited Poster Symposium. Organizers: Michelle M. Glantz and Janet Monge. **Hyatt Herald/Doll.**

Known for his pioneering approaches to the study of the hominin fossil record, engaging pedagogical style, and keen critical powers, Alan Mann is fittingly described as a paleoanthropologist's paleoanthropologist. His influence on the work of his former students and colleagues can be credited for the continuation of a perspective that places variation at the center of how our discipline conceptualizes human evolution. From South African australopithecines to Neandertals and early modern humans, Alan has embraced new methodological approaches to fossil studies that underscore the importance of growth and development and life history to human evolution. In addition to his research program, Alan has been actively involved in the dissemination of our field's findings to the public. Always enthusiastically received, his public lectures on what it means to be human are responsible for a continued interest in paleoanthropology. Also, Alan has long made it a priority to create and promote non-invasive ways to approach the fossil record in the context of both research and teaching. Through his direction of the University of Pennsylvania's fossil casting program, the discipline is assured of the preservation of precious fossil material with the laborious production of accurate replicas. This symposium brings together a group of scholars whose work has been influenced by Alan Mann, in theory and method. Posters reflect the breadth and depth of his influence.

1:00-2:00 pm Poster set-up. 5:30-6:00 pm Poster take-down.

5:00-5:30 pm Discussants: Janet Monge, University of Pennsylvania and Mica Glantz, Colorado State University

- 1 **An examination of modern human cranial variation using frontal bone morphometrics.** S. ATHREYA.
- 2 **Mandibular correlates of somatic growth in chimpanzees and gorillas.** Z. COFRAN.
- 3 **Neuroscience, natural history, and the lesson of paleoanthropology.** D.B. EDELMAN.
- 4 **The refugium no one is talking about: Hominin admixture in Central Asia.** M.M. GLANTZ, T. BEETON, K. HORTON.
- 5 **Social insects and cultural origins.** J. LESNIK.
- 6 **The polemic question of Neandertal cannibalism from the perspective of the Mousterian site Les Pradelles (Charente, France).** B.A. MAUREILLE, C. MUSSINI, M. GARRALDA, B. VANDERMEERSCH, A.E. MANN.
- 7 **Global patterns of human orbit size: Implications for Neandertals.** M.R. MEYER, J.E. LEWIS, M.R. FONG, J.M. MONGE, R.L. HOLLOWAY.
- 8 **Human variation and the biocultural response to colonialism: A view from the central coast of Peru.** M.S. MURPHY.
- 9 **Variability in variability - variation in sexual size dimorphism in *Homo sapiens*.** H.C. PETERSEN.
- 10 **Beyond Neandertal morphology: Alan Mann's impact on the studies of the Krapina Neandertals.** J. RADOVČIĆ, D. RADOVČIĆ.

- 11 **Infant helplessness in the human fossil record from ape to Mann.** K.R. ROSENBERG.
- 12 **The crania of African origin in the Samuel G. Morton Collection: Investigating aspects of health in two historical samples.** E.S. RENSCHLER.
- 13 **Casts and endocasts: The enduring legacy of Zhoukoudian.** L.A. SCHEPARTZ, X. WU.
- 14 **Maternal mortality and longevity in the past: A paleodemographic approach to understanding risk and survivorship.** P. SELINSKY.
- 15 **Strontium isotopes in the Sterkfontein valley: What do they say about early hominin habitat usage?** A. SILLEN.
- 16 **What can we learn from the Levantine Mousterian Kebara Hominins?** A. TILLIER, B. ARENSBURG.
- 17 **Open science and paleoanthropology.** S. TRAYNOR, J. HAWKS.
- 18 **Life history changes in three hominin lineages (*Australopithecus afarensis*, *Australopithecus robustus*, early *Homo*) as inferred from mandibular remains.** A.P. VAN ARSDALE.
- 19 **Science, storytelling, and the place of race in evolutionary narrative.** D. WALRATH.
- 20 **Some paleodemographic aspects of the South African Australopithecines.** M.H. WOLPOFF, R. CASPARI.

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Does female dominance facilitate female mate choice? An examination of mate choice in Verreaux's sifaka (*Propithecus verreauxi*)

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Studies of mate choice hypothesize that females prefer dominant males as mates because these males are presumably of higher quality. However, females may mate with dominant males due to coercion or to reduce infanticide risk rather than because they are preferred mates. Verreaux's sifaka (*Propithecus verreauxi*) exhibit female dominance and infanticide. We used two years of mating season behavioral data combined with morphological and genetic data from Kirindy Mitea to test the hypotheses that female dominance increases the ability of females to exhibit mating preferences and that nonresident and/or nondominant males sometimes sire offspring, which may indicate successful female choice. Paternity analysis of 14 offspring born over a 6 year period in 5 social groups is in progress; work completed thus far identified panel of 19 variable microsatellite markers sufficient for robust parentage analysis. Analyses of behavioral data show that while approaches did not significantly vary by sex or rank in intersexual dyads, Hinde Indices indicate females were responsible for maintaining proximity with nondominant but not dominant males. Dominant males spent a significantly greater proportion of time in proximity with females and groomed females more frequently, but intersexual grooming bouts involving nondominant males lasted significantly longer. Neither male canine size nor male chatter rate was correlated with Hinde Indices, suggesting females did not prefer males with superior fighting ability or more submissive males. Our results suggest that while females may be able to exhibit some mating preferences, mate choice may still be constrained by the behavior of dominant males.

The human calcaneus: A test case for models of bony resistance in impact forces

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Human bipedal walking and heel-strike running is characterized by repetitive impacts to the heel, including the calcaneus. This study tests the hypothesis that species differences in trabecular bone volume fraction (BVF) in the calcaneus can be used to infer selection for resisting repetitive impacts during bipedal locomotion. First, we describe two competing models for how trabecular bone evolves to resist impacts. The bone-first model predicts that high density trabecular bone is most beneficial for avoiding bone fracture, while the cartilage-first model predicts that low density trabecular bone helps to dissipate energy and protect cartilage. These models were used to develop an optimization model, and were tested comparatively using 30 humans, 10 chimpanzees and 10 gorilla calcanei from various populations. Bones were microCT scanned at high resolution (between 39 and 46 microns) to obtain trabecular

bone structural data. Trabecular BVF, bone mineral density, orientation, thickness, number and separation were analyzed from the calcaneal tuberosity and beneath the talo-calcaneal joint surface using VGStudio Max. The results suggest that trabecular bone in the human calcaneus resists impact forces using low density trabecular bone in order to dissipate energy and shield cartilage from damage, and that trabecular BVF approaches the predicted optimum in the human calcaneal tuberosity. Results from this study have implications for trabecular bone structure-function relationships, as well as for inferring the biomechanics of gait in ancient hominins.

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New fossil remains of *Pliopithecus canmatensis* from Abocador de Can Mata, and their implications for the taxonomic validity and phylogenetic position of *Epipliopithecus* (Primates, Pliopithecidae)

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Pliopithecids—a Eurasian clade of stem catarrhines—are mostly known by dentognathic remains, whereas their postcranial morphology is only well known for *Epipliopithecus* (sometimes synonymized with *Pliopithecus*). Here we report new cranial, dental and postcranial remains of *Pliopithecus canmatensis*, originally described in 2010 based on dentognathic remains from several Middle Miocene (11.8–11.7 Ma) localities of Abocador de Can Mata (Vallès-Penedès Basin, Catalonia, Spain). The new fossils, enabling a refinement of the original diagnosis of the species, correspond to 14 specimens (one cranial, seven dental and six postcranial) from three similarly-aged localities: ACM/C5-A8, ACM/C5-C3 and ACM/C5-C4 (new). Body mass estimates based on the current hypodigm range from to 4–5 kg (female teeth) to 5–6 kg (male teeth and postcranial biomechanical estimators). The new craniodental remains indicate a lack of sagittal crest and for the first time enable the description of the lower deciduous canine and the upper central incisor of this species. The postcranial remains (three partial phalanges, a partial fifth metatarsal, and femoral and humeral shafts) show in turn several differences compared to *Epipliopithecus*. Most significantly, *P. canmatensis* lacks an entepicondylar foramen in the distal humerus—like crown catarrhines and dendropithecids, but unlike *Epipliopithecus* and other stem catarrhines. Overall, the postcranial differences between *P. canmatensis* and *Epipliopithecus* substantiate the generic distinctiveness of the latter, which further lacks in the lower molars the pliopithecine triangle characteristic of pliopithecids. We therefore conclude that *Epipliopithecus* is a well distinct genus that most

likely occupies a more basal phylogenetic position than *Pliopithecus*.

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Cranial modification among prehistoric groups of Patagonia and Tierra del Fuego, Chile

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At the time of European contact, inland hunters of guanacos (*Lama guanicoe*) known as Selk'nam and Aonikenk, and two marine nomads identified as Kaweshkar and Yámana inhabited Patagonia and Tierra del Fuego. To date, archaeological evidence does not allow for a clear differentiation between these groups. Moreover, the temporal depth of these ethnic identities is unknown. Bioarchaeological analyses can greatly contribute to the study of prehistoric identity, since the body is a place where affiliation is commonly displayed. In particular, we have selected cranial modification because modified skulls are a permanent and highly visible symbol of social identity in South America. Thus, the goal of this study is to explore the temporal and geographic distribution of artificial cranial modification. A total of 75 individuals were analyzed. These individuals were divided as Fuegian or Patagonian, and later subdivided as terrestrial, maritime, or undetermined hunter-gatherers based on their geographic location. The individuals were evenly distributed as Patagonian (37) and Fuegians (38). Patagonian skulls were modified in 45.9% of the cases. Most of the modified skulls (70.6%) corresponded to terrestrial hunter-gatherers. Among Fuegians, 26.3% of the skulls were modified, and most of the cases (50%) corresponded to terrestrial hunter-gatherers. Although, cranial modification shows a higher frequency among Patagonian groups, in both Patagonia and Tierra del Fuego, cranial modification was most common in terrestrial hunter-gatherers. However, most cases correspond to modifications that resulted from cradle boarding, and were thus unintentional, and not necessarily used to express ethnic identity.

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Strongyloids in the soil: An exploration of gastrointestinal parasite load and geophagy in lemurs at Tsinjoarivo, Madagascar

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The lemurs of Madagascar are hosts to several gastrointestinal parasites, although reports of the intensity and diversity of these parasites vary by species. Gastrointestinal parasites may pose a sublethal threat to wild lemurs as several of these pathogens drain immune systems and reduce digestive efficiency. Effort should be made to understand variables affecting parasite load in order to better inform conservation policy and minimize the spread of potential zoonoses.

We collected fecal samples from lemurs living in fragmented forests at Mahatsinjo in the Tsinjoarivo region during June 2013. Feces were collected from *Haplemur griseus*, *Propithecus diadema*, *Microcebus lehilahytsara*, and *Lepilemur mustelinus*. Samples were processed within 24 hours of collection using zinc sulfate flotations and examined microscopically. In June 2013 (as reported earlier in May-June 2012), adult *H. griseus* individuals had significantly higher parasite load than other species. All individuals with high (>50 eggs/gram) or medium (25-50 eggs/gram) parasite loads were *H. griseus*; only one *H. griseus* had a low (<25 eggs/gram) parasite load. The most common parasites in *H. griseus* were nematodes of the superfamily Strongyloidea.

We took GPS points and soil samples for all observed geophagy sites for *H. griseus*. Soil samples were examined for eggs/larvae using zinc sulfate flotations and a modified Baermann technique. Three of the five geophagy sites contained strongyloid eggs/larvae preliminarily identified from both techniques. One of these was within six meters of a bamboo lemur latrine site. These data may provide a partial explanation for the high degree of strongyloid infection in *H. griseus*.

Changes in endocast shape precede encephalization in anthropoid evolution

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It has been proposed that endocranial shape co-evolved with encephalization as a consequence of spatial and/or developmental constraints on cephalic growth. However, early anthropoid endocasts possess qualitative similarities with living anthropoids at relatively small endocranial volumes, perhaps indicating a disconnect between endocast shape and encephalization in early anthropoid evolution. This project quantifies endocast shape in extant and fossil primates via geometric morphometrics to explore variation in endocranial shape and its relationship to encephalization over time.

Three-dimensional landmarks were collected on virtual endocasts, segmented from micro-CT scans of primate crania. The sample includes thirty-one extant primate species, an Oligocene stem anthropoid (*Parapithecus*), a stem catarrhine (*Aegyptopithecus*), and two Miocene stem platyrrhines (*Homunculus*, *Tremacebus*). Endocast shape is explored via Principal Components Analysis of General Procrustes-aligned variables.

The first principal component separates extant strepsirrhines and tarsiers from anthropoids. Shape changes on this axis include: olfactory fossa size and projection, anterior-posterior position of the foramen magnum, posterior projection of the cerebrum, and flexion of the

endocast base. Accounting for phylogenetic effects, PC1 scores for extant primates significantly correlate with residual endocranial volume ($p < 0.001$). On PC1, *Parapithecus* is intermediate between extant strepsirrhines and anthropoids. *Aegyptopithecus* falls within the lower limit of the extant anthropoid group, while *Homunculus* and *Tremacebus* are aligned with extant platyrrhines.

Despite the correlation between encephalization and endocast shape among modern primates, fossil anthropoids have a somewhat anthropoid-like endocranial form at a strepsirrhine-like endocranial volume. Thus, the fossil record indicates that a potentially adaptive reorganization of the endocranium preceded encephalization in anthropoids.

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Immigrants in America: Experiences with tuberculosis amongst Buffalo's poor

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Infectious disease, a viable enemy which has significantly influenced humans and the trajectory of history, remains elusive in the osteological record. Because of this difficulty, other lines of evidence to support skeletal analyses have become imperative.

Historic urban institutions built to serve the poor (poorhouses, asylums, and hospitals), often geographically forgotten, are more frequently being discovered and salvaged. In the case of the Erie County Poorhouse Cemetery excavation in Buffalo, NY, surviving documentation from the infirmary provides a unique opportunity to study those who experienced economic hardship and were served by these institutions. Utilizing historic documents, we aimed to learn specifically about the experience and prevalence of tuberculosis amongst this 19th and early 20th century skeletal population.

As one of the most prolific and diverse infections throughout human history, tuberculosis has often struck hardest at impoverished individuals. Utilizing mortuary registers from the infirmary, the population from which our sample came from lists 1,440 of 7,182 deaths as associated with tuberculosis from 1880-1913. With 663 recorded with a nativity outside the United States, we have exposed an existence of marginalization amongst the era's newest Americans. With less than 3% of the skeletal sample showing markers congruent with chronic tuberculosis, this historic record provides a unique view into a phenomenon the osteology severely under-represents. By integrating historic records, archaeological evidence and osteological analyses, a holistic picture of suffering and social stigma due to tuberculosis amongst impoverished immigrants and Buffalo's poor recreates the experience of a demographic which history has all but forgotten.

Modularity, covariance patterns and morphological integration in the human skull

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Models based on both fossil and genetic evidence suggest that the genesis of modern humans occurred in Africa 200,000 years B.P., and then migrated to other parts of the world. With regard to the cranial morphology, authors observed the decrease of variability as the populations diverged, spatially and temporally, from each other and from their African ancestors, although it is also recognized among experts that human cranial diversity is partitioned into two fundamental patterns: one represented by morphology similar to that characterizing the first *Homo sapiens*, so-called "general morphology", and the other represented by other morphological variations, called "specialized morphology". In this context, the primary objective of this research is to characterize the evolution of human cranial variation, approached from two themes: 1) The investigation of the composition, pattern of occurrence, distribution and structuring of human cranial morphological diversity, and, 2) analysis of the context of evolutionary change observed in the human skull, due to its characteristics of integration, modularity and evolutionary stasis investigated from the exploitation of their patterns of variance and covariance. For this, we used the metric cranial characteristics (24 variables from Howells) of 9,287 individuals distributed in 161 indigenous people of worldwide dispersion. The results obtained through the different strategies employed in this work reinforce the idea that the evolution of cranial morphology is best explained by a model that assumes the occurrence of different evolutionary dictates, as genetic drift and natural selection, for example, acting on cranial modules in a differentiated mode.

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Seasonal fluctuation of men's testosterone levels and body composition in rural Poland

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The steroid hormone testosterone coordinates male reproductive function and behavior, and supports secondary sexual characteristics. Testosterone is hypothesized to mediate trade-offs between reproduction and survival through the management of sexually dimorphic muscle

mass. Implicit in this hypothesis is an underlying assumption that a persistent relationship is maintained between men's testosterone levels and musculature. However, our earlier research found that physical demands of fathers' provisioning responsibilities augmented their musculature and strength, despite testosterone decline. We extend this research by examining whether seasonal shifts in men's workload produce fluctuation in testosterone levels and body composition. Data were collected from 103 rural Polish men (at the Mogielica Human Ecology Study Site) in an agricultural community where men's subsistence activities often require intense labor. During the summer and winter, participants reported their work habits, and provided morning and evening saliva samples. Additionally, upper-body strength was estimated using a portable dynamometer to measure grip and chest strength, and upper-body musculature was estimated from flexed arm circumference adjusted for body fat. Paired t-tests were used to examine within-individual variation between seasons. Men reported greater workload demand during the summer harvest compared to winter months ($p < .01$). Relative to winter, summer was associated with increased arm circumference ($p < .01$) and grip strength ($p < .01$), but a concomitant decrease in morning testosterone ($p < .01$). Although testosterone's role in maintaining skeletal muscle is emphasized in men's life history, our data suggest the importance of provisioning and subsistence activities in determining male phenotype.

Female takeovers in *Hamadryas* baboons: Consequences and counter strategies

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Male hamadryas baboons use sexual coercion to herd females into one-male units (OMUs), resulting in female defense polygyny within multi-male groups. Here we explore the consequences of this social system for females and two potential female strategies to mitigate this cost. Data were collected from 152 females from 2005 to 2009. Over this period, 67% of females with young infants that experienced a takeover also experienced infant mortality. In addition to the loss of infants after takeovers, interbirth intervals of females that experienced a takeover between subsequent births were significantly longer than those that did not experience a takeover. Preliminary data from Filoha also suggest, however, that hamadryas females exhibit counterstrategies to alleviate the fitness expenses they incur via male takeover, especially with regard to infanticide. While hormonal data on this population are still forthcoming, observational swelling data post-takeover ($N=18$) revealed that, regardless of reproductive state, all females developed sexual swellings within 30 days of takeover. In addition, females may have been more likely to experience fetal loss after takeover. We propose

that hamadryas females may have evolved strategies to reduce the costs of male takeovers via post-takeover deceptive swellings and abortions. The hamadryas baboon social system benefits males while concurrently imposing considerable fitness costs to females. However, the possibility of female counterstrategies suggests that sexual conflict in hamadryas baboons may not carry as substantial female fitness costs as would be expected in such a sexually coercive species.

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An ateline foraging strategy: Nutritional intake of the black howler monkey (*Alouatta pigra*) in Palenque National Park, Mexico

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Because howler monkeys consume high proportions of leaves during some months of the year, and leaves tend to be lower in energy and higher in protein than ripe fruits, howler monkeys are generally assumed to be energy-limited. However, plant species vary dramatically in nutritional content, and during some months of the year, howler monkeys consume mostly fruits. Therefore, simplified descriptions of howler diets based on broad categories are likely insufficient for understanding patterns of energy and nutrient intake. To determine how diet composition relates to nutritional intake we estimated energy and nutrient intake over a 10-month period in two groups ($N=16$ individuals) of black howler monkeys (*Alouatta pigra*) in Palenque National Park, Mexico. Data indicate that black howlers are not energy-limited since during the study they met estimated energy requirements by consuming an average of 0.57 MJ of overall energy per metabolic body weight per day and surpassed protein requirements by consuming an average of 8.6g of protein per metabolic body weight per day. Activity levels were not dependent on diet. The howlers also maintained a consistent level of average daily protein intake regardless of diet composition, while non-protein energy intake varied dramatically in response to the amount of ripe fruits consumed. This pattern appears to be a result of howler food selectivity and a higher fruit intake than traditional, time-based estimates suggest. These findings suggest that howler nutrition is similar to that of other fruit-eating atelines, and many common assumptions regarding howler behavior and feeding ecology must be reexamined.

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Controlled diet experiments for diet reconstruction with stable isotopes of hair, muscle, bone collagen and bone apatite

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Rat litters were fed from conception with ingredients of known isotopic composition in order to determine whether whole diet or dietary protein carbon is preferentially used to synthesize hair, muscle, bone collagen, and whether carbon from non-protein dietary fractions (lipids and carbohydrates) or whole diet is reflected in bone apatite. Diets were synthesized with 5%, 20% and 70% protein. Protein sources included C₃ and C₄ milk proteins (casein) and marine fish (canned tuna). Carbohydrates and fats came from C₃ and C₄ plants.

Diet to apatite $\delta^{13}\text{C}$ enrichment average +9.4‰ for all dietary combinations ($n=28$), demonstrating that carbon atoms from all dietary macronutrient fractions are incorporated in apatite carbonate without discrimination. Average diet-to-tissue $\delta^{13}\text{C}$ differences for hair, muscle and bone collagen are 1.5‰, 3.0‰ and 5.1‰, respectively, when the whole diet and dietary protein have the same $\delta^{13}\text{C}$. When dietary protein and non-protein $\delta^{13}\text{C}$ differs then consumer tissue protein $\delta^{13}\text{C}$ follows that of dietary protein. These experiments demonstrated that apatite carbonate always accurately reflects the isotopic composition of the whole diet. However the isotopic composition of collagen, hair and muscle mainly reflects that of dietary protein. This bias toward dietary protein isotopic composition is commensurate with the proportions of carbon from indispensable (essential) and conditionally dispensable (semi-essential) amino acids in these tissue types. These results have significant implications for diet reconstruction with stable isotopes: Analysis of bone apatite and tissue protein carbon and nitrogen isotopes permits more accurate estimation of the isotopic composition of protein and non-protein diet components.

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Testing the predictions of the developmental origins of adult health and disease (DOHaD) hypothesis on an identified human skeletal collection II: Age at death and femur length

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Short stature has been used as an indicator of environmental stress during the growth process in DOHaD studies, and the association of these indicators with mortality has yet to be demonstrated in skeletal populations. The aim of this study was to test the association between age at death and femur length as a proxy for body height, in a modern skeletal sample of known age, as an independent test of the DOHaD

hypothesis in non-living and pre-modern populations. The femora of 115 adult males from the Lisbon identified skeletal collection housed at National Museum of Natural History and Science were measured. The association between femur length (the exposure) and age at death (the outcome) was quantified using binary logistic regression models, calculating crude and adjusted odds ratios (OR). Results show a weak association of femur length with age (OR=1.88, 95% CI= 0.80-4.40), where individuals in the lower quartile for femur length are almost twice as likely to die before the age of 53 years (median age). This association was not lost when controlling for cause of death (OR=5.90, 95% CI= 1.79-19.43), socioeconomic (OR=4.79, 95% CI= 1.40-16.43) and migration status, year of birth (OR=0.91, 95% CI= 0.88-0.95) and presence of enamel hypoplasias (OR=0.958, 95% CI= 0.22-4.22). In this sample, femur length as a cumulative measure of environmental stress during the growth period, seems to capture some of the long lasting early life influences that affect premature mortality, as predicted by the DOHaD model.

A reassessment of dental variation in the genus *Cercopithecoides* and its implications for species diversity

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The taxonomy of the fossil colobine genus *Cercopithecoides* has been debated by paleoprimatologists for decades. Currently, six species of *Cercopithecoides* are recognized in the Late Miocene to Plio-Pleistocene of South and East Africa. *C. williamsi*, found at Koobi Fora, Leba, Makapansgat, Sterkfontein, Swartkrans, Bolt's Farm, and Kromdraai, is one of only two *Cercopithecoides* species recognized in South Africa. Material from Kromdraai B (KB) and Swartkrans (SK), however, has previously been noted to be larger than that from Sterkfontein, Makapansgat, and Bolt's Farm. This analysis examines the status of these larger specimens relative to other *C. williamsi* populations and other recognized *Cercopithecoides* taxa.

To assess the taxonomic affinities of the various *C. williamsi* populations, the size and shape of *Cercopithecoides* molars were compared to a sample of 407 upper and 529 lower molars of extant and fossil colobines. The KB and SK material generally overlaps the largest *Cercopithecoides* species, *C. kimeui*, in size, but the lower molars fall at the lowest end of the *C. kimeui* range. Furthermore, specimens from KB and SK have different relative upper and lower molar proportions compared to *C. kimeui*. Based on dental size and shape, the KB and SK *Cercopithecoides* material is larger than all other *C. williamsi* and most similar to *C.*

kimeui. Our analysis supports the presence of a third, dentally large, species of *Cercopithecoides* in South Africa. Whether this species is *C. kimeui* or different taxon will require further analyses of cranial morphology and the anterior dentition.

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Evaluating age-related bone loss in the Eriksen femur collection

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Evidence for human bone loss can be seen in femora in the form of endosteal expansion and intracortical porosity. This work evaluates measures of bone area that may contribute to understanding modern age-associated bone loss. The research objectives are to investigate age- and sex-related variation in bone area measures in human femora, and compare and assess trends in age-related bone loss among ten-year age cohorts.

Complete transverse midshaft femur cross-sections (M.F. Eriksen collection, $n=267$) with a balanced sex distribution were used. Ages range from 30-97 years. Histomorphometric variables include: total cross-sectional area (Tt.Ar), bone area (B.Ar), and endosteal area (En.Ar).

All mean overall Tt.Ar values decrease with age, especially after the seventh decade of life. An age group comparison reveals significantly different Tt.Ar measures between the ages of 40-60 and 70+. Males have a larger mean Tt.Ar than females. Mean overall B.Ar values decrease with advancing-age after 70+ years. B.Ar declines with age and this decrease is dramatic among females. En.Ar increases with age after the sixth decade of life. Females have a significantly larger mean En.Ar. Significant mean differences in Tt.Ar and B.Ar exist between males and females in the 40-50, 50-60, and 80-90 age categories. In the 60-70 and 70-80 age cohorts, mean B.Ar significantly differs between males and females. Females have a significantly larger mean En.Ar after age 70.

This research demonstrates the application of bone area variables to measures of femoral cross-sections. Results indicate that individuals from the Eriksen sample exhibit normal age-related femoral bone loss.

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Testing a predictive model for identifying fossil vertebrate localities in the Eocene of Wyoming

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Remote sensing and other technologies from the geographic information sciences have the

potential to revolutionize how fieldwork in paleoanthropology is conducted. We have developed and field tested two different predictive models for identifying fossiliferous localities in the Eocene of Wyoming. We used satellite imagery to prioritize areas for survey and collection in the Wasatch Formation of the Great Divide Basin (GDB), a large (ca. 10,000 km²) sedimentary basin in southwestern Wyoming where we have been working since 1994. The first model used low resolution LANDSAT imagery and a pixel-based artificial neural network (ANN) approach to image classification. The second model used commercially available high resolution satellite imagery and a Geographic Object oriented Image Analysis (GEOBIA) approach, which joins similar pixels into larger objects. Both models were developed using training sites based on known localities and other land cover classes (e.g., sand dunes, woodlands, wetlands, etc.). We ground-truthed both predictive models during the summer 2012 and 2013 field seasons by surveying areas that were identified by our predictive models as having a spectral signature that closely resembled known localities. Of the 20 areas we surveyed, essentially all of them yielded vertebrate fossils and more than 75% yielded fossil mammals. Our results serve as a proof of principle that predictive models based on remotely sensed imagery can yield productive fossiliferous localities and can lead to more efficient and effective paleoanthropological fieldwork. We suggest that the future of paleoanthropology will involve routine and close collaborations with specialists in the geographic information sciences.

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Inferring post-Peopling Amerindian population history from published and synthetic data

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Genetic data has proven pivotal in the investigation of the seminal migration that has become known as the Peopling of the Americas. Whilst genetic data have clearly improved our understanding of this event, they have provided substantially less clarity when considering the post-Peopling history of Amerindian populations. Here, we investigate the utility of mtDNA data for inferring more recent regional population histories of Amerindian groups. Specifically, we use a combination of previously published and synthetic data to assess the ability of such data to reflect unique regional population dynamics. We place especial focus on the well-attested post-Columbian population crash associated with the introduction of European pathogens, exploring whether the existing mtDNA data are sufficient to discern unique regional patterns in North and Central America. Our findings suggest that mtDNA may provide significant insights into the most recent events in Native American population history.

Integrating datasets in biological anthropology: An introduction to the Bones and Behavior Project

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Biological anthropologists seek to understand patterns of variation and underlying adaptive processes and histories, yet increasingly researchers in each of the subdisciplines work in relative isolation and without collecting comparable datasets. Given the interdependence of physiology, skeletal biology, and behavior within an individual organism, our ability to address “umbrella questions” concerning the evolution and adaptation of populations is weakened by this inattention to comparability across subdisciplines. The NSF-funded “Bones and Behavior Working Group” was formed to address this fragmentation that weakens the integrative strength of biological anthropology. The group’s goal is to foster greater synthesis across the discipline and ultimately provide new insights into questions concerning human and nonhuman primate adaptation and evolution.

From an intensive workshop in 2007 and annual follow-up meetings, the Bones and Behavior Project has produced results that can be found at BonesandBehavior.org. These include development of: 1) a standardized Integrative Measurement Protocol (IMP) that facilitates the linking of behavioral, biological, and skeletal databases utilizing proxies for key skeletal measures; 2) a protocol for the standardization of human skeletal measurements; 3) refinement of several measurement techniques that can be applied to questions in biological anthropology; and 4) initiation of a series of research projects that apply the IMP in human biology, primatology, and skeletal biology – the results of which are presented in this symposium. Our current efforts focus on finalizing a protocol of standardized skeletal measurements of nonhuman primates and further developing an online clearinghouse for measurement protocols in skeletal biology, physiology, and behavior.

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Pathogenesis of SIVagm infection in wild African Green Monkeys

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Studies on SIV-infected captive African green monkeys (AGM) concluded that they generally do not progress to AIDS. We performed large scale studies on wild AGMs in South Africa and Gambia and we report that SIV prevalence varies dramatically between infants/juveniles (4%) and adults (68%) ($p < 0.0001$) and between females (78%) and males (57%), pointing to sexual transmission as the main route of SIV transmission in AGMs and negligible maternal-to-infant transmission (MTIT). By performing single genome amplification of the viral quasiespecies in acutely infected AGMs and identifying a major virological bottleneck of transmission, we confirmed that the high SIV prevalence is not due to increased mucosal permissivity in AGMs. Immune cell populations were not different between infected and uninfected AGM. Expression of the SIV coreceptor CCR5 on CD4⁺ T cells dramatically increased with age and was higher in infected vs uninfected AGMs, suggesting that limited SIV MTIT is due to low target cell availability in newborns and infants and supporting HIV MTIT prevention strategies aimed at limiting the availability of target cells at mucosal sites. Viral loads were in the range of those observed in experimentally-infected monkeys, validating the experimental approaches in natural hosts. None of the markers of persistent immune activation (Ki-67, HLA-DR and cytokine expression), inflammation (C-reactive protein and proinflammatory cytokines) or hypercoagulation (d-dimer), which are strong predictors of disease progression and death in humans, were increased in SIV-infected AGMs. Our study thus clearly demonstrates the nonpathogenic nature of SIV infection in wild AGMs.

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Palaeopathological and biomolecular evidence for leprosy in Sweden: The evidence and its interpretation

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The earliest case of leprosy in Sweden is dated to the Roman Iron Age, and the last person who contracted the disease in Sweden died in 1976. In leprosy, pathological bone manifestations depend on the immune status of the infected. Lepromatous leprosy is the more severe form and tuberculoid leprosy is the milder form. In the last two decades new bioarchaeological evidence

has been discovered in Sweden in addition to the publication of new biomolecular results. This makes it possible to discuss transmission routes and the distribution of the disease in Sweden.

This study aims to relate the evidence of leprosy to historical records; chart its distribution; and classify type of leprosy suffered. Two hypotheses are proposed: the Swedish sample will resemble the demographic distribution seen in modern clinical studies, and an exclusion from society at death is observable throughout the centuries.

Materials studied include historical sources and all Swedish skeletons diagnosed with the disease. The diagnostic criteria were biomolecular data, rhinomaxillary syndrome alone or a combination of bilateral inflammatory changes of the tibia and of the peripheral skeleton.

The results show that as early as the late Viking Age, the disease was widely spread in Sweden. Nevertheless, leprosy frequency and distribution varied. From the late Middle Ages to the 20th century a decline is suggested, although a slight rise is indicated during the mid-19th century. Taphonomic factors made classification to leprosy type problematic. Historical records show that, at least for medieval society, those affected were treated with certain respect.

Urinary cortisol variation in redtails (*Cercopithecus ascanius*) and red colobus (*Piliocolobus rufomitratus*) of Kibale National Park, Uganda: Hunting or habitat?

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The non-invasive measurement of urinary cortisol levels is one method of evaluating the impact of environmental pressures on wild primates. Variation in cortisol concentration suggests metabolic stress, which may have significant downstream effects on individual and population-level health. Our previous study (Jaimez et al. 2012) found cortisol level variation in gray-cheeked mangabeys (*Lophocebus albigena*) associated with habitat disturbance.

Here, we expand on this research, reporting on cortisol levels in two cercopithecoid monkeys from two sites in Kibale National Park, Uganda. One is highly disturbed (Mainaro), while the other shows very little modern disturbance (Ngogo). Redtail monkeys, with smaller body size, wide ecological flexibility, and relatively rapid metabolism, showed little intersite difference. In contrast, cortisol levels in red colobus monkeys, which are larger and have a less generalized diet, differed significantly. This difference appeared to be associated with severe predation pressure by chimpanzees at Ngogo, rather than with habitat disturbance at Mainaro. We discuss the implications of socioecological stressors and the need to review both habitat and primate community data when assessing ecophysiology and hormonal indicators of stress in wild primates.

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Patterns and predictions: What a long-term data base can tell us about the future of food availability in a Malagasy rainforest

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The links between climate change and plant phenology patterns are becoming increasingly well documented in the literature. However, there are very few primate field studies that have maintained continuous records of both weather and plant productivity data sufficient for their analysis within a primate conservation context. Here, we analyze over 25 years of weather and plant phenology data collected from Ranomafana National Park, to improve our understanding of both seasonal and long-term changes in plant productivity at this site. Since 1987, rainfall and temperature data have been collected daily and measures of plant productivity (i.e.: abundance of flowers, unripe and ripe fruits, leaf buds, new leaves and mature leaves) have been recorded at least monthly for 100 trees of 25 species (with an additional 100 trees of 45 new species added to the database in 1995) as part of a broader study of the behavior and ecology of lemurs within the Park. While our results confirm previous findings of tremendous interannual variation in both climate and phenological patterns reported by shorter-term studies at this site, the larger database also yields several trends not previously confirmed, including that average temperatures at the site have increased 2% over the past 25 years, and that rainfall patterns have become increasingly unpredictable and appear to be linked decreased predictability of fruit and leaf production. Given their reliance on young leaves and fruits/seeds, these findings provide a cautionary note as we consider the future of lemur populations in Ranomafana in light of ongoing temperature increases.

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Male participation in between-group conflicts in wild vervet monkeys: Testing the mate defence, hired guns and nepotism hypotheses

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Although male participation in between-group encounters is thought to function primarily as mate defence, other explanations for this behaviour warrant investigation. Males may also act as "hired guns" and defend food resources on behalf of females to indirectly increase their own reproductive success. Alternatively, males may participate in between-group encounters to

protect potential offspring, or to improve their reputation and increase their access to mates in the future. We employed both observational and experimental approaches to study male participation in between-group conflicts in a wild population of vervet monkeys (*Chlorocebus aethiops pygerythrus*). We examined the temporal variability exhibited by males' participation in observed encounters to test if males were more likely to defend access to mates, food resources, or potential offspring. We further tested the hired guns hypothesis by combining playback experiments with food provisioning boxes from which males were excluded. After training the adults in three groups to understand female access and male exclusion, we tested whether males were more likely to approach simulated intruders when females had access to high-quality resources than they were when no food was provided. Lastly, we investigated the importance of audience effects during the playback experiments to determine potential effects of social context (e.g. the presence of vulnerable offspring, active cooperators or female observers) on male participation.

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Teeth filing in Surabayan Javanese and Balinese: A change of tradition

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Teeth filing has been done as a tradition in Bali and Java for a long time, to signify the rite of passage. It was called "Gusaran" in West Java, "Pangur" in central and east Java, and "Mesangih" in Bali. The practice in Bali was to symbolize the elimination of 6 wicked desires on the maturing individual. The practised filed the incisors and the canines. This study analysed 31 skulls from Java and Bali, and 70 Javanese and Balinese Surabayan respondents, whether they practised teeth filing. Among 31 skulls observed, 23 of them exhibited teeth filing. The study found that none of 30 Javanese practised teeth filing. Among the 20 respondents of Balinese origins, 16 of them asked the "Pedanda" to file their teeth just to observe the tradition without actual filing. However the researcher found that teeth filing were done to the respondents to some degree of abrasion. Three of the respondents practised "symbolized teeth filing". One of the respondent—a 42 years old—underwent a more severe teeth filing, although the filing did not reach the dentin region. Modern Surabayan Balinese origins still observed teeth filing tradition for the coming of age, but they were aware of the problems of teeth filing so that they asked the "Pedanda" to restrain from filing too much of their teeth. However, some "Pedandas" seemed to believe that beside being the symbol of eliminating 6 wicked desires, filing teeth was important for esthetical reason, so that they filed the teeth to some degree anyway.

The use of 3D GM methods to investigate sexual dimorphism in human foramen magnum shape: A preliminary analysis

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The foramen magnum (FM) has increasingly gained attention as a potential adult human sex indicator in the literature. Previous work indicates the FM is a relatively poor sex indicator, where maximum sex estimation accuracy for adults ranges between 70-80% using FM length and breadth measurements, or FM area (inaccurately describing the FM as perfectly circular). However, no quantitative studies have investigated foramen magnum shape as a potential sex indicator; FM shape may more accurately estimate sex than simple linear measurements or areas. This study tested whether 35 adult, white crania (17 F, 18 M) from William M. Bass Collection (Knoxville, TN) could be accurately sexed on the basis of FM shape. Three-dimensional surface scans were applied with sliding semilandmark curves (8-32 landmarks total) along the FM perimeter. Principal Components Analysis (PCA) of FM shape showed some separation between M and F specimens, but with substantial overlap (PC1 = 25.2% total shape variation). Interestingly, analyses using fewer semilandmarks showed clearer separation between M and F, suggesting that while general FM shape exhibits much overlap between the sexes, only a subset of these points are biologically informative with regard to sex. Discriminant Function Analysis (DFA) cross-validated M and F specimens with 62.8% accuracy. Results of this preliminary analysis indicate that FM shape in not an accurate sex indicator, although sample sizes used were small. Further analyses will test these hypotheses using larger sample sizes in recent adults and subadults of European and African ancestry.

An examination of modern human cranial variation using frontal bone morphometrics

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Throughout his distinguished career, Alan Mann has consistently emphasized the importance of understanding modern human biological and behavioral variation, making him an anthropologist in the truest sense of the word. Through his teaching, research and public outreach over the past forty years he has encouraged an examination of our current patterns of diversity in order to have a meaningful interpretive framework for evaluating the range of variation observed in our past. In this study, the frontal bone morphology of 349 modern humans from 10 populations was analyzed using Elliptical Fourier Analysis. Harmonic amplitudes and baseline-perimeter distances were examined to determine the pattern by which modern human groups vary in frontal bone traits. The results demonstrate that for the most part, this is not a useful cranial region for assessing population affinity due to the significant overlap in the majority of features among most human groups. However, three populations were consistently distinct: South African Khoi-San were outliers in their overall morphology as well as their frontal subtense height; Tierra del Fuegians and Aboriginal Australians were significantly different from most populations in their glabella morphology; and the latter two sample groups were

significantly different from the Khoi-San in most analyses. This suggests that frontal bone morphology is distinct in historically isolated populations but is generally not useful in assessing population affinity. These results should be taken into consideration in studies that use the frontal bone to assess population affinity, particularly in forensic settings. The utility of such an approach is highly questionable.

The patchwork pelvis: Evolution and variation in human pelvic size and shape

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Investigations by many researchers have revealed patterns of constraint and variation in the morphology of the human pelvis. These studies demonstrate that the shape of the pelvic cavity varies independently from overall size of the pelvis; however, there are diverse relationships among the dimensions of the lesser pelvis, and with the size of the individual. While we have established the *patterns* of variation, the *processes* and evolutionary factors driving those are only starting to be understood. Given the multiple factors that are thought to affect the pelvis—which include obstetrics, locomotion, and thermoregulation—creating clear models for the evolutionary effects of these factors is fundamental for future research.

This study works toward establishing these models, using skeletal data from the global Goldman Data Set, in addition to data from over 2500 indigenous North and South American skeletons. Study of pelvic dimensions among ten of the indigenous North American groups showed that variation in pelvic canal shape did not correlate with latitude, that wide bi-iliac breadths are a retained (and ancient) trait in these populations, and that younger females have anteroposteriorly narrower pelvic outlets and narrower pelvic inlets mediolaterally. Furthermore, using MCMC to assess models of variation in pelvic breadth globally against microsatellite data—and thus neutral population structure—there is a strong implication that genetic drift alone did not shape these wide breadths. Together, these results indicate dissimilar evolutionary forces shape the pelvis, but more work with larger samples are necessary to determine the roles of factors in those forces.

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Mycobacterium tuberculosis in prehistoric California: A review of evidence and paleoepidemiological comparisons of impacted and related populations

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Most prehistoric evidence for *Mycobacterium tuberculosis* infection has derived from the eastern United States and a few southwestern localities. Recently, we documented tuberculosis in a prehistoric West Coast population. Besides this geographic difference, the population inhabiting this locality (CA-CCO-138) differs by having a hunter-gatherer economy. Five new cases of tuberculosis from CA-CCO-138 have now been identified. We describe these affected individuals and present results of a paleoepidemiological analysis of this and associated localities.

We evaluated disease processes in 793 individuals from CA-CCO-138, a Late Horizon site (≈700-1500 AD). For diagnostic purposes we also medical CT-scanned and reconstructed a nearly complete juvenile skeleton using Amira. Data on the incidence of tuberculosis and related diseases in prehistoric California were compiled from a database of 2,570 pathological skeletons (PHMA, UC Berkeley), and 175 potential tuberculosis cases were examined. In addition to the statewide assessment of tuberculosis, we established paleoepidemiological profiles for CA-CCO-138 and geographically and culturally similar prehistoric mound populations.

We determined that only the CA-CCO-138 locality preserves evidence of tuberculosis in prehistoric California. Further, the disease profile for CA-CCO-138 is otherwise unremarkable, being essentially identical to the other large mound populations examined. A probable autoimmune-induced joint disease (rheumatoid-like) is associated in high frequency with tuberculosis cases, and morphological overlap in expression is described. We discuss a physiological link between these two pathological conditions that may account for the unusually extreme expression of joint disease and the presence in this hunter-gatherer population of tuberculosis.

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Intergenerational changes in linear growth among adult Maya mothers and daughters from the city of Merida, Mexico

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Historically, the Maya from the Yucatan have lived under very unfavourable socioeconomic conditions. The effect of this adverse environment is evident on the growth and nutritional status of the Maya. The purpose of this poster is to analyse the differences in linear growth between adult Maya mothers (n = 109) and their daughters (n = 109) from the city of Merida, Mexico, measured in 2012. Because of lower body segments are less reduced with age, leg length (LL= height – sitting height), z-score of LL and knee height (KH) were compared between generations. Z-score values for LL were

calculated using the references published by Frisancho (2008). On average, the mothers' age was 59.00 (SD=8.41) years and the daughters' age was 32.75 (SD=5.67) years. Mothers and daughters exhibited very low heights (143.08 cm [SD=4.77] and 147.91 cm [SD=4.84], respectively). Daughters showed significant longer LL (68.52 [SD=3.64] vs. 67.23 [SD=3.06], p<0.05) and KH (45.67 [SD=2.01] vs. 44.54 [SD=1.88], p<0.05) than mothers. Z-score values for LL were also significantly lower in mothers (-2.04, SD=0.76) than in daughters (-1.70, SD=0.86) and 69% and 59% of them were classified as leg stunted respectively. The results suggest: 1) the persistence of adverse ecological conditions during growing periods along the two generations of women and, 2) Maya daughters show slightly better growth status than their mothers although the intergenerational differences are possibly lacking of biological significance, given the fact that they are 1.29 cm for LL and 1.13 cm for KH.

Late Pleistocene modern humans east of Zhoukoudian Upper Cave? Morphometric perspectives of hominin fossils from Ryonggok Cave (Democratic People's Republic of Korea)

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Ryonggok Cave, located near Pyongyang (Democratic People's Republic of Korea), is one of the most important Late Pleistocene localities east of Zhoukoudian Upper Cave. The remains of at least five hominins were identified in the deposits including two relatively intact crania (#3 and #7), several mandibles, and an array of postcranial fossils. Our study attempted to determine whether the Ryonggok hominin crania most closely align with *Homo heidelbergensis*/archaic *H. sapiens*, *H. neanderthalensis*, modern *H. sapiens*, or a yet to be identified hominin species in the region. Comparative non-metric, linear metric, and 3D geometric morphometric (GM) data were collected on a series of modern human crania from Chosun Dynasty (1392-1897 A.D.) cemeteries in the Republic of Korea, and other modern human groups (e.g., Chinese, Japanese, German, Nigerian) and hominin fossil casts (e.g., *Homo heidelbergensis*, *H. neanderthalensis*, Upper Paleolithic modern humans) stored in the American Museum of Natural History. Comparative data were also culled from published sources. The linear metric and 3D GM data were subjected to univariate, principal components analysis, and canonical variates analysis. Results indicate that the Ryonggok hominins, although most closely aligning with modern *H. sapiens*, retain some archaic features. Because the initial uranium series date places the deposits between 50-40 ka, the Ryonggok hominins may be among the earliest modern humans in eastern Asia (penecontemporaneous with the Tianyudong human). This has implications for the various models that are

currently being debated regarding the nature and timing of Late Pleistocene human migration(s) into eastern Asia.

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The effect of caloric restriction on the rate and severity of age-related spinal osteoarthritis

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Caloric (or dietary) restriction has been shown to decrease the rate of senescence and increase maximum life span in several species, but how caloric restriction impacts age-related degenerative processes, such as osteoarthritis, is unclear. Unlike most species but like humans, Rhesus macaques develop spontaneous osteoarthritis with age and they have been studied under caloric restriction protocols for almost two decades. Given this opportunity, we hypothesized that calorically restricted macaques would develop less spinal osteoarthritis with age than monkeys fed a normal diet.

We assessed osteoarthritis in the thoracolumbar spine of macaques from dietary/caloric restriction studies at the Wisconsin National Primate Research Center (WNPRC) and the National Institute on Aging (NIA). Using an Atlas grading scheme, we assessed osteophytosis (OST) and disc space narrowing (DSN) from annual radiographs of 68 macaques from the WNPRC (males, n=41 (20 restricted); females, n=27 (13 restricted)) and 104 macaques from NIA (males, n=52 (26 restricted); females, n=52 (22 restricted)) studies. Animals varied in the numbers of annual radiographs available: n=322 for the WNPRC and n=680 for the NIA samples.

After adjustment for repeated measures, positive association between age and both OST (p<0.001) and DSN (p<0.001) was found for monkeys from both sites, but no difference was found between normally fed and restricted animals (WNPRC: OST p=0.222, DSN p=0.574; NIA: OST p=0.238, DSN p=0.386) when sex and body mass were included in the analysis.

Caloric/dietary restriction does not affect spinal osteoarthritis, which perhaps implicates loading as a contributor to the etiology of osteoarthritis.

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Population density survey of *Pygathrix cinerea* (the grey-shanked douc langur) in the An Toàn Nature Reserve, Vietnam

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The grey-shanked douc langur, *Pygathrix cinerea*, is currently classified as Critically Endangered by the IUCN and is also listed on The World's Twenty-Five Most Endangered Primates. These classifications are due to the fact that there are less than 700 individuals of this species remaining. This study presents preliminary data on the population density of this species in the An Toàn Nature Reserve in Vietnam. An Toàn is located in Bình Định province which is positioned along the central coast of Vietnam and was only recently established. The reserve is located at high altitudes (600m – 1000m) and the mountainous terrain is extremely rugged. Throughout June and July of 2013 a total of 36 transects were conducted in the reserve. Each transect was 100 meters in length and visibility limited the width to 20 meters. Over the course of this study, only one group of nine langurs were observed and the group contained one infant. This results in a density of one langur per 8 km². Despite the heavy fragmentation throughout the reserve no difference in population density was observed between forest edges and primary central locations. The extremely low population density and single sighting of *Pygathrix cinerea*, especially in a protected forest, underscores the necessity of further research and the need to promote conservation action to ensure the survival of this species.

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Taxonomic differences in deciduous upper second molar crown outlines of *H. sapiens*, *H. neanderthalensis*, and *H. erectus*

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A number of Middle to Late Pleistocene sites contain only, or primarily, deciduous teeth. While many studies of the fossil hominin deciduous dentition have focused on standard metrical variation, non-metric and morphometric variation also promise to shed light on long-standing taxonomic questions. This study examines the taxonomic significance of the crown outline of the deciduous upper second molar (dm²) through principal components and linear discriminant analyses. We test whether the crown shape of the dm² separates *Homo neanderthalensis* from *H. sapiens* and explore whether it can be used to correctly assign individuals to taxa. This study builds on previous work by focusing on the crown rather than cervical outline and by including a large sample of geographically diverse recent human populations. Our recent human sample includes 80 individuals representing Asia, Africa, Europe and the Americas. Our fossil samples include 17

H. neanderthalensis, 5 early *H. sapiens*, and 11 Upper Paleolithic *H. sapiens* individuals. In addition, we include two *H. erectus* specimens in order to evaluate the polarity of observed crown shape differences. Our results show that crown outline shape of the dm² distinguishes *H. sapiens* and *H. neanderthalensis* quite well, but does not discriminate *H. erectus* from *H. sapiens*. We conclude that the squarer crown shape of *H. sapiens* is a primitive retention and that the skewed shape of *H. neanderthalensis* is a derived condition. Finally, the strong similarity between the Tighenif dm² and that of *H. sapiens* tentatively suggests some dental continuity within Africa back to 700,000 years BP.

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Using clinical evidence to infer lived experiences of individuals with leprosy in the past

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Leprosy, a disease associated with social stigma, was once widespread and is still endemic in Brazil, India, Nepal, Madagascar, and much of sub-Saharan Africa. Although cured readily today with multidrug therapy, individuals who contracted leprosy in the past or are untreated in the present suffer not only from skin lesions but involvement of the peripheral nerves and, in the most severe multibacillary form, progressive pathology that involves the skeleton and impairs normal function on multiple levels. Because leprosy has received considerable clinical attention, the course of untreated disease is well documented. Skeletal pathology can, thus, be linked to specific soft tissue sequelae to reconstruct impairment (reduction of normal function) that developed as the disease progressed in a given individual. The degree of debility (weakening) and impairment among living individuals described clinically can then be used to reconstruct the extent to which an individual in the past was affected. The duration and disease progression can then be inferred.

Skeletal pathology in an adult female from 15th-century Cyprus and other published cases illustrates the correspondence of specific lesions and their clinically documented effects, including rhinomaxillary involvement associated with obstructed breathing and periodontal disease, hand and foot alterations related to loss of feeling and paralysis, and periosteal reaction on lower legs linked to foot ulcerations. Such impairment, however, may not correspond directly with socially constructed views of disability or with social stigma historically associated with leprosy. Instead, these aspects of disease are variable across time and space and require careful contextualization.

Dental evolution: Patterns of sequence evolution within the primate lineage suggestive of positive selection on genes involved in tooth growth and morphology

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Recognizing the genetic substitutions underlying phenotypic modifications is a fundamental goal of evolutionary biology. However, the task of assigning a genotype to a phenotype is difficult because genes function within a complex network of cofactors, transcription factors, signal receptors, epigenetic forces, and other regulatory elements. As a result, there are a large number of genes, both purported and confirmed, involved in various stages of dental development. Fossil evidence indicates trends in the hominin lineage toward thicker enamel, and first an increase and later a decrease in the size of the dentition and jaw. In the present work we used a comparative genomics approach to examine the molecular evolution of 48 genes known to be involved in tooth growth and morphology searching for evidence of positive selection in the primate lineage. To investigate the evolution of these genes we examined multiple sequence alignments from 10 primate species and 4 outgroups. The results imply strong purifying selection acted on the majority of this gene-set throughout primate evolution. Patterns of sequence evolution are suggestive of positive selection on *CDKN1A* in marmosets and on 4 genes in macaques: *DLX2*, *FGF3*, *GLI1*, *SMO*, and within the family Hominidae it is consistent with evidence of positive selection in relation to 3 genes, *CDKN1A*, *FGF3*, and *SP6*. These results encourage us to pursue a more detailed investigation using covarion-like codon models to estimate gene-specific rates of switching between selective regimes, and attempt to link these molecular dynamics to evolutionary trends in tooth morphology within the hominin clade. *A GWU Presidential Merit Fellowship funded this study.*

Different diversity measures tell different primate community assembly stories

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Primate community composition has been explained by three separate processes: (1) niche-based (deterministic), (2) dispersal limitation and environmental stochasticity (stochastic), and (3) biogeographic dispersal barriers (biogeographic). Patterns in community variation are usually documented using taxonomic diversity measures, including between community beta diversity (β). However, communities can also be described functionally by the ecologically important traits they possess (functional diversity (FD)). Using FD across taxonomic groups can provide insights into how environmental factors shape diversity, and may indicate the operation of different

assembly processes. FD analyses are particularly relevant where phylogenetic and ecological similarity are not strongly correlated, such as for the primates of Madagascar. Using occurrence and trait data of non-volant mammals from 34 sites in Madagascar, I calculated both β and FD metrics for each community. I then compared the detected contribution of deterministic, stochastic, and biogeographic processes to community diversity measures using principle coordinates of neighbor matrices and variation partitioning. β is best explained by deterministic and stochastic processes, significantly explaining 9% and 8% of the variation in β , respectively. By contrast, FD is only explained significantly by deterministic processes, accounting for 17% of the variation in FD. These results support the conjecture that different diversity measures can be explained by different processes. Since trait analyses are common in paleoanthropology, these methods allow for the study of community assembly in the past and present, and can help predict changes in the future. The study of community assembly is critical to understanding the evolution of communities, and their conservation.

Early human dispersal from Africa: A model-based test of two hypotheses

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It is unclear whether early modern humans left Africa through a major migration process, dispersing simultaneously over Asia and Europe, or in two main waves, first through the Arab peninsula into Southern Asia, and later through a Southern route crossing Palestine into Western Asia and Europe. We collected genomic data on twenty populations and developed explicit geographic models of the demographic expansions, finding good correlations between geographic and genetic distances, but only insignificant differences between models involving single or multiple dispersals. Because such an uncertainty probably reflects the interplay between population splits and contacts, we used a newly developed method to incorporate both phenomena in the population tree. We thus found evidence for several admixture events, mostly involving Central Asian populations. Once presumably admixed populations were excluded from the analysis, we estimated clearly different divergence times from Africa for Asians and Europeans. A good correlation emerged between linkage disequilibrium estimates and geographic distances from Africa, but only when geographic distances were calculated according to a Multiple Dispersal model. These results have important implications for the debate on the possible interbreeding between anatomically modern and archaic human forms in the Pleistocene. *Supported by an Italian Ministry for Research and Universities (MIUR) PRIN 2008 grant and, in part, by the European Research Council ERC-2011-ADG_20110406 grant (Langelin).*

Paleoenvironments of the Hadar and Shungura Formations: Synthesizing multiple lines of evidence using bovid ecomorphology

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This study reconstructs past environments of the Hadar and Shungura Formations (Plio-Pleistocene, Ethiopia) using two semi-independent lines of evidence: mesowear of bovid molar teeth and locomotor ecomorphology of bovid astragali. These elements are among the most frequently preserved fossils, and therefore provide a robust statistical sample for inferring dietary and locomotor adaptations of past bovid communities.

Astragalar morphology is functionally related to habitat-specific modes of predator avoidance. Bovids occupying structurally distinct habitat types differ in their astragalar anatomy, and these differences are significant after controlling for body size and phylogenetic signal (Barr, 2013 Ecomorphology of the bovid astragalus: body size, function, phylogeny and paleoenvironmental reconstruction. *American Journal of Physical Anthropology Supp 56: 74*). 86 astragali from Hadar and 241 astragali from Shungura were analyzed. Habitats were predicted using measurements previously shown to relate to habitat preference.

Mesowear was conducted on upper 1st and 2nd molars following published protocols for scoring cusp height and shape. Mesowear is a predictor of diet, differentiating between abrasion-dominated grazers with low-blunt cusps and attrition-dominated browsers with high-sharp cusps. 193 upper molars from Hadar and 292 upper molars from Shungura were analyzed.

Results indicate a mosaic of habitats through time in both formations. Astragali from several submembers of both formations were classified to both extremes of the habitat continuum (Open and Forested). Similarly, mesowear scores suggest that grazing, browsing, and mixed-feeding bovids were present in varying proportions throughout both sequences. The degree to which this represents true habitat mosaicism versus temporal/spatial averaging is discussed.

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Using the parallel laser method to estimate body size in wild mantled howler monkeys (*Alouatta palliata*)

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The parallel laser method of remote measuring has recently been used to estimate body size in terrestrial primates and tail length in arboreal primates. We expand on these studies and use the method to estimate body length and limb length in an arboreal primate. The parallel laser device consists of two parallel lasers a set distance apart mounted to a camera. The lasers provide a scale in each photograph that can be used to calculate various body measurements. We piloted this method in a group of wild mantled howler monkeys (*Alouatta palliata*) on Ometepe,

Nicaragua during July-August 2013. We took photographs of adult males, adult females, juveniles, and infants. We then used ImageJ software to calculate various body measurements including crown to rump, base of skull to rump, and limb length. We calculated the mean and ranges of each measurement for each age-sex class. We also calculated and compared both the inter-measurer error as well as the error in measurements between multiple photographs of the same individual. The inter-measurer error (3.6%) was lower than the inter-photo error (10.5%). The latter increased when either the monkey or lasers were in different positions in different photos. Our results provide information on the ideal circumstances in which to photograph individuals, which will inform the future use of this method in arboreal primates. Both types of error are minimized when subjects are suspended from a branch by their tails and the lasers are located on a tree trunk within one meter of the subject.

Vocal survey of white-handed gibbons (*Hylobates lar*) in the Huai Kha Khaeng Wildlife Sanctuary, Western Thailand

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Due to the worldwide acceleration of habitat loss, in the future primates will be increasingly confined to disturbed or otherwise suboptimal habitat throughout their range. Consequently, there is a growing need to understand the impact of suboptimal habitat on primate population density. Toward this end we conducted vocal surveys of gibbons in the Huai Kha Khaeng (HKK) Wildlife Sanctuary in Thailand from February 2012 – August 2013. The habitat in HKK is comprised of bamboo, dry dipterocarp, mixed deciduous, and dry evergreen forest. We established 62 listening posts along main roads and trails throughout the sanctuary and at each location recorded the dominant habitat type. Over 3-5 days per post we recorded the total number of great calls detected and estimated the number of distinct groups heard per day. The average number of detections/day differed across forest types [$F(3,58)=3.69$, $p=0.016$] as did the number of groups/post [$F(3,58)=3.39$, $p=0.023$]. Tukey post-hoc comparisons indicate that the number of detections ($p<0.01$) and the number of groups ($p<0.01$) were greater in evergreen than in bamboo forest, but no other comparisons were significant. These findings are consistent with our expectation that forest quality influences gibbon population density; however, there were no significant differences between other forest types, despite presumed differences in resource density. We suspect that this is because the habitat type surrounding the listening post does not accurately reflect habitat availability across the full listening area. Future analysis will make use of satellite imagery to more accurately quantify habitat quality within each listening area.

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Comparison of decomposition rates between autopsied and non-autopsied human remains in Central Texas

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Numerous researchers have conducted studies of human decomposition in various environments, but they seldom, if ever, separate autopsied and non-autopsied remains when performing analyses. Therefore, it is necessary to test if the rate of decomposition varies between autopsied and non-autopsied bodies in the same environment. This study compares the decomposition rates between autopsied and non-autopsied human remains in an outdoor central Texas environment in order to determine if using both types of remains in research protocols results in statistical skewness. The sample consists of 59 non-autopsied and 24 autopsied remains donated to the Forensic Anthropology Center at Texas State (FACTS) from 2010-2013. All remains were placed on the ground surface unclothed and in a supine position. The day each set of remains reached early, advanced, and mummified decomposition stages was recorded, and the number of accumulated degree-days between each stage was determined. T-tests show that there is no statistically significant difference between the decomposition rates of autopsied and non-autopsied remains at any stage of decomposition. No statistical skewness results from including autopsied and non-autopsied remains in human decomposition studies in this central Texas environment. Therefore, it is unnecessary to separate these two types of remains when studying human decomposition in the area.

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Differential gene and protein expression in the human and chimpanzee brain: A comparison using high-throughput techniques

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Gene expression has become the standard to explore the brain from a molecular perspective.

Advancements in technology now allow for the identification and quantification of large numbers of proteins, which provides a closer approximation of phenotype than mRNA expression levels. However, the extent to which the expression of gene-coding regions is indicative of the downstream expression level of a protein product is unknown, particularly with regard to regional specificity in the brain.

Here, we performed high-throughput genomic (RNA sequencing) and proteomic (liquid chromatography coupled with tandem mass spectrometry) methods on samples of the anterior cingulate cortex (ACC) and caudate nucleus (CN) from 3 humans and 3 chimpanzees (*Pan troglodytes*). We hypothesized increased protein expression in humans relative to chimpanzees to support enhanced neuronal transmission. We identified 522 genes with protein expression in humans relative to chimpanzees to support enhanced neuronal transmission. We identified 522 genes with protein products. In each region and species, the median variance was greater in genes than proteins ($p<0.001$), and the shape of the distributions of variance were different (Kolmogorov-Smirnov, $p<0.001$). We found an extremely low correlation between overall gene and protein expression (OLS $\beta=0.14-0.17$, $R^2=0.03-0.04$ for both regions and species). However, several functional categories of genes and proteins exhibited higher correlations, including those involved in protein synthesis and modification ($\beta=0.50-0.65$, $R^2>0.60$ for both regions and species), and oxidative metabolism ($\beta=0.40-0.80$, $R^2>0.45$ human ACC, CN), potentially supporting neuronal structural complexity and synaptic transmission. Our results highlight the importance of studying comparative molecular biology at the protein level and identify candidate genes for further exploration of differential genetic regulatory control between humans and chimpanzees.

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Hemoglobin concentration does not explain significant variation in fertility and child survivorship of post-reproductive Tibetan women residing at high altitudes in Nepal

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Tibetans have lived at altitudes above 3000m (~10,000') for at least 10,000 years and presently have distinctive biological traits including relatively low levels of hemoglobin compared with other highland populations. Variants at SNP sites in the *EPAS1* locus associate with hemoglobin concentration among Tibetans and occur at uniquely high frequency. The likely mechanism for this high frequency is higher fertility and child survival among women with the low-hemoglobin alleles. It is not clear whether hemoglobin concentration is the phenotype under selection. This report tests the hypothesis that lower hemoglobin concentration associates with higher fertility or child survival.

The sample consists of 605 Tibetan women 40+ Tibetan years of age living at 2985 – 4052m altitude in Gorkha and Mustang Districts, Nepal. All were continuously married during their most fertile years from 25 to 40. Fertility histories

were collected by interview and hemoglobin concentration was measured noninvasively (Masimo Pronto-7™).

The average western age was 55 + 10.5 (SD) years, number of pregnancies was 6.5 + 2.9 (SD). The average hemoglobin concentration was 13.9 + 1.47 gm/dl (n=566). Hemoglobin concentration did not increase with altitude; it increased slightly with age ($r=0.085$, $p = 0.04$). It did not associate with number of pregnancies, living children, infant deaths, or prenatal deaths when age at marriage and age were also considered. These findings suggest that either hemoglobin concentration may not be under selection presently or that control over additional direct and indirect socioeconomic factors influencing fertility is required to detect an association.

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Age and sex related cortical bone loss in two Imperial Roman skeletal populations: Exploring the interplay between gender, social status and the life course

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This poster compares age- and sex-related patterns of cortical bone loss, assessed by metacarpal radiogrammetry from two Roman skeletal samples, Velia (1st and 2nd centuries AD) and Isola Sacra (1st to 3rd centuries AD). Patterns of bone loss at Isola Sacra have been reported previously, but not using radiogrammetry. The purpose of this research was to expand the available data for bone loss at Isola Sacra, and also to examine how differing patterns of activity and diet between the two populations contributed to patterns of bone maintenance and loss. It was hypothesized, based on previous work, that patterns of age and sex-related bone loss in the Isola Sacra sample (N = 85) would mirror those reported in modern populations and thus show significant sex differences with age. The Velia sample (N = 70) has previously been shown to not have sex differences with age, although significant age-related changes with the metacarpal index were noted. As hypothesized, the Isola Sacra sample shows significant differences in the quantity of cortical bone between three age groups (18-29 yrs., 30-49 yrs., 50+ yrs.) for both sexes, as well as significant sex differences in the metacarpal cortical index in the 30-49 and 50+ age groups. While Velia and Isola Sacra are similar in many respects, the results of this research suggest important social differences may have contributed to the observed sex differences. We emphasize the possible biocultural and gender-related factors over the life course that may have contributed to the patterns of bone maintenance.

Full sequence dating of South African early hominins units based on new cercopithecoid chronological markers

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Opportunities to assess the age of South African Plio-Pleistocene sites by absolute radiochronological methods are limited by the nature of the cave deposits and the complex related stratigraphy. Although faunal dating has certain limitations, biostratigraphic comparisons carefully performed at regional scale still represent one of the most reliable methods for temporal seriation of the South African paleocaves. Given the high density of their remains and their stratigraphical co-occurrence with hominin remains, cercopithecoids are among the best candidates as temporal biomarkers for dating such paleontological sites.

Our sample investigated so far consists of cranial specimens representing eleven fossil papionin and colobine taxa from different stratigraphic units at Sterkfontein, Swartkrans, Kromdraai and Makapansgat, and a representative sample of seven extant cercopithecoid species. The fossil remains (n>100) were detailed by X-ray microCT at the South African Nuclear Energy Corporation (Necsa). A number of craniodental features describing the endocranium, the middle/inner ear cavity, the inner facial morphology, and tooth endostructural organization have been virtually extracted in both fossil and extant specimens and comparatively assessed by methods of geometric morphometrics (original deformation-based models) and phylogenetic analysis, among other methods.

Besides providing new quantitative evidence for clarifying the still debated taxonomic and phylogenetic status of some South African fossil cercopithecoids, our results assess for the first time the variability of the geometry and dimensions of the bony labyrinth, of the enamel-dentine junction, of tooth tissue proportions (including enamel thickness topographic variation) which, together with the occurrence of the maxillary sinuses, behave as efficient taxon-related chronological markers.

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Intrasite variability in subadult burial during the Iberian Copper Age

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Subadult burials during European late prehistory have the potential to shed light on

issues of ancient demography, identity formation, social organization and lived experience in the past. However, they remain relatively under-explored in the literature. Here, I focus on the case of Marroquies Bajos, a 113 hectare Copper Age enclosure site in Andalusia that was salvage-excavated in advance of urban expansion of the city of Jaén during the last two decades. The internal organization of the site, with a series of concentric ditches as well as an adobe wall around the fifth ditch, is evidence for the investment of a great amount of communal labor in site construction and maintenance. Importantly, excavations of Marroquies Bajos have revealed seven discrete mortuary areas, including individual or communal burial in subterranean domes, tombs located in artificial caves, and inhumation in the concentric ditches themselves. Here, I compare the proportion, categorical age and formal treatment of subadults from Necropolis 3 and Communal Burial 5 to my recent investigation of an additional two necropolises from the site. My bioarchaeological analysis of Necropolis 1 and Necropolis 2 provides a more extensive formal, spatial and temporal backdrop against which to examine variation in the treatment of subadults at the site. Results suggest significant intrasite variability in the form and practice of subadult burial in Copper Age Iberia. This variability has important implications for social organization and the construction of community identity at large-scale centers during the Chalcolithic in southern Spain.

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Isotopic analysis of diet among Archaic (10,000-2,000BP) and Early Ceramic (2000-1500BP) prehistoric groups in North-Central Chile

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Archaic archaeological sites (10,000-2,000 BP) in Chile's Semi-arid North are characterized by the presence of hunter-gatherers groups that focused mostly on coastal resources. Due to climatic changes, local groups intensified their exploitation of marine and plant resources towards the Late Archaic (4000-2000 BP). This initial manipulation of plants would culminate with their domestication during the Early Ceramic period (2000-1500 BP). In fact, the presence of mortars and grinders at Early Ceramic sites, suggests that the diet of these groups was supplemented with cultigens such as maize and quinoa, although it was still composed mostly of marine resources. To date, most of the evidence used to reconstruct the diet of these groups is indirect, and their interpretation is informed by a cultural-evolution model that interprets change as the result of a continuous and successful adaptive process. By using isotopic analysis, the goal of this study is to

reconstruct the dietary variability of these groups in space and time. To date we have analyzed 27 individuals from Archaic and the Early Ceramic period. During the early ceramic period collagen stable isotope ratios range from -12.2 to -19.6‰ $\delta^{13}C$ and 6.5 to 10.9‰ $\delta^{15}N$ while apatite carbon ranged from -13.8 to -4‰ $\delta^{13}C$. The results show that groups from the Early Ceramic period did not have a C3 enriched diet.

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Cervical lordosis and the orientation of the foramen magnum, implications to human evolution

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As a critical intersection of the respiratory, locomotor, neural and masticatory systems, the cranial base provides an insight into the evolution of the human head. Due to the complexity of the structures, technical and taphonomical difficulties very few authors have explored the relationship between cranial base morphology and cervical spine posture.

The objectives of this study are to explore the relationship between the foramen magnum orientation in the sagittal plane and the cervical lordosis, and to develop a model for reconstructing cervical lordosis in extinct hominins.

A total of 76 lateral cervical radiographs of healthy adults aged 20 to 50 years, were examined. On each radiograph the following angles were measured: The angle between the foramen magnum (FM) and the horizontal plane; The angle between the foramen magnum and the palatine plane; Total Cervical lordosis between the foramen magnum and C7; Upper cervical lordosis between FM - C3; And lower cervical lordosis between C3 - C7.

The orientation of the foramen magnum correlates positively with all cervical lordosis measurements. It shows moderate to high correlation to the total cervical lordosis and to the upper cervical lordosis, and weak correlation with the lower cervical lordosis.

With the assumption that these finds in modern humans apply to all bipedal hominins, the reconstruction of the cervical lordosis of extinct hominin based on their cranial base morphology seems feasible. The posterior orientation of the foramen magnum in australopithecines suggests small cervical lordosis.

Do physical anthropology students have an edge for reasoning about human evolution? Comparisons with biology students

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Inclusion of human evolution in biology curricula at all levels of education has been gaining advocates in the United States. Yet the

learning, teaching and assessment of evolution remain challenging. If students' knowledge representations are situated within the context of their learning, then learning evolutionary theory in the context of human evolution could result in different reasoning patterns about evolutionary change. Nonetheless, research on understanding of evolution has focused on biology students, who primarily learn about non-human evolution. Previous literature suggests students who learn evolutionary theory within the context of humans should perform better on assessment items of human context. Undergraduate students from introductory biology (n=223) and physical anthropology (n=152) courses participated in an online survey comprised of a multiple-choice test on natural selection, a written-response test with either human or non-human items, and a test to measure evolution 'acceptance.' All students tended to have higher levels of acceptance measures if they scored well on the multiple-choice test (Biology Pearson's $r=0.31$; physical anthropology $r = 0.37$; $p<0.001$). Biology students used a greater number of key concepts (t-test $p=0.0136$) and fewer misconceptions (t-test $p=0.0136$) for non-human taxa items compared to human taxa items. Physical anthropology students had similar reasoning patterns for both human and non-human taxa items. These results suggest that learning evolution in the context of humans provides students with a more generalized reasoning model for evolutionary change, while learning evolution primarily in a non-human context does not, lending further support for including human evolution in all evolution curricula.

Another look at the Ngorora hominoids

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Much has been made of the dearth of evidence of hominids in Africa between 13.5 and 10 Ma. Perhaps they were absent, with the African ape and human clade originating in Eurasia and dispersing later into Africa. Or, it may be that ancestral hominids remain to be discovered in the vast, unexplored regions of Africa. Ngorora is a rich paleontological locality from Kenya dated between about 12.7 to 12.2 Ma. It is the only African hominoid locality intermediate in age between *Kenyapithecus* at Fort Ternan (13.5 Ma) and the late Miocene *Chororapithecus* (10.5 Ma) and *Nakalipithecus* (10 Ma) localities in Ethiopia and Kenya, respectively. The Ngorora sample includes two isolated hominoid teeth with unclear affinities. A third hominoid specimen from Ngorora, a nearly complete intermediate phalanx, has recently come to light. The phalanx, KNM-BN 2094, is hominoid, with characters associated with arboreal positional behavior. It is an intermediate phalanx probably from a hand, with moderately developed fibrous flexor sheath ridges. Asymmetry of the ridges suggests an attribution to rays two or five. The shaft is robust, flat and curved, and more closely resembles the phalanges of late Miocene apes than those of *Proconsul*. More fossils are needed to determine if the hominoids from Ngorora are derived relative to *Proconsul* or if the more derived-appearing attributes of the phalanx and molar are parallelisms. The hypothesis of a Eurasian origin of the hominids will certainly be

tested if the presence of a stem hominid in Africa before 12 Ma can be confirmed.

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Hurricanes and coastlines: The role of natural disasters in the distribution of Central American *Alouatta* species

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Currently, *Alouatta palliata* ranges through most of Central America, where its sister species *A. pigra* is restricted to a small range on the Yucatan peninsula. The reason for this separation is not well understood and may be because *A. palliata* outcompeted *A. pigra* in most of Central America. It also may be that some environmental features of *A. pigra*'s range made it unsuitable for colonization by *A. palliata*. While all of Central America is frequently hit by hurricanes, most cross the northern part of the region subjecting animals in that area to more stochastic conditions that may require different behavioural and demographic strategies for survival. This paper looks for evidence of different levels of environmental stochasticity faced by *A. pigra* and *A. palliata* by comparing the frequency of storms making landfall in each species' range and at interspecific differences in group size and energy constraining behaviours, both of which are associated with living in stochastic environments. We found that *A. pigra* live in significantly smaller groups than *A. palliata* and exhibit more energy conserving behaviours, which may be a result of the significantly higher storm to coastline ratio of *A. pigra* (0.132) than *A. palliata* (0.0292) ($\chi^2=12.36$, $df = 1$, $p=0.0004$). While not the only factor behind the range separation of these species, we argue that the role of hurricane activity cannot be ignored as a possible explanation for the current distribution of these two species.

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In bonobos and chimpanzees age-related changes in urinary thyroid hormones indicate heterochrony in their development

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Primates have a slow life history and the emergence of specific developmental stages may vary even between closely related species. In this study, we investigate age related patterns of

thyroid hormone levels in bonobos and chimpanzees. For this purpose, total T3 (TT3) was measured in urine samples of individuals ranging between 1 and 56 years of age using a commercial competitive total triiodothyronine ELISA kit. In both species immature individuals had higher TT3 values than adults. However, chimpanzees experienced a significant decline in urinary TT3 values several years earlier than bonobos. In chimpanzees, the decline of TT3 appears to coincide with the time when somatic growth terminates while TT3 values in bonobos decrease long after termination of somatic growth is assumed. The temporal asymmetry in urinary TT3 values suggests heterochrony in the ontogeny of the two sister species and the prolongation of high TT3 levels in bonobos which is characteristic of immatures of both Pan species is another example for this species to retain juvenile traits into adulthood. Unlike those developmental studies that are based on post-mortem analyses of skeletons, measures of urinary thyroid hormones offer a non-invasive tool for exploring ontogenetic changes in living wild and captive hominoids.

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What's grit got to do with it: An analysis of grit accumulation in the canopy of a fragmented forest of Madagascar?

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Dental microwear analysis focuses on the microscopic traces, such as pits and scratches, on the occlusal surfaces of teeth resulting from the processing of food items. These traces result not just from the intrinsic composition of the foods and the processing methods, but also the amount of grit on the surface of food items. As little research has been conducted on the accumulation of grit within a canopy and its effects on primate dentition, it remains largely unknown (1) what proportion of dental microwear is due to grit, and (2) the magnitude of variation in grit, and its effects, across and within populations. We quantified the amount of grit on leaf surfaces at Tsinoarivo, eastern Madagascar by collecting the grit directly from off the surfaces of leaves onto pieces of tape. We sampled leaves on a well-traversed path, with paired sampling locations adjacent to the trail and 25 meters off-trail. At each site leaves were sampled at four heights (0, 1, 4, and 7 meters). Levels of grit were expected to be higher on leaves closer to the ground and on leaves that were on the main trail. Preliminary results show higher grit accumulation adjacent to the trail with no differences detected among heights. This research can aid in explaining dental microwear patterns on the teeth of living lemurs based on the height and location of feeding in the canopy, suggesting that habitat fragmentation may have accelerated rates of dental microwear, and help contextualize dietary reconstructions of extinct lemurs.

When, where and why did Old World monkeys evolve?

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The earliest fossil record for the clade containing Old World monkeys has long proved elusive, with the oldest cercopithecoids described from Neogene sites on continental Africa north of the equator. These include the early Miocene *Zaltanpithecus* and *Prohylobates* from northern Africa, and *Noropithecus* and *Victoriapithecus* from the early and middle Miocene respectively of eastern Africa. The recent discovery of *Nsungwepithecus* from the Rukwa Rift Basin of southwestern Tanzania extends the clade into the Oligocene (~25 Ma), and expands geographic sampling south of the equator. Comparisons among these taxa help to refine ideas about potential factors influencing the emergence of Cercopithecoidea.

Prohylobates was the first recognized stem cercopithecoid, but was until recently represented by highly abraded specimens. *Zaltanpithecus* is the largest bodied form. *Noropithecus* is the most diverse, represented by up to three species that exhibit somewhat more mesio-distally elongate molars. With over 2500 specimens, *Victoriapithecus* is the youngest and best sampled form. The recently described *Nsungwepithecus* represents the oldest known stem cercopithecoid. Like the other early cercopithecoids, it lacks cingulids and exhibits deep buccal clefts, with molar flare and cusp placement resembling those of *Noropithecus* and *Victoriapithecus*. Notably, *Nsungwepithecus* exhibits substantial elaborations around the entoconid, yet it lacks a complete distal lophid on M3 (also absent in *Prohylobates*). This suggests that complete bilophodonty may not have been the primary adaptive feature defining the earliest phases of Old World monkey evolution. Indeed, bilophodonty appears not to have been perfected until 10-12 mya, with the appearance of true colobines and cercopithecines.

A genetic history of indigenous American mitochondrial DNA lineages of the Caribbean

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Knowledge about Caribbean peoples prior to European contact is generally limited to the archeological record, and more recently, genetic data. These lines of evidence help address questions about their origins and migrations within the Caribbean basin. Additionally, post-

contact ethno-historical data provide some idea about the ethnic and cultural diversity of the Caribbean's first peoples. Despite these data, there are not extensive records regarding the way in which indigenous Caribbean women shaped the contemporary region. In the current study, we examine published and novel indigenous Caribbean mitochondrial lineages to gauge the scope and distribution of the maternal genetic diversity present in the region. Using summary statistics and principle components analysis, we assessed these data for general levels of diversity and used them to examine genetic relationships both within and between the Caribbean and circum-Caribbean regions. Although most Native American mtDNA lineages were present, haplogroups A2 and C1 predominated. Furthermore, we noted differences in the mitotypes found in the Greater and the Lesser Antilles, with many of them being unique to their respective region. Finally, the Caribbean lineages did not show a dominant affinity to one specific circum-Caribbean region. In addition to supporting a general South American origin of indigenous Caribbean women, our findings suggest that genetic variation within these populations may be the result of multiple migration events coupled with the effects of genetic drift. Our focus on the maternal histories of indigenous Caribbean peoples adds to the body of knowledge of Caribbean history and highlights understudied populations.

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Hybrid zone genomics: The structure of a baboon contact zone inferred from RAD tags

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Interspecific hybridization is now believed to affect many primate lineages, including our own. The significance and specifics of admixture's effects on the genome are less clear, however. Genomic mosaicism, the result of recent introgression, necessitates the use of large numbers of loci to characterize thoroughly the genetic structure of hybrid zones, especially those between closely related species. The expansion of inexpensive genotyping via massively parallel sequencing methods to non-model organisms now allows fine scale exploration of admixture in wild populations, such as in the well-studied hybrid zone between *Papio anubis* and *P. hamadryas* in Ethiopia. To characterize the genetic structure of this hybrid zone, we sequenced approximately 43,000 random loci from hybrid and phenotypically pure individuals sampled between 1982 and 2000, using double-digest RAD sequencing. For each individual, an average of 25.8 Mb (million bp) was sequenced, with 7.5 Mb and 2.9 Mb sequenced to at least 5x and 10x coverage, respectively. From the tens of thousands of

variants discovered and genotyped, we inferred ancestry, both overall and within sliding blocks along the chromosome, and correlated the estimates with morphological, endocrinological, and behavioral data collected in previous studies. This and other such analyses of wild primate hybrid zones using multilocus data promise to increase our understanding of hybridization, a widespread evolutionary phenomenon that has shaped our genome.

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Predictors of foraging behavior in white-faced capuchins (*Cebus capucinus*)

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There are several hypotheses about the foraging goals of non-human primates. While some researchers posit that energy maximization is the focus of foraging behavior, others theorize that specific resource characteristics such as nutritional components are targeted or avoided. We aimed to determine which resource characteristics of fruits eaten by white-faced capuchins predicted foraging selectivity. We collected 12 months of behavioral data between February 2007 and August 2008 on four free-ranging capuchin groups. We calculated a selectivity score based on the number of times a group entered a fruit tree relative to the abundance of the tree species. To assess nutritional composition of fruits we measured gross energy (cal/g) and macro-nutrient content of 37 commonly-consumed fruit species. We also calculated tree diameter at breast height (DBH) as a measure of monkey carrying capacity. We used multiple regression analysis to test if DBH and gross energy significantly predicted selectivity. These two predictors explained 80.5% of the variance in selectivity ($R^2 = 0.805$, $F(2,34) = 0.173$, $p < 0.0005$). Results indicate that while both variables make statistically significant contributions to the model, the capacity of a resource to support most or all of a group ($\beta = 0.846$, $p < 0.0005$) may be more important than gross energy ($\beta = 0.210$, $p < 0.01$). Future analyses will expand upon these results to look more closely at capuchin preferences for specific macro-nutrients. We will also investigate additional social and ecological variables affecting the ability of capuchins to optimize energetic payoff per unit time.

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Overimitation in the Aka and Ngandu of the Congo Basin

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In western experimental settings, when a series of both causally relevant and irrelevant actions was demonstrated to children, the children persistently copied irrelevant actions even when instructed not to do so. This phenomenon, termed overimitation, was claimed to be an innate, universal response in early childhood. Here, we present contrary evidence from a group of Aka hunter-gatherers and associated Ngandu agriculturalists in the Congo Basin rainforest of the Central African Republic. We hypothesized that, due to the foundational egalitarianism of traditional hunter-gatherer cultures, there should be significantly less overimitation in Aka children than in Ngandu or western children. Using an apparatus consisting of a transparent box with an opaque chamber holding a reward, an adult model demonstrated four irrelevant actions and two relevant actions to three test groups: Aka children ($n = 28$), Aka adults ($n = 14$), and Ngandu children ($n = 28$). Results of this study were striking in that 56% of Aka hunter-gatherer children completely ignored irrelevant actions and copied only relevant demonstrated actions, as opposed to 23% of Ngandu children, 10% of Aka adults, and less than 10% of western children. This analysis not only shows that Aka and Ngandu children do not overimitate to the same degree as western children, but that Aka adults do overimitate, suggesting that some elements of learning are not fixed cross-culturally at any stage of development. This emphasizes the need to consider the cognitive mechanisms and cultural traits underpinning differences in human social learning, teaching, imitation, and behavior.

Walter Neves: His contribution for a better understanding of human cranial diversity in prehistoric Brazil

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The association of specific geographic human groups with particular cranial morphologies to provide a better understanding of the prehistoric population dynamics in a given region can be traced back to the early work developed in the field of Physical Anthropology. Regardless of the typological nature of these first studies, further developments made the study of cranial morphology one of the most important and popular areas in Physical Anthropology. In Brazil, this field was relegated to a secondary position until the mid-1980s. Up to that time, studies on cranial morphology were restricted to the use of both small sample sizes and univariate statistical techniques. Walter Neves was the person responsible for changing this scenario, through the introduction of new methodological approaches in the study of the morphological diversity of prehistoric skulls. In this paper, we aim to discuss these novelties introduced in the Brazilian Physical Anthropology by Neves and how they influenced the many generations of Physical Anthropologists he supervised.

To every thing there is a season: Breast milk, infant growth, and birth seasonality in rural Gambia

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Maternal health and physiology during milk production, as well during maternal early life, may influence concentrations of bioactive factors in milk that orchestrate infant growth and development and carry potential long-term effects on infant metabolism. In addition to showing postnatal growth patterns typical of infants in the developing world (low birth weight followed by modest catch-up and stunting), the growth of infants in rural Gambia is further modulated by season of the year. Specifically, poor growth is typical during the wet, or 'hungry' season when diarrheal and other infections are more prevalent; this is also the season of highest maternal workload and disease burden. We investigate how this seasonality, experienced across generations, affects cues present in mother's milk and how these in turn influence infant growth trajectories. We used 712 milk samples from 178 rural Gambian mothers, whose infants were born across wet and dry seasons. We analyzed milk collected at months 3, 4, 5 and 6 of lactation from each mother, along with matched anthropometrics from their infants. We measured adiponectin, epidermal growth factor, epidermal growth factor receptor, leptin, and transforming growth factor- β_2 in the skim fraction of milk using enzyme immunoassay. Our results show that 1) all measured bioactives are identified as significant components of models constructed to explain variation in infant growth in both weight and length, and 2) both maternal and infant birth season exert significant effects on variation in milk bioactives. These results inform our thinking on how local ecology affects growth across generations.

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Were Neandertal humeri adapted for spear thrusting or throwing? A finite element analysis study

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An ongoing debate concerning Neandertal ecology is whether or not they utilized long range weaponry. The anteroposteriorly expanded cross-section of Neandertal humeri have led some to argue that their humeri were adapted to thrust hunting weapons, while the rounder cross-section of Late Upper Paleolithic humeri suggests modern humans threw their weapons. We test the hypothesis that Neandertal humeri

were built to resist strains engendered by thrusting rather than throwing, using finite element models of one Neandertal humerus and three recent modern human humeri, representing a range of cross-sectional shapes. Electromyography, kinematic data and articulated skeletons were used to determine muscle loads and directions applied to the models at three positions during throwing and thrusting cycles. Maximum von Mises strains (VMS) at the 35% and 50% cross-sections were determined. During throwing, maximum VMS produced by the Neandertal humerus fell within or below those produced by the modern human humeri, while during thrusting maximum VMS in the Neandertal humerus fell within or above those produced by the modern human humeri. The Neandertal humerus performed as well or better than the modern human humeri during throwing and just as well or worse than the modern human humeri during thrusting. We also did not find any correlation between maximum VMS and biomechanical metrics used to measure humeral adaptation in throwing and thrusting (retroversion angle, I_{max}/I_{min} , J). These results failed to support the hypothesis that the shape of Neandertal humeri reflects thrusting loads, and suggest they were capable of using long distance weaponry.

Putting the pelvis in its place: Distinguishing the ‘phenomenon’ of locomotion from the mechanisms that produce it

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To understand locomotion in a flying or swimming animal, it is necessary to understand how the organism interacts with the fluid dynamics of its environment in terms of lift, drag, thrust and weight. Likewise, for terrestrial organisms using legs to move across a substrate, it is first necessary to understand how the organism integrates with the solid dynamics of its environment. This involves the interaction of masses, the mass of the organism and its components and the mass of the world on which it moves. We contend that a limited number of effective strategies exist for that interaction, and these strategies we regard as the ‘phenomenon’ of locomotion – what the organism is attempting to accomplish. Most of what can be directly observed, however, are the mechanisms responsible for implementing the strategy. Those mechanisms, composed of the anatomical components and their actions, such as the form and motion of the pelvis, can only properly be interpreted within the context of the phenomenon of locomotion. We describe the main movement strategies available to upright bipedal locomotion and evaluate the role the pelvis can play in implementing these strategies.

Association between blood telomere length in young adults and longitudinally-assessed adiposity and diet among a Filipino population

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Excess energy intake is associated with increased morbidity and mortality while moderate caloric restriction purportedly prolongs lifespan. Little is known, however about how under- and over-nutrition during critical years of growth and development may influence aging and disease processes.

Telomere length (TL), nucleotide sequences protecting eukaryotic chromosome ends from degradation, is considered a biomarker of aging and is associated with disease and mortality risk. The attrition of telomeres in somatic cells may be accelerated by oxidative stress and inflammation induced by metabolic stressors. Previous studies on nutritional status and TL among younger populations have produced inconsistent results. Most are cross-sectional, comparing TL between obese and non-obese children from relatively well-nourished populations.

We examined the association between longitudinally-assessed adiposity (using the average of five BMI z-score estimates between ages 8.4 and 22.4) and TL at 20.7-22.4 years old among a sample of relatively lean Filipino males and non-pregnant females (n=1,328). Contrary to our hypothesis, there was no evidence of a linear or curvilinear association between average BMI z-score and TL for either males or females (p-values>0.22). This lack of association might be due to the effects of caloric intake on aging not being observable until later in life, or this population might not have enough excess caloric intake to allow the detection of such an association. Analyses of associations between TL and other measures of adiposity and diet are ongoing and will be discussed as potential factors contributing to variation in aging and disease processes across individuals and populations.

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A bioarchaeological study of childhood mortality in 17th century Transylvania

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A growing area of research in bioarchaeological scholarship involves the analyses of juvenile skeletal remains. Recent book length treatments of the bioarchaeology of children confirm this trend and have sparked renewed interest in assemblages that have been oftentimes overlooked by biological anthropologists.

In this presentation, we present findings related to a recently excavated 17th century Reform Church located in the village of Telekfalva, Romania. After salvage excavations were conducted in 2007, remains of 70 well-preserved individuals were accessioned into the Haaz Rezo Museum located in the city of Odorheiu Secuiesc, Romania. In this presentation, we describe our initial findings related to the analysis of this mortuary context, including the notable result that 69 of the individuals were juveniles. Age-at-death estimates derived from the London Atlas, long bone lengths, and/or ossification of skeletal elements indicated that 50.0% of the juvenile assemblage was assigned to the perinatal age cohort (38-40 weeks) and 21.0% of the assemblage was allocated a fetal age cohort (<36 weeks). The remaining juvenile individuals were all aged between birth to 10 years. A single elderly adult female was documented.

We synthesize the skeletal data to interpret the role of this Reform Church as sacred burial space in 17th century Transylvania. Moreover, given the large number of perinatal and fetal individuals, we utilize this assemblage to discuss maternal health, pregnancy, midwifery, and infant mortality during the late Middle Ages from a bioarchaeological perspective.

Evidence for a substantial effect of neutral microevolutionary processes in shaping human pelvic variation at a global scale

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Human pelvic shape variation has often been interpreted in the light of thermoregulatory adaptation and sex-related obstetrical requirements. Although selective factors are likely to play a role in shaping human pelvic variation, their effect cannot be fully understood without first taking into consideration the influence of past population history and neutral evolutionary processes. Neutral demographic processes have been shown to have a substantial effect on cranial variation, and a similar effect can be hypothesized for other skeletal regions. Here, we use a global dataset of human pelvic variation (1,494 individuals), quantified using 3D geometric morphometric methods, to represent the complex shape of the os coxae in both male and female individuals. Neutrality of pelvic variation was examined with different approaches: 1) by evaluating global patterns of apportionment of variance; 2) by testing for the presence of a signature of the Out-of-Africa expansion and related serial founder events; 3) by fitting an “isolation-by-distance” model of

increasing morphological differences between populations with increasing geographic distance (i.e. mirroring the pattern of increasing neutral genetic distance with decreasing geographically-mediated gene flow). Our results reveal an overall neutrality of pelvic variation, and the preservation of population history effects. Although our analyses do not contradict the effect of selective pressures and adaptation on the human pelvis, they do highlight a strong neutral component to variation, similar to that previously found for cranial morphology.

Pastoralism, agriculture, and stress: A comparative analysis of two 19th century Qing Dynasty populations

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In order to improve anthropological understandings of mobile pastoralism as a strategy for the exploitation of marginal environments, this study tests the hypothesis that a mobile, diffuse, animal-product dependent population is less likely to experience elevated physiological stress loads than a comparatively sedentary, aggregated, agriculture-dependent population. Three indicators of subadult systemic stress (porotic hyperostosis, cribra orbitalia, and linear enamel hypoplasia) were assessed in skeletal samples of two historic 19th century populations from the Qing Empire (AD 1644 – 1912) of Imperial China. Samples include crania from a mobile and relatively diffuse pastoralist population from Urga, Mongolia (n=40) and crania from a group of southern Chinese laborers (n=40) interred in Karluk, Alaska who represent a sedentary and highly aggregated agriculture-dependent population. The presence, location, and severity of porotic hyperostosis, cribra orbitalia, and linear enamel hypoplasia were assessed macroscopically. Results show that both porotic hyperostosis and linear enamel hypoplasia were significantly more frequent in the agriculturalist Karluk sample than in the pastoralist Urga sample; cribra orbitalia had equivalent frequencies (13-15%). Porotic hyperostosis frequency differences were moderate (15%) but significant, while differences in linear enamel hypoplasia frequency (33%) and severity were more substantial. These results support the conclusion that mobility, population density, and diet have a significant effect on stress loads in these settings and that there are generally lower physiological costs associated with a pastoral rather than agricultural lifestyle.

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A morphometric approach to characterizing heterogeneity in cranial modification in the South-Central Peruvian Highlands

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An enduring debate in Andean bioarchaeology concerns the nature and meaning of intentional cranial vault modification (CVM). Traditionally, crania were characterized based on the modification technique used (boards or circumferential bindings) and the angle of the back of the head (erect or oblique). However, broad categories obscure the variability of head-shape within each group. Here, we attempt to characterize CVM variation quantitatively using 3D geometric morphometric techniques. Variation in CVM may speak to a type of ascribed identity that, in the Peruvian Andahuaylas region ca. AD 1150–1250, was associated with hardships including violence and disease.

Eighty well-contextualized crania with and without CVM excavated at the Andahuaylan Chanka polity site of Cachi were assessed for patterns of variation. The crania were scanned, and 12-18 landmarks were collected on 3D images to capture various aspects of cranial vault shape. The crania were then aligned using Generalized Procrustes Analysis, and Principal Components analyses were subsequently employed to highlight meaningful differences across crania for different landmark sets. Along the X-axis there are changes to the degree in which the frontal and occipital are elongated and angled. Along the Y-axis the degree of flexion changes, confirming the variation of shape found from the compression of the frontal and occipital from binding. The continuum of variation among CVM crania along the principal components axes suggests a large amount of heterogeneity in circumferential CVM and points to a moderately standardized practice; head shape may signal a lineage-based or “ethnic-like” social identity.

Fission-Fusion in chimpanzees: Feeding as a proximal mechanism at Gombe

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Pan troglodytes has a fission-fusion system of social organization. There are many explanations for the variation in party size, particularly feeding competition: The more individuals present and feeding, the greater the competition for food, therefore when food is scarce, party sizes should drop. Most studies have found correlations between chimpanzee party size, however defined, and proxy measures of feeding competition. We asked if transitions to and from feeding bouts influence a chimpanzee's number of companions. We compared the number of companions at the beginning and end of feeding bouts (n=558) and number of companions 30 minutes before and after feeding bouts (n=69). Data were extracted from Travel and Group charts collected at the Gombe Stream Research Centre in 1973. Focal subjects were 10 independently-ranging males of the Kasekela community. We hypothesized that party sizes are smaller during bouts of feeding than before or after feeding, based on presumed feeding competition. Males fed with fewer companions than they had a half-hour before the next bout of feeding and a half-hour after finishing feeding. Moreover, on average, males had more

companions at the end of a feeding bout than at its beginning. Number of companions before versus after feeding did not differ. The hypothesis was supported: Feeding chimpanzees were in smaller parties than in non-feeding parties. Increase in party size during feeding may indicate recruitment or random but cumulative discovery of the food source by others.

Genomic reconstruction of Neandertal brain structure and function

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There are many hypotheses regarding intellectual and behavioral differences that enabled anatomically modern humans (AMH) to outcompete Neandertals when their ranges overlapped, including enhanced language capacity, social intelligence, and tool use. Neandertals likely had an advantage in visual acuity. Testing these hypotheses is difficult without biological data from living Neandertals; however, the sequencing of multiple Neandertals opens up the possibility of reconstructing Neandertal phenotypes (or phenotypic trends relative to AMH) based on the effects of “Neandertal alleles” present at low frequency in modern human populations. We develop a statistical genomic-based framework for making such phenotypic inferences.

Whole genome sequence, MRI brain images and cognitive measures from 383 participants in the Genetics of Brain Structure (GOBS) study were used to identify Neandertal-specific rare sequence variants associated with volumetric variation in regions of the brain associated with language, vision, social intelligence, and motor skills. 56,294 variants monomorphic in the three Vindja Neandertal samples and polymorphic in the GOBS sample were included in variance components-based association analysis implemented in SOLAR. Broadly, language- and motor-skills related regions of the brain show enlargement associated with the human alleles while vision-related regions show expansion related to Neandertal variants. Results for social intelligence are mixed. We further develop a general method for estimating phenotypic Neandertal trends from genomic data using best linear unbiased prediction and high-dimensional imaging data to predict major features of Neandertal brain structure. Our results suggest Neandertal sequence can be used with genomic and phenotypic data from modern humans to infer Neandertal phenotypic features.

Novel object exploration in wild vervet monkeys

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Individual differences in responses to novel objects have been studied intensively in captive vervet monkeys. These differences are consistent over time and have a strong genetic basis. However, little is known about the functional significance and ultimate causes of individual variation in novelty seeking in vervet monkeys. In order to study the ecology of novelty seeking in natural populations, valid tests for measuring the trait need to be developed for use in a field setting. A key criterion of test validity is repeatability: appropriate tests will measure behavioral responses that are repeatable across time and contexts. I tested for repeatability of behavioral responses to different novel objects, using both group-based and individual-based approaches, in two groups of wild vervet monkeys in South Africa. For each test, I recorded time spent visually inspecting the object from within 1m and all sniffing, touching, handling and biting of objects. I assessed repeatability of composite novel object exploration scores for all adult and subadult individuals that participated in tests. Exploration scores were significantly repeatable across individual- and group-based tests, as well as across all tests combined. The repeatability estimates in this study are smaller than those for novel object responses in captive vervets, but similar to repeatability estimates for this trait in studies of other wild primates. As has been found in studies of captive vervets and other primates, age was a significant predictor of novel object exploration, with subadults having higher exploration scores than adults.

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A role for host-bacteria interactions in shaping patterns of genetic variation across human populations

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The composition of bacteria in and on the human body varies widely across human individuals, and has been associated with multiple health conditions. Although host genetic factors are expected to control the human microbiome through the immune system and metabolic pathways, elucidation of the genetic influence on microbiome composition has proven to be a challenge. Here, we present a genome-wide association study aimed at identifying human genetic variation associated

with microbial diversity in multiple body sites. By mining the shotgun metagenomic data from the Human Microbiome Project for host DNA reads, we gathered information on host genetic variation for 93 individuals for whom bacterial abundance data are also available. Using a two-stage discovery and validation approach, we identified 26 candidate human genes that are associated with microbiome composition in 15 host body sites. These genes are significantly enriched in immunity functional categories, and form an interaction network highly enriched with immunity-related functions. To investigate the evolutionary history of bacteria-associated host genes, we used available sequencing data from the 1000 Genomes Project, and find that these genes show a significant excess of highly differentiated allele frequencies among human populations. Moreover, these genes are over-represented with genes that have been identified in recent genome scans for positive selection and balancing selection. Combined, these results highlight the role of host immunity in determining bacteria levels across the body, and underline a possible role for the microbiome in driving the evolution of bacteria-associated host genes.

Mosaic habitats and refugia in the Plio-Pleistocene Omo-Turkana Basin, Ethiopia and Kenya

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Research on the environmental context of human evolution in eastern Africa has demonstrated that hominin habitats were varied and complex during the Plio-Pleistocene, and researchers have postulated that environmental heterogeneity played an important role in shaping hominin adaptations. One of the richest and best-studied records of hominin habitats in Africa derives from the lower Omo Valley (Ethiopia) and the Turkana Basin (Kenya). Most of the faunal record from the Omo-Turkana region is captured in a growing network of databases currently including nearly 63,000 records of fossil mammals from the Mursi, Usno, Shungura, Koobi I, Nachukui, Kanapoi, and Nawata formations. This faunal record along with other lines of contextual evidence (e.g., stable isotopes) provides a rich picture of environmental variability within the region, and of important environmental changes over time. Analyses of fossil mammal abundance in different parts of the basin indicate that the lower Omo Valley remained consistently more wooded and wetter than other parts of the basin during much of the Plio-Pleistocene, and that it provided an ecological refuge for mammal species requiring wetter conditions. These interpretations are strengthened by stable isotope data from paleosols and tooth enamel published during the last few years. Faunal abundance and association data also indicate that although hominins were present across diverse mosaic habitats in the Omo-Turkana Basin, they thrived in habitats that were intermediate within the wet-dry spectrum of options. These results are relevant to our understanding of Plio-Pleistocene hominin adaptations and ranging patterns.

Caring for a chronically ill offspring affects maternal behavior and reproduction in a wild female chimpanzee (*Pan troglodytes schweinfurthii*)

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Simian immunodeficiency virus (SIVcpz) affects approximately 12% of the Kasekela community at Gombe National Park, Tanzania. Individual responses to infection vary from years of apparent good health to rapid emaciation and death. Furthermore, infected individuals may indirectly alter the behavior of close relatives by limiting daily activities, potentially depressing their reproductive success. Urine pregnancy tests revealed two failed conceptions in an uninfected female (Eliza) from January – July, 2013. During this time, Eliza was caring for an SIV-infected juvenile son: Eric was markedly slow and weak and suffered from gastrointestinal worms. Based on observations of Eliza, we hypothesized that Eric's condition inhibited her foraging efficiency, delayed her movement, and impeded her ability to engage in social behavior. We compared Eliza's activity budget and diet to those of 4 other mothers of juvenile offspring during the same period (May – August, 2013). Eliza consumed pith, a low-quality resource, over three times more frequently (19.9% versus 6.1% of feeding time). She rested during a greater proportion of the day (29.3% versus 20.2%) as she waited for Eric to finish extended feeding bouts or catch up during travel. We frequently observed Eliza staying behind with Eric as the group moved away; as a result, she spent less time with other adults (18.2% versus 25.7%). Eliza's poor diet and restricted activity may have contributed to two lost pregnancies, demonstrating how SIVcpz can act beyond its immediate host to threaten not only health, but lifetime reproductive success as well.

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How do we know that so many suffered from leprosy? A comparison of the pathological and the epidemiological approaches to estimating leprosy frequency in Medieval Denmark

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Paleopathologically, Medieval leprosy is described as a relatively rare disease. Epidemiological research has indicated that leprosy was much more widespread. More than 40 leprosariums were established in Denmark during the 13th century. By 1550 leprosy had ceased to be a major public health problem and the leprosarium went out of use. This poster sets out to estimate the frequency of leprosy in the city of Odense using data about burials in the leprosarium.

In Odense the leprosarium was established in the 1270s. The cemetery of the leprosarium was excavated totally in 1980 yielding evidence of some 2500 mostly adult burials. Analyses of the burial custom showed that more than 90% of the

burials were made before 1350. This means that around 40% of all burials of adults in the city of Odense between the 1270s and 1350 were made in the cemetery of the leprosarium. Based on an epidemiological analysis, virtually all the skeletons came from people who suffered from leprosy; based on a pathological analysis more than half of the skeletons came from people with leprosy.

Consequently, more than 20 % of the people of Odense died with leprosy between 1270 and 1350. This means that leprosy was an extremely common disease and that the epidemiological estimate of the frequency of leprosy are much more accurate than those based on pure pathological analyses.

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Identity marker or medicinal treatment? An exploration of the practice and purpose of dental ablation in ancient Nubia

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Dental ablation, as both a social and physical experience, is performed for many reasons. This practice has a long history in Sudan, though its implementation and significance appear to vary through time. Ablation is portrayed as a male rite of passage in Neolithic Sudan and in ethnographic and clinical literature; however, this pattern is not found in Meroitic (c. 350 BC-AD 350) to Christian (c. AD 550-1400) period samples. In this study, 409 Meroitic individuals from the Second Cataract Semna South site were examined using a previously developed system for the differential diagnosis of ablation. Thirty (7.3%) individuals, 17 of 164 (10.3%) males and 13 of 168 (7.7%) females, show dental ablation. Of these, 18 of 30 (60%) exhibit ablation of one to four mandibular incisors and 14 of 30 (40%) exhibit ablation of both mandibular and maxillary incisors. A previous study of 96 late Meroitic through Christian period individuals from the Fourth Cataract Ginefab School site revealed similar frequencies of mandibular ablation. Chi-Squared Tests confirmed there is no statistically significant sex bias in instance or pattern of ablation in either sample.

The social correlates of ablation are often prioritized in study, resulting in neglect of consideration of biological implications. These results suggest ablation may have been a form of medicinal practice in this period, possibly in prevention and treatment of febrile illness and lockjaw. This study demonstrates that both the social and biological significance of ablation should be investigated as temporally fluid, elucidating the evolving function of cultural practices.

Ancient DNA from Early to Mid-Holocene Burials in Northwestern Argentina: Implications for understanding the colonization and early populations of South America

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Archaeological evidence demonstrates that humans have been living in South America since the late Pleistocene. However, relatively little is known about the genetic diversity present in early hunter-gatherer populations on this continent, and few studies have examined ancient DNA from Pleistocene or early to mid-Holocene human remains from South America. Many questions therefore remain about the early populations of this continent and the routes of migration that were used by some of the earliest settlers.

In this study, we extracted DNA from the remains of 13 individuals unearthed at early and mid-Holocene archaeological sites in northwestern Argentina. The remains come from four locations in the Antofagasta de la Sierra region, in the southern Argentine Puna, and they date between ca. 9500-3330 cal BP. We identified mitochondrial DNA (mtDNA) haplogroups based on coding-region SNPs, and sequenced 372 base pairs of the first hypervariable region of the mtDNA to confirm haplogroup assignments and define mtDNA haplotypes. All results were confirmed through multiple independent DNA extractions and PCR amplifications. We compared the genetic lineages in these individuals with those in other ancient and contemporary populations from the Americas to help elucidate the genetic affinities between the prehistoric inhabitants of the Puna and peoples in other regions. We found that one of the most common mtDNA lineages in these ancient Argentinians was haplogroup D4h3a, which is rare in indigenous Americans today but most common along the Pacific coast. Our results shed light on the early populations and routes of migration in South America.

Anti-predator vocalization usage in the male ring-tailed lemur (*Lemur catta*)

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The ring-tailed lemur (*Lemur catta*) is a group-living strepsirrhine primate endemic to Madagascar that faces considerable predation pressure from aerial and terrestrial predators. This species engages in mobbing and vigilance behavior in response to predators, and has referential alarm vocalizations. Although *L. catta* is female-dominant, males may also engage in anti-predator behavior. This study tests two hypotheses for male anti-predator vocalization behavior on wild *L. catta* at Beza Mahafaly Special Reserve in Madagascar. To test the predator confusion hypothesis, we collected focal data on males, and predicted that when a male made an alarm call, one or more group members would also make the same vocalization. To test the mobbing hypothesis, we

played wolf (*Canis lupus*) howls and control playbacks to five *L. catta* groups, and predicted that lemurs would make alarm calls following wolf playbacks, but not following controls. We found support for both hypotheses. When a male *L. catta* made an anti-predator call, one or more group members made the same vocalization more often than expected by chance (binomial tests: $p < 0.05$). Males as well as females from all five *L. catta* groups made alarm calls following wolf howls, but not following control playbacks (Wilcoxon: $p < 0.05$). Some groups responded more strongly to playbacks, which may reflect differential predation pressures. Our results show that *L. catta* males participate in group-level anti-predator vocalization usage. Although females are known to hold the primary role in group defense, *L. catta* males also participate in behavior that may confuse or drive away predators.

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Growing up gibbon

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A sample of 45 (23 female, 22 male) immature, wild collected white-handed gibbons (*Hylobates lar*) were assessed for body mass, trunk height, limb lengths, bone fusions and cranial capacities and compared with 92 adults (42 female, 50 male) wild-collected during the A.P.E. 1937 expedition. Schultz's 1944 monograph highlights age changes in this population, but new dental aging techniques and long term behavioral research allow a reassessment of anatomical growth within a chronological and behavioral framework. The immatures were categorized into 4 age classes by molar eruption sequences and proximal humeral fusion. Results highlight individual features by age class: age class 1 infants (~4-21 months) have intermembral indices of 127.2, close to the adult averages of 130.8; by the end of age class 2 (before M2 eruption), individuals reach about 50% of adult body mass and over 75% trunk height. By age class 4 (M3 eruption, ~6.1 yrs), sub-adult gibbons have all of their permanent teeth; body growth is incomplete and sex differences appear. Sub-adult males are significantly different from adult males at 90% their trunk height and average 88.6% the body mass of adults. Sub-adult females are 97% the trunk height of adults and 93.1% adult body mass, not significantly different than adults. The extended juvenility up to 10.0 yrs of wild female gibbons suggests that they may spend almost 4 years as sub-adults before reproducing.

Implications of vertebral degenerative disease and vertebral ligamentous ossification in native populations of the Lower Tennessee River Valley

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Cervical vertebrae are an effective data source for understanding physical activities of a populace due to the osteological reactivity of nuchal muscle use to extensive weight and pressure. Differentiation in the distribution of osteophytosis (OPL), osteoarthritis (OA), and ossification of the ligamentum flavum (OLF) along the cervical vertebrae may indicate particular load-bearing stresses and/or behavioral differences between subsistence strategies.

A collection of 287 pre-Columbian Native American individuals (N = 854 vertebrae) was analyzed for presence and severity of OPL, OA and OLF. The sample consists of remains from six archaeological sites located in the lower Tennessee River Valley: three sites (Cherry, Eva and Kays Landing) from the Archaic period (~2500-1000 BC) that reflect an intensive hunter-gatherer subsistence strategy; and three sites (Link, Slayden and Thompson Village) from the Mississippian period (~AD 1000-1200) that reflect an agriculturalist subsistence economy. Multivariate statistical analysis was employed to compare the 167 individuals viable for OPL analysis and 103 individuals viable for OLF analysis to determine frequency and distribution. Granted that degenerative changes are ultimately phenomena related to age and body size and are etiologically multifactorial, the results of this study, in conjunction with previous paleopathological studies of the rotator cuff, suggest a strong patterned co-association between reactive changes on the cervical spine and particular repetitive load-bearing movements (e.g., head balancing, forehead and chest level tump line use, weight bearing by the arms) and subsistence economy.

The standard Procrustes analyses may be inappropriate for applications to variation at large geometric scale

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For phylogenies varying greatly at the largest geometric scales, the geometric morphometric (GMM) shape coordinates produced by the conventional "generalized" Procrustes analysis (GPA) may be less appropriate than a different set of Procrustes shape coordinates taking phylogeny into account much more explicitly. Howells, Oxnard, and others have argued that any concordance between shape similarity and phylogeny should concern only aspects of shape that are uninformative about functional morphology; but large-scale shape features of animals often have obvious functional implications. For the mammals as a clade, Marcus et al. (2000) claimed that the standard GMM coordinates of skull form over 53 mammal genera conveyed hardly any information about phylogeny. We reanalyzed the midline forms of a slightly larger sample of their specimens, covering a considerable diversity of 13-gons, not by GPA but by a substantially different algorithm that takes into account not only the now-conventional phylogenetic correlations but also empirical anisotropies of the shape coordinates, the a-priori curvatures of Kendall shape space, and the Oxnard-Howells concern. Using one good contemporary phylogeny we find a substantial phylogenetic

signal within an arguably nonfunctional subspace of midline skull shape over these mammals. The new method is based on shape distances, Brownian models over divergence time, and the approximation of functional indices by linearized shape factors. Reanalyses along these lines might constructively reopen the old argument about the role of quantitative morphology in systematics studies. For studies of clades showing substantial variation at the largest geometric scales, biometric progress may depend on replacing GPA.

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Ecological correlates of diet and social structure in the greater bamboo lemur (*Prolemur simus*)

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It has been argued that the unpredictable climate of Madagascar and high energetic cost of reproduction have favored female dominance in the Malagasy lemurs; however, this strategy varies in effectiveness depending on the distribution and seasonality of a species' preferred food source. Bamboo lemurs are unique among primates in their ability to detoxify large quantities of cyanide while consuming their primary food, the Madagascar giant bamboo (*Cathariostachys madagascariensis*). This adaptation has allowed for the utilization of an abundant resource with little competition among sympatric species.

In this study, we explore the rates of intersexual competition found in the greater bamboo lemur (*Prolemur simus*). We hypothesized that the lack of interspecific feeding competition, in addition to a male size advantage, has led to a deviation in the pattern of female dominance found in the majority of lemurs. Data were obtained from June to August 2013 at Kianjavato Ahmanson Field Station in southeastern Madagascar. More than 160 focal hours were collected from 14 adults in three groups (N=5 males; N=9 females). During 2-hour focals we recorded behaviors using instantaneous scan samples at 5-minute intervals. Agonistic and affiliative interactions were recorded *ad libitum*, but were only included in analyses if they pertained to focal individuals. Over the 10-week study, 51 intersexual agonistic interactions were observed. All but one were initiated by males and resulted in female displacement. While more long-term data are needed to account for seasonality, this preliminary study has highlighted key differences in the social organization of the greater bamboo lemur.

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Urinary oxytocin, sociosexual behavior, and grooming in bonobos (*Pan paniscus*): Preliminary analyses

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Oxytocin is a hormone known to regulate the social memory and reward systems of the brain in several species of mammals, including primates. Recent research suggests that this hormonal system may be the underlying mechanism that facilitates cooperation and social bonding in unrelated individuals. Bonobos represent an ideal species to study this mechanism because, although bonobos are male-philopatric, females form strong and cooperative non-kin social bonds and frequently engage in sociosexual behavior as a mechanism to diffuse tension and facilitate cooperation, particularly during feeding. This study presents preliminary data on mean urinary oxytocin and social behavior in the Columbus Zoo bonobo colony (N=16 individuals). We collected observations of all social behaviors including grooming and sociosexual behavior. Urine was collected from each individual and assayed for oxytocin using a commercially available enzyme immunoassay kit. We found that mean urinary oxytocin and rank were positively correlated for females ($r=0.952$; $p<0.05$) but not for males ($p=0.14$). We also found a positive correlation between mean oxytocin and grooming bouts (N=71) with unrelated individuals ($r=0.705$; $p<0.05$). We found that sociosexual behavior predominantly occurred between unrelated individuals and that adolescents engaged in significantly more sociosexual behavior than did the adults (ANOVA: $F=13.309$; $df=1,4$; $p<0.05$). In addition, mean oxytocin was significantly higher among adolescents (N=4, age range = 7-12 years) than among adults (ANOVA: $F=8.725$; $df=1,5$; $p<0.05$). These results support the hypothesis that oxytocin regulates the maintenance of social bond formation in unrelated individuals and may play a role in the facilitation of sociosexual behavior in bonobos.

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Intra-annual variation in lemur hunting on the Masoala Peninsula of Madagascar

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Recent evidence has shown that lemurs and other mammals are (and have been) widely hunted for food throughout Madagascar. This study examines the seasonal variation in mammal hunting on the Masoala Peninsula of Madagascar, an area of heightened biodiversity and endemism. From July 2011 to June 2012 a focal hunter was shadowed daily and an individual from 100% of a focal village's households was interviewed about seasonal wildlife consumption. These data revealed specific intra-annual patterns in trapping efforts and wildlife consumption. While lemurs and bushpigs were predominately targeted during the cool, wet austral winter, carnivores were

targeted during the warm austral summer. Interviews about the socioeconomics, health, demographics, and micro- and macro-institutional resource regulation of households revealed economical, nutritional, and environmental reasons for this variation. This information may affect the efficacy of future conservation efforts by providing detailed information on the incentives and specific timing of threatened lemur and other mammal species extraction. Moreover this study exemplifies a growing trend in conservation research: rather than focusing strictly on the ecological needs of endangered primate species, researchers are studying the interactions of primates and humans in shared habitat spaces.

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Modes of alpha male change and reproductive success in Hanuman langurs at Ramnagar, Nepal

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Primate males acquiring the alpha position within the first few days after immigration have been called bluff immigrants. Alternatively, males can enter the hierarchy at a lower rank and later replace the alpha male. Both modes can occur in a given population but may differ in reproductive output. We investigated this question in Hanuman langurs (*Semnopithecus schistaceus*) at Ramnagar, Nepal, a seasonally breeding population with male dispersal and female philopatry. In two multimale groups observed extensively for five years each (1991-1996), paternities were analyzed for 28 infants (genotypes at five microsatellite loci). Overall, 21 alpha male changes occurred (involving 12 adult males). The majority of the alpha male changes were of the bluff type (57%) and only these resulted in alpha tenures lasting longer than 40 days. Males would attain the alpha position up to six times, but 75% held it only once. During 24% of tenures, alpha males did not sire infants because it fell outside of the mating season (July-November). In 43% of tenures no female conceived even though the tenure occurred during the mating season and in 33% of tenures conceptions occurred. Aside from four paternities by non-alpha residents and six extra group paternities, only bluff immigrant alpha males sired offspring. Together this suggests a much higher reproductive success for bluff immigrants. However, two bluff immigrants rated as exceptionally aggressive by observers had very low percentages of alpha paternities (but sample sizes were small). Whether this is a reflection of female choice awaits further investigation.

Data collection in Nepal was supported by the German Research Foundation, the Alexander von Humboldt-Foundation, the Society for Technical Cooperation, the German Academic

Exchange Service, and the Ernst-Stewner-Foundation.

A preliminary evaluation of *Mycobacterium tuberculosis* genomes from the pre-contact New World using high throughput DNA sequencing

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The success of DNA capture techniques as applied to ancient pathogens, coupled with the phenomenal molecular preservation observed in *Mycobacterium leprae* from medieval European bone, suggests promise for genomic-level analyses of related pathogens such as *Mycobacterium tuberculosis*. Comparative genomics of modern isolates suggest that *M. tuberculosis* attained its worldwide distribution by following human dispersals out of its native Africa, though ancient genomes will be highly informative to evaluate the suitability of this model. Here we report on a preliminary screening of *Mycobacterium tuberculosis* from skeletal material from the pre-contact New World using DNA capture and high throughput sequencing. Our genome-wide data will be discussed within a phylogenetic and phylogeographic framework, addressing theories on pre-contact mycobacterial infections in the New World, and the evolution in general of the *Mycobacterium tuberculosis* complex.

Evolutionary developmental anthropology: An introduction and historical overview

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Evolutionary developmental biology, or evo-devo, is concerned with the reciprocal relationship between organismal development and evolution. Evo-devo integrates genomic, developmental, organismal and population-level approaches to identify and understand the proximate mechanisms of evolutionary change. The discipline traces its origins back to advances in molecular and developmental genetics in the late 20th century, chief among them the discovery that the morphology of complex organisms emerges from relatively few, highly conserved and iteratively deployed genetic "toolkits". In terms of morphological evolution, this important discovery suggests that small regulatory modifications to genetic toolkits can effect large phenotypic changes among lineages. Biological anthropologists have long been interested in the comparative study of primate development and evolution, and accordingly evo-devo is gaining traction in primate and human evolutionary biology. To date, evo-devo studies in biological anthropology have focused on two complementary questions. The first concerns the identification of genetic, molecular and

developmental mechanisms, especially regulatory changes, that not only distinguish primates from other vertebrates, but also make humans unique among primates. The second looks at how normal processes of development structure phenotypic variation, and how this structure in turn influences the evolvability of primate phenotypes. In this introduction, we provide a brief historical context to the emergence of evolutionary developmental anthropology, and an overview of the research questions this growing discipline addresses. We outline future directions for evolutionary developmental anthropology, and highlight their potential for identifying the mechanistic basis of evolutionary change – both morphological and behavioral – in the human lineage.

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Interaction of ACE, TPA, WNK-1, and GCGR Alu polymorphisms with hypertension within the context of racism in African-Americans

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African Americans are disproportionately affected with cardiovascular disease in comparison with non-Hispanic, white Americans and have a 30% higher instance of mortality. Cardiovascular disease is multifaceted with a number of genetic and environmental risk factors. Using hypertension as an indicator of cardiovascular disease, this study sought to test the correlation of four Alu polymorphisms with diastolic and systolic blood pressure levels in relation to instances of racism, quantified from collected survey data, in a population of African-Americans from Tallahassee, FL (n=181). The Alu polymorphisms in the angiotensin I-converting enzyme (ACE), tissue plasminogen activator (TPA), WNK lysine deficient protein kinase 1 (WNK-1), and glucagon receptor (GCGR) genes were selected based on previously published findings of association with hypertension in African-American and European populations. The poly(A) Alu polymorphism on the GCGR gene has been previously utilized as a means to genotype the Gly40Ser mutation but without proven association correlation between the two polymorphisms. Thus, another objective of the study was to test for linkage between these variants. Genotyping to determine allele frequencies for each Alu polymorphism was accomplished by PCR amplification, followed by electrophoresis on 2% agarose gel. Statistical regression analyses were performed to test for correlation of the allele frequencies and the quantified instances racism with diastolic and systolic blood pressure values (mmHg). Combining the genetic and social-cultural data analysis will provide a more holistic understanding of the effects and interactions of some of the risk factors contributing to hypertension in African-American populations.

Testing the hypothesis of paralogy of jaws and limbs using biacromial diameters from children with cleft-lip-and-palate

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This study tests the hypothesis of serial homology, or paralogy, of mammalian jaws and limbs in humans. The recent discovery that the upper jaw is not the derivative of the first branchial arch, and has its own growth center suggests the re-examination of this hypothesis. Hox gene products direct limb, but not their girdles' development, nor first branchial arch development. Other homeobox genes are anterior to the Hox sequences in both time and space, which allows a mechanism for paralogy of the mid-face and shoulder girdle.

To test this hypothesis biacromial diameter is examined in children with clefts-of-the-lip-and-palate (CLP). The under-development of the embryonic maxillary prominences are proximal causes of CLP. These children also show a delayed mid-childhood growth spurt in the height, and lack the mid-childhood growth spurt in the mid-face twice as often as unaffected children. Their parents also show altered bi-zygomatic diameters.

Biacromial breadth was one of the measurements recommended by the International Year of the Child. As part of clinical growth evaluation, the auxologist measured biacromial diameter in children attending the Philadelphia Facial Reconstruction Center. Z-, or standard-deviation scores of these measurements were used to test the paralogy hypothesis. Males and females were analyzed separately because of known differences in the actions of the sex steroids on development of the jaws and body breadths. Here the analyses of biacromial diameters in children with CLP are reported, and their implications for the paralogy of the upper jaw and shoulder girdle in mammals and other vertebrates considered.

Managing 3D digital data sets of morphology: MorphoSource is a new project-based data archiving and distribution tool

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Studying variation in biological form and relating it to evolutionary processes is often hindered by difficulty in accessing relevant comparative samples. With the increasing efficiency and fidelity of 3D scanning, and better infrastructure for digital storage, the prospect of online digital collections for improving access to

comparative samples becomes more realistic. We have launched the first project-based database for storing, collaborative sharing, and distribution of microCT scans and surface renderings of specimens (<http://www.morphosource.org/>). Any researcher can add their data to it, and we have structured it for maximum flexibility of end-user aims. Our major goals are 1) to provide effective access to 3D data sets [including TIFF stacks, surface mesh files (like .stl) and photographic documentation] that were acquired with funding from sources that mandate sharing and distribution, like NSF; 2) To provide a framework in which users can store and quickly retrieve critical digital imagery metadata in a standard format to ensure that valuable information will not become uninterpretable in the future; 3) to give users a tool to track third party usage of their original data sets for grant-agency reporting. This website will form the main venue for distributing Duke Lemur Center Division of Fossil Primates (DFP) collections: some iconic specimens can already be downloaded. More than 500 digital files representing almost 150 extant and fossil specimens from the DFP, the American Museum of Natural History and the Smithsonian are already available for download by any researcher who registers on the site at the time of this writing.

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The evolution of primate pelage: Morphological analyses of museum research skins

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Hair plays diverse roles in mammalian biology: thermoregulation, pathogen resistance, camouflage, and communication. Primates exhibit some of the most striking examples of hair ornamentation, and substantial intra- and inter-specific variation in hair color, growth and texture. Although this diversity has likely been shaped by natural and sexual selection, the evolution of hair has generally been unexplored. Using digital microscopy, we quantify hair morphology (density, width, follicle clustering, length, coat depth) for multiple body regions of 42 museum research skins (collected 1915 – 2009) representing 18 species spanning all major primate clades. We first tested whether the long-term storage of museum research skins results in hair degradation. Consistent with our earlier research showing no correlation between storage time and pelage coloration, we found no correlation between storage time and morphological condition (Spearman's rank correlation $r=0.108$, $p=0.622$). For two species, we also compared hair collected from living animals, cadavers, and museum pelts, and we found no significant differences in hair measurements (*Macaca mulatta*: $t=0.453$,

$p=0.656$; *Microcebus murinus*: $t=1.141$, $p=0.154$). Our comparisons of hair microstructure indicate that similar coats often evolve via different morphological mechanisms. For example, pelage "darkness" can be altered by melanism, but also by changes in medulla structure. Similarly, coat density varies due to differences, not only in follicle number, but also in the average number of hair shafts per follicle (often 7+). Interestingly, these aspects of morphological variation are not tightly linked to phylogeny, providing an ideal context for comparative analyses of ecological and social factors shaping hair evolution.

Hair plucking and cortisol levels in a captive group of bonobos (*Pan paniscus*): Evidence of a female-biased stress induced behavior

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Although hair plucking has been observed in nearly all captive primate species, including the great apes, the aetiology of this discrete behavioral pattern is poorly understood. While this behavior has not been reported in wild apes, an ethologically identical behavior in humans, known as trichotillomania, has been linked to stress and is a predominantly female disorder. This study examines hair plucking behavior in a captive group of bonobos (N=13) at the Columbus Zoo and Aquarium in Columbus, Ohio. We define hair plucking as a rapid jerking away of the hair shaft and follicle by the hand or mouth, often accompanied by inspection and consumption of the hair shaft and follicle. Plucking data were collected using behavioral sampling, all-occurrence and 1450 social and self-directed grooming bouts were recorded during 128 hours of observation. Twenty-one percent of all grooming bouts involved at least one instance of plucking. Urine samples (N=52) were collected and analyzed for the stress hormone cortisol. Preliminary analyses of urinary cortisol levels showed a significant positive correlation between mean cortisol and self-directed plucking for females ($p<0.01$) but not for males ($p=0.2585$). These results support the hypothesis that hair plucking may be a stress-induced behavior in female bonobos and highlights the occurrence of a sex bias in human and bonobo self-directed hair plucking. This is the first study to investigate the aetiology of this behavior and adds to our knowledge of a contemporary issue in captive ape management.

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Genetic evidence for natural selection at the high-altitude candidate gene, *EGLN1*

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For millennia, Earth's highest mountain plateaus, the Andean Altiplano and the Tibetan Plateau, have been home to millions of people despite seriously harsh living conditions. To cope with the demanding environment, Andean and Tibetan populations show distinct circulatory, respiratory, and hematological adaptations to high-altitude hypoxia. Recent genome-wide scans indicate that both populations' patterns of genetic adaptation to this condition are largely distinct. However, a single locus, *EGLN1*, shows evidence of positive selection in both populations. *EGLN1* is part of the hypoxia inducible transcription factor (HIF) pathway wherein cellular oxygen homeostasis is regulated by HIF-1. To further characterize the pattern of genetic variation at this locus, 9.8 kb of coding and putative regulatory regions were resequenced in a panel of Andean and Tibetan highlanders. We applied several tests that detect departures from neutrality, including Tajima's *D* and Fu and Li's *D* and *F*. We also compared patterns of nucleotide diversity in the two highland populations to closely related low altitude populations using F_{ST} . Together, these tests suggest positive selection has operated at this locus in both populations. For Andeans and Tibetans, haplotype analysis revealed a single, dominant haplotype, which is unique to both populations. These data contribute to our understanding of high altitude adaptation in two geographically distinct, but environmentally similar regions of human habitation and the molecular basis for convergent human adaptations.

Causes and reproductive consequences of social network position and personality in free-ranging rhesus macaques

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There is growing evidence that intra-specific differences in behavioural tendencies are important, yet their evolutionary basis is poorly understood. For instance, we have little understanding of how variation between conspecific individuals arises and is subsequently maintained by selection. We have previously shown that social network position is heritable and associated with reproductive output in the free-ranging rhesus macaques (*Macaca mulatta*) of Cayo Santiago Island, Puerto Rico. Here, we explore the genetic basis of personality – a potential determinant of network position – in this population. We collected observational data via focal-animal sampling for 108 adult

females living in three social groups. We applied principal component analysis to nine spontaneously-occurring behaviours and identified six putative personality components, which we named Meek, Bold, Aggressive, Passive, Loner, and Nervous. These components were not artifacts of other features, such as dominance rank. All components were repeatable and heritable, with heritability estimates ranging from 0.14 to 0.35. We found no evidence of an association with reproductive output, measured either by infant survival or by inter-birth interval, for any of the personality components, suggesting either that personality does not have fitness-related consequences in this population or that selection has acted to reduce fitness-associated variation. We conclude by demonstrating how well an individual's personality predicts their position in the social network. These results form the scaffold for future research into the proximate and ultimate causes of intra-specific differences in primate sociality.

Functional characterization of Toll-like receptor signaling pathways in primates

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Despite close genetic relatedness, humans, apes and monkeys exhibit inter-species differences in susceptibility to certain pathogenic infections that are major causes of severe disease in humans. For example, humans are highly susceptible to Gram-negative bacterial sepsis, HIV/AIDS, and tuberculosis, while some monkey and ape species remain resistant or progress very rapidly. Such differences between humans and other primates are thought to result, at least in part, to inter-species differences in immune response to infection. However, due to the lack of comparative functional data across species, it remains unclear in what ways the immune systems of humans and other primates differ. Here we report a genome-wide comparative study of immune responses among primates, specifically focusing on Toll-Like receptor (TLR) signaling pathways. We stimulated leucocytes from humans, chimpanzees and rhesus macaques with TLR2, 4 and 7 –detected bacterial and viral ligands (LPS from *E.coli*, Lipomannan from *Mycobacterium smegmatis*, single-stranded RNA viral mimetic Gardiquimod). Blood was stimulated for 4 and 24 hours and innate immune response was assessed via global expression profiling of total blood leukocytes using RNA sequencing. Inter-species differences in gene expression were noted across many immune gene families, with humans manifesting many unique gene expression profiles in response to both bacterial

and viral ligands. These observations suggest that innate immune responses of human and non-human primates have evolutionary diverged, lending support to the notion that human-specific immune responses might account for some of the known differences in susceptibility to infectious diseases between humans and our closest evolutionary relatives.

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Identifying trends in the environmental heterogeneity at *Australopithecus robustus* sites

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Recent research has demonstrated that environmental heterogeneity exists between the *Australopithecus robustus* fossil bearing cave infills of South Africa. The goal of the present research is to test whether there is any indication of directionality in this heterogeneity; specifically, this study assesses whether there is evidence for an increase in aridity over time across the faunal assemblages associated with the robust australopithecines. Previous studies have suggested that the derived masticatory morphology of *A. robustus* enabled a wider dietary breadth, and that this development coincided with increased aridity across Africa. Fossil bovids from Cooper's D and from Members 1 (Hanging Remnant, Lower Bank), 2, and 3 of Swartkrans were assessed using a morphometric tool developed specifically for accurately identifying bovid teeth found in direct association with the hominins. This tool allows us to include isolated and otherwise difficult to identify teeth, and thereby utilize a maximum of available faunal material, as isolated teeth constitute the vast majority of all bovid remains in the South African cave infills. The relative abundances of the bovids were compared across the sites in chronological order to detect environmental changes. The results of the research support an increase in aridity over time, reflected in an increase in the proportion of grazers, and a concomitant decrease in browsers. This is not to say that *A. robustus* necessarily occupied arid, open grasslands. Rather, we can conclude that the environments from which the hominins and their associated faunal assemblages were recovered did become increasingly open and arid over time.

Flex heart rate measures of physical activity, but not scores on a widely used physical activity questionnaire, significantly predict BMI z-scores in a multiethnic sample of school children in Hawaii

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The epidemic of childhood obesity is due in part to reduced physical activity levels. Obesity is a particular concern among Native Hawaiians

and Pacific Islanders (NHPIs). Accordingly, physical activity levels and adiposity were measured in two cohorts of school children (ages 5.6 ± 0.5 and 8.7 ± 0.5 , respectively) residing in Hilo, Hawaii. Physical activity was measured through the flex heart rate method; children underwent a submaximal exercise protocol in which oxygen consumption and pulse were measured at multiple exercise levels on a treadmill. Children then wore heart watches on two days, from which Physical Activity Level (PAL) and Percentage of Time Inactive (PTI) (pulse below the flex rate) were calculated. The Physical Activity Questionnaire for Children (PAQ-C) was also completed. Body mass index (BMI) was calculated from anthropometric measures. In regression analyses that controlled for age and sex, BMI was negatively associated with PAL ($P < 0.05$) and positively associated with PTI ($P = 0.07$); BMI was not significantly associated with the PAQ-C score. Regression analyses indicated a significant positive relation between BMI and PTI for NHPIs ($P < 0.01$), but no significant relation between BMI and either PAL or PAC-Q score; for non-NHPIs, there was no significant relationship between BMI and any of the three exercise measures. In general, objective activity measures are more closely related to BMI than the questionnaire score. The ethnic difference in significant relationship between BMI and PTI may be due to the greater mean and variance in BMI among NHPI children.

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Changes in 86aella86s and association patterns in Black-handed Spider Monkeys (*Ateles geoffroyi*) from day to night

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Activity, association patterns, and range use of many diurnal species may be different at night, especially in those species with highly flexible social patterns like spider monkeys (*Ateles* spp.). Using focal, scan, and ad libitum sampling during the day and during the night (January 2013-August 2013), we compared grouping patterns and behaviour of black handed spider monkeys (*Ateles geoffroyi*) at Runaway Creek Nature Reserve, Belize. We found that subgroup size at sleeping sites was significantly higher than during the day, as well as differences in subgroup composition. We also observed changes in activity budgets, particularly for lactating mothers, infants, and juveniles. Many sleeping sites were repeatedly used, whereas resting location during the day was highly variable. The choice of sleeping site within the range appears to be heavily influenced by proximity to fruiting trees: individuals preferred specific sleeping sites near, but not in, the fruiting trees in which they were last foraging. This study suggests that spider monkeys, known for their high fission-fusion dynamics during the day, may in fact be considerably more cohesive at the night, a change that may be explained by the switch from avoiding feeding competition during the day to avoiding predation at night.

Strong group effects on energetic balance in redbtail monkeys (*Cercopithecus ascanius*)

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Between-group contest competition is thought to have relatively weak effects on individual fitness, particularly in terms of access to food resources. However, this assumption has rarely been tested, and only with indirect methods prone to high margins of error. In this study, I sought to compare urinary C-peptide levels as an objective indicator of group-wide energy balance to more traditional measures of energy inputs and expenditures. I studied six groups of redbtail monkeys (*Cercopithecus ascanius*) at the Ngogo site in Kibale National Park, western Uganda. I expected urinary C-peptide levels to be positively correlated with food abundance (measured within each home range on a bi-weekly basis) and minimum nighttime temperature (a potential source of environmental stress). I expected C-peptide levels to be negatively correlated with group travel distance, number of infants in the group, rainfall, and maximum daytime temperature. I used multilevel linear regressions to test these predictions and the information theoretic approach to choose the best model. The strongest predictor of energy balance was group identity; in contrast, food abundance, travel distance, number of infants, temperature, and rainfall were poor predictors of energy balance. Group energy balance was weakly associated with group size and home range quality, calculated as the basal area of food trees within the range. These results demonstrate that redbtail monkey groups exhibit variable levels of energetic balance, which are likely a result of their frequent interactions with neighboring groups over access to food resources.

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Another example of a chimpanzee-like black-handed spider monkey (*Ateles geoffroyi*) "raid" observed at La Milpa, Belize

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Stealthy chimpanzee-like raids by male black handed spider monkeys (*Ateles geoffroyi*) into neighboring territory were first documented in 2006 in the Yucatan Peninsula of Mexico. Raiding groups of males traveled on the ground apparently searching for individuals to attack. They traveled in single file with tails held erect. More recently, hostile events leading to a takeover by neighboring male spider monkeys were documented in NW Costa Rica. Hostile raids in Mexico were linked to male-male philopatry with males remaining in their natal groups, but genetic identification of relatedness of takeover males in Costa Rica revealed they were not as closely related as previously believed.

We report here another example of spider monkey male gang aggression toward individuals of a neighboring group. On March

27th, 2013, during our third brief field trip to La Milpa in North West Belize we witnessed and video recorded spider monkey males traveling arboreally in single file with tails erect. They attacked an adult female and her young offspring. Approximately one minute into the attack another individual arrived at the scene from the opposite direction in which the attackers entered, leading to an escalation of hostilities. Five attacking individuals were photographed leaving the scene in single file and displaying. Since this incident, guides at La Milpa observed two other hostile attacks and one monkey with a bite wound on his shoulder. Attacking monkeys never traveled on the ground. Our observations indicate that hostile attacks by neighboring males may be a normal part of this species' behavior.

Death during the Scottish Wars of Independence: An osteological and isotopic analysis of Medieval individuals from Stirling Castle, Scotland

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Stirling Castle was one of the key garrisons of the Scottish Wars of Independence, 1296-1328 and 1332-1357AD. In 1997, excavations at Stirling Castle revealed a lost royal chapel and nine burials that were radiocarbon dated to the 14th and early 15th centuries. Earlier skeletal analysis revealed healed sharp force trauma to the frontal of one individual and possible perimortem puncture wounds to the cranial vault of a second skeleton. However, our re-analysis identified an abundance of peri-mortem trauma – predominantly blunt force – within this small group. One individual suffered over 80 peri-mortem fractures, many to his post-cranial skeleton. Small numbers of sharp force and penetrating trauma were also present. While many of the fractures found in isolation could be attributed to accidents, the sharp-force injuries clearly relate to inter-personal violence. It is argued that these individuals died in encounters relating to the Scottish Wars of Independence and that the significant burial location within a royal castle suggests they may be high-status.

Carbon and nitrogen isotope analysis of bone collagen indicated these individual enjoyed a mixed diet, with ratios similar to other medieval populations in Britain. Stirling Castle changed hands repeatedly during the course of the wars of independence. Oxygen and strontium isotope analysis of tooth enamel was undertaken to investigate the origins of all individuals with surviving teeth, but our analyses to date could not differentiate English from Scots. Our research revealed new evidence for the brutality of medieval warfare and highlights the importance of reanalysing curated skeletal material.

This project was funded by Historic Scotland.

Ontogenetic changes in inter-limb length and strength proportions in baboons (*Papio cynocephalus*) and vervet monkeys (*Cercopithecus aethiops*)

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Studies of closely-related species are useful for exploring the consequences of subtle behavioral differences while controlling for phylogenetic effects. Baboons and vervet monkeys are close relatives and largely sympatric, but differ in their degree of arboreality and possibly in hind limb weight support in terrestrial walking. This study compares the effects of these differences on femoral to humeral length and strength proportions in juveniles and adults of the two taxa. Bending strength (polar section modulus) was determined from images of midshaft cross-sections in vervets (n=28) and CT scans in baboons (n=30), and lengths by linear measurements. Individuals were placed into biological age categories based on dental eruption for statistical comparison.

Femoral to humeral length proportions change during ontogeny in both taxa: the youngest vervets have significantly shorter femora relative to humeri than baboons in the same age cohort, but this relationship is reversed in adults (p<.01). Vervets have relatively stronger humeri compared to femora than baboons at all ages (p<.001). When scaled by a biomechanical size variable (body mass*bone length), vervets are shifted above baboons at comparable ages; this difference is more pronounced in the humerus than the femur.

Fore- and hindlimb length and strength proportions are therefore decoupled: strength proportions are consistent with differences in arboreality from very young ages, while length proportions are variable and less clearly behaviorally mediated. Biomechanically-scaled bone strength appears to be more highly correlated with substrate use and less so with load sharing between the limbs during terrestrial locomotion.

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A reassessment of intentional dental modification in the American Southwest

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Intentional dental modification is the practice of purposefully modifying the appearance of human teeth through removal, staining, inlays, filing, or notching. The practice ranges temporally from the Upper Paleolithic to modern times and is found worldwide, most commonly in Mesoamerica, Africa, and Australasia. Intentionally modified teeth have also been proposed in the American Southwest, including cases in Arizona (n=6), New Mexico (n=6), and Texas (n=2). This poster critically reassesses all

known cases in terms of their physical characteristics and bioarchaeological context in order to illuminate whether this practice originated independently in the American Southwest or if affected individuals are actual Mesoamericans.

The proposed cases are diverse morphologically, including notching of the crown corners and filing of the labial and/or occlusal surfaces of anterior teeth. This poster adds new observations to the original physical descriptions of several key cases, including the first documented case at Sikyatki, AZ. In addition, a reevaluation of characteristics such as notching in root stumps (Gun Sight shelter, TX), the irregular appearance of notching (Pueblo Bonito, NM), and the asymmetry and nature of modification in other cases supports unintentional chipping as a more likely causal factor. The ambiguous evidence of intentionality in these cases suggests they are not strong candidates for intentional dental modification. The extreme rarity and lack of uniformity among other proposed cases argue against an independent origin of intentional dental modification in the American Southwest. However, neither the bioarchaeological context or modification types provide clear links to Mesoamerica.

A preliminary 3D analysis of ecogeographical variation in modern human (*Homo sapiens*) maxillary sinus shape

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Compared to maxillary sinus volume, ecogeographical patterning of modern human sinus shape has been less critically investigated, due largely to methodological limitations in assessing its complex curvilinear morphology. Here, we investigated maxillary sinus shape using CT-scan models of crania from two climatic extremes: "Hot" (n=34) sub-Saharan Africans and "Cold" (n=37) Siberian and Arctic crania. A Principal Components Analysis (PCA) following Procrustes superimposition of 3D coordinates of eleven landmarks reveals considerable idiosyncratic variation in sinus shape, with the first four PCs explaining only 50% of the total shape variation. However, PC1 (20.1%) and PC2 (14.4%) do largely discriminate the two samples, with individuals from cold climates generally exhibiting relatively mediolaterally wider, superoinferiorly taller, and anteroposteriorly shorter maxillary sinuses compared to individuals from hot climates. These two PCs also contrast differences in the relative positioning of the lateral (zygomatic) portion of the sinus and in a suite of complex shape differences in the medial (nasal) wall. Moreover, a Discriminate Function Analysis employing PC shape scores correctly classifies 78% of individuals into their climatic group, considerably better than maxillary sinus volume (65%). These results confirm that ecogeographical differences in maxillary sinus shape exist, and that sinus shape may be a more accurate indicator of populational differences versus sinus volume. These preliminary results suggest that more detailed analyses of maxillary sinus shape, potentially employing 3D

semilandmark surface meshes, are warranted to further evaluate ecogeographical variation and to assess the relationship between sinus shape with overall craniofacial architecture and specific environmental pressures.

Quantification of talar medial tibial facet variation among primates

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Distinctive differences in talar morphology are widely recognized to separate anthropoids, tarsiforms, and strepsirrhines, including the relative size of the medial tibial facet. Expanded medial tibial facet area among "prosimians" has been related to postural behaviors that transmit a greater percentage of body mass through the facet. While this feature has been qualitatively recognized and used to assess fossil material, it has not been evaluated quantitatively. Using measurements from microCT scan-generated surfaces from a comprehensive sample of primates, we compare the relative size of the medial tibial facet in strepsirrhines and haplorhines. Area measurements of both the medial tibial and ectal (or posterior calcaneal) facets were taken in Geomagic Studio. Because the most appropriate denominator for assessing relative facet size is debatable, we used two different approaches so far: 1) we standardized facet area to talar trochlea width; 2) we standardized facet area to body mass estimated from ectal facet area. ANOVA of these ratios show a consistent pattern of results: there are significant differences between anthropoids and strepsirrhines in the expected direction (larger in latter). The relative size of the medial tibial facet of tarsiers is more similar to those of anthropoids than strepsirrhines. Adapiforms and most omomyiforms are similar to strepsirrhines, while plesiadapiforms, *Teilhardina*, *Tetoni*, and eosimiids are similar to anthropoids and tarsiers. Our results confirm the phylogenetic salience of this feature among primates, but complicate explanations of its functional significance.

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Mortuary and paleopathological analyses of juvenile burials at the New Kingdom site of Tombos, Sudan

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In the New Kingdom component (1400-1050 BC) of the site of Tombos, located at the Third Cataract of the Nile River in Sudan (ancient Nubia), juvenile skeletons have been underrepresented at approximately 15% of the excavated remains. Previously excavated juvenile skeletal material was located in an

alleyway around one elite pyramid structure as well as scattered in various middle-class underground chamber and pit tombs. It was hypothesized that children may have been buried in house floors, rather than the cemetery. However, excavations in 2013 revealed one tomb that appears to have been a small funerary chapel containing additional numerous juvenile individuals. These mostly commingled remains were found nearby in situ and commingled adult burials with Egyptian-style grave goods and painted coffins, suggesting an elite status.

Demographic analyses indicate that, at a minimum, eleven individuals are represented in the remains, ranging from newborn to adolescent in age. Similar to the previously excavated juvenile burials, children aged 4-12 years comprise the largest cohort, which suggests that infants may be buried elsewhere. Paleopathological analyses indicate a similar profile of non-specific stress with none of the individuals exhibiting periosteal lesions on the tibia and 20% showing cribra orbitalia. Location of burial (around pyramid, inside funerary chapel, middle-class tomb) does not appear to be associated with varying levels of stress indicators. This increase in non-adult individuals provides a more broad examination of childhood experiences than was previously available and allows for a contextual analysis with the consideration of indications of ethnicity and social status.

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(Dis)Ability and traumatic injuries of the poor: An analysis of morbidity and mortality in the Erie County Poorhouse Cemetery

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The modern American concept of disability emerged in the 19th century at a time when the ability to work and fully participate in the Industrial Revolution literally defined what was “normal.” During this period, poorhouses were established to alleviate the suffering of those who could not support themselves, including many individuals with physical impairments who were considered disabled. This study applies disability theory to the analysis of skeletal remains excavated from the Erie County Poorhouse Cemetery to examine the history of disability in America. Using clinical literature as a guide, traumatic injury data are examined to determine the probable degree of impairment. Twenty-five percent of the cemetery population analyzed displayed visible traumatic injuries that could be assessed. The majority of individuals with traumatic injuries (50%) showed minor to no signs of probable impairment or complications with healing of the injury. Trauma that more than likely caused impairments to “normal” activity was observed in 35% of individuals, where range of motion, associated pain, and/or locomotion would have been a consequence of trauma and healing. Approximately 15% of individuals showed signs of trauma that caused definite impairment, including healed amputations of limbs, severely mal-aligned fractures, and associated complications. These individuals were probably disabled in the eyes of their society. However,

these figures may underrepresent the total impaired population because of the difficulty in diagnosing impairments based on skeletal remains alone. Also, attempting to understand how the impairment may or may not have disabled a person can be even more problematic.

The effects of fine branch arboreality on the tail musculature in a non-specialized climber

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The origin of Primates *sensu lato* from Euarchonta likely relates to arboreality, pedal grasping, and the invasion of the fine-branch niche to exploit angiosperm food resources. This paradigm assumes initial transitional forms that are small-bodied, non-specialized, and capable of rudimentary hallucal opposability. Laboratory work using an experimental climbing model reveals that mice learn skillful foot grasping while gaining hallucal robusticity. Additional musculoskeletal changes include larger vertebral processes consistent with greater tail coordination. Here we investigate whether other caudal musculoskeletal tissues like tail tendons and muscles show similar climbing dependent plasticity. All experiments were performed in accordance with our institution’s animal care and use policies. Tails (N=10) were harvested from mice at 6 months old after having lived since weaning entirely in a climbing or control habitat. Histological cross-sections of tissue (10 µm) were prepared and stained with H&E and Masson’s trichrome, and diameters of muscle and tendon bellies were measured and compared between dorsal and ventral regions as well as between experimental groups. Results suggest that climbing mice have enhanced ventral musculature compared to control mice (total mm², P<0.1; Ventral mm²/Dorsal mm², P<0.05) and the ventral tendon area is marginally smaller in climbers (total area, P<0.1). Other tail muscles and tendons do not exhibit statistical differences between climbers and controls. This pattern is consistent with Primates where ventral musculature and tail flexion is important for arboreality. We conclude that the tail, as a critical organ of positional behavior, would have enhanced grasping specializations in the earliest stages of Primate evolution.

Concepts of leprosy today in the western world – results of a survey

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Anecdotally, there is a dearth of knowledge about leprosy in the western world. This study summarizes the results of a survey that assessed key knowledge of leprosy, the hypothesis being that the majority of people are not familiar with this infectious disease. A 10 question survey was developed about present and past leprosy, and five keywords relating to ‘leper’ were requested. A range of groups in the UK were targeted, including museum visitors, new students (on entry to university), and various groups made up of the public, i.e. groups who had not been

exposed to knowledge of the past and present of leprosy. Two hundred and seventy questionnaires were completed. A lack of knowledge about leprosy was apparent for some questions. Most notable were incorrect answers for the causative pathological organism, the method of transmission, predisposing factors, its apparent description in the Bible, and how people with leprosy were treated in the past. Keywords for ‘leper’ were wide ranging but overall were negative. The data collected and analysed suggest that people’s perceptions of leprosy are generally misinformed and need to be changed, through further action on the part of those working with people with leprosy and those with leprosy, and also medical historians and bioarchaeologists. Media perceptions of leprosy are likely a major contributory factor to this situation, and also authors of popular fiction. Once perceptions change, it is likely that funding for research and donations to leprosy charities may increase.

Mapping activity patterns through Musculoskeletal Stress Markers: Vertebral anomalies of a Middle Horizon population in the north-central highlands of Peru

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While the bioarchaeological analysis of Andean lifeways during the Middle Horizon (600-1000 AD) has flourished in recent years, these studies have focused largely on the Wari Empire in south-central Peru. Instead, this study focuses on activity patterns at Hualcayán, an ancient community center in the north-central highlands of Peru, through osteological analysis of vertebrae collected from a Middle Horizon ossuary. 143 complete adult vertebrae (MNI ≈ 6) were analyzed macroscopically for trauma, entheses, and anomalous morphology. The cases of trauma that were observed included a Jefferson Fracture of C1 and compression fractures in various vertebrae with resultant ossification. The presence of overdeveloped entheses was noted on 57% of thoracic neural arches and 50% of upper lumbar neural arches. Lumbar anomalies included vertebral osteophytosis, cleft neural arches, and diffuse idiopathic skeletal hyperostosis. Anomalous morphologies, including lipping of the spinous process, non-symmetric growth patterns, and fusion of C3-C4 were observed on 23% of examined cervical vertebrae. The majority of these observed vertebral anomalies illustrate spinal damages suffered by individuals repeatedly exerting both compressional and rotational forces through their backs. Furthermore, the trauma noted on various vertebrae may be consistent with use of a tumpline—or cranial strap—to carry goods, a form of transportation that is widely depicted in ancient Andean iconography. The findings of this study are consistent with well-documented archaeological and historical evidence of intensive agricultural labor practices, and

exemplify the specific osteological pathologies present in Middle Horizon populations in the north-central highlands of Peru.

Skeletal variability of femoral robusticity in two human populations

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Biomechanical forces influence long bone diaphyseal morphology and skeletal robusticity is often used to interpret behavioral differences among human populations. While differences in robusticity inform about differences in activity levels between populations, intra-population variances in these measures may inform about variation in behavior. This study investigates inter- and intra-population variation in femoral diaphyseal robusticity. Cross-sectional geometric properties of the femoral diaphysis were calculated from external contours using a non-invasive 3D laser scan technology for two modern European populations (Lisbon $n=62$; Sassari $n=62$). Size standardized measures of total section area (TA), second moments of area (I), polar second moments of area (J) and indices of diaphyseal shape (ratio of I_{max}/I_{min}) were calculated to determine diaphyseal strength at the femoral midshaft. Coefficients of variation (CV) were calculated for each variable by sex, sample, and occupation (Lisbon only) and tested for equality between groups. Results of CV comparisons demonstrated that variation in femoral diaphyseal strength does not show differences in activity between samples, sexes, or laborer groups (Lisbon males). While no significant differences in CVs were found between groups, for the inter-sample comparison, I_{max} displayed the greatest difference (pooled-sexes, CV = 19.5 and 24.6, $p=0.07$), suggesting a trend towards greater variation among Sassari individuals to load the femur in the antero-posterior direction. The shape of the femoral midshaft does not vary significantly between sexes or samples, supporting results of previous studies wherein low inherent variation of the femur at this location provides greatest optimization of form in relation to functional constraints.

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Effects of cold adaptation on the growth and development of the Neandertal cranial base

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Neandertals and modern humans exhibit different postnatal cranial growth trajectories. Modern humans undergo globularization, in which the basicranium flexes and the neurocranium expands. Neandertals undergo a more archaic form of development and possess some of their quintessential cranial traits at birth, notably a lengthened anterior cranial base (ACB). In addition, Neandertals also experience more rapid cranial growth, obtaining adult size more quickly than modern humans.

Two factors that have been posited as the main contributors to these developmental differences are genetic change in cognitive development and rate of bone growth. However, it is the growth trajectory of the ACB that has profound effects on the brain shape and other cranial elements during ontogeny. In this paper, we present the hypothesis that a size increase in ACB and rapid cranial growth are due not to cognitive differences, but environmental factors, specifically Neandertal adaptation to cold.

Our data indicate that anterior cranial base length is correlated with measures of cranial height, facial size and facial projection. The elongated ACB reflects larger size in Neandertal infants through the more vulnerable subadult years and an accelerated growth trajectory causes them to reach adult size at an earlier age. Data on modern populations show that infants and young children are greatly impacted by cold stress and that increased head size is associated with higher skin temperature retention. Thus, environmental factors are a valid argument for the differing shapes and developmental trajectories of Neandertals and modern humans.

Infant and child burials at a Formative Period site in the Lake Titicaca Basin, Peru

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The Lake Titicaca Basin is one of the few areas in the world in which early complex societies developed. The extreme aridity of this high altitude region has proved to be an excellent preserver of both cultural material and human remains. At the major Formative Period site of Taraco, north of Lake Titicaca, excavations of a ceremonial sunken court were conducted in the summer of 2013. Based on similar contemporary sites, the authors expected to find human remains associated with the court.

The excavations revealed several examples of well-preserved juvenile remains, ranging in age from neonates to young children. Remains were found in closely intertwined groups of 2-3 individuals, and demonstrated a complete lack of grave goods or funerary architecture. The groups were found around the periphery of the sunken court in association with terrace architecture. Although infant burials are common in agricultural terraces from this region and time period, the condition and circumstances of these burial groups are unusual. The deposition of the remains strongly suggests that they were buried simultaneously, and their partial disarticulation is almost certainly indicative of secondary burial. The lack of burial goods or architecture supports this theory, while the location of the burials in relation to the ceremonial court and the canal may indicate a ritualistic nature for the burials. In light of other data from the region, these burials may represent dedicatory offerings associated with the construction of ritual spaces.

Identification of rodent microfauna using postcranial with implications for paleoenvironmental reconstruction

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Paleoenvironmental reconstruction using fossilized microfaunal (<500g) remains often rely on the assumption that the environmental tolerances of fossil specimens are similar to the extant taxa they resemble. In such analyses, craniodental remains are typically used for taxonomic identification; rodent postcranial remains are generally not considered, and such omissions may limit inferences. In this study we explore using rodent postcrania in taxonomic assessments, using traditional morphometric techniques. Nineteen linear measurements were taken on five postcranial elements: the humerus, radius, ulna, femur, and tibia. A total of 90 rodent specimens were examined from the Natural Science Research Laboratory at Texas Tech University (Lubbock, TX) and at the United States National Museum of Natural History (Washington, D.C.), representing extant taxa from 4 families, 8 subfamilies and 15 genera. Specimen size was calculated as the log geometric mean of the suite of linear distances. Shape data (as scaled proportions) were created by dividing log distances by the size measure. Shape data were distilled by principal components analysis to five axes that collectively represented 95% of total variance. The five shape variables were analyzed using MANOVAs for the categorical variables of family, subfamily, genera within subfamilies, allometry, and interactions. Shape differences were evident and strong for all levels of taxonomic organization. These results suggest that shape analysis of postcranial skeletal remains can be a reasonable means to estimate paleocommunity composition. As postcranial remains are not often found in association in paleontological deposits, we briefly discuss the use of this source of data in paleoenvironmental reconstructions.

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The impact of unrealistic primate management expectations on community support for a riverine corridor restoration project in western Uganda

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In executing primate conservation near human settlements, community support is critical to project success. Seven villages within the Hoima district of western Uganda were involved in a three-year conservation project including the restoration of a riverine corridor connecting two chimpanzee (*Pan troglodytes*) populations. This corridor also allows passage of olive baboons (*Papio anubis*) and red-tailed monkeys (*Cercopithecus ascanius*).

The current study explored how community attitudes towards primates and expectations for management impacted community support of the corridor restoration project. A total of 85 semi-structured interviews were conducted from

project participating forest- and river-adjacent households between May and August, 2012.

Attitudes towards primates were overwhelmingly negative, with all respondents using only negative words to describe baboons, and 29% using negative words to describe chimpanzees. Primary concerns were crop-raiding (baboons, guenons, and occasionally chimpanzees) and injury to humans (chimpanzees). The majority (64%) of respondents used non-lethal methods to control encroaching primates, but 80% of this group was unsatisfied by the effectiveness of current control methods. Ideal future management options involved one of two scenarios: 62% expected increased lethal control, while the remaining 38% expected primates to be restricted to fenced or patrolled areas. Lastly, while 60% of respondents held positive attitudes regarding the restoration project, support was contingent on a guarantee that primate presence would not increase in their land (73%).

Our findings reveal a discrepancy between conservation goals and community expectations. These unrealistic expectations highlight the importance of transparent dialogue between conservation agencies, government bodies, and local communities.

Dental nonmetric traits and geography

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The global pattern of human biological variation has been strongly shaped by geography. It has long been observed that dental nonmetric traits reflect the geographic structure of human populations, including some regions with distinctive morphological patterns. The geographic pattern of dental nonmetric traits reflects both the long history of interactions among regions, as well as particular historical events such as ancient migrations. Determining which historical factors have been important requires examining the degree of match between morphological and geographic distances. We examined dental nonmetric traits scored under the ASUDAS system for 592 prehistoric and contemporary human population samples, comprising a total of more than 67,000 individuals. The trait frequencies in these samples were collated into geographic regions and visualized using multidimensional scaling. We used Procrustes analysis to consider the similarity between dental morphology and the geographic structure of the samples. The results confirm earlier work linking the morphological pattern of Northeast Asian and Native American samples, and confirm that Southeast Asian and Oceanian dental morphology is closer to sub-Saharan African morphology than predicted by geographic distance. We additionally quantify the variability among samples historically termed as "Sinodont", including a substantial evolutionary trend in Chinese samples. Overall, dental morphology fits well with the pattern of geographic relationships evident for genetic data.

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Investigating the molecular mechanisms of evolutionary variation in hominin scapula shape

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Primates exhibit significant variation in appendicular and axial morphology, reflecting a diverse range of locomotor and postural adaptations. In the human lineage alone, evolutionary shifts in the shape, size, and proportions of the limbs and their adjoining girdles are associated with some of the first and arguably most important behavioral changes in hominins, such as reduced arboreality, increased bipedal specialization, and tool use. Here we address the developmental (embryonic) mechanisms that may have influenced the evolution of the human scapula, focusing on its shape, size, and sub-element proportions. Developmental explanations for scapula variation have the potential to inform questions of evolutionary relationships, the potential for homoplasy (e.g., in apes and humans), and reconstructions of ancestral states. We outline a framework for generating testable hypotheses for scapular evolution that is informed by both comparative 3D morphometric analyses of living humans and apes and the developmental biology of the scapula. We use this model to generate testable hypotheses for evolutionary variation in scapula shape, specifically regarding alternative trajectories from the last common ancestor of chimpanzees and humans, and compare these predictions to known fossil hominins. We next interpret these alternatives in the context of our current understanding of scapula development, and suggest key areas where more information is required, and the types of investigations that should be performed in the future to resolve outstanding questions.

Shrew and rodent incisor microwear textures as a proxy for paleoenvironmental reconstruction

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Dental microwear of fossil mammals has been used to reconstruct diet, but also to make inferences about paleoenvironments. Most studies have examined larger species, which often use resources across an expansive, mosaic home range. Fewer analyses have focused on micromammals, even though their smaller ranges and abundance in many habitats can make them well-suited as paleoenvironmental proxies. Here we report on the first study to assess the potential of shrew and rodent incisor microwear textures for habitat inference. Lower incisor labial surfaces were used because of their direct exposure to the environment and lack of signal noise related to the vagaries of chewing. All specimens examined have associated

provenience data, and are housed at the Smithsonian. Habitat types, ranging from desert to rainforest to semi-aquatic, were determined by ground cover using Google Earth. Diets were ascribed based on the literature for each species. Microwear texture data were generated for both the shrews ($n = 133$) and rodents ($n = 429$) using confocal profilometry and scale-sensitive fractal analysis. General linear models (MANOVAs, ANOVAs, multiple comparisons tests, all on ranked data) were used to evaluate effects of habitat type and diet on six standard microwear texture attributes. Shrews and rodents were evaluated separately using an otherwise taxon-free approach. Results indicate significant variation in texture attributes by both diet and habitat type for both shrews and rodents, and that these variables are easily parsed. This suggests that incisor microwear of micromammals holds potential both as a paleoenvironmental proxy and an indicator of paleodiet.

A retrospective analysis of blunt force trauma in 22 cases of known circumstances of death

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Despite some advances in the biomechanics of blunt injury patterning, little is known about how much of the actual circumstances of death can be gleaned from the analysis of blunt force trauma in bone. This study wishes to determine how reliably and to what extent can forensic anthropologists reconstruct the events surrounding death from blunt force trauma analysis. The sample used consists of 22 individuals from two identified human skeletal collections in Portugal. These individuals died of a violent death and were submitted to medico-legal autopsy between 1926 and 1974, before being incorporated in the collections, and are of known circumstances of death. The skeleton of each individual was analysed at a macroscopic level without any previous knowledge. Blunt force injuries were classified as to location, type, point of impact, force intensity and force direction. The overall pattern of injuries identified was then used to generate probable mechanisms of causation and reconstruct possible circumstances of death, based on the published literature. Results show an agreement between the proposed and the reported circumstances of death for 13 individuals (59.1%), a disagreement for 3 individuals (13.6%) and a similarity in 3 cases (13.6%). An additional 3 individuals (13.6%) provided no information due to insufficient skeletal data. Although the significant amount of agreement between the proposed and actual circumstances of death highlight the potential in bone trauma analysis, the cases with disagreement draw attention to the pitfalls and shortcomings of attempting to reconstruct the circumstances of death from trauma analysis alone.

Elevation and intersite $\delta^{13}\text{C}$ variation between chimpanzee dietary niches at Ngogo and Bwindi Impenetrable National Park, Uganda

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The ability to quantify dietary intake in the absence of direct observation is a key tool for the study of extant primate dietary ecology and hominin evolution. Dietary reconstruction by stable light isotope analyses has emerged as one such method, but ultimately depend on (1) a known diet to tissue fractionation rate, (2) an isotopically defined list of potential dietary inputs, and (3) control for additional non-dietary factors that may impact the dietary signal or physiological fractionation. This study examined inter-site dietary variation in $\delta^{13}\text{C}$ between two geographically distinct wild chimpanzee habitats at Ngogo and Bwindi to further understand items (2) and (3) above. Over 300 plant samples were collected between the two sites, dried, ground to a powder, and analyzed via IRMS.

Isotopic variation in $\delta^{13}\text{C}$ ranged from -32.6 to -23.5‰ at Bwindi, and -35.6 to -21.8‰ at Ngogo. Carbon values for most food types differed significantly between sites with leaves at ground level 1.8‰ more ^{13}C -enriched at Ngogo, pith 2.3‰ more enriched at Ngogo, and flowers 3.3‰ more enriched at Bwindi. No difference was found in fruit pulp between sites. At Ngogo, $\delta^{13}\text{C}$ of *Pterygota mildbraedii* sapling leaves was significantly associated with elevation ($r^2=0.1709$, $p<0.05$), whereas fruit pulp of *Uvariopsis congensis* was not. These results suggest that geographic differences between chimpanzee study sites modify $\delta^{13}\text{C}$ signatures associated with food type. Additionally, the impact of elevation on plant $\delta^{13}\text{C}$ appears to be modified by food type, plant species, or both.

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New evidence in an old debate: Computer-assisted extraction and identification of fossilized eggshell fragments from the Taung hominin locality, Taung, Northwest Province, South Africa

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Recent decades have seen lively debate over agents of accumulation operating at the site. Different avian accumulators (e.g., an owl and a raptor) have been suggested as contributing to the fossil assemblage. In order to advance debate with new evidence, we digitally extracted and analyzed fragmentary fossilized bird eggs (T92-88 and T93-17) from Dart deposits excavated in 1992-3. We conducted a shape analysis with modern bird eggs as analogues to test hypotheses that one or more avian taxa may have been present at the site.

We acquired serial CT scans of fossilized eggshell fragments and extant eggs. Image data were saved as DICOM files and imported into Avizo 6.1 software. Manual segmentation was needed to produce isosurface reconstructions for

fossilized fragments, while automated segmentation was used for extant eggs. Using a surface alignment procedure in Avizo similar to a Procrustes analysis, but restricted to translation and surface rotation, surface curvatures of fossilized eggshell fragments were matched to different regions of extant eggs. Subsequently, a second iteration was performed allowing size to vary as well.

Using surface curvatures, T 92-88 best matched the blunt pole of a helmeted guinea fowl egg, whether size was allowed to vary or not. T 93-17 best matched the equatorial region of a black eagle egg when size was not allowed to vary, but matched the helmeted guinea fowl egg when size was allowed to vary. Though unlikely, it is possible that the presence of eggs and birds of a given taxon were mutually exclusive events.

Occupational markers and artifacts: The osteobiography of a weaver from ancient highland Peru

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The concordance or disjuncture between social identity, conveyed by burial goods, and the lived experience of those interred individuals—revealed through osteological analyses—is of great interest to bioarchaeologists. In this paper we examine an adult female skeleton interred within a large pre-Inca hill fort (ca. AD 1000–1100) in the mountainous region of Andahuaylas, Peru. The remains of were located in a mostly commingled burial pit, and there was no associated standing funerary architecture. Despite the economy of mortuary infrastructure, the female's skeleton was nearly complete, mostly articulated, and associated with burial artifacts including a llama bone awl and an avian bone needle, a common assemblage in this region. These small, personal goods are associated with weaving, a task overwhelmingly realized by women in ancient Peru. Remains were examined for 1) stress markers including robusticity, articular modifications, and changes in muscle and ligament attachment sites; 2) degenerative joint diseases (e.g. osteoarthritis); and 3) traumas. Results do not cleanly conform to occupational markers expected of full-time weavers, but some congruence exists in Andahuaylas between the signs of habitual activity during life, and the suite of artifacts that accompanied someone in death.

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Evaluation of sickle cell hemoglobin and glucose-6-phosphate dehydrogenase deficiency genetic mutations in Haiti

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Haiti is one of the poorest countries in the Western Hemisphere and, as a result, has limited disease surveillance data. Erythrocyte genetic disorders, such as sickle cell disease/trait and glucose-6-phosphate dehydrogenase deficiency (G6PDd), are likely prevalent in the population given the high West African ancestry in Haiti, but genetic variant frequency data are lacking. In this study, we identified hemoglobin S (HbS), HbC and the G6PDd A- mutations in the West and Southeastern Departments of Haiti and discuss implications for sickle cell screening and for malaria treatment of G6PDd patients. Of the 194 individuals genotyped for HbS and HbC mutations, one (0.52%) was HbSS, 14 (7.2%) were HbAS, one (0.52%) was HbCC, 12 (6.2%) were HbAC, and 166 (85.5%) were HbAA. Of the 110 individuals genotyped for the G6PDd A- mutations, six were A- hemizygous males, one was an A- homozygous female, and 15 were A- heterozygous females. The remaining 60 females and 28 males did not carry the G6PDd A- variant. Our results suggest that a high proportion of the people in the West and Southeast Departments of Haiti likely carry sickle cell associated mutations (14.4%) or G6PDd mutation (20.0%). These data support the need for wider sickle cell screening in Haiti and a recommendation for a lower primaquine dosage for malaria treatment to reduce the risk of hemolytic reaction in G6PDd patients. In sum, our study contributes to the limited knowledge of erythrocyte genetic disorders in Haiti with implications for erythrocyte genetic disorder and malaria public health policy.

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Vertebral body area profiles in primates and other mammals

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The endplates of human vertebral bodies increase steadily in size from C.2 downward. This trait is sometimes described as an adaptation to upright bipedality, in which each vertebra must carry more weight than the one above it. That analysis is supported by vertebral body area profiles in typical quadrupedal mammals, which have relatively larger cervical and smaller lower lumbar vertebrae than humans have. However, the profiles seen in humans are not explicable as adaptations to bipedality, because human-like profiles are also seen in non-bipedal primates, including great apes, baboons, and sloth lemurs. Wider comparisons suggest that vertebral body area profiles are influenced by both phylogeny and function.

Preservation and weathering of the human remains from the battle of Stoney Creek during the War of 1812

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Mass graves may be disarticulated, commingled and fragmented, restricting information obtained on such assemblages. Preservation analyses such as bone condition and completeness can produce important information about complex collections such as mass graves. A review of the literature suggests that preservation analyses are not always completed, and if they are, the number and description of preservation scores vary, making comparisons between collections difficult. Previously published literature is conflicting among which bones are most likely to be underrepresented in archaeological collections. Some authors suggest denser, larger elements are better represented, while others suggest the opposite. To address this question in the context of human remains and mass graves, a database of disarticulated and fragmentary human remains was used. Completeness was recorded using the Zonation method, and weathering was recorded using the scale presented by McKinley. Using the z-statistic, all the bilateral bones were found to be similarly represented in the collection ($p=0.05$). At a 5% level of significance, the small bones, including the metacarpals, metatarsals, calcanei and tali are differentially represented than the femora, tibiae and ulnae ($z=-7.93$), which is interesting when compared to the weathering data. This research highlights the importance of preservation analyses, and adds to the current literature on bone preservation in mass graves. Recognizing which bones are underrepresented, gives future researchers the opportunity to be more aware of these bones.

Abundance estimates for the nocturnal lemur community of Mangevo forest in southern Ranomafana National Park

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Little information is known about the nocturnal lemur communities of Mangevo forest in southern Ranomafana National Park. Mangevo is a relatively undisturbed forest located near the southeastern park boundary that boasts a high concentration of lemur species; ten species are present, half of which are listed by the IUCN as threatened. Two of the remaining species, *Lepilemur microdon* and *Avahi peyrierasi*, are listed as data deficient. While relative abundance estimates are available for the majority of the diurnal species, data for the nocturnal species are sparse. Our project aimed to fill this void by providing abundance estimates for the nocturnal species of Mangevo, comparing results from three periods across 10 years of sampling.

Line transects of various lengths (1.5/2km) were surveyed during the dry season of 2004, 2005, and 2013 for a total effort of 96.5 km

walked. We encountered only three of the five nocturnal species reported to be present. *Avahi peyrierasi* and *Microcebus rufus* were seen in all three years while *Cheirogaleus major* was not seen in 2013. *M. rufus* abundance estimates were similar across the years, as were the estimates for *C. major* the years it was encountered. Abundance estimates for *Avahi peyrierasi* increased from 0.05/km in 2004/2005 to 0.26/km in 2013. These results are lower than most estimates in the published literature; however, considering the ecological preference of *A. peyrierasi* and their mode of locomotion, it is possible that the site characteristics (i.e. forest structure) may be the cause.

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Effects of physical activity on sex differences in lumbar lordosis development in rural and urban Kenyan populations

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Lumbar lordosis varies greatly within populations and sexes, with females tending to have more lordosis than males. Lordosis develops primarily due to wedging of vertebral bodies and intervertebral discs. However, the relative strength and tone of the primary trunk flexors/extensors have also been shown to influence variations in lordotic angle (LA), suggesting an effect of physical activity. To test this, we collected cross-sectional data on LA, activity levels, and other variables in two groups of Kalenjin children ($n=117$) age 4-17 years. A rural group was recruited from a school in South Nandi where subsistence farming is the primary economy; a more sedentary urban group came from schools in the city of Eldoret. The rural and urban students differ markedly in activity levels and aerobic capacity (Gibson et al., 2013). Standing LA was measured on the surface of the back using a digital protractor to approximate the TRALL angle. In contrast to previous findings that LA increases gradually with age until puberty with no sex differences, we found no effect of age on LA in the overall sample. However, sex and activity had a significant interaction effect, explaining 20% of variation in LA ($p<0.001$). The sedentary group had significantly straighter backs than the active sample ($p<0.05$). Although LA remained constant with age in females, male LA decreased significantly with age ($r=-0.33$, $p<0.01$), more so in the rural group. These data suggest patterns of lumbar development are highly variable between populations, and sex differences in LA may be modulated by physical activity.

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Next steps and best practices in primatology, human biology, forensic anthropology, and paleoanthropology for the Bones and Behavior Project

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Recognizing the risks and limitations of isolation within biological anthropology, the NSF-funded Bones and Behavior Working Group was formed in 2007 in order to maximize comparability between behavioral, biological, and skeletal databases. The initial workshop and subsequent annual meetings resulted in the development of the *Integrative Measurement Protocol for Morphological and Behavioral Research in Human and Non-Human Primates* (www.bonesandbehavior.org), which is used by Working Group members and others to address research questions across biological anthropology and related fields.

We evaluate the lessons learned from these studies regarding how to implement and expand the protocol, and discuss which next steps will be most effective for integrating datasets across the discipline. The protocol emphasizes proxies for skeletal measures that can be taken on living/fleshed subjects. Current studies suggest a critical next step is to 'ground-truth' the relationships between these proxies and the skeletal measures themselves. Forensic anthropology and human anatomy offer unique means of corroborating human measures, and comparative anatomy studies can be easily expanded to include this component for non-human primates. Equally important are investigations of the magnitude of error with which 'skeletal' proxies, once used by behavioral researchers, can be related to protocol measures.

Human biologists and primatologists currently employing the Integrative Measurement Protocol can resolve this issue. We emphasize that we do not intend to provide 'best practices' for protocols within specific subfields, such as those pursued by SWGANTH (www.swganth.org), but rather to provide guidance for the application of the Integrated Protocol across subfields.

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Long term changes in primate social structure and population density: How important are climate change and non-equilibrium forest dynamics?

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Many of the theories in primatology require long-term data (e.g., fitness) or make assumptions about the stability of the environment (e.g., population equilibrium, competition), yet few field programs are sufficiently long-term. The red colobus (*Procolobus tephrosceles*) of Kibale National Park, Uganda are an exception having been studied almost continuously for over 40 years. Building on data from Struhsaker and others we demonstrate a series of changes including: 1) consistent changes in population density of primate species, 2) changes in the nutritional value of red colobus foods, 3) a progressive increase in the size of red colobus groups at local and regional scales, 4) dramatic changes in parasite infections, and 5) changes in the structure of old-growth forest previously assumed to be stable. For example, red colobus have acquired notable protozoan infections when they were absent 20 years ago and their groups have increased in size by as much as 40% in less than a decade. Explanations for these changes are typically not readily apparent. Thus, this long-term data leads us to question many existing models and serves to generate new hypotheses. For example, this long-term research points to the importance of deciphering the role of non-equilibrium forest dynamics and climate change in primate social structure and density.

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The utility of GIS in analyzing patterns of osteoarthritis in the people of the Erie County Poorhouse

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The assessment of osteoarthritis is a key component in understanding the daily lives of past people. The traditional approach to analysis is identifying and coding the severity of osteoarthritis on isolated articular surfaces. This

study focuses on documenting and analyzing overall and regional patterns of osteoarthritis using GIS software. The authors examined the utility of GIS in comparing patterns of osteoarthritis using skeletons excavated from the Erie County Poorhouse Cemetery. The authors propose that the use of GIS produces a more holistic picture of the effects of osteoarthritis than traditional methods. Individuals interred in the cemetery were often of low socio-economic status, had less access to healthcare and many were life-long laborers, thereby making them an ideal population for testing the utility of osteoarthritis pattern analysis.

From the 383 burials excavated, the authors selected 50 adult individuals for this study. In order to more effectively analyze patterns of osteoarthritis, an individual was selected only if their skeleton (including articular surfaces) were at least 80 percent complete. The presence and severity of osteoarthritis was digitized to produce a homunculus diagram. In order to allow for quantitative analyses, the images were used to create shapefiles. Linear models were used to examine the correlation between location and severity of osteoarthritis and demographic information. Differences in patterns among and between groups (sex, age, etc.) were noted. This study demonstrates that utilizing GIS allows for a more comprehensive investigation of osteoarthritis and its use may yield more information than traditional techniques.

The evolvability of conserved neurogenesis programs of the cerebral cortex

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Whether basic features of the organization of the isocortex such as neuron numbers per "cortical column" are constant or variable across species and cortical areas has been controversial. In general, it has been assumed that neuron numbers should be allocated to regions that underlie particular sensory or behavioral adaptations. The problem with this view is that there has been a lack of systematic analyses that relate changes in developmental processes with adult phenotypes. Here we focus on gradients in neurogenesis timing in the primate isocortex and how they relate to neuron numbers per unit of cortical surface area across its axis. We present a stereological assessment of neuron numbers in layers II-IV and V-VI in the isocortex of primate species (i.e., owl monkey, *Aotus trivirgatus*; tamarin, *Saguinus midas*; capuchin, *Cebus apella*). We find that neurons per unit of cortical surface area increase systematically towards the caudal pole of the isocortex. Layer II-IV neuron numbers account for most of the variation in total neuron numbers per unit of cortical surface area. These rostro-caudal gradients in neuron numbers in adulthood are mirrored in gradients in neurogenesis duration in development. The observation that neuron numbers per unit of cortical surface area vary globally rather than selectively across the isocortex does not support the notion that more neurons are allocated to particular cortical regions to bestow organisms with particular sensory or behavioral adaptations. Rather, these findings support the notion that the central nervous system evolves as a general computational device.

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The evolution of trabecular bone density in humans

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Modern humans are unique compared to our closest living relatives and early hominins in having an enlarged body size, enlarged joint surfaces, elongated lower limbs but also a relatively gracile skeleton. Most of these features appear ca. 2 Ma with the emergence of the genus *Homo*, and are generally considered to reflect a modern human-like body plan and gait. Our previous research has revealed that modern humans are also unique in having 'lightly' built skeletons, with low trabecular bone density throughout the limb joints compared with other anthropoids. However, when and how humans evolved low trabecular density remains unknown.

Here, we test the hypothesis that fossil hominins have reduced their trabecular bone density over the course of human evolution consistent with the temporal decrease in skeletal robusticity from the late Pliocene to the present. We use pQCT and microCT scanning to measure trabecular bone density in the lower and upper limb joints in samples of modern humans and other anthropoids, as well as fossils attributed to *Australopithecus africanus*, *Paranthropus robustus*, *Homo neanderthalensis*, and early *Homo sapiens*. Our results show that throughout the limb joints, mean trabecular bone density does not decrease in a temporally linear fashion. Instead, modern humans are unique in having low trabecular bone density compared with other anthropoids and fossil hominins, including fossils of early modern humans. These results suggest that only recent modern humans evolved low-density joints late in our evolutionary history, possibly corresponding with the shift to increased sedentism.

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Sex differentiation in late palaeolithic hand silhouettes: A new methodology

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Despite their prevalence in the archaeological record, the late Palaeolithic hand silhouettes found on cave walls throughout the Old World

lack the quantitative descriptions necessary to substantiate arguments for their symbolic meaning, especially those reliant on sex variation and representation in various cave contexts. The aim of this project was to quantify hand size variation via surface area analysis in order to determine whether or not sexing prehistoric hand silhouettes is viable. First, we tested whether hand silhouettes are accurate proxies for actual hands. Despite an absolute size difference, this held true, as real hand sizes follow the variation pattern of their silhouettes. We then hypothesized that the overlap in surface area across male and female hand silhouettes would be large enough to prevent researchers from accurately determining sex. Contrary to our prediction, hand sizes were bimodally distributed, with males and females statistically significantly different. The overlap between the sexes was not substantial enough to negate the distinctness of the two groups. This suggests that it is possible to identify the sex of these silhouettes with a high degree of confidence. This new methodology was applied to a scaled image of a Palaeolithic hand silhouette from Pech Merle cave, France, and the resulting sex classification differed from its previous attribution. These results emphasize the importance of applying more precise methodology to the determination of sex in hand silhouettes. In addition, they indicate that the difference between real and silhouetted hands must be kept in mind for more detailed analyses.

Factors affecting turnovers and takeovers in chacma and hamadryas baboon societies

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Polygynous and polygynandrous primates can vary in amount of reproductive skew depending on demographic and social factors. While higher-ranking males typically achieve higher reproductive success, reproductive opportunities are also available to subordinate males, who may rise in rank or take over females. Here we examine factors leading to turnovers and takeovers in two closely related primates – chacma and hamadryas baboons. Chacma baboons form multi-male multi-female groups in which males compete to attain alpha position. Hamadryas baboons form one-male units (OMUs) comprising a leader male, several females, and secondary “follower” males, who may take over females in the future. Our data on chacma baboons derive from two years of observations on three troops (MT1, MT2 and JT) in the Cape Peninsula, South Africa. Male membership fluctuated over time, with 3–8 males in MT1, 1–11 in MT2 and 2–6 in JT, and alpha status changed twice in each troop. Data on hamadryas baboons span seven years and 80 OMUs in one band at Filoha, Ethiopia. 82% (88 of 108) of hamadryas female takeovers occurred in OMUs with follower males. Here we compare the demographic and social factors allowing males to change their access to females, with a focus on the role of subordinate males on male

turnovers in chacma groups and of follower males on female transfers in hamadryas OMUs. Ultimately, we see far higher reproductive skew among hamadryas compared to chacma males, but some parallels in the social dynamics surrounding turnovers and transfers in each species.

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Genetic origins of central Asian populations: An examination of mtDNA sequence diversity

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Central Asia, a vast geographic area with a complex history, has played a major role in human evolution; however, the genetic origin of Central Asian populations is not well understood. The goal of this study is to examine the mitochondrial DNA (mtDNA) diversity of this region. A more complete understanding of the peopling of Central Asia would greatly improve our knowledge of the genetic consequences of widely disparate environments; complicated cultural phenomena; and the effects of conquests, expansions and migrations on human populations. Y-chromosome research suggests an early settlement of Central Asia by modern humans, while mtDNA studies indicate an admixed origin from differentiated Eastern and Western Eurasian gene pools.

For this study, complete mitochondrial genomes of individuals from Central Asia and neighboring areas were downloaded from GenBank. Sequence diversity was estimated and the significance of differences between populations was tested using nonparametric procedures. Genetic distances were calculated and genetic distance matrices were built. In addition, neighbor-joining trees were constructed to examine the genetic relationships of Central Asian populations with one another and with other Eurasian populations. The results of this study indicate that mtDNA sequence diversity in Central Asia is among the highest in Eurasia. This high mtDNA sequence diversity is likely the result of admixture within Central Asia between differentiated gene pools from Eastern and Western Eurasia.

Geometric morphometric assessment of cranial shape change in trigonocephaly

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The individual analyzed here suffered from a complex form of trigonocephaly, a condition thought to result from premature *sutura frontalis* fusion. Investigations of cranial changes in this condition have been limited in scope and based

on living individuals. Here we describe cranial shape change in the only known prehistoric case of trigonocephaly.

The individual derives from a prehistoric context on Santa Rosa Island (CA-SRI-24), dates to 1500-1650 AD, and is housed at the PHMA, UC Berkeley. Comparative skulls ($n=43$) are housed at the Institute for Craniofacial Study, UOP. The trigonocephalic is aged at 8.0 years ± 24 months while the normal crania range from 6.0-8.0 years. Ninety-three 3D landmarks were collected from normal skulls with a Microscribe 3D digitizer and from a CT scan of the trigonocephalic using Amira 5.5. Skull shape was explored using Principle Components Analysis (PCA) on Procrustes-aligned shape variables. PC1, clearly separating the trigonocephalic from the others, explains $\approx 26\%$ of the variance in the sample.

The PCA reveals major shape change in the frontal squama with flattening of the eminences/lateral squama. This flattening extends into the temporal fossae as they become narrow and anteroposteriorly elongated. The anterior cranial base appears stable. These changes are coupled with cranial shortening and supramastoid-level broadening. Maximum cranial breadth is displaced anteroinferiorly. Facial mask elongation, nasal cavity narrowing, and broadening of the palate are marked. The degree of shape change occurring in virtually all regions of the skull in this malformation is well beyond that currently documented.

An exploration of the utility of dental calculus in the study of diet in the middle Holocene Cis-Baikal

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The utility of dental calculus as a proxy for diet is explored for the middle Holocene Cis-Baikal region of Central Siberia. The study area was inhabited by two culturally and biologically distinct cultures, the early Neolithic (EN) Kitoi culture (8000 to 7000/6800 cal. BP) and the late Neolithic-early Bronze Age (LN-EBA) Isakovo-Serovo-Glaskovo (ISG) cultural complex (6000/5800 to 4000 cal. BP), separated by a period of cultural transition marked by a cessation in formal cemetery use. Data were collected from four cemetery sites, two predating the middle Neolithic biocultural ‘hiatus’ and two post-dating it. Individuals were scored for calculus on four separate tooth surfaces, using a standardized ranking system, in order to create severity indices for each individual. Mann-Whitney U tests show that the EN cemetery of Shamanka II exhibits considerably higher rates of calculus formation compared to the other cemeteries. Previous research has shown that the diets did not differ considerably between the EN and LN-EBA groups. This suggests diet is only one of many factors affecting calculus formation and, therefore, that other factors such as environment mask the direct relationship

between calculus and diet. Alternatively, samples were taken from ten individuals from each site to explore more direct ways of studying diet from dental calculus. This included microscopic analysis of inclusions within calculus, focusing on starch grain and phytolith identification, and isotopic analysis of carbon and nitrogen signatures. Presented is a promising first look at plants and other food stuffs in the diet.

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Effects of habitat fragmentation and isolation on the genetic diversity and structure of *Lemur catta* in south-central Madagascar

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Madagascar, renowned for its high degree of endemism and species richness, represents one of the world's priority biodiversity 'hotspots'. Due to persistent habitat destruction less than 10% of the original forest-cover remains, resulting in a highly fragmented landscape. Such severe alterations to the landscape pose a number of challenges for the fauna inhabiting these areas, such as a lack of dispersal opportunities, potential inbreeding, a loss of genetic diversity, and reduced reproductive fitness. Thus, Madagascar's endemic lemurs are now considered the most threatened group of mammals.

Knowledge regarding the population and conservation genetics of threatened lemur populations are essential to ensuring their viability, as well as future conservation efforts. This study is the first to investigate the effects of habitat fragmentation and isolation on the genetic diversity and structure of *Lemur catta*, a newly designated endangered species endemic to the southern regions of Madagascar. Non-invasive genetic samples were obtained from three wild populations of *L. catta* within south-central Madagascar. A total of 44 individuals from three populations were genotyped at up to eight polymorphic microsatellite loci. An analysis of molecular variance (AMOVA) was performed to investigate population structure and revealed the greatest amount of variation lies within populations rather than between, 87% versus 13%, respectively. Pairwise F_{st} values and Nei's genetic distance revealed moderate genetic differentiation for one of three populations. In addition, none of the populations showed a significant departure from Hardy-Weinberg. These preliminary data suggest that these populations maintain substantial diversity and are therefore appropriate targets for protection. *This study was supported by The Explorers Club Exploration Fund.*

Comparing the decline in ovarian follicle counts with age in chimpanzees (*Pan troglodytes*) and humans

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Humans, like other living members of the hominid radiation, have latest parturitions in the 40s but not beyond. This similarity suggests an ancestral rate of ovarian aging has been maintained while greater longevity with a post-fertile life stage evolved in the human lineage. Consistent with this hypothesis, a previous study found that the linear rate of decline in log-transformed follicle counts in chimpanzee (*Pan troglodytes*) ovarian sections was statistically indistinguishable from the decline in published human counts.

We use a larger sample (N=67) of post-mortem chimpanzee follicle counts to further explore the comparison. Following the methodology of the original analyses, we requested post-mortem ovarian sections at necropsy from primate research institutions. We then compared the rate of change with age in primordial follicle counts from single chimpanzee sections to that in whole human ovaries. Fitting non-linear models to the transformed counts showed that the rates of change in the age-specific counts are statistically distinct. Unlike the steep human slope over the age of 35, the chimpanzees in these ages exhibit virtually no decline with age.

These findings rely on notably small samples from chimpanzee in over 35 age classes, and variation in heterogeneity and mortality selection between the species likely contribute to our results. But we cannot rule out the possibility that the two species experience ovarian aging in different ways. Increasing the chimpanzee sample size continues to be a priority.

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Application of non-invasive endocrine profiling methods in wild bonobos (*Pan paniscus*); Iyema Forest, DR Congo

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Non-invasive examination of endocrine profiles in non-human primates has become increasingly common in recent years. Accordingly, methods for analysis have become more sophisticated and wide-ranging in scope, feasibility and cost. This study incorporated a range of methods, including urinary chemstrips, radioimmunoassays (RIA) and high-pressure liquid chromatography/mass spectrometry (HPLC/MS) to assess reproductive and energetic hormonal profiles in wild bonobos (*Pan paniscus*).

Using 199 urine samples collected between 2010 and 2011 from a semi-habituated community of wild bonobos at the Iyema study site, DR Congo I compare results from a HPLC/MS analysis for four steroid hormones

(androstenedione, testosterone, progesterone, and cortisol) with results from corresponding samples analyzed using commercial RIA kits for a) fecal glucocorticoids and b) urinary C-peptide of insulin. Cortisol, testosterone and C-peptide are all useful hormones when investigating energetics, while comparison of progesterone and testosterone levels potentially offers a means of discerning the sex of unknown individuals. Both comparisons are particularly appealing in situations where the study group is unhabituated. Samples were tested the day of collection for ketones and other biomarkers, and remaining urine was preserved on filter paper (Whatman 903 Protein Saver Cards) for analysis at Emory University. Results are compared against phenological data taken during corresponding months, representing seasonal patterns of 1805 individuals from 45 species of trees and lianas.

Holistic consideration of all these hormones framed in an ecological context offers the opportunity to discuss stress, energetics, and sexually differentiated behaviors from both theoretical and methodological point of views.

The project was funded by The Leakey Foundation, USFWS, and the Emory University Anthropology Department.

Mandibular correlates of somatic growth in chimpanzees and gorillas

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Subadult fossil mandibles are much more frequently preserved, and have more reliable taxonomic attribution, than isolated postcranial elements. Mandibular remains could potentially elucidate body size growth in fossil taxa, but it is not clear which mandibular traits track body size, if any. To address this problem, this study compares mandibular and somatic growth in wild-shot *Pan troglodytes* (n=38) and *Gorilla gorilla* (n=30) from the Powell Cotton museum. Somatic data include up to four anthropometrics (height, head+body length, chest girth, and arm span) taken either in the field or upon dissection, and up to 20 mandibular dimensions were measured on corresponding specimens. Samples span several dental eruption stages, and sexes are pooled because of limited sample sizes.

Correlations between mandibular and somatic dimensions are generally high. In both species, antero-posterior corpus and ramus lengths are most highly correlated with all somatic dimensions ($r > 0.93$), while posterior corpus breadths are least correlated ($r < 0.50$). Regression analyses further show that many mandible-body relationships follow similar patterns of scaling between species. Importantly, mandible-body relationships with the highest correlations in each species also show the most similar scaling between species (e.g., ramus length and body height). Nevertheless, there are species differences. For instance, most correlations are higher in *Gorilla* than in *Pan*, especially those involving corpus and ramus height. The generally high correlations between mandibular and somatic ontogenetic allometries, and the comparability of scaling between species, suggest fossil species' growth and life history may be reliably reconstructed using mandibular remains.

A branch-and-bound method for recognizing similarly-shaped anatomical features using landmark coordinate data

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Many studies of landmark coordinate data focus on aspects of shape where two or more observations differ most. However, there are other times when an investigator's interest is in finding the localized anatomical regions where these same observations differ *least*. One example would be identifying shapes that remain conservative in the course of growth or evolution; other applications might include surgical planning or facial recognition. This study presents a new method for identifying subsets of landmarks that describe locally similar shapes, even though they may be parts of larger landmark configurations that are very different in an overall sense.

Comparing shapes for every possible landmark subset is computationally infeasible for even a moderate amount of landmarks. As an alternative, a branch-and-bound search algorithm is developed, where the search for similarly-shaped landmark subsets is considered a variant of the maximal cliques problem, studied in computer science and operations research. Not only does a branch-and-bound approach make the search computationally feasible, but it guarantees that all similarly-shaped landmark subsets are found. The objective function for the search is based on Euclidean distance matrix analysis, ensuring that comparisons are both coordinate-system- and scale-invariant.

The algorithm is demonstrated first with hypothetical data and then with a comparison of skull shapes between a sample of children with Apert syndrome and an age-matched normal sample. The results reveal some localized parts of the Apert syndrome face that are normally shaped, but abnormally oriented with respect to one another, "hinging" in the upper face.

Bergmann's rule in human females: A reassessment

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It is widely accepted that humans conform to Bergmann's rule, which holds that body size in endothermic species will increase as temperature decreases. However, there are reasons to question the reliability of the findings on which this consensus is based. One is that the main studies that have supported the idea that humans conform to Bergmann's rule have employed samples that contain a disproportionately large number of warm-climate and northern hemisphere groups. Recently, we have shown that when these biases are controlled for, the hypothesis needs adjustment with respect to men (Foster and Collard [2013] PLoS ONE 8, e72269). Men conform to Bergmann's rule but only when there are major differences in

temperature among groups. Here, we report a study that investigated whether female body size variation correlates with temperature in a similar fashion. The dataset comprised values for four body size and two temperature variables, for 177 groups. We stratified samples by latitude and carried out both global and hemisphere-specific analyses. The global sample conformed to Bergmann's rule even when the warm-climate bias was controlled. However, when the northern and southern hemisphere groups were analyzed separately, the degree to which women conformed to Bergmann's rule varied depending on the body size and temperature variables used. The pattern in question was different from the one obtained for men. Thus, the study supports the idea that Bergmann's rule only applies to humans in certain circumstances, but also suggests that there are differences between men and women with respect to thermoregulation-related selection.

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Where are the warriors? Trauma and violence in Roman Iron Age Denmark

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The Roman Iron Age (RIA) was a time of considerable change in Northern Europe. During this period (AD 1-400), archaeological remains in Denmark demonstrate increasing evidence of violence through the construction of defensive structures, bog deposits of weaponry and human remains, and Roman written accounts describing a warlike society. Despite the potential archaeological evidence for violence, trauma analysis of 373 individuals from the Danish island of Sjælland demonstrates very few indications of violence-related trauma.

The skeletal remains from Sjælland were macroscopically analyzed for trauma. Only 17% (n=64) showed evidence of ante- and perimortem injuries and trauma was better attributed to occupational and accidental mechanisms than violence. There was a significant difference in the frequency and distribution of trauma between the Early and Late RIA, with a higher frequency in the Early RIA. The distribution in the Early RIA was highest in the spine and spread evenly between males and females. In the Late RIA, the distribution was predominately male and cranial trauma had the highest frequency.

While the distribution in violence-related trauma was not statistically significant between the two periods, the shift in distribution to predominately male individuals and from the spinal region to crania supports the increase in violence-related archaeological material at the beginning of the Late RIA. By placing this analysis within the specific cultural context, the archaeological and skeletal evidence suggests that this cultural group engaged in violent practices or exploited violence in ways that did not necessarily lead to conflict and physical trauma.

Get a grip: How does arboreal substrate orientation affect hand and foot use in primates?

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As arboreal substrate orientation increases, forces required to locomote on the substrate must also increase, because the animal's mass becomes increasingly aligned with the force of gravity. However, the relative magnitude and distribution of autopodal pressure across the digits, or between autopods, during arboreal locomotion on differently oriented substrates has yet to be explored experimentally. Without knowing how autopod grasping pressure factors into arboreal locomotion, important functional patterns may be overlooked. In this study, an artificial arboreal substrate was instrumented with a pressure-sensing pad. Grasping pressures across the hand and foot of 4 adults (2 male, 2 female) from 3 species of lemur (*Lemur catta*, *Propithecus coquereli*, *Varecia variegata rubra*) were collected during above-branch, vertical and below-branch locomotion. Mann-Whitney U-tests were used for pairwise comparisons of the average pressure exerted by the total hand/foot to the pressure exerted by the pollex/hallux and lateral digits within each species at each orientation. Findings demonstrate that autopod use varies at different orientations. Across orientations, higher lateral digital pressures are exerted in both hands and feet during suspensory postures. Between autopods, the hallux exerts significantly higher pressures than the pollex only in suspensory and vertical postures. Lateral pedal digits exert greater pressures in suspensory and vertical postures than manual digits, but lower pressures in above-branch postures. These experimental results demonstrate that autopod use varies across hands and feet at the same orientation, and within the same autopod at differing orientations, confirming the complexity of hand and foot use during dynamic arboreal locomotion in primates.

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Palate shape and diet in *Homo sapiens*

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While it has been previously established that mandibular morphology varies in response to diet, the association between palate shape and diet is poorly understood in *Homo sapiens*. This project addresses this gap in our knowledge. We hypothesized that there are differences between the palate shapes of non-agricultural human

populations who subsist on coarser, less easily processed food items and agriculturists who largely consume softer, more frequently mechanically-processed food items. Additionally, we hypothesized that hunter-gathers have palates that are wider and shallower than agricultural populations as a result of greater masticatory forces placed on the palate both during growth and development, and throughout the lifetime of the individual. To test these hypotheses, we employed three-dimensional geometric morphometric techniques. Three-dimensional surface scans of human crania were landmarked with single points and semi-landmark curves on the face, neurocranium, and palate region. Specimens include recent modern humans of European and African ancestry from the W.M. Bass Skeletal Collection, agricultural French and Austrians, Khoisans, southwestern Amerindians, and Point Hope Native Alaskans. Results indicate a substantial amount of variation in palate shape with no clear partitioning along ancestry lines in the modern Americans—an important finding given the regional diversity of our sample, and indicate that diet does have an effect on palatal morphology. Establishing the range and types of palatal shape differences across modern *Homo sapiens* has important implications for understanding morphological changes that have occurred in response to shifts in substance strategies over the course of human evolution.

The many layers of cranial vault thickness: Cranial vault composition, but not thickness alone, may be autapomorphic in Pleistocene hominins

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Extremely thick cranial vaults have been noted as a diagnostic characteristic of *Homo erectus* since the first fossil of the species was identified, but potential mechanisms underlying this seemingly unique trait have not been rigorously investigated. Cranial vault thickness (CVT) is not a monolithic trait, and the responsiveness of its layers to environmental stimuli is unknown.

Measurements of cranial vault thickness in fossil hominins were obtained from the literature and supplemented with additional measurements taken on African fossil specimens. Total CVT and the thickness of the cortical and diploë layers individually were compared to measures of CVT in extant primates measured from more than 500 CT scans of female human and non-human primates.

Frontal and parietal CVT in extant and extinct species were regressed against species mean cranial capacity, and deviations from the extant species regression calculated. Even after controlling for cranial capacity, African and Asian *Homo erectus* do not have uniquely high frontal or parietal thickness residuals, either among extinct hominins or extant primates. Extant primates with residual CVT thickness similar to or exceeding *Homo erectus* (parietal residual Asian specimens: 0.694, African specimens: 0.453) include *Alouatta caraya* (0.573), *Perodicticus potto* (0.590), and *Nycticebus coucang* (0.593). However, the especially thick vaults of extant non-human

primates that overlap with *Homo erectus* values are composed primarily of cortical bone, while *Homo erectus* and other hominins have diploë-dominated vault bones. Thus, the combination of thick vaults comprised of a thickened diploë layer may be a reliable autapomorphy for members of the genus *Homo*.

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New 1 Ma old human cranial remains from Mulhuli-Amo, near Uadi Aalad, Danakil (Afar) depression of Eritrea

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Field work carried out in the northern part of the Eritrean Danakil depression led to the discovery of a late Early Pleistocene sedimentary succession outcropping south of Buia. Identified within a 25 m-thick spot at Uadi-Aalad (UA), the LK3 *Homo*-bearing layer consists of deltaic and fluvial deposits dated to ca. 1 Ma. Together with postcranial and dental remains, it has delivered a virtually complete adult cranium (UA 31) displaying a blend of *erectus/ergaster*-like and progressive morpho-architectural features, including a high positioning of the most external parietal points, a weak angulation along the midline and slight parasagittal flattening, thin parietal bones, and from sub-vertical to slightly downwards converging lateral walls. Whether such parietal bossing is a structural consequence of dolichocephaly, the expression of individual/regional variation, or a derived feature with possible phylogenetic relevance remains undetermined.

Since 2010, we have been intensively investigating the sedimentary succession of Mulhuli-Amo (MA), which stratigraphically correlates with the 4.7 km apart LK3 outcrop. Spread over an area of ca. 9000 m², the site has provided ten cranial and dental human remains from likely three individuals.

Besides an isolated frontal fragment bearing a thick torus (MA 14) and a permanent lower molar crown (MA 93), we collected so far eight parietal (MA 64 and 88a-f) and temporal (MA 89) fragments from a single adult individual. Six specimens articulate into an almost complete left parietal (MA 88) including the asterion region, whose structural (thickness distribution) and

architectural features (proportions, curvature) closely fit the morphology anticipated by UA 31. *The Buia Research Project is funded by: Eritrean Authorities for Cultural Heritage, Italian Ministry for University and Research, "Sapienza" University of Rome ("Grandi Scavi"), Italian Ministry for Foreign Affairs.*

Contribution of virtual 3D reconstruction and printing (VIR COPAL®) to paleoanthropology: The case of the Neanderthal Subalyuk 2 child skull (Bukk Mountains, Hungary)

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Methodological developments in medical imaging, computer sciences and rapid prototyping technologies offer new possibilities for research in Paleoanthropology.

In this perspective, our team has elaborated a digital imaging chain dedicated to anthropology, going from (micro)-CT acquisitions to 3D printing (VIR COPAL®), based on a specific software program (Treatment and Increased Vision for Medical Imaging-TIVMI®) developed by one of us (B.D.). It implements a 3D HMH (Half Maximum Height) algorithm that ensures a high fidelity digital model from CT data of fossil specimens. The 3D reproduction by rapid prototyping, using liquid resin (such as Objet® Eden series), provides a 40µm resolution for a more precise rendering of the surface and thus a better texture reproduction.

These advances led us to develop dedicated resources for training and research in paleoanthropology and paleopathology.

Taking as an example the Neanderthal child skull of Subalyuk 2 (Northern Hungary), we reconstructed missing or damaged parts, corrected most of the cranial deformations, re-associated isolated fragments to the skull and then printed a restored version of this fossil specimen. This virtual restitution will allow new comparisons with other immature specimens of the Neanderthal lineage. This approach illustrates the interest of 3D digital chain for research, training and heritage preservation applied to studies on human evolution.

The original fossil is kept in the Department of Anthropology of the Hungarian Natural History Museum which supported our joint research.

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Within and between group agonism in male mantled howlers (*Alouatta palliata*) living in a fragmented habitat at La Pacifica, Costa Rica

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Understanding the nature and extent of a species' behavioral flexibility has become particularly important as many primates are increasingly impacted by anthropogenic change such as habitat fragmentation. However, we know little about how habitat fragmentation may affect primate social interactions, particularly among male primates, who are expected to maintain competitive relationships to structure access to females. I examined and compared intergroup encounter (IE) and agonistic interaction (AI) rates among males in two large mantled howler groups (G2: N=4; G12/42: N=4 to 3) within a highly fragmented habitat at La Pacifica, Costa Rica. I collected 1751 H of behavioral data on adult males from Jan-Dec 2010. Both groups were of similar size and sex ratio, inhabiting the same upland forest type, but in fragments of differing size, shape, and level of isolation. The group living in the smaller, irregular, and more isolated fragment had fewer group neighbors, experienced significantly lower IE ($p=0.002$), and higher AI rates ($p=0.014$) than the group inhabiting the larger, more intact fragment with a higher percentage of forest connectivity. When compared to reports from other mantled howler study sites, results suggest that male mantled howlers living in fragmented habitats may be under greater pressure to compete for resources than males living in more intact forests. However, males may adjust competitive relationships (i.e., become more tolerant within groups as IE rates increase) as fragment characteristics vary. While preliminary, these data provide a valid starting point to better understand the link between habitat fragmentation and social behavior in primates.

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The function of scent-marking in territorial owl monkeys

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Examining mechanisms by which territoriality is maintained helps identify factors that may have driven the evolution of social and mating patterns. Owl monkeys are socially monogamous primates that live in small, territorial groups consisting of an adult pair and a few young. If scent-marking plays an important role in territory defense we predict that it will occur more frequently in the periphery of the home range. To examine this hypothesis, we evaluated the spatial distribution of scent-marking within territories of four Azara's owl monkey groups (*Aotus azarae*) in the Gran Chaco of Argentina. We observed these groups during a three-year period, and used

kernel density estimates to determine core (50%) and periphery (45%) areas within a 95% volume contour home range. We recorded 103 instances of scent-marking (urine-washing and face, pectoral, and sub-caudal rubbing). The majority of them ($n=73$) were sub-caudal rubbings, and nearly all ($n=102$) occurred within the 95 PVC of home ranges. Three groups scent-marked more frequently in the core area (range 64% – 76%), and the fourth one in the periphery (83%). Our data do not support the hypothesis that scent-marking is related to the defense of a home range. Instead, we propose that the distribution of scent-marking within a territory may be related to resource defense and/or to intra-group communication. Further examination of scent-marking in both field and laboratory settings is needed to assess other potential functions of scent-marking in owl monkeys.

Rethinking night monkey's nocturnality

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As the only nocturnal anthropoid, there are multiple hypothesis regarding night monkeys' nocturnality and the secondary shift towards cathemerality in one species. Predation, competition and unfavorable climate conditions are among them. It has been recently proposed that the shift in their circadian cycle is influenced by temperature and fluctuations in light availability in the seasonal and high latitude localities where the only cathemeral species, *Aotus azarae*, occurs.

We studied a group of Andean night monkeys *A. miconax* in the cloud forests of the Private Reserve Huiquilla in Amazonas, Peru, at an altitude range of 2800-3000 masl, for 17 months. Annual temperatures during the night fluctuated between 3 and 12 °C. The forest is dominated by Lauraceae trees, which represent 47% of the tree diversity of the area. This site harbors no other species of primates, one species of medium sized nocturnal arboreal mammal, and a potential diurnal predatory species, the black and chestnut eagle.

Through scan samplings, the group's activities were recorded from sunset to sunrise, with a total of 675 hours of follows. We also monitored sleeping trees during daylight for a total of 31 days. They exited the sleeping tree at dusk, returned before sunrise and no diurnal activity was observed during the study period. Given the fact that *miconax* show no diurnal activity despite the low temperatures, in contrast to *azarae*, we believe that activity patterns in *Aotus* may be influenced by more complex dynamics in addition to temperature fluctuations and light availability.

This research had been funded by International Primatological Society, Mohammed Bin Zayed Species Conservation Fund and Overbrook Conservation Fellowship Award.

Early Miocene catarrhine fossil localities at Napak, Uganda: Geologic, faunal, and

isotopic analyses reveal contrasting paleoenvironments

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Early Miocene catarrhines document fundamental shifts in locomotion and diet that are tied to the origin and diversification of hominoids. Understanding the adaptive significance of these characteristics requires studying them in the contexts in which they evolved. Fossil localities associated with the Napak volcano in Uganda represent an ideal context to investigate these shifts, as they have produced six species of fossil catarrhine primates. Here, we report results from our geological and paleontological research at two recently discovered localities: Napak CC and CCI. To date, there are approximately 2000 vertebrate fossils from these localities, with catarrhines more common at CC. Although both localities are ~20 Ma, CCI formed during the early stages of the volcano on a gently sloped floodplain. In contrast, CC sediments were deposited later as high-energy channel debris on the mid-slope of the large and active volcano. Differences in site formation processes are reflected in the preservation, body part distribution, and taxonomic composition of these fossil assemblages. Cluster analysis demonstrates that the overall community structure at Napak CC is similar to most other Napak localities (I, IV, V, and IX) and likely represents a montane forest community. Napak CCI represents a relatively open habitat characterizing incipient volcanism on the metamorphic basement peneplain. Furthermore, isotope analysis of herbivore enamel from these localities reveals relatively C¹³-enriched enamel values for CCI, indicating water stress, higher irradiance, and potentially less canopy. Overall, our results suggest that catarrhines at Napak are associated with the more forested communities on the developing volcano.

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Differences between biological and chronological age: Is it possible to measure the rate of aging in bones?

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A reliable method to estimate biological age (BA) that approaches perfect correlation with chronological age (CA) has for long proved elusive. The aging process has complex sets of variabilities – importantly those that contribute to quality of life – that impact on rates of aging. Then why should BA be expected to match CA? Analysis of Tooth Cementum Annulation (TCA) to estimate age has proved to have a closer relationship to CA in known age populations, because its nature makes it less susceptible to variability in aging. This study considers that in

populations of unknown age, TCA can be used as a reliable reference to CA, and that age estimated by auricular surface (AS) and pubic symphysis (PS) may be considered closer to the "true global state" of BA. Two modern (Mexican) ($n=33$ (known age); $n=26$) and one archaeological populations ($n=21$) were analysed. The results show that CA-TCA are strongly correlated ($r=.992$, $p<0.01$) and the differences in years were not significant ($p>0.05$; $M=1.95$, $SD=1.32$). The mean differences in years between CA-TCA and AS-PS varied from 4.31 ($SD=3.66$) to 6.49 ($SD=6.7$). This study concluded that TCA could reliably be used to establish CA, but more importantly, that the discrepancy between CA-AS/PS and TCA-AS/PS could be as a result of differing rates of aging, and not obviously to the inaccuracy of morphological methods. However, one must be cautious with the age category >60 . Further comparative analyses between CA-TCA and AS-PS will likely give new clues about rates of aging, in past populations.

Biomechanical perspectives on starvation and malnutrition in immature individuals

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While methodological advances have been made in detecting disease and malnutrition from skeletal remains, many indicators of physiological stress in the past are non-specific and have multifactorial etiologies. Given the well-documented link between diaphyseal cross-sectional geometry and body mass in immature individuals, it may be possible to detect declines in body weight through analyses of lone bone strength. This research explores this possibility in two ways. First, the hypothesis that reduction in body mass affects cross-sectional strength but not articular surface size is tested in a previously published mouse model. Second, the relationship between cross-sectional properties and articular surface size is evaluated in seven diverse populations of immature humans.

The results of this analysis confirm that reduction of body mass in mice results in statistically significant reductions on femoral cross-sectional area, but not in proximal or distal articular surface size. In immature humans, body mass was estimated using two sets of formulae based on either femoral polar second moment of area (Robbins et al., 2010) and femoral distal metaphyseal breadth (Ruff, 2007). Differences in body mass estimates exist among populations ($p<0.001$). In particular, at the site of Kulubnarti, which has well-documented evidence of nutritional stress, individuals under age 12 show significantly lower values in body masses estimated based on polar moment of area. While previous research has focused on the utility of cross-sectional properties for reconstructing activity patterns, the extremely close relationship between body mass and long bone robusticity may make it possible to detect starvation via a functional perspective.

Duffy's Cut: A brief report of the bioarchaeological findings from a massacre of Irish immigrant railroad laborers from 1832

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Contemporary newspapers record that between 5 and 9 men from Duffy's Cut died in a cholera epidemic in August of 1832; however, official railroad documents list all 57 men laboring at the site as deceased. Historical research into the event revealed major gaps and inconsistencies between newspaper accounts, official documents, and oral traditions of the area, leading to a more in-depth historical investigation and eventually the discovery of the location of the burials in March 2009.

Archaeological excavations at Duffy's Cut began with the intention of uncovering the sequence of events that led to the deaths of the 57 Irish laborers, and the expectation of finding a mass burial of these men in the embankment that they were constructing for the railroad tracks. However, during the Summers of 2009-2011, the team uncovered the burials of seven individuals, each buried in coffins, evidencing very traditional Catholic burial rights, but all with traumatic head injuries. Completed investigations and analyses of the site have so far consisted of geophysical surveys, bioarchaeological excavation, and bio-anthropological skeletal analysis. The information gathered from the site has led to a complete rewrite of the story of Duffy's Cut, which blends together various aspects of all the different accounts of the massacre and introduces new elements that had previously been lost to history. Future investigations of a large anomaly on the geophysical survey will hopefully yield the remaining 50 men and a full understanding of the events that transpired at Duffy's Cut.

Genetic structure of island Carib populations

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The Islands of the Caribbean were populated by the expansion of Arawk indigenous populations from Venezuela, followed by a Carib invasion in 1400 AD. This Native population intermixed with escaped West African slaves after European Contact. Depopulation decimated the region with only two islands: St. Vincent and Dominica providing refuge for Native American settlements. Research was initiated in 1975-1982 in Belize, St. Vincent and Guatemala and in Dominica Carib Reserve in 2005. The purpose of this study is to characterize the genetic structure of Caribbean populations and ascertain admixture patterns in Native American and African populations of Dominica.

The Carib Reserve of Dominica contains the highest proportion of Native American maternal genes (mtDNA RFLPs and sequencing HVS1) in Caribbean populations with 58%, and 16% African. This estimate is based on the 50% of the

mtDNA haplogroups are C, and the remainder 8% belong to the A haplogroup. Krawczak (2012) indicated that among the Black Caribs of St. Vincent Island 44% of the haplogroups are Native American (similarly A and C) and 47% African. The African component was detected by the presence of L0, L1 and L2 mtDNA haplogroups. Both STRs and SNPs were used to estimate Native American and African admixture in Dominica.

This study indicates: (1) that there are few remnants of the Arawak-Carib populations in the Caribbean; (2) the transplantation of the Black Caribs from St. Vincent Island to Honduras has successfully "preserved" the genetic structure of hybrid Island Caribs in Central America.

New insights on the role of tubers in hominin evolution: Data from the Hadza hunter-gatherers of Tanzania

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The ability to exploit underground resources, such as tubers, is argued to have been a significant part of the early *Homo* foraging repertoire that would have allowed for survival in a savanna environment. The diets of contemporary hunting and gathering populations are often recruited as a reference standard for the evolution of human nutrition and as a potential representation of the early hominin diet. Despite the significance placed on the diets of foraging peoples, few quantitative nutrition studies are available. Here, I outline the contribution that tubers make to the annual Hadza diet and provide nutritional composition data (including energy values) for four species of tuber: matukwayako (*Coccinea surantiaca*), //ekwa (*Vigna frutescens*), shakeako (*Vigna macrorhyncha*), and shumuwako (*Vatoraea pseudolablab*). In addition, results from an ethnoarchaeological project where the Hadza peeled and processed wild tubers using Oldowan replica stone tools are also presented. These data are then situated in an evolutionary framework to further our understanding of the role of tubers in hominin evolution.

Democracy or despotism? How do baboons decide?

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Living in a group means not necessarily being able to do what you want to do, when you want to do it. When group composition is heterogeneous and members have different needs and capabilities, some individuals must compromise their preferred patterns of behavior, presumably at some cost to themselves, to prevent group dissolution. How do animal groups reach a consensus about where to go or what to do? Collective decisions like these are a primary challenge of group-living, but despite

substantial theoretical attention, the strategies social animals use to achieve consensus remain largely unknown. To address this gap, we placed high resolution GPS collars, which record one location per second, on the adult and subadult members of a baboon troop (*Papio anubis*) at the Mpala Research Center in Laikipia, Kenya. For each baboon dyad, we calculated the average time-lag between (a) one individual changing direction and the other aligning itself with the new travel trajectory (time to directional alignment-TDA), and (b) one individual transitioning from an inactive to active behavioral state (time to behavioral synchrony-TBS). To test the predictions of theoretical models, which suggest that dictatorial processes should be more common in decisions about *where* to go than decisions about *when* to go, we examined the structure of these TDA and TBS networks. Contrary to previous studies, we found little evidence that the alpha male determined the direction of group travel. Instead, leadership appears to be distributed, and varies depending on social and ecological context.

Funding for this research was provided by the Max Planck Institute for Ornithology, the Smithsonian Tropical Research Institute, and the Department of Ecology and evolutionary Biology at Princeton University.

An Anglo-Saxon child burial with evidence of a brain tumour: A discussion of the pathology, unusual burial context and possible socio-cultural perspectives

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Neoplastic disease, especially malignant disorders, involving the human crania is well documented in archaeological populations. However, examples of benign soft tissue lesions are less common. This case study examines the evidence for an occipital tumour in a juvenile from an Anglo-Saxon period (c.7-9th century AD) site in England. Osteological examination indicated an otherwise healthy individual 6-7 years old, possibly male, with a skeletal morphology and stature similar to a modern American child. Differential diagnoses, etiology and possible physiological effects of such a tumour are discussed. A small, circular, penetrating lesion, c.3mm externally, was located inferior to the lambdoid suture. Further macro- and microscopic examination revealed endocranial remodelling that suggested a slow-growing, vasculated soft tissue mass. Elevated intracranial/localised pressure in the occipital lobe can cause significant disruption of the visual processing functions of the brain. While this individual does not display extreme pathology, the minimal skeletal changes may indicate extreme physical/behavioural disorder. This case is an important addition to the knowledge of neoplastic disease in the past. It highlights the need for special attention to endocranial morphology and the possible significance of subtle changes. In addition, the value of contextual evidence is highlighted as potentially supporting physical diagnosis. The juvenile formed part of an unusual burial. He was placed in a woman-horse burial, his body replacing the fore-portion of the horse. The

context suggests the child (pathological condition?) was deemed to require special burial procedures. In turn this may give support that the child expressed psychological/physical symptoms of the neoplasm.

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Can oxygen isotope values distinguish niche divergence in mammalian communities?

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Stable isotope data provide insight into the foraging ecology of cryptic and extinct animals by preserving a quantitative record of food and water assimilated into body tissues. Traditionally, carbon and nitrogen have been used to infer dietary and habitat differences among species. However, oxygen isotopes may be more effective in densely forested, arid, or ancient environments. We examine carbon, nitrogen and oxygen isotope values in bones from a diversity of mammals from a dry forest and a moist forest in Costa Rica and test the following predictions: (1) Isotope values are higher in the dry than the moist forest, (2) Carbon isotopes predominantly reflect feeding height within the forest canopy; (3) Nitrogen isotopes distinguish animals that consume more and less animal matter, but not fruits versus leaves; and (4) Oxygen isotopes distinguish folivores, frugivores, carnivores and insectivores and may also reflect feeding height.

Oxygen and nitrogen isotope values are higher in the dry forest. We find significant differences in carbon isotope values among dietary categories, yet no differences among animals feeding at different canopy heights, or among localities. Nitrogen isotope values separate herbivores from faunivores. Folivores have higher oxygen isotope values than frugivores, and faunivores have lower oxygen values than herbivores. Trophic omnivores exhibit a range of values for each isotope. Our findings shed new light on patterns of isotopic differentiation among animals with varying foraging strategies. Establishing these patterns can help identify ecological niches of cryptic or rare living species and may reveal differences among now-extinct organisms.

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Intra-site variability as a mean to assess population dynamics using dental morphological traits

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Dental morphological traits are commonly used to estimate population affinities and migratory patterns among archaeological

populations. In contrast, they are not used to estimate the extent of variability within each series. From a theoretical perspective, higher degree of variability should be related to more intense gene flow. The present paper presents new approaches to estimate intra-site variability using dental morphological traits that are dichotomized into presence/absence. It rests on the theoretical assumption that the maximum variability is reached when each trait is expressed with a frequency of 0.5. The first approach calculates $2^x \cdot y$, where x and y are the frequencies of "presence" and "absence" of each trait by simulating the heterozygosity of simple Mendelian traits. The second approach calculates the absolute deviation from the expected 0.5 threshold. The means are then calculated for all the traits analyzed for all sites. Seventy-nine traits were scored in 11 Prehispanic Maya skeletal collections from the Yucatán Peninsula. Average values are related to the sites' position within the region's political and economic sphere of influence. Collections obtained by grouping together many sites from a single region present the highest values of internal variability, followed by sites known to have played an important role in trade activities or in other socio-political contexts of exchange. The lower end of the internal variability scale is represented by smaller communities or kin-related isolated groups. Although intra-site variability does not reveal the direction of gene flow, it represents one more method to reconstruct ancient population's dynamics

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New estimates of body mass in KNM-WT 15000

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Recent analyses suggest that KNM-WT 15000 experienced a pattern of growth and development intermediate between modern humans and chimpanzees, and therefore was nearing the end of his growth cycle at death. Consequently, he would have only attained an adult stature of approximately 163 cm. Given the combination of decreased stature and an intermediate growth trajectory, it is logical that KNM-WT 15000 would have also attained a lower adult body mass than previously estimated.

In this study, we used reduced estimates of stature, age-at-death, and growth rates to re-estimate KNM-WT 15000's adult body mass. We created hypothetical growth curves for this specimen using baseline chimpanzee and South African modern human growth curves. We used the software program Engauge® to generate numerical data for the baseline velocity curves, developed intermediate growth curves, and accelerated the schedule of life history events to create conceptual growth models for *Homo erectus*. We estimated juvenile body mass-at-death using new, wider estimates of living bi-

iliac breadth for KNM-WT 15000, and increased this value by the area remaining under the hypothetical growth curves to produce estimates of adult body mass.

Our results suggest that KNM-WT 15000's adult body mass would have ranged between 62.6 and 66.6 kg. Along with the new pelvic reconstructions and stature estimates, these figures suggest that KNM-WT 15000 would have been shorter, lighter and stockier as an adult than previously predicted, which has important implications for reconstructions of *Homo erectus* life history, energetics, and evolution.

Patterns of dental macro-wear in sub-fossil *Lemur catta* (~ 500 BP) from Ankilitelo, Madagascar: Indications of ecology and habitat use

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Ankilitelo, Madagascar (~500 BP) was originally a transitional habitat between dry deciduous forest and spiny bush. It preserves a wide range of extant and recently extinct subfossil lemurs including the extant taxa *Lemur catta* and *Eulemur fulvus*, which today are rarely found in sympatry. We collected tooth wear data from Ankilitelo *L. catta* and *E. fulvus*, to compare wear in sympatric, related forms. Wear was scored using an ordinal scale from zero to five. Mean wear for *L. catta* ranges from 1.333 for p2 (n = 6) to 1.793 for m1 (n = 29). Mean wear for *E. fulvus* ranges from 1.400 for p2 (n = 5) to 2.455 for m1 (n = 11). For both m1 and m2, *E. fulvus* displays significantly more wear (p < 0.05) than *L. catta*. As Ankilitelo represents one of the most southerly samples of *E. fulvus*, these wear data suggest that 500 years ago, the diet of *E. fulvus* near the edges of its geographic range included mechanically challenging foods, similar to gallery forest *L. catta*, where frequently eaten foods lead to notable and sometimes extreme wear. In contrast to *E. fulvus*, these data indicate that sympatric *L. catta*, at 500 BP, was using foods along the boundary between the spiny and deciduous forests that were not significantly impacted by human actions, and for which they were dentally adapted. These data also suggest that this non-gallery forest habitat may be the "adaptive home" of *L. catta*, given the lack of notable tooth wear.

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Marital status, maternal deaths and bone mineral density in the Coimbra Identified Skeletal Collection

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In order to evaluate the overall effect of reproductive dynamics on bone mass in a

historical sample, bone mineral density (BMD) at the proximal femur was assessed by dual-energy X-ray absorptiometry in a base-study of 78 young women (17 – 39 years) from the Coimbra Identified Skeletal Collection. BMD was compared within the skeletal base-study («maternal deaths» [ICD – 10: chapter XV] vs. «other causes of death», and «married/widowed women» vs. «single women»). Also, BMD patterns of decline with age were compared with age-matched women from two modern Portuguese reference samples – acknowledging that the prototypical reproductive histories were different amongst these groups. Results showed that mean BMD differences among groups are not significant. As such, a direct association between reproductive factors and premature bone loss in young women from historical contexts is not sustained by empirical evidence.

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Toward defining “mosaic” in paleoanthropological contexts: Examples from Woranso-Mille, Ethiopia and La Senèze, France

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Many reconstructions of paleoenvironmental conditions at hominin sites are classified as “mosaic”, but what is meant by this term? In neoecology, the heterogeneity (mosaic of habitats) of landscapes is understood as a process of changing patch dynamics. Due to time averaging and differential taphonomic processes, paleoanthropologists rarely have the fortune of well-stratified, high-resolution deposits to satisfy such a definition. Instead, we work with a series of paleoenvironmental proxies that have their own spatial, temporal, and resolution limitations. With such restrictions, how do we define ‘mosaic’ so that it is both useful and meaningful in paleoanthropology?

To explore this question, paleoenvironmental reconstructions of two very different sites are presented using a variety of methods and proxies. Preliminary reconstruction (based on a combination of community analysis, mesowear, and linear and geometric morphometric based ecomorphology) of Woranso-Mille, Ethiopia (locality: Aralee Issie, 3.76-3.72 Ma, which contains the remains of *Australopithecus* sp.) points to shrublands as the closest modern habitat analog, though with enough variation in available vegetation to support both grazers and browsers. The 2.0 Ma site of Senèze, France, containing remains of the large-bodied papionin, *Paradolichopithecus arvernensis* and reconstructed with pollen analysis, functional morphology of *Paradolichopithecus*, and cervid ecomorphology, falls on the more open end of the environmental continuum, though it has evidence for forested regions. Though these reconstructions have very different characters, both can be considered mosaics due to their heterogeneous natures and variety of available resources. These features should be central to defining habitat mosaics in paleoanthropological contexts.

Bone tapping at the Pearson Complex (33SA9), Ohio

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Bone tapping (also known as bone perforation and bone drilling) is a term describing a type of postmortem cultural modification of human skeletal remains, typically affecting the cranium (occipital, parietal) and/or the larger long bones (humerus, femur, tibia). The practice has been documented in skeletal populations from Middle and Late Woodland Native American sites in the Upper Midwest and Great Lakes region, including Minnesota, Wisconsin, Michigan, and Ontario, but has not been previously reported to extend into Ohio. This paper presents evidence for bone tapping at the Pearson Complex, a Sandusky Tradition site in north-central Ohio, including data on skeletal elements affected, and the frequency and age/sex distribution of affected individuals. These data are then compared to published data on bone tapping at other Midwestern sites to determine whether the patterns observed at Pearson are consistent with the practice elsewhere.

Foot function during barefoot and indigenously shod walking in populations from India, Northern Scandinavia, and Western Europe

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Current knowledge of human foot function is based on Western subjects. In order to extend our understanding of normal human foot function, we compared three populations living in different environments, and using different types of footwear: South Indians, inhabitants of Samiland (N Scandinavia) and Western Europeans. Each population was studied (plantar pressures, kinematics, EMG, accelerometry) walking barefoot and with footwear: Kolhapuri sandals (Indians), indigenous reindeer boots (Scandinavians), and comfortable city shoes, Kalhapuri-inspired sandals and “minimal” shoes (Western Europeans). Analysis focused on comparisons of the different populations while walking barefoot, and on intra-population differences between footwear conditions. In addition, two substrate types were used for the Indian population (artificial/concrete and natural/sand).

Barefoot walking was comparable between populations. Shod walking differed between populations, but the differences with barefoot walking were smaller than expected with respect to plantar pressure distribution in the case of the indigenous and of the minimal footwear. Differences between walking on an artificial and a natural substrate were relatively minor (both shod and barefoot) in the Indian population.

We suggest that two types of morphologically very different indigenous footwear, adapted to

extremely different environments, both manage to respect the normal (barefoot) function of the foot to a large extent.

Oral health in the eastern-central Brazil: From past to present

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Lagoa Santa, Brazil, is a unique region in the Americas owing to its large number of human skeletons dated to the Pleistocene/Holocene boundary (ca. 11,000-7,000 yBP). In the 1990s, Walter Neves and colleagues reported unexpected high prevalence of caries for hunter-gatherer Paleoamericans of Lagoa Santa, which was confirmed in subsequent studies. A combination of wild fruits and tubers found in the Brazilian savannah (cerrado) has been raised as explanation for these findings. In this study, we analyze dental markers of oral health in dentitions from recent hunter-gatherers (Botocudos) living in the eastern-central Brazil during the 19th century (n=38). We test the hypothesis that Botocudos have poor oral health similar to Paleoamericans of Lagoa Santa, since they likely consumed a similar mix of foods. The results show significantly (chi-square, p<0.05) higher prevalence of caries in the Botocudos (63/305; 20.66%) than in the Lagoa Santa series (72/917; 7.85%). Lagoa Santa skeletons show significantly (t-test; p<0.05) more tooth wear (n=945; 3.68 degrees) than Botocudos (n=301; 2.45 degrees), while the latter show significantly (chi-square, p<0.05) more antemortem tooth loss (139/893; 15.57%) than Lagoa Santa (171/1925; 8.88%). Abscess prevalence is statistically similar in both skeletal series. These results show that Botocudos have poorer oral health than Lagoa Santa population, suggesting some participation of plant domesticates in Botocudos diet (e.g., manioc) as well as more intense food processing. This study contributes to our understanding of the human-environment relation in eastern-central Brazil, which started with the pioneer studies of Walter Neves in Lagoa Santa.

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A test of the inhibitory cascade (IC) model on primate deciduous premolars

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The inhibitory cascade (IC) model describes the size and development of molar proportions across a range of mammals. This model predicts that the M1 affects both the size and timing of subsequently developing distal teeth (i.e., M2 and M3) through a balance of genetic activators and inhibitors. In primates, the deciduous premolars develop ahead of the M1 in both time and space. We investigate the application of the IC model for primate mandibular deciduous premolars. We shift the prime tooth of the model

from M₁ to dp₃ to test the hypothesis that deciduous premolar proportions do not differ from the predictions of the IC model (i.e., slope=2.0; y-intercept=-1.0).

We collected linear measurements to calculate maximum occlusal areas from casts of 88 individuals and supplemented the sample with data from the literature for a total of 22 haplorhine species and eight hominin taxa. Reduced major axis regression results for the extant primates demonstrate a strong correlation between dp₄/dp₃ vs. M₁/dp₃ (r²=0.80, p<0.001). The slope (slope=2.30, p-value=0.30) and the y-intercept (y-intercept=-1.44, p=0.66) do not differ significantly from the IC model. Despite the wide range of fossil hominin tooth sizes, they all fall within the predicted morphospace.

This study is the first to test the IC model on deciduous premolars. Our results suggest a pattern of reduced inhibition compared to activation resulting in the proportions—dp₃<dp₄<M₁. These results suggest that a cascade effect from a single deciduous tooth affects subsequently developing teeth and, thus, the IC model may extend beyond molars.

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Patterns of variation in the static allometry of sexual and non-sexual traits in vervet monkeys

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Sexual traits vary a great deal in how they scale relative to body size. The hypothesis that may account for the widest variation in allometry involves an interaction between the form of selection and body-size dependency in the strength of selection. Within the variability that occurs in sexual allometries there is a strikingly consistent pattern: Animal genitalia predominantly exhibit shallow allometries, with the exception of vertebrates. However, for vertebrates and other animals that may continue to grow after reaching the adults stages (vertebrates as opposed to arthropods), sampling individuals of different ages can cause late-developing structures (some sexual traits) to appear to have steeper allometries than they really have across individuals of the same age. We tested the prediction that higher condition dependence will increase the steepness of allometric scalings. Our data consisted of a survey of geographic variation in the allometry of various body parts in 222 mature male vervet monkeys in Africa and the Caribbean. We found that traits exhibiting higher condition

dependence had steeper allometries. This offers the highest potential to date for explaining the very broad range of variation in the allometry of sexual traits. We also tested the prediction that adult age classes can confound allometric patterns, finding that after accounting for age the penis in vervet monkeys shows a shallower allometry than other sexual and non-sexual traits. This suggests that steeper estimates for other vertebrates may be due to the confounding effects of mixed age classes.

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A comparison of mediolateral ground forces in humans and chimpanzees

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The evolution of bipedalism is associated with morphological changes in the ilia that allow for trunk and hip stabilization during single-legged stance. Living apes, which lack this pelvic adaptation, are an important point of comparison for understanding joint mechanics and kinetics in early hominins. In this study we analyzed mediolateral and vertical ground reaction forces (GRFs) during walking in chimpanzees and humans to investigate the effects of anatomy and gait on ground force production and skeletal stress. The modern human sample (n=12, m=7, f=5) walked along a trackway with an embedded force plate while kinematics and kinetics were recorded. Three conditions were examined: narrow, normal, and wide step widths. Inverse dynamics were used to calculate mediolateral moments at the knee. In a separate study of captive chimpanzees (n=3, m=2, f=1), kinetics were recorded via forceplate during bipedal and quadrupedal walking. Peak force ratios (mediolateral/vertical) for humans increased with step width, reflecting the greater mediolateral ground force required as the supporting foot moves away from midline. Conversely, mediolateral stresses at the knee were negatively correlated with step width. In chimpanzees, mediolateral ground force ratios were intermediate between narrow and wide stance conditions for humans, reflecting chimpanzees' wide bipedal step widths. During quadrupedal walking, chimpanzee ground force ratios fell below ratios for normal human walking. These results suggest that human morphology and gait represent a compromise between reducing skeletal stress at the knee and minimizing mediolateral ground forces during bipedal locomotion. Implications for interpreting locomotor mechanics in fossil hominins are also discussed.

Life before death in an Imperial Age necropolis: Multidisciplinary approach to understand life conditions

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The heterogeneous kinds of data from anthropological sites raise important questions of interpretation which can only be resolved through the use of several different techniques. The anthropological data recorded for 307 burials in Castel Malnome (Rome, 1st-3rd century AD) were analyzed in order to determine the demographic profiles and the interactions with the environment. All these markers suggest the skeletons were from a social group that performed heavy manual labor, such as could be ascribed to the salt works discovered nearby. No significant differences were found between males and females. In addition, it was possible to obtain information about the chemical structure of the bones, through new technologies. One of these is the attempt to reconstruct the diet of ancient populations. In order to reach an holistic approach of the anthropological findings of Castel Malnome, a significant sample has been subjected to stable isotope analysis to identify the type of diet. This information was then compared to classic surveys able to show both the direct and indirect impact with the food uptake. The results of the stable isotope analysis shows the community had access to a good diet, despite the features relating to hard labor. The excavation of an individual with obvious pathological features related to severe ankylosis of the temporomandibular joint, led us to analyze the aDNA, because of recent associations highlighted between rheumatic diseases and genetic markers in the HLA complex. Our results show that the integration of different analytical approaches can be an important and comprehensive tool to delineate the biological profile of ancient populations.

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Characterizing dental evulsion in the Maghreb

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Tooth evulsion or ablation has been reported from archaeological and ethnographic contexts around the world. The research presented here is based on observations of evulsion practices in adults from Northwest African archaeological sites from the Iberomaurusian, Capsian and Neolithic periods.

The earliest known example of tooth evulsion is an Iberomaurusian adult female skull from Taza, Eastern Algeria from deposits dated between 16,100 and 13,800 BP. Evulsion is present in 90% of adults from burials at Tafoualt dated between 12,675 and 10,935 BP. A similar prevalence (94%) was recorded at Afalou. The most common Iberomaurusian practice involved

removal of both upper central incisors (Afalou: 74%; Tafoualt: 61%) although removal of fewer, none and more teeth was also recorded. The pattern of alveolar remodeling following evulsion revealed that there was no standard age for tooth removal. Among individuals showing evulsion of multiple teeth, variation in the extent of alveolar remodeling of different sockets implies that teeth were removed at different ages. Both males and females practiced evulsion with no apparent difference in the number of teeth affected or the age at which the intervention took place.

During the Capsian, the practice was elaborated, often involving removal of all 8 permanent incisors. Tooth evulsion was uncommon following the onset of the Neolithic, although isolated examples have been reported. The increasing availability of well dated samples allows us to infer that Northwest Africa was the first region where evulsion was widely practiced. Possible reasons for the emergence of this tradition will be further explored.

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There's a hole in my skull Dear Liza: Skull-based osteomyelitis

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Skeletal analysts tend to recognize skull-based osteomyelitis (SBO) through the presence of endocranial lytic lesions via macroscopic and radiographic methods. Clinicians use radiography, biopsy, and patient interviews to identify SBO. While clinicians link the condition to (1) localized bacterial infection of the cranial vault, (2) chronic inner ear infections (*otitis media*) and (3) localized mycotic (fungal) infection of the cranial vault, our review of the forensic, bioarchaeological and osteology research indicated that skeletal analysts hesitate to link SBO with these and other types of cranial pathology. Furthermore, clinical studies show that geriatric males most often express the condition. Lastly, because SBO is often misidentified as arachnoid invaginations (normal anatomy), we present our method of identification and the SBO co-occurrence with other types of cranial lesions to aid the skeletal analyst. Our forensic casework refutes previous studies, due to the high frequency of cases in a few months. Specifically, we have identified SBO in adult males and females in the third and fourth decade of life and observed that the condition tended to manifest with periodontal disease.

Further insights into the skull of *Australopithecus sediba*

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Dated to ca. 1.977 Ma, the site of Malapa, South Africa has yielded partial skeletons of several individuals, including well-preserved cranial remains belonging to a juvenile probable male (MH1) and an adult probable female (MH2). Continued preparation of surrounding matrix, alongside digital reconstruction of cranial remains via synchrotron and CT scans, has allowed us to examine certain areas of the skull of *Australopithecus sediba* in greater detail than was previously possible. In particular, we are now better able to observe the inner orbits, nasal aperture, mandibular fossa, basicranium, and palate of MH1. In addition, correction for displacement of some cranial bones of MH1 has resulted in revised estimates of several cranial measurements. Certain aspects of the neurocranium (cranial shape, post-orbital constriction), cranial base (relative mandibular fossa size, relative articular eminence size, bi-entoglenoid breadth), face (relative inter-orbital breadth, relative nasal bone size), and mandible (symphysis size, condyle height, ramus breadth) appear to align *Au. sediba* more closely with specimens attributed to *Homo*. Conversely, other aspects of the palate (depth, wedging) and mandible (ramus size relative to corpus size) appear to align *Au. sediba* more closely with other australopithecines. Still other aspects of the face (nasal aperture size, infraorbital plate), palate (length, breadth), and mandible (corpus robusticity) are somewhat equivocal. As was noted in the announcement of *Au. sediba*, this species shares a number of features with australopithecines, but also shares more features with early *Homo* than any other australopithecine known.

Morphological affinity of the Balanica mandible (BH-1): Enamel-dentine junction morphology and enamel thickness

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The Middle Pleistocene period of human evolution remains an intriguing and controversial area of research due to the widespread presence of *Homo erectus* fossils in Africa and Asia and debates surrounding the relative dating of non-Neanderthal and early Neanderthal morphology in Europe. The Balanica mandible has recently been re-dated to a minimum age of ~400 ka and its well-preserved mandibular dentition presents an excellent opportunity to characterize molar crown morphology at this time period, and re-examine claims for a lack of Neanderthal affinities in the specimen.

In this study we employ microtomography to image the internal structure of the mandibular molars (focusing on the morphology of the enamel-dentine junction, or EDJ) of the BH-1 specimen and a comparative sample (n = 141) of *Homo erectus sensu lato*, *Homo neanderthalensis*, Pleistocene *Homo sapiens*, and

modern *Homo sapiens*. We quantitatively assess EDJ morphology using geometric morphometrics and examine the expression of discrete dental traits at the dentine surface. We also compare molar enamel thickness in BH-1 to *Homo neanderthalensis* and modern *Homo sapiens*.

Our results highlight the reliability of the EDJ surface for classifying hominin taxa, confirm a primitive dental morphology for BH-1 molars, and a lack of Neanderthal affinity. The implications of these results for understanding Middle Pleistocene hominin evolution will be discussed.

Big-bodied, big scars? A investigation of the role played by body shape in the presence of parturition scarring

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Pitting and sclerotic tissue deposition on different areas of the bony pelvic girdle has been thought to represent evidence of human childbirth. This type of scarring has been attributed to the repeated musculoskeletal microtrauma of parturition, yet in some populations it is also present in males. Other factors, such as body size or pelvic canal size may lead to similar scarring resulting from muscle and tendon activities. In this study, body mass and stature (estimated from skeletal proxies), and pelvic outlet size were examined in relation to the presence and degree of parturition scarring amongst males and females in two skeletal samples with known parity status (total female n=144, male n=147). A modern forensic sample and the Spitalfields archaeological sample were examined. Parturition scarring was categorized into types and was scored on degree of development. Non-parametric tests were used to test mean rank scarring scores between sexes in both samples, correlation with scarring scores and pelvic outlet breadth, and correlation of scarring scores with body mass and stature. Sclerotic tissue deposition and dorsal pitting are associated with body mass in males of both samples, but not in females. Medio-lateral pelvic canal outlet size correlates negatively with dorsal pitting amongst females in the archaeological sample only. Body mass, stature and pelvic outlet breadth do not correlate with one another amongst females in both samples. Results suggest that parturition scarring may not necessarily indicate childbirth, but may be intensified by pelvic outlet constriction in females and increased body mass in males.

Can ontogeny inform our understanding of homology? Unique patterns of growth and postorbital septation in tarsiers

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Complete postorbital septation (closure) is a synapomorphy of anthropoids, distinguishing them from strepsirhines. Partial postorbital septation in tarsiers is often considered to be an

intermediate character state, resembling an anthropoid ancestor in this region. However, the tarsier skull is highly derived as a result of profound eye hypertrophy, a trait not shared by early haplorhine fossils.

We evaluated growth of the orbit for evidence of cranial morphology independent of eye hypertrophy. A unique ontogenetic sample of *Tarsius syrichta* allowed us to study facial morphology before massive growth of the eye in the postnatal period. Four specimens representing different stages of growth (fetal to 6-days postnatal) were imaged using both microCT and histology. Anthropoid and strepsirrhine specimens at similar stages of development were used for comparative analyses.

We observed an incomplete postorbital bar and no bony closure of the orbit in all of the tarsier specimens, in contrast to complete closure of the orbit in prenatal anthropoids. Instead, tarsiers have a thick postorbital membrane extending from the zygomatic superiorly to the frontal bone and lateral cranial fontanelle. Also, the zygomatic bone of the tarsier is more similar to that of strepsirrhines, lacking the posterior lamina that encloses the orbit in anthropoids. Structural differences and delayed closure suggest that postorbital septation in tarsiers may be secondary to eye hypertrophy. If this is the case, then it may not appear in the last common ancestor of anthropoids and tarsiers, and homology of postorbital septation in tarsiers and anthropoids cannot be assumed.

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A reanalysis of fossil hominin phylogeny using a craniodental supermatrix

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Many phylogenetic studies of the hominins have been published in the last 20 years. However, the majority of these studies have been limited in their taxon coverage. They have either focused on the early hominins or on the later hominins. Only two recent studies have incorporated multiple early hominin species and multiple later hominin species, and they utilized numerous idiosyncratic characters and ignored within-species variation when assigning character states to several species, which undermines their reliability. Currently, therefore, we lack a comprehensive phylogeny for the hominins.

The study reported here was undertaken with a view to rectifying this state of affairs. We used published sources to compile a supermatrix of craniodental characters for all widely recognized hominin species and an outgroup. When creating the matrix, we merged similar characters and systematically resolved conflicts in character state assessments. The resulting matrix records the states of 348 craniodental characters for 20 fossil hominin species and the chimpanzee, *Pan troglodytes*. After compiling the matrix, we

subjected it to maximum parsimony analysis and bootstrap analysis in PAUP*.

The analysis yielded two equally parsimonious trees (Length=1122, CI=0.78, RI=0.59). The relationships of some species, including the earliest hominin species, were unresolved. However, several clades appeared in both trees. Three of these are particularly noteworthy. First, *Homo floresiensis* is most closely related to *Australopithecus africanus*. Second, *Homo rudolfensis* and *Kenyanthropus platyops* form a clade with *Homo habilis*. Third, *Australopithecus sediba* is the sister taxon of a clade containing all members of the genus *Homo* and *K. platyops*.

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Global survey of PGA indicates high CNV variability in human populations

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Human pepsinogen A (PGA) is an inactive precursor for pepsin and accounts for over 50% of all protein products in gastric cells. PGA3, PGA4, and PGA5, located in the 11q13 region of the genome, are the three genes within the PGA gene family in humans. For the purposes of this study, the HapMap and Human Genome Diversity Project databases were examined to determine the frequency of Copy Number Variations (CNVs) in the PGA region. The individuals were from European (CEU), Chinese (CHB), Japanese (JPT), Yoruba (YRI), and Pygmy ancestry. Of the 299 individuals studied, 78.93% contain CNVs within the PGA region, ranging from Mbuti Pygmies with 38.9% to the YRI with 98.9%. qPCR was performed on six HapMap individuals and on 24 buccal swab samples obtained from human subjects. Both subject samples indicate a high CNV rate within the PGA region, with some individuals having three times more copies than others. The samples used in this study are comprised of a variety of ancestries and CNV in the PGA region was found in each group. Given that only 7.6% of the entire genome contains CNVs, our results demonstrated that the PGA genes are highly variable through the human population.

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Reconstructing foot form and function in early hominins using modern human models

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Aspects of extinct hominin foot anatomy, such as arch height and midfoot mobility, have been inferred from the shapes of isolated pedal fossils in comparison with foot bones of skeletonized apes and humans. However, these methods for reconstructing hominin foot functional anatomy have never been thoroughly validated in modern humans with known foot forms. Here, we suggest that the large range of variation in modern human foot anatomy, analyzed with modern imaging techniques, provides an opportunity to test hypotheses of early hominin foot function. We examined MRI scans of human feet (n=51) belonging to individuals with asymptomatic congenital pes planus (flatfoot) or with pes cavus to test whether the many skeletal correlates of arch height used to interpret the hominin fossil record actually differ in humans with high or low longitudinal arches. Additionally, we collected plantar pressure data and MRI scans of modern humans with consistent midfoot rigidity and those with a midtarsal (midfoot) break to test whether foot anatomies used to infer midfoot function in hominin fossils actually differ in modern humans with those extremes of midfoot motion. We found that the calcaneocuboid facet angle is significantly more obtuse in humans with pes cavus than those with pes planus, and positively correlates ($r=0.57$, $p<0.0001$) with arch height, as measured by navicular height. Only the 2.36 Ma calcaneus from Omo, Ethiopia is complete enough to accurately take the calcaneocuboid facet angle, which indicates that the Omo specimen would have come from a hominin with flatfeet by modern human standards.

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Nutritional deficiency in colonial Epidamnus, Albania

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This study addresses the relationship between nutritional deficiency, as measured by cribra orbitalia and porotic hyperostosis, and Roman colonization at ancient Epidamnus (modern Albania). We test the null hypothesis that the synergistic relationship between nutritional deficiency and parasitic infection led to equal prevalences of cribra orbitalia and porotic hyperostosis in colonial Epidamnus as have been observed in other areas of Roman control. To test this hypothesis, 76 skeletons from Epidamnus, Albania were observed for evidence of cribra orbitalia and porotic hyperostosis using standard data collection protocols. Twenty-four percent of individuals (18/76) showed evidence of either cribra orbitalia, porotic hyperostosis, or both. Of the individuals with cribra orbitalia or porotic hyperostosis, all but one were subadults (94% of individuals with cribra orbitalia and/or porotic hyperostosis). The prevalence of cribra orbitalia and porotic hyperostosis observed at Epidamnus is higher than that observed at other sites under Roman control (Belcastro et al., 2007 *Am J Phys Anthropol* 132:381-394). Thus, the null hypothesis is rejected, and our data tentatively indicate that local conditions at colonial Epidamnus were more conducive to the development of porotic hyperostosis than were conditions in other locales. Potential impacts of

coastal versus inland environment on the development of cribra orbitalia and porotic hyperostosis will be discussed.

This research was supported by the University of Northern Colorado's Summer Support Initiative and a New Projects Program Grant awarded to McIlvaine.

Leptin blunts the starvation-induced increase in bone marrow adiposity

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Undernourished humans often exhibit both low bone mass and high bone marrow fat. The adipokine leptin, which falls in starvation, induces mesenchymal stem cells to form osteoblasts rather than adipocytes. Thus we hypothesized that starvation-induced hypoleptinemia might underlie both bone marrow adipogenesis and suppressed osteogenesis, and that leptin replacement would reduce marrow fat and improve bone mass. We tested this hypothesis in female C57Bl/6J mice fed a 30% calorie-restricted (CR) or normal (N) diet from 5-10 wks of age, with daily injections of vehicle, 1 µg/kg/day leptin, or 2 µg/kg/day leptin (N=6-8/group). Outcomes included body mass (BM), serum leptin, %body fat, whole body bone mineral content (BMC), cortical and trabecular bone architecture at the midshaft and distal femur, and marrow adiposity. Overall, CR mice had lower BM, %body fat, and cortical bone area fraction, and higher trabecular bone volume fraction vs. N mice ($p<0.05$ for all). Fasting serum leptin (~16h post-injection) was lower in CR vs. N ($p<0.05$) regardless of leptin treatment. However, leptin-treated CR mice gained more BMC/BM vs. CR vehicle ($p<0.05$ for all). Leptin-treated N mice had lower %body fat ($p<0.05$) but similar BMC/BM vs. N vehicle. Importantly, while CR vehicle mice had 354% greater marrow fat in the proximal tibia compared to N vehicle, leptin-treated CR mice had only a 113% increase. In summary, leptin replacement during CR inhibited bone marrow fat formation and increased bone mass acquisition, supporting the hypothesis that hypoleptinemia contributes to starvation-induced bone marrow adiposity and low bone mass in humans.

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A comparison of craniometric and molecular genetic variation in a population of cotton-top tamarins (*Saguinus oedipus*)

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Non-human primate skeletal collections are often used as a proxy for humans in anthropological research as lab-raised populations allow for control of environmental factors and have lineage information for numerous generations, which is not possible with

human collections. The goals of this study are to examine heritability estimates generated from craniometric measurements to those generated through genetic data, and to test these to the metric results derived by Cheverud and Buikstra (1982) using another population of non-human primates (cotton-top tamarins, N = 157).

Two sets of traditional craniometric measurements were collected: 1. measurements used in Cheverud and Buikstra (1982) and 2. the standard forensic set (Moore-Jansen et al. 1994). In order to compare the data to genetic data from previously published research, the craniometric measurements were sorted by families and run through RMET with heritability = 0.450, which was derived from previously published research on cotton-top tamarins using 3D craniometric landmarks. RMET produced R matrices from which Fst values and within-group phenotypic variance were calculated.

Results for the standard forensic measurements produced an among-group variance of ~2% (Fst = 0.249, mean within-group variance = 0.977). Cheverud and Buikstra's measurements produced an among-group variance of ~15% (Fst = 0.341, mean within-group variance = 0.847). The values derived from the standard forensic measurements more closely resembles the genetic data, which estimates average heterozygosity <1%. However, Cheverud and Buikstra's measurements account for 34.1% of variance in this population, more than the standard measurements (24.9%), which are often used in humans to estimate ancestry.

Setting the stage for medieval plague: Pre-Black Death trends in survival and mortality (1000-1300 AD)

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The 14th-century Black Death was one of the most devastating epidemics in human history; it killed tens of millions of people (i.e. 30-50% of affected populations) in a very short period of time. Questions remain about what led to the emergence of the disease at that particular time and why the mortality rates were so very high. One possibility is that the affected human populations were particularly stressed in the 14th century, perhaps, at least in areas such as England, as a result of repeated famines. This project examines survival and mortality in two pre-Black Death time periods, 1000-1200 vs. 1200-1300 AD, to determine if demographic patterns were deteriorating right before the epidemic occurred. This study is done using a sample of individuals from several London cemeteries that have been dated, in whole or in part, either to 1000-1200 (n = 268) or 1200-1300 (n = 196). The age-at-death distributions from the two pre-Black Death time periods are significantly different, with fewer older adults in 13th-century. The results of Kaplan Meier survival analysis indicate reductions in survival before the Black Death, with significantly lower survival in the 13th-century (Mantel Cox $p<0.001$). Lastly, time period was also modeled as a covariate affecting the Siler hazard of mortality, and the results reveal increases in mortality rates across all ages right before the Black Death. Together, these results suggest that health in general in the pre-Black Death

population was declining right before the epidemic.

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Morphometrics of wild woolly monkeys: Implications of sexual dimorphism in body and canine size

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Woolly monkeys (*Lagothrix*) are large-bodied frugivorous primates that are widely distributed throughout the central and western Amazon. Although data on wild individuals are limited, woolly monkeys appear to be more sexually dimorphic than other atelins, including marmosets (*Brachyteles*), their sister genus, and spider monkeys (*Ateles*), which are basal within the atelin radiation. Over a seven-year period, as part of a long-term study of behavior, range use, and population genetic structure, we darted and captured 32 woolly monkeys for fitting with ID tags, radiocollars, or GPS collars. During captures, we recorded body mass and morphometrics and assessed the general health of the animals. Captured adult females weighed an average of 5.7±0.4 kg, while adult males averaged 7.1±0.9 kg. Within the set of adult males, those who showed the most marked development of secondary sexual characteristics averaged 8.0 kg, while those with only slightly developed secondary sexual characteristics averaged 6.5 kg. Sexual dimorphism in canine size was even more pronounced, with adult males having upper canines that were an average of 92% longer than adult females (13.8 vs. 7.2 mm). This high degree of body mass and canine size dimorphism is remarkable, given that the sexes are essentially monomorphic in the other atelin genera. Our results imply either that direct intragroup mating competition among males is more intense than behavioral observations would suggest, or that the evolution of large male body and canine size has been driven by other factors (e.g., competition between groups or intersexual mate choice).

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A new composite index of nutritional burden in adult women aged 22 to 41 years, their monthly family income and expenditure for food in Merida, Yucatan

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Background: High rates of stunting, overweight and obesity are prevalent in adult Mexican populations. **Methods:** The present study, carried out during 2011-13 in Merida, Yucatan, aimed at the estimation of rates of nutritional status in a sample of 138 adult women aged 22 to 41 years. WHO-defined criteria of stunting (short height), and body mass index (BMI)-based overweight and obesity were followed. Composite index of nutrition burden (CINB) included rates of: (A) no burden, (B) stunting, (C) overweight, (D) obesity, and combinations of (E) stunting and overweight, and (F) stunting and obesity. Socioeconomic factors included monthly family income or MFI (<10000 and ≥10000 Mexican Pesos) and monthly expenditure for food or MEF (<5000 and ≥ 5000 Mexican Pesos). **Results:** Mean age was 32 years. Mean height (148 cm), weight (64 kg), and BMI (29kg/m²) indicated in general that women had short height (<150cm) and overweight. Overall rates of stunting (72%), overweight (44%) and obesity (40%) were very high in the sample. Height below 150 cm (0= no, 1= yes) coincided with the rate of stunting. CINB included rates of: (A) 5%, (B) 11%, (C) 12%, (D) 10%, (E) 32%, and (F) 30%. BMI had significant relation (p< 0.05) with MFI and MEF in linear regression analysis after controlling age. **Conclusions:** High prevalence of excess weight (overweight and obesity) was alarming among adult women.

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The importance of contact network assumptions in epidemic simulation models

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Anthropological research into the cultural, biological and demographic impacts of epidemics across time and space demonstrates the importance of infectious disease in human populations. However, practical and ethical complications hinder research on the introduction and spread of diseases in living groups. Therefore, models are frequently used to study this process. Different techniques require certain assumptions and simplifications, which affect model results and interpretations, but these techniques are rarely systematically compared. This poster presents a comparison of two modeling approaches that are gaining in importance: agent-based simulations and social network models. The models are used to study the spread of the 1918 influenza pandemic in the small community of Newell's Island, Newfoundland and Labrador. In these models, disease parameters, community structure and transmission processes are kept as similar as possible in order to focus on the differences that result from how relationships and interactions are considered. In the agent-based model, a dynamic contact network emerges from individual movement to social spaces related to age and sex-specific behaviors. In the social network model, contacts based on these behaviors and other relationships are established prior to and held mostly constant during simulations. Results indicate that, on average, the social network model produces larger, faster epidemics than the agent-based model, and there are opposite trends observed between the two

models in the number of individuals driving epidemics at varying transmission probabilities. These comparisons demonstrate the importance of the assumptions used in disease models when addressing various research questions.

Comparative morphology of the proximal hallucal phalanges of *Homo floresiensis*

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Foot bones are relatively rare in the hominin fossil record, especially in Southeast Asia. Two reasonably complete hominin proximal hallucal phalanges were recently identified from the late Pleistocene deposits at Liang Bua, on the Indonesian island of Flores. These deposits contain other skeletal and cultural remains attributed to *Homo floresiensis*; thus, we attribute these two bones to this taxon. These phalanges indicate that LB10, originally described as a proximal hallucal phalanx, is actually a proximal pollical phalanx. Here we compare the proximal hallucal phalangeal morphology of *H. floresiensis* with that of a large sample of modern humans and great apes (N=196) and published data from other fossil hominin specimens (N=5).

Ten linear measurements were taken on each phalanx, including articular surfaces dimensions, and were converted into Mosimann shape variables by dividing each measurement by the geometric mean. Univariate, bivariate, and multivariate statistical analyses were used to assess phalangeal shape variation and hallucal affinities among groups; group-independent analyses of hallucal shape variation were also investigated using principal components analysis. Results show that the proximal hallucal phalanges from Liang Bua are small relative to modern humans and other late Pleistocene hominins; however, they are relatively more robust, exhibiting a considerably thicker midshaft in the dorsoplantar plane compared to all other taxa examined. Additionally, the *H. floresiensis* phalanges are characterized by a relatively shallower distal articular facet and a relatively narrower proximal articular facet. These two phalanges thus add important new details to the corpus of data on *H. floresiensis* foot morphology.

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Evolutionary developmental variation in primate musculature and implications for human medicine

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Previous studies have suggested that modern humans with genetic disorders such as trisomy (e.g., 13, 18 and 21) have several muscular abnormalities. However it is not clear whether these are malformations, 'atavisms', or the result of other evolutionary/developmental factors. In order to investigate these possibilities we have explored the comparative and ontogenetic context of these abnormalities by examining a wide range of primates and other mammals. Our comparative studies suggest that only a few of the reported muscular abnormalities (e.g., the presence of contrahentes in the hand, and of a platysma cervicale in the face) represent true evolutionary 'atavisms'. Interestingly, in karyotypically 'normal' modern humans although these muscles are also present early in ontogeny they usually disappear before birth. This suggests that at least some of the muscular 'atavisms' in trisomic individuals are the result of delayed/arrested development. Our contribution investigates the evolutionary, developmental, mechanistic and phylogenetic context of these muscular abnormalities and explores whether the same abnormalities occur in modern human individuals with other genetic disorders, as suggested by the late developmental and evolutionary biologist Pere Alberch.

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Patterns in resorptive spaces in elderly rib cortices

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During growth, juveniles display resorption in the endosteal cutaneous and periosteal pleural regions of the rib resulting from cortical drift. This pattern seems to disappear when growth-driven bone modeling ceases in adulthood, until cortical porosity in the ribs again becomes prevalent in old age. Unlike during cortical drift, where resorption in one cortex is countered by deposition on the other, in the elderly there is net bone loss with age. As cortical bone loss increases, large pores appear predominantly on the endosteal envelope, resulting in trabecularization of the cortex.

This study explores patterns of cortical resorption in opposing cortices of the rib in an elderly sample. Histological sections of the left, mid-shaft 6th rib of individuals between 60–92 years of age were analyzed. Each rib image was divided into cutaneous and pleural regions for data collection. Variables included raw counts of and area measurements for resorption spaces with scalloped reversal lines and pores with an area >2000µm², as well as cortical area of the cross-section. Results indicate a higher incidence of both resorption events and area loss occurring on the endosteal cutaneous cortex, similar to cortical drift. This patterning suggests adaptive maintenance to preserve the integrity of the pleural cortex occurs throughout the life span. Future work will attempt to investigate the difference in processes of trabecularization between juveniles and adults. Furthermore, multiple ribs will be considered to determine if the same pattern exists across the thorax.

Bio-archaeological comparison of medieval Icelandic and Irish remains from Haffjardarey and Alftanes, Skriduklaustur, and Augherskea

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Historical DNA research and historical documents have suggested that the initial Icelandic settlers migrated from Norway and Ireland, but little osteological research has been completed with the express purpose of exploring and supporting this hypothesis. Directed research comparing osteological assemblages across these populations will provide significant insight into the origins of the isolated Icelandic populations. My research focuses on the medieval, western Icelandic cemeteries of Haffjardarey and Alftanes curated at the Peabody Museum of Archaeology and Ethnology; two separate medieval sites from the Skriduklaustur Monastery in eastern Iceland (n=124); and a cemetery in Augherskea, County Meath, Ireland (n=187). The Peabody Museum's mixed and undocumented collection of around 95 individuals (based off cranial MNI) restricted the data collection to aging and sexing of the crania and os innominates, calculating stature from long bones, and observing cribra orbitalia, osteoarthritis and trauma for the construction of a population profile. The skeletal data is supported with research on the medieval archaeological context of the Icelandic and Irish regions, resulting in a bio-archaeological profile of the relatively unknown Haffjardarey and Alftanes sites that augments the burgeoning field of osteological research on Icelandic populations.

Molecular biomarker studies on the interrelation of ancient leprosy and tuberculosis

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Leprosy and tuberculosis (TB) are recognizable in past populations by their typical paleopathology and specific molecular biomarkers. Ancient DNA (aDNA) is detected by Real-Time PCR and confirmed by the detection of cell wall lipid biomarkers of *Mycobacterium leprae* and *Mycobacterium tuberculosis* using negative ion chemical-ionisation gas chromatography-mass spectrometry and fluorescence high-performance liquid chromatography. Molecular biomarkers enable confirmation of morphological diagnoses and recognition of infections without paleopathology. They have demonstrated leprosy from the Roman period and TB from the pre-

Pottery Neolithic period around 9000 years ago. Leprosy reached epidemic levels in Medieval Europe but declined after the 14th–15th centuries and is no longer an endemic infection there. In contrast, TB remains a problem, exacerbated by human population increases associated with the industrial revolution and urbanization. One hypothesis for leprosy decline in Europe is that cross-immunity between these mycobacteria reduced acquisition of leprosy by TB patients. An alternative hypothesis is that TB is more virulent than leprosy, so where there is a high population density, leprosy patients acquire TB and die from this disease – supported by observations that Hansen made in the late 19th century. Detection of lipid and aDNA biomarkers has demonstrated co-infections of leprosy and TB in ancient skeletal material from the near East and Europe. In addition, recently examined Medieval skeletal remains from Hungary also demonstrate paleopathology of both diseases. Skeletal paleopathology indicates survival of the infected individual over time, but in the absence of effective treatment, TB is likely to be the direct cause of death.

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“The monkey problem” in St. Kitts: Integrating political ecology into ethnoprimateology

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Over 350 years ago, the ecology of St. Kitts was dramatically altered by the advent of sugar cane production and the introduction of a highly adaptable, invasive animal species: the vervet monkey (*Chlorocebus aethiops sabaeus*). This project employed both primatological and ethnoprimateological techniques to assess conflict between vervet monkeys and Kittitian farmers. Methodological tools from primatology allowed for the creation of a predictive model of monkey crop-raiding behavior. The model was highly informative about monkeys' current raiding patterns; however, viewing Kittitian farmers and vervet monkeys as interconnected through an ethnoprimateological perspective revealed the significance of history with regard to this conflict. Land use patterns associated with the closure of the sugar cane industry in 2005 have significantly increased the interconnections between humans and primates. The ethnographic data showed that monkeys' increasing visibility has played a large role in Kittitians' cultural conceptualizations of vervet monkeys and the unique nature of pestilence discourse on monkeys in St. Kitts. The ethnographic data also showed that a third level of analysis was necessary for a robust understanding of the St. Kitts “monkey problem”: an assessment of the complex relationship between Kittitian farmers and the land on which they work. There is a unique human-environment relationship in St. Kitts due to the political repercussions of the island's colonial history - most farmers do not own their land. This case study serves as an example of how ethnoprimateological investigations can be informed well by the

theories and methods of environmental anthropology, more specifically, political ecology.

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It's all in the timing: Developmental basis of variation in vertebrate limb bone length

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Mammal limb skeletons are tremendously diverse in size, shape, and proportions. This morphological diversity is correlated with functional specializations for locomotor behaviors. Among primates, for example, suspensory species have relatively longer forelimbs, leapers have longer hind limbs, while quadrupedal species have fore- and hind limbs of equal length. Mechanistically, evolutionary changes in limb size and shape are the long term outcome of selection acting on continuous phenotypic variation in limb bone length within populations. This phenotypic variation can readily be observed among juveniles and adults. However, the relative contribution of embryonic, fetal and postnatal developmental events to adult variation in skeletal traits remains poorly known. Here, we present ontogenetic data from an ongoing artificial selection experiment, in which tibia length among selectively bred mice has been increased by over 10% relative to a control cohort. We test the hypothesis that, although selection occurs at skeletal maturity, the developmental origins of this length difference between Selected and Control mice can be traced back to prenatal stages. We compared tibia length in embryos, fetuses and postnatal stages of the two mouse samples. Results show that tibia length differences are detectable no earlier than mouse fetal stage E18, i.e. after tibial cartilage condensations have begun to ossify. This suggests that continuous limb bone length variation within populations arises after embryonic patterning, most likely through fetal and postnatal developmental changes to the mechanisms of endochondral bone growth. Implications for macroevolutionary diversity among mammals, and primates in particular, are discussed.

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Metatarsal structure and function in catarrhines

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Metatarsal torsion varies among primates. Apes are characterized by inverted 2nd, 3rd, and 4th metatarsals, while cercopithecoids have a lateral foot that is more everted. These differences are associated with length and

robusticity differences across the metatarsal row in which apes exhibit relatively longer and more robust medial metatarsals than monkeys. These differences in torsion and morphology across the metatarsal row are hypothesized to reflect the prehensile foot of the apes and the more propulsive foot of monkeys. However, torsion values have never been compared to function during locomotion. Here we present a study that compares metatarsal torsion in three taxa (*Pan troglodytes*, *Erythrocebus patas*, *Macaca fascicularis*) with plantar pressure patterns during locomotion on the ground and on a simulated arboreal support. We expected that *Pan*, because of their inverted 2nd to 4th metatarsals, everted 1st, and robust 1st and 2nd metatarsals, would exhibit higher pressures on the medial-most metatarsals, particularly on substrates that allow for prehension. Monkeys, on the other hand, are expected to exhibit relatively higher pressures on the lateral forefoot, as reflected by their everted lateral metatarsals. Our results show that, although all taxa present high peak pressures on the first digit, monkeys have proportionally greater pressure on the lateral three metatarsals. *Pan* exhibits the highest peak pressures for the first and second digit when walking on a horizontal pole that allows for prehension. These results indicate that metatarsal torsion and morphology does appear to correlate with forefoot function during locomotion among the taxa studied.

Reassessing Bateman: Sexual selection in strepsirrhine primates

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In the classical view of sexual selection theory, the role of male-male competition is emphasized over that of female choice. Even less appreciated is female-female competition and male choice. Species with varying degrees of 'sex-role reversal,' such as strepsirrhine primates, present interesting case studies for examining intrasexual competition and mate choice. Reduced sexual dimorphisms in lemur morphology (evident in body size, genitals, and scent glands) and behavior (female aggression and social dominance, promiscuity, rough play, and scent marking) challenge traditional biases in sexual selection research. In either sex, investment in ornamentation (through the manufacture of chemically rich scent signals) can be costly. Similarly, females, like males, may suffer costs associated with their aggressive encounters (including via wounding or infanticide). To better understand the underlying proximate mechanisms associated with these traits, in both sexes, I present relevant neuroendocrine, semiochemical, and genetic data for various lemurs. In ring-tailed lemurs, for instance, an individual's genetic makeup can predict the response to olfactory signals by members of the opposite sex. These responses are consistent with scenarios predicting mate choice based on genetic quality or compatibility. I place these examples within an evolutionary context to argue that, as in males, sexual selection likely has acted directly on female strepsirrhine primates.

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The pelvis in 3D: Shape differences in the modern human pelvic canal

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Bipedality and a focus on sexual dimorphism have led to extensive research on the modern human pelvis, and the parturition/bipedalism causal relationship with the current form of the bony pelvis is currently vigorously debated. While traditional morphometry continues to be useful in comparative research, 3-dimensional geometric morphometry offers an alternative way to quantify the variation of the complex structure of the pelvis. In this study, differences in the pelvic canal shape between the sexes, ancestral groups, and birth cohorts were explored.

The rearticulated bony pelvic girdles of individuals born between 1842 and 1981 were used in this study. Skeleton from the Hamann-Todd Osteological Collection, the Robert J. Terry Anatomical Skeletal Collection, and the William M. Bass Donated Collection were used. 3-dimensional coordinates were collected, and measurements were calculated. The samples were then compared between sexes and ancestries (black and white) and across birth cohorts.

In this study, the results of traditional morphometric analyses and 3-dimensional geometric morphometrics yielded similar (and expected) results. However, the 3-dimensional renderings enable easy visualization of the complex pelvic shape across and between populations and give a more thorough picture of the differences between the groups. The results of this study show that these differences are significant between males and females, black and whites, and between cohorts. These findings provide a solid basis from which to work toward a better understanding of the morphology of the modern human bony pelvis.

Sex differences in the use of whinny vocalizations in Spider Monkeys (*Ateles geoffroyi*)

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A community of spider monkeys consists of multiple males and females, with a pattern of male philopatry and female dispersal at sexual maturity. Throughout the day, community members break into subgroups which vary in size, composition, and spatial cohesion. Whinny vocalizations are frequently produced by both males and females, and have been suggested to allow close associates to maintain contact while dispersed within or between subgroups. Females do not form close associations however, and little is known about how this affects their use of the call. We investigated sex differences in the use of the whinny vocalization by the Yucatan spider monkey (*Ateles geoffroyi yucatanensis*) at the Runaway Creek Nature Reserve, central Belize. Females called at higher rates while

feeding, traveling and resting in comparison to males. The likelihood of a female calling increased in association with subgroup fissions and fusions; call rate by females was positively correlated with the number of animals joining or leaving a subgroup. Neither behavioral context, nor changes to subgroup composition affected the likelihood of calling by males. We suggest these different patterns indicate that the call may function differently for males and females.

Male red skin ornamentation and female mate choice in free-ranging rhesus macaques

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Male sexually-selected traits can take different forms depending on the mechanism under which they evolve: colorful ornaments usually evolve through female mate choice, while weapons usually evolve through male-male competition. Male ornaments are rare among mammals in comparison to birds, suggesting that female mate choice generally plays little role in mammalian trait evolution. Here, we review evidence that this general pattern may not apply to a rhesus macaques (*Macaca mulatta*) trait: the colorful red skin ornaments that males develop during the mating season. It has recently been suggested that red coloration is associated with social status because males avoid humans wearing this color. However, in two new, independent studies on rhesus macaque males on Cayo Santiago, we found no correlation between male coloration and dominance rank (N=22-24), suggesting that it plays little role in male-male competition. In contrast, an experimental study has shown that females pay more attention to redder males, and we recently found that females solicit dark red males more frequently (N=24 males, 33 females). Furthermore, we have analyzed color heritability utilizing data from 127 males and 139 females, finding that male color and luminance are highly heritable. Interestingly however, there is no evidence that male coloration influences mating (N=22-24) or reproductive success (N=81), which may reflect a complex set of alternative tactics. Together, these findings provide good support for the idea that male color ornaments are involved in female attraction in this species, but more work is needed to understand whether and how this translates into fitness.

Testing the Dual-Structure hypothesis for the colonization of the Japanese Archipelago: Evidence from southern Japan

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This study builds upon previous research that has investigated cranial variation of prehistoric Japanese populations. Examination of the cranial base and neurocranium was employed to test the Dual-Structure hypothesis, which posits that admixture rather than replacement occurred between the prehistoric Jomon and Neolithic Yayoi cultures. While prior research has elucidated much of the population and migration history of Japan as a whole using facial

dimensions, less emphasis has been placed on using the neurocranium from specific geographic areas with temporal continuity.

This study examines metric cranial variability utilizing the skeletal collection housed at Kyushu University, which curates samples from Kyushu Island and nearby locales that represent a nearly temporally continuous sequence from the prehistoric Jomon culture to the Medieval period. Additionally, this region-specific sample allows for testing of the dual-structure hypothesis, while building upon recent findings that suggest the neurocranium correlates more significantly with neutral genetic traits and is a better predictor of population affinity.

This preliminary study indicates that the removal of facial landmarks and concentration on dimensions associated with the vault and base provide differential results and alternate interpretations regarding admixture between the Jomon and Yayoi populations. These results support the hypothesis that the cranial vault may provide better resolution for population affinity, as well as provide support for population continuity in the context of prehistoric southern Japan.

Cranial sexual dimorphism in Hispanics using geometric morphometrics

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Hispanics comprise the second largest population group in the US. Further, 63% of U.S. Hispanics are of Mexican origin with 37% foreign born (Motel and Patten, 2012). Sex estimation is an important component of the forensic anthropological profile and is considered population specific in that human groups differ in size. Sexual dimorphism in the cranium has been explored in American Whites and Blacks (Kimmerle et al., 2008), but little is understood concerning sexual dimorphism in the fastest growing US population (Martinez and Ariosto, 2011). A better understanding of sexual dimorphism among US population groups will facilitate more accurate sex estimation techniques within forensic anthropological practice.

Therefore, the purpose of this presentation is to explore size and shape sexual dimorphism using geometric morphometric methods. Landmark data for American Blacks (N=78) and Whites (N=388) was obtained from the Forensic Anthropology Data Bank. Because the majority of Hispanics are from Mexico, Mexican data (N=126) was utilized and comes from two modern skeletal collections in Mexico, all with 20th century birth years. A total of 35 landmarks were chosen to maximize sample size and represent overall craniofacial morphology.

A MANOVA indicates no significant differences in the expression of sexual size dimorphism among the groups, however significant sex-specific differences in shape among the groups were detected. Shape differences using the Procrustes coordinates in a canonical variates analysis demonstrate shape differences in the vault regions for American Blacks and Mexicans while American Whites differ in shape in the entire craniofacial complex.

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Phylogenetic variation in subcellular distribution and isoenzyme composition of energy metabolism enzyme, lactate dehydrogenase, in primate brain evolution

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Absolute brain size has been shown to predict interspecific variation on measures of cognitive flexibility. However there are other features that change with increasing brain size and might account for our species' enhanced cognitive abilities, including molecular adaptations for high neuronal activity level. Metabolic demand and accompanying synaptic reorganization differ significantly among species.

In the present study, we investigated phenotypic variation in lactate dehydrogenase (LDH) expression and isoenzyme composition of the cerebral cortex in several primates using quantitative Western blotting and LDH isoenzyme analysis of total homogenates and subcellular fractions. Analysis of the isoform expression profile revealed that LDH in the synaptosomal fraction shifted towards the heart-type, aerobic isoforms, LDH-B, among haplorhines as compared to strepsirrhines, while in the total homogenate of neocortical tissue there was no statistical difference from the LDH isoenzyme composition between the primate suborders. In cytosolic and mitochondrial subcellular fractions from haplorhines, LDH-B expression level was elevated and LDH-A declined as compared to strepsirrhines. We also found a significant correlation between the protein levels of LDH-B in the synaptosomal, sub-neuronal, and mitochondrial subcellular fractions from haplorhine cerebral cortex that suggests a relatively higher rate of aerobic glycolysis that is intimately linked to mitochondrial metabolism.

Our results indicate that there is differential subcellular compartmentalization of LDH isoenzymes and metabolism in neuronal synaptic terminals and subcellular fractions that evolved among different primate lineages to meet the energy requirements at the subcellular level in neocortical cells.

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Rib histomorphometry: Testing sampling and population errors on existing formulae

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Bone histomorphometry is often the only available ageing method for highly fragmented human remains, thus it is vital to test and revise existing techniques particularly for use in legal cases. This study tested Stout & Paine (1992) and Stout et al.'s (1994) histological methods on a Greek population using 3 sampling sites (vertebral, middle and sternal part).

The sample consists of 6 left 4th ribs of known age from a modern Greek collection. The ribs were cut into three equal segments. A thin section was acquired from each segment. Four variables were calculated (cortical area, intact and fragmented osteon density and osteon population density) and age was estimated for each section according to Stout & Paine (1992) and Stout et al. (1994).

Stout & Paine (1992) underestimated age in all samples (-1.14 years to -33.78 years) while Stout et al. (1994) produced average ages within the reported error for all individuals with the exception of the two oldest individuals (46 and 58 years old). Comparison of the different sampling sites showed no specific pattern, suggesting that a larger sample should be used to further test sampling error.

The Stout et al. (1994) formula performed better for the Greek sample; this can be attributed to the fact that the Stout & Paine (1992) formula was developed for the 6th rib. These results contradict previous research reporting no significant differences between 3rd-8th ribs. There is a scope for expanding the number of individuals sampled to verify findings and further explore sampling error.

Landmark-free 3D method for comparison of fossil hominins and hominids based on endocranium and EDJ shapes

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This research focuses on an *Australopithecus* versus *Paranthropus* comparison using a promising landmark-free morphometric method,

which analyzes the shape of two anatomical structures: the endocranium and the enamel-dentine junction (EDJ) on complete dental arcades.

Landmark-based approach is often used in morphometry to statistically study shape differences but it involves pointing manually some specific points, which could implicate arbitrary assumptions. We present a method for the generation of 3D anatomical atlases based on landmark-free deformation maps. These statistical atlases are composed not only of an average template but also quantify local morphological variation. They are then used to classify anatomical 3D data. More precisely, an average shape and deformation maps describing how each individual surface differs from the average shape are estimated using "currents", a mathematical model for surfaces, curves, point sets and volume. New specimen can then be classified with deformation comparisons, and the approach permits also to highlight the local variability for each species.

Atlases were built with EDJs as well as endocrania from extant human, bonobo and chimpanzee. A linear discriminant analysis using the deformations was significant for identification of extant species both based on endocranium or EDJ. We also determined the taxonomic usefulness of endocrania versus EDJs, and we used the variability of these samples to compare *Australopithecus africanus* (Sts 5, Sts 52) with *Paranthropus robustus* (Sk 48, Skw 5). This study gives visual and quantitative tools to study inter and intra-species variability, providing a better model for the comparison and the classification of new fossils.

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Taphonomic study of the fossil fauna from the Mursi Formation and Member A of the Shungura Formation, Ethiopia

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The Mursi Formation has an age estimated at more than 4 million years, which corresponds to the time of emergence of the australopithecines, the first indisputably bipedal hominins. In this study, the Mursi faunal collection (N=201 fossil vertebrates) is compared taphonomically to that of another Pliocene locality of the Omo Valley, Member A of the Shungura Formation (N=300 fossil vertebrates). This research describes the main taphonomic differences and similarities between these two collections and makes paleoenvironmental inferences based on the fossil evidence. For each taphonomical agent (weathering, trampling, etc.), fossils are graded using previously established stages. It was found that in spite of a few significant differences (carnivore action, weathering), the two collections are taphonomically similar and their link with water, as predicted by paleoenvironmental reconstructions, is supported (Voorhies groups, abrasion). This new evidence provides key information for our understanding of the range of East African environments during

the time of emergence of the genus *Australopithecus*.

Comparative forelimb use during foraging in three cercopithecids from Côte d'Ivoire's Tai Forest

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Interspecific differences in primate limb anatomy are frequently related to variation in locomotion. Much less is known about how limb morphology co-varies with activities that occur when an individual is stationary, such as behaviors employed during manual acquisition of food. Several early studies suggested black and white colobus monkeys (*Colobus* spp.) were distinct from other cercopithecids in the high frequency with which they used forelimb elevation and abduction to gather food. We test this hypothesis by comparing data on forelimb activities during feeding in two colobines (*Colobus polykomos* and *Procolobus badius*) and one guenon (*Cercopithecus diana*) collected over three months in the Tai Forest, Côte d'Ivoire. Focal animal sampling was used to quantify rates of four forelimb activities: retrieval of foods (1) inferior, (2) parallel, or (3) superior to the trunk of the body and (4) transmission of food items from hand to mouth. We used Mann-Whitney *U*-tests to compare average frequencies of activities per five minute focal.

The three taxa differ markedly in their forelimb use: *C. polykomos* foraging involves significantly more parallel retrieval ($p < 0.001$), *P. badius* uses more superior retrieval ($p = 0.005$), and *C. diana* uses more inferior retrieval ($p < 0.001$). Based on these results, we conclude that the *P. badius* glenohumeral joint is capable of greater abduction, lateral rotation, and forelimb elevation relative to *C. polykomos* and that these kinematic differences are reflected in the extent of humeral head expansion, height of the greater tuberosity, and geometry of the scapular glenoid.

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Primate postcrania from the early Eocene of India, and implications for the initial diversification of strepsirhines and haplorhines

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The oldest fossil primates from India come from the Cambay Formation at Vastan Mine in Gujarat and date from approximately 54.5 Ma. The Vastan primate fauna comprises both adapoids and omomyids, with the asiadapine

adapoids *Marcgodinotius* and *Asiadapis* being the most common and the two species of omomyid primates, *Vastanomys gracilis* and *V. major*, each being previously known only from a single tooth. Vastan Mine has produced the best preserved early Eocene primate postcranial elements known from anywhere in the world. Newly discovered limb bones represent three of the recognized primate taxa, including the first omomyid postcrania from India. Five new humeri (two complete) consist of one distal humerus of *Asiadapis* and four that lack obvious specializations of either group. Elements attributed to *Vastanomys* (two femora and a talus) are more primitive than any other known omomyid postcrania. Femora attributed to *Vastanomys* are only subtly different from those of asiadapines but differ from them in features suggestive of more leaping behavior (cylindrical femoral heads, lateral condyle higher than medial, proximal position of the third trochanter). The talus of *Vastanomys* resembles those of omomyids more than those of other primates; however, features such as the relatively short, medially angled neck and oval head suggest less commitment to leaping than younger omomyids. The antiquity of the fossils, together with the greater morphological difference between asiadapines and omomyids in hind limb rather than forelimb elements, suggests that the initial behavioral diversification between these two groups involved hind limb-driven locomotor behaviors.

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The utility of the first metatarsal for estimation of body mass and stature: Validation of De Groote and Humphrey (2011)

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The estimation of the biological profile from atypical skeletal elements is a necessity in both forensic and archaeological contexts due to differential preservation and recovery. De Groote and Humphrey (2011) present a method for the evaluation and estimation of body mass and stature based on the osteometrics of the first metatarsal calculated via Pearson's Product Moment Correlations from a sample of 33 individuals of disparate geographic origin. The regression equations presented in the publication are tested here for validity.

388 European-American individuals from the William M. Bass Donated Skeletal Collection were assessed; both male and female individuals were included in the sample. Five osteometric dimensions from the first metatarsal were recorded: proximal and distal dorsoplantar diameter, proximal and distal mediolateral diameter and maximum metatarsal length. Bi-iliac breadth, femoral head diameter and maximum femoral length were also measured for each skeleton. Body mass and stature are estimated via De Groote and Humphrey's (2011) regression equations and compared to the methods of body mass and stature estimation presented by Auerbach and Ruff (2004) which employ the bi-iliac breadth, femoral head diameter and maximum femoral length.

A student's t-test was performed on the comparable body mass, and stature calculations. All of the compared calculations of the biological information found no statistically significant ($p=.05$) difference between the De Groote and Humphrey (2011) protocols and the Auerbach and Ruff (2004) protocols. These results show that an often over-looked skeletal element has the ability to more thoroughly inform the biological profile of an individual.

Skeletal, cutaneous, and anthropometric measures of childhood changes in knee breadth

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Measuring juvenile skeletal form is central to human biology and physical anthropology. Depending on study design, diverse methodologies (i.e., skeletal, radiographic, anthropometric) are employed to assess form, often precluding the combination or comparison of datasets. The Bones and Behavior Working Group aims to facilitate such analyses with protocol development for integrating datasets and unifying disparate measures. As part of this initiative, we assessed the validity of using soft tissue proxies for skeletal measures of knee growth in the coronal plane in a cohort of children with skeletal ages between 3.2-18.0 years.

Serial measures of knee breadth were collected from 1,582 posterior-anterior knee radiographs (50 boys, 51 girls; 5-27 time-points). Non-concurrent anthropometric knee breadth was measured on 266 boys and 238 girls (5-34 time-points). Using cubic splines, we found that mean femoral epicondylar breadth increases until skeletal age ~13.5 years in girls and ~16.0 in boys. Radiographic measures of cutaneous soft-tissue at the knee show continued expansion past the age of skeletal maturity in girls; boys were more variable, with some plateauing at ~16.0 years skeletal age and others still expanding after skeletal maturity. Anthropometric knee breadth plateaus at skeletal age ~15.0 years in girls and ~15.5 in boys. These results demonstrate that for girls (and some boys) soft-tissue expansion continues well after bone growth at the femoral epicondyles is completed. These results caution using anthropometrics as proxies for skeletal measurements near the end of growth, and highlight the need for additional validation studies on other areas of the skeleton.

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"Homo floresiensis" is LB1

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It is argued philosophically that "species are individuals" (Ghiselin 1966-81, Hull 1975-81), meaning that in theory species are irreducible wholes rather than sets of organisms. The "Homo floresiensis" debate turns less on theory than evidence, but "H. floresiensis" is, for all practical purposes, an individual: LB1. Virtually all the original supposedly defining characteristics of that hypothetical taxon are embodied only in LB1. The other far more fragmentary specimens of still uncertain number provide evidence for little more than the existence of a short-statured human population. There, "...the proposed stature of 106 cm (Morwood *et al.* 2004) is most likely incorrect and should be re-evaluated..." and the Flores population from Liang Bua Cave "...is small-bodied, but still falls within the body size range of other extant insular populations (a similar hypothesis was put forth by Jacob *et al.* 2006)" (De Klerk 2012:241). All craniofacial and endocranial characteristics of "H. floresiensis" are those of LB1, the only skull extant; the second isolated mandible, LB6, chiefly corroborates size but neither symphyseal region details nor the marked mandibular asymmetry of LB1. Since humerus and femora exist only for LB1, "primitive limb proportions" are individual. Humeral torsion originally reported outside the range of extant humans is not, and other subsidiary "unique" features (clavicle, etc.) are not.

The new contention that LB6 wrist bones support LB1 being non-pathological embodies the covert assumption that all skeletal elements of a developmentally anomalous individual must be abnormal, which is counter-factual to the orthopedic literature and our developmental genetic research.

Neuroscience, natural history, and the lesson of paleoanthropology

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Contemporary neuroscience finds itself at a confounding crossroads—though not for any lack of substantive progress. Studies of the molecular, cellular, and systems properties of perception, action, learning, and memory are yielding detailed pictures of nervous system function. Electrophysiological activity across large swaths of the cerebral cortex in animals and humans can now be recorded. Non-invasive neuroimaging technologies, including functional magnetic resonance imaging (fMRI), diffusion tensor imaging (DTI), and magnetoencephalography (MEG), have pushed back the limits of spatial and temporal resolution to describe brain function and neural connectivity. Finally, the structural characterization of the entire human brain is just now achieving micron-scale accuracy. Yet, all of the foregoing is tempered by the reality that the human brain is the most dynamically complex object known to biology. Just as the complex ecologies of large natural systems defy easy characterization, so, too, the hyper-complex 'micro-ecology' of the human nervous system presents a serious challenge to neuroscience,

despite a formidable technological armamentarium.

I argue here that modern neuroscience has reached an impasse in achieving a deep understanding of brain function, due in part to dogmatically reductionist research models that atomize systems artificially into seemingly tractable—but globally less informative—elements. I outline an alternative approach that seeks to derive rule-like properties from richly degenerate structure and function—akin to the paleoanthropologist's reconstruction of a hominin species from a variant range of fossil character traits. Such an approach may represent the best way forward in our quest to understand how the human brain works.

The ontogeny of bite force: A test of the constrained lever model

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Dietary mechanics are thought to constrain food selection in juvenile primates, yet little is known about how bite forces change, both absolutely and within the dental arcade, during ontogeny. The constrained lever model (CLM) predicts the distribution of bite forces along the dental arcade based on the architecture of the masticatory system. The CLM predicts that in adults, the highest bite forces are produced at M1 and decrease posteriorly and anteriorly. This model has the potential to predict bite force during ontogeny but has yet to be validated against empirical data. Accordingly, we compared CLM-derived and empirically measured bite force distribution curves.

We collected 3D coordinate landmark data using a cross-sectional ontogenetic sample of modern human skulls ($n=30$). We used the CLM to make predictions of average maximum bite force curves. Using a force sensor, we collected maximum bite force data on a cross-sectional sample of human subjects (ages 6.5-29; $n=15$). Data were binned according to molar eruption stage.

For each molar eruption stage, CLM-estimated and empirically measured bite forces were highly correlated ($r=0.93-0.96$; $p<0.005$). The highest bite forces are produced at M1 throughout ontogeny. Average bite forces at M1 increased 4.5x from M1 eruption to adulthood. The distribution of bite forces across the dental arcade did not change. These results affirm the predictive value of the CLM in an ontogenetic context and suggest that changes in size (e.g., muscle physiological cross-sectional area) more than shape (e.g., muscle orientation) of the masticatory system results in bite force changes throughout ontogeny.

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Friends, sex, and stress: Social behavior, reproductive condition, and cortisol levels of female Brown Capuchins in Suriname

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Female stress hormone concentration is affected by reproductive condition. Among many primate species, female cortisol levels are significantly higher during pregnancy than during other reproductive stages. The responsiveness of the HPA axis to stress, however, has been shown to decrease during late pregnancy and throughout lactation. Considerably less has been published regarding the relationship between stress hormones and cycling females. Using brown capuchins (*Cebus apella*) in Raleighvallen, Suriname as my study system, I investigated the relationship between female social behavior, fecal cortisol levels, and reproductive condition. From January to December 2006, the seven focal females encompassed the spectrum of reproductive conditions: cycling, pregnancy (primiparous and multiparous), and lactating; reproductive condition was assessed based on behavioral indicators. Female cortisol levels varied by reproductive condition, and reproductive condition was found to affect female affiliative behavior. Pregnant females had the highest cortisol levels, while lactating females had significantly lower cortisol levels than anestrus, estrus, and pregnant females. Cycling females were the focus of male grooming effort; when these females became pregnant, however, the alpha male ceased all grooming interest. Lactating females received the most grooming from other females, but such grooming effort steadily decreased as the infants aged. While proximity between females decreased as their infants aged, female-male proximity scores did not. Further, there was an inverse association between female cortisol levels and the grooming of adult males. The results of this study strengthen my previous finding that, in this *C. apella* group, female-male relationships are more beneficial and thus more stable.

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Identification of features and trends associated with hybridization in the nasal cavity of baboon hybrids, *Papio anibus* x *P. cynocephalus*, as an analogue for Neanderthal and anatomically modern *Homo sapiens* hybrids

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Hybrids, such as Neanderthal and anatomically modern *Homo sapiens* crosses, are difficult to identify in the fossil record. In this project, baboons are used as an analogue to develop a model facilitating the identification of recent hominin hybrids. Using CT scans and visual examination, crania of first-generation baboon hybrids (*Papio anibus* x *P. cynocephalus*) were compared to purebred parental populations. The nasal cavity of 175 specimens was measured and analyzed for anomalies, including nonmetric traits and pathologies. The nasal cavity was chosen because internal structures, whose morphology is critical for functioning organ systems, are hypothesized to be more stable

during development compared to external features. This study found that hybrids have unique nasal cavity morphology. In hybrids, the anterior lower nasal cavity is significantly larger than parental populations. Posteriorly, the upper nasal cavity and lateral recess are significantly larger in hybrids. However, posterior margin features of the nasal cavity, beneath the eye orbits, were conserved and did not differ from parental populations. Hybrids showed greater sexual dimorphism and overall variability throughout the nasal cavity compared to parental populations that showed greater sexual dimorphism posteriorly. The frequency of nasal cavity anomalies did not differ between hybrid and parental populations, though Ackermann et al. (2006) found that hybrids showed a greater frequency of external anomalies. The identification of features and trends of the nasal cavity in baboon hybrids may contribute to the identification of hybrids among potential outliers and "transitional" populations of Neanderthals and anatomically modern *Homo sapiens*.

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Comparison of telomere length measurements from monochrome multiplex qPCR and Southern blot techniques in the Cebu Longitudinal Health and Nutrition Survey

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Telomeres are repeating DNA sequences at the ends of chromosomes that are implicated in the process of senescence. While telomere biology is a burgeoning field, measurement of telomere length (TL) is not straightforward and considerable debate regarding measurement error, analytical strategies and bias remain. We have previously measured the telomere lengths of over 3,565 individuals (36-69 year-old mothers and their 21-23 year-old offspring) from the Philippines using monochrome multiplex qPCR (MMQPCR) and reported results based on these measures. Here we re-measure the TL of a subset of these individuals using a Southern blot of the mean length of the terminal restriction fragments (TRF) and compare these to the previous MMQPCR results in order to cross-validate the MMQPCR results and provide comparability across studies. The subsample here consists of 94 37-68 year-old mothers and 96 unrelated 21-23 year-old individuals. The correlation between MMQPCR and TRF measures was 0.62 ($p<3\times 10^{-21}$) and not

quadratic, but heteroscedasticity was evident ($p=0.0064$). Since TL is known to decline with age we used this as a putative external verification of the validity of these measures. The association of TL with age in all 190 individuals was -0.459 and -0.456 ($p<4\times 10^{-11}$) using MMQPCR and TRF measures respectively. The average TL was 7.857 kilobase (± 0.762) with a decline of 22 base pairs/year—a slightly higher mean but similar decline as results from European-descendants. Analyses in progress are examining whether improvements of MMQPCR correspondence with TRF and/or age results from adjustments for PCR plate well position effects and assay non-linearity.

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Fracture toughness and nutritional content as measures of food choice in ursine colobus (*Colobus vellerosus*) in Boabeng-Fiema Monkey Sanctuary, Ghana

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Ursine colobus monkeys (*Colobus vellerosus*) are highly endangered primates with special adaptations that allow for a highly folivorous diet. Previous studies propose that colobines select quality leaves, identified as consisting of a high protein-to-fiber ratio, through their toughness, an energetic measurement of how much work is required to initiate and continue a crack in a substance. Feeding observations and collections of food of *C. vellerosus* were conducted in central Ghana during December 2010 and 2012 by the authors and 12 students. It was hypothesized that there would be an inverse relationship between toughness and the nutritional content indicators non-digestible fiber (NDF), acid detergent fiber (ADF), and lignin content. Fracture toughness was measured by a portable tester designed by Darvell et al. (1996). The mean values of fracture toughness were compared between the field seasons to identify any discrepancies in the range of toughness. A two sample t-test was used to determine the variability of the data. Toughness of eight food species utilized by the colobines was compared against previously recorded NDF, ADF and lignin content values. A Pearson correlation was used to determine the relationship of the protein-to-fiber ratio and fracture toughness.

Diet varied substantially between field seasons, as did the range of toughness. Results of the 2012 study indicate that the toughness of the colobine food ranges from 161.38 KJ/m² to 4301.12 KJ/m², which significantly varied from the 2010 data (p -value=0.0009). Comparisons of fracture toughness values with nutritional indices did not demonstrate a significant negative correlation, as was predicted.

Measurement protocol considerations for the cercopithecoid appendicular skeleton: Body mass and function

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At present, there is no standard protocol for measuring cercopithecoid skeletal material. Researchers create unique sets of measurements for their investigations, which has led to problems with data sharing and reporting. Here we offer a measurement protocol designed for analyzing questions of size, function, and phylogeny.

This specific measurement set was designed to be useful in many contexts, as the measures include both size and functional distances. There are 82 measures, taken with calipers, on postcranial bones including the scapula, humerus, radius, ulna, femur, tibia, calcaneus, talus, and metapodials. The study sample includes 19 cercopithecoid genera, comprising 520 individuals from 34 species. Here, we highlight 15 measures that had high correlations to body mass, with regression R² values from 0.84 to 0.95 (mean of 0.90). Further, we report measures and indices that successfully distinguish arboreal from terrestrial forms and highlight subfamily differences. Specifically, these include the humeral epicondylar index, humeral trochlear flange index, and ulnar olecranon retroflexion.

Regardless of protocol, quantitative skeletal information particularly among appendicular elements is rare among nonhuman primates. Therefore, baseline information necessary to explore aspects of many proposed hypotheses is missing. Our ability to relate biological and ecological factors within skeletal analyses is strengthened by collaborative data collection, which must include repeatable and known protocols. Considering a protocol designed to be useful in any number of contexts makes answering ultimate questions about evolutionary processes more possible.

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Estimating hominin body mass from cranial variables: An evaluation of current methods using three-dimensional computed tomography

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Body mass estimates are an essential aspect of palaeoanthropological research. Most techniques employ postcranial elements, but methods based

on cranial variables have also been developed. Designed to address the paucity of associated skeletons in the fossil record, cranial methods employ extant primate samples to generate regression equations for estimating mass in fossil hominins. Some cranial variables have been argued to estimate mass almost as reliably as postcranial dimensions, but no study has tested the existing cranial formulae on a population of known mass. In addition, the main methods have not been compared. Thus, questions remain about the accuracy of these techniques.

To address this, the present study used human specimens of known body mass to test the three main cranium-based body mass estimation methods. Virtual models of the skull were created from post-mortem CT scans and cranial measurements were taken from the models. The cranial variables were then entered into published regression equations. Finally, the estimated and known body masses were compared. Because the formulae have been used to estimate the mass of single hominin specimens as well as fossil species, values for both individuals and sample means were tested.

For most formulae, prediction errors exceeded 25% and few individuals were estimated within 20% of their known mass. In addition, variables that had previously been argued to be good predictors of mass in hominins, including humans, did not estimate mass reliably. These results suggest that current cranium-based body mass estimates for fossil hominins, particularly *Homo*, may need to be reconsidered.

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Ranging and association patterns of woolly monkeys (*Lagothrix poeppigii*) in lowland Ecuador

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A high degree of flexibility in association patterns is a hallmark of the social systems of atelin primates, both among and within taxa. For example, in woolly monkeys (genus *Lagothrix*), socially cohesive groups often split into subgroups that range independently for several hours or even days; two or more social groups may coalesce to form temporary 'supergroups'; and in some cases, individuals may leave their usual social group for brief periods to associate with individuals in neighboring groups. Using ranging data collected from 2006-present at the Tiputini Biodiversity Station, Ecuador, we found that woolly monkey home ranges (estimated as 95% kernel densities) overlap 13 to 90% with those of neighboring groups. With such extensive overlap, intergroup interactions are likely to occur frequently. In fact, follows of two

groups from June-August of 2013 revealed that they ranged within 100m of each other on 30% of full day follows. Tolerant intergroup associations – where members from both groups were found either foraging in the same tree, resting in proximity (<10 m), or traveling together to a new resource – took place on 20% of full day follows. Excluding several overnight associations, intergroup contacts lasted, on average, 193±128 min. Why neighboring groups may be tolerant of each other is unclear, but we suggest that intergroup associations may facilitate information transfer about the availability and location of food resources and/or the reproductive status of neighboring group members. Furthermore, intergroup tolerance in woolly monkeys may reflect kinship patterns among animals across a dispersed network of social groups.

Contextualising monkeys: Cercopithecoid community palaeoecology in the African Plio-Pleistocene

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Today there are only three southern African cercopithecids (*Cercopithecus mitis*, *Chlorocebus aethiops* and *Papio hamadryas ursinus*). This is in marked contrast to the Plio-Pleistocene, where up to six monkey species have been recognised from Sterkfontein Member 4 alone, and a total of nine species have been identified in the Blaaubank Valley region (the 'Cradle of Humankind'). Previous work has linked diversity decline to grassland increase and environmental homogeneity. Here, Plio-Pleistocene cercopithecoid species diversity in the Blaaubank region is re-evaluated in the light of new site discoveries and in a more general mammalian context. Cercopithecoid species presence / absence and abundance data for Sterkfontein Members 2, 4 and 5, Kromdraai A and B, Swartkrans 1 - 3 and Malapa were downloaded from the Paleobiology Database, supplemented with recent literature and inspection of museum collections. Similar data for the other large primary consuming mammals (i.e. excluding carnivores but including hominins) were also recorded. Menhinick's richness index, a measure of species diversity, and Spearman's rank correlation were used to examine trends. Mammalian diversity shows a significant decrease over time; the presence of many grazers at Swartkrans conforms to expectations of grassland increase. Cercopithecoid species diversity declines over time, with a striking decrease in Swartkrans Member 3. However, there is no statistically significant trend, in part because of the absence of monkeys at Malapa, and also because of the radiation of large-bodied terrestrial cercopithecids after 1.75 Ma. Further comparisons of the monkey and wider mammalian fauna will help illuminate these diversity patterns.

Immunosenescence in Tsimane forager-horticulturalists

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Prominent theories of aging center on the role of chronic inflammation, the markers of which predict age-related illnesses, particularly cardiovascular disease. This is manifest in age-associated elevation in inflammatory markers and reduced ability to respond to immune challenges. Longevity and resistance to degenerative diseases is associated with weak pro-inflammatory responsiveness, a feature which can only be selectively advantageous in a relatively pathogen-free environment. Yet, early data from foraging populations suggests a paradox of high pathogen load and scarcity of cardiovascular disease in the aged. To examine this further, we analyzed 13 serum cytokines in a sample of 1154 adult individuals in the Tsimane, a large population of forager-horticulturalists in Bolivia. Cytokine production increased with age, indicative of an increase in low-grade inflammation. Cytokine response of serum cultured with antigens generally decreased with age, consistent with a reduction in the ability to respond to new challenges. Cytokines exhibited significant sex differences. Females had higher concentrations of most cytokines, driven chiefly by a sharp increase around the time of menopause. We discuss these results in light of cross-population comparisons, specific features of the Tsimane environment, and evolutionary implications for human immune function.

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Degenerative joint disease among populations of northern China and Mongolia during the Bronze Age-Iron Age: Implications for the pastoral lifestyle and subsistence-related activities

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Pastoralists occupied Inner Asia, the steppe region that includes Mongolia and northern China, as early as the Bronze Age (second millennium BC), developing alongside agricultural societies within China. By the early Iron Age (second half of first millennium BC), mounted pastoralism arose and neighboring Chinese states similarly adopted use of a cavalry to counter nomadic threats such as the Xiongnu. A sample of 428 individuals (N=238 males, N=190 females) from the Bronze Age (N=118) and Iron Age (N=310) from China and Mongolia was analyzed for degenerative joint disease (DJD) located in the vertebrae and all major limb joints to test assumptions of similarities in patterns of DJD associated with this "shared" pastoral lifestyle during this transitional period of early stock-raising to mounted pastoralism. Within the Iron Age sample is a military sample from northern China (N=85) that had cavalrymen who also engaged in agriculture subsistence, which is compared to the more "traditional" pastoral samples.

With respect to overall presence of DJD within any joint examined, the military sample from China has the highest rate (63.3%), significantly

higher than the Bronze Age (33.9%, Fisher's exact $p=0.000$), but similar to the contemporaneous Iron Age pastoral sample (58.4%, Fisher's exact $p=0.406$), which is also significantly higher than the Bronze Age (Fisher's exact $p=0.000$). This study also examines differences between the sexes and age cohorts, patterns in DJD joint location and severity, and contributes to our understanding of potential variation in DJD among pastoralists, as evident by distinctions in frequencies during different time periods.

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Female cryptic choice in primates

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Post-copulatory sexual selection (PCSS) occurs whenever sperm of different males compete within the female reproductive tract for fertilisation of the ovum. A specific form of PCSS is cryptic female choice - female-related mechanisms that give advantages to the sperm of certain males over the sperm of others. PCSS is well recognised as an important mechanism of selection in diverse taxonomic groups, including mammals. It is, however, drastically understudied in primates. Evidence that PCSS occurs in this order is scarce and mainly indirect, but given its prevalence in other groups, it is likely to be an important selective force in primates too. I will first review evidence that the necessary conditions for PCSS to take place are met in various primate species, i.e. that females in multimale groups usually mate polyandrously during the fertile phase. Furthermore, because in several species females might be limited in their ability to express pre-copulatory choice due to sexual coercion, cryptic choice might be the only form of mate choice available for such females. I will then discuss the role of female sexual signals in giving females the freedom to exert cryptic choice, and consider how male sexual signals may serve as quality signals in this context. Finally, I will suggest a number of ways in which female cryptic choice may manifest at the proximate level. This review is intended to draw more attention to the importance of PCSS in primates and to provide ideas for future studies on this topic.

Increased preference for spatial association with adult males during adolescence in wild male chimpanzees (*Pan troglodytes*)

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Adolescence is a crucial stage of life in which one completes puberty and subsequently becomes a viable reproductive competitor. Among male chimpanzees, reproductive success

is likely determined by the extent to which an individual becomes integrated into the adult male hierarchy. Thus, adolescent males might secure long-term reproductive benefits by establishing relationships with adult males during this period. Previous research has suggested that hormonal changes at adolescence are manifested through shifts in preferred grooming partners and spatial proximity with conspecifics. However, many of the proposed behavioral correlates of the transition to adulthood remain speculative, owing to a relative dearth of data. This study provides an initial analysis of adolescent male behavior in a community of wild chimpanzees. Continued longitudinal research will reveal how aspects of individual variation in behavioral correlates of entering adulthood differentially influence the eventual rank of adolescent male chimpanzees. I conducted all-day focal follows and 10-minute scans of spatial proximity on five adolescent males in the Kanyawara community of Kibale National Park, Uganda from June to August 2013. Proximity data indicated that adolescent males (average age 12.8 years) showed increased proximity to adult males, and decreased proximity to their mothers, compared to younger males. The probability of having an adult male as a nearest neighbor increased more than ten-fold with male age. These findings may reflect attempts by male chimpanzees to enter the adult male hierarchy during the period of adolescence, and suggest an intensified preference for association with adult males at this time.

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Skeletal evidence of infanticide in Virunga mountain gorillas (*Gorilla beringei beringei*) from Volcanoes National Park, Rwanda

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Infanticide, or the killing of an unweaned unrelated infant, is a male reproductive strategy that is proposed to be an influential factor shaping the evolution of social behavior in anthropoid primates. In Virunga mountain gorillas, infanticide accounts for up to 37% of all infant deaths. However, little is known about skeletal trauma inflicted as a result of this event. This study examines patterns of infanticide-related trauma in a large collection of mountain gorilla skeletal remains from Rwanda, many with life history and veterinary records.

In a sample of 36 infants (age 1-3 years), cause of death is reported for 20 individuals; 10 died as a result of infanticide, six due to non-infanticide

related causes, and four with undetermined deaths. We investigated frequencies of perimortem trauma by documenting the presence and location of blunt force fractures, punctures and associated plastic deformation.

Results of this study reveal a characteristic pattern of blunt force and puncture trauma associated with documented cases of infanticide. This trauma pattern was observed on nine skeletons (25% of infants), eight of which are confirmed infanticidal deaths. Infanticide-related trauma is characterized by an increased frequency of fractures affecting bones of the cranium, ribs, and pelvis compared to other skeletal elements. These results provide a basis for identifying infanticide as a potential cause of death for unidentified infants where a similar pattern of skeletal trauma is observed, and thus may shed light on the occurrence of infanticide in other modern and paleontological contexts.

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Bi-acromial and clavicular scaling in hominoids: Implications for locomotor behavior

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The clavicle forms the sole bony connection between the shoulder complex and the thorax, and, with the manubrium, determines bi-acromial breadth. Relative bi-acromial breadth may be a correlate of locomotor behavior and may therefore be a useful trait for interpreting locomotor behavior in fossil hominins. Asian apes have the relatively longest clavicles among hominoids; *Pan* has the relatively shortest, and *Homo* and *Gorilla* fall in between. Here I test the hypothesis that locomotor behavior is reflected in bi-acromial width in hominoids.

Bi-acromial width (the length of both clavicles plus manubrium width at the height of the first rib) was regressed against femoral head height, a common body size proxy, in a log-space least squares regression. A cercopithecoïd outgroup, *Macaca mulatta*, exhibits strong negative allometry, whereas *Pongo* and *Hyllobates* demonstrate strong positive allometry. *Homo* is characterized by slight negative allometry while *Gorilla* is essentially isometric. The *Pan* regression did not reach significance, while for all other taxa bi-acromial width is significantly correlated with femoral head height ($p < 0.0075$). Results did not differ significantly when the clavicles alone were used, however, the regression of manubrium width followed a different pattern.

These results suggest that Asian hominoids have longer-than-expected clavicles, particularly at increasing body sizes, which contrasts with African apes and humans. This could reflect differences in locomotor behavior or be a result of the body size proxy chosen for this study. More research is required to explore this issue as well as the unexpected results regarding clavicle scaling in *Homo* and *Pan*.

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Dietary ecology of wild chimpanzees (*Pan troglodytes verus*) inferred from a comparison of behavioural and bone carbonate ($d^{13}C$ and $d^{18}O$) and collagen ($d^{13}C$ and $d^{15}N$) isotopic analysis

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Activities related to the search for, and consumption of, food are known to play a large role in ecological and behavioural differences among extant human and non-human primate species. The field of great ape isotope ecology is still in its infancy and as such limited isotopic data on wild chimpanzees exists. Our study presents stable isotope data on organic collagen and keratin, as well as inorganic bone and enamel apatite, on the same group of wild Western chimpanzees (*Pan troglodytes verus*). By incorporating behavioural data on the diet of these chimpanzees, our results present more precise fractionation data between organic and inorganic tissue types and provide the opportunity to examine how carbonate isotope data accurately reflects dietary ecology. This research has implications for understanding and interpreting the isotope data on carbonate of extinct fossil hominins.

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Novelty seeking in vervets: Genetic and environmental influences

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Novelty seeking is a trait with important implications for primate life history and for human health and disease. The multigenerational pedigree of vervet monkeys (*Chlorocebus aethiops sabaeus*) at the Vervet Research Colony (VRC) has created the opportunity to study genetic influences, physiological mechanisms and environmental influences on individual differences in novelty seeking in vervets living in stable, matrilineal social groups. The Home Group Novelty Test provides a reliable and trait-like measure of the tendency to approach and show interest in novel and potentially threatening objects. Variance components analysis using the VRC pedigree has shown that individual differences in Novelty Seeking are heritable and are related to variation in the dopamine D4 receptor gene. Baseline levels of cortisol are inversely correlated with Novelty Seeking scores, and a stressful environmental change increased cortisol levels and suppressed Novelty Seeking in adults. Genetic correlations within

and between the two environments indicated that different sets of genes influence Novelty Seeking under low and higher stress conditions. Current work using the vervet whole genome sequence data is focused on identifying the specific genes and systems that are involved.

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Shared biology and culture of the first Americans: Data from submerged burials

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The links between groups of humans as they dispersed across the New World may be discovered from comparing their biology and cultural legacies across time and space. Modern interpretations suggest at least two distinct waves of colonizers who looked different from one another in physical and social attributes. We report on how burial practices can be used to discriminate between them. We compared five prehistoric Florida sites with wet burials (~9000-2500 yBP) to a contemporaneous Costa Rican population with the same internment tradition to test this hypothesis. Discriminate analysis of 21-29 linear variables of cranial morphology was used to answer the following: 1) do the six study groups differ from one another anatomically; 2) what are the biological markers of each population and 3) do our data show the presence of two or more discrete biological ancestral lineages? We found three discrete populations, based on the shape and form of the crania used to distinguish subsets of living populations (e.g. orbit shape, facial breadth, etc.). This study suggests that a common cultural variable was shared among them more extensively than were genes. Our findings also support the hypothesis that the Americas were populated in repeated waves of people, beginning as early as 10 kYA. These early peoples can be distinguished from one another in their cranial morphology but they all share the unique cultural tradition of wetland burials, a practice not seen in other New World colonizers or in contemporaneous populations in the Old World.

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Strontium and oxygen isotopic evidence for migration to 19th century Grafton, Illinois

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The "Great Migration" in 19th century America was a period of rapid demographic change. Grafton, Illinois, located on the Mississippi and Illinois Rivers, offered prosperity in shipping commerce, fishing, farming, and limestone quarrying. Based on historical reports, Grafton drew populations from Kentucky, North

Carolina, Pennsylvania and elsewhere; however, little is known of the immigrant identity such as age during migration and biological sex. Here we utilize stable isotopic methods to detect mobility in a skeletal population from 19th century Grafton to investigate how national historic migration trends were reflected on a local scale. Strontium and oxygen isotopic analyses were conducted on the premolar enamel of 27 individuals; of these, 15 yielded ⁸⁷Sr/⁸⁶Sr values, and 25 yielded $\delta^{18}\text{O}_{\text{VPDB}}$ values. ⁸⁷Sr/⁸⁶Sr values show a large range (0.70863-0.71215) indicating that 80% (12/15) of the sample was composed of potential migrants. $\delta^{18}\text{O}$ values range from -7.3 to -4.0‰, suggesting that 40% of the sample population (10/25) potentially originated from nonlocal areas. Considering both datasets, we interpret 19 potential migrants in the total sample. The age profile of interpreted migrants is broad, including 4 children (age 5-10), 7 young to middle-aged adults (age 20-45), and 8 older adults (age 55+). Of 11 potential migrants whose biological sex was determined, 5 are assigned as male and 6, female. This demographic range diverges from historical accounts of young male migrants marrying local females, and suggests that 19th century American migration patterns were more complex than previously understood.

Collaborative long-term data sets and plans for the future: Thirty years of primate research in Costa Rica

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Extensive, longitudinal datasets provide a rare and valuable resource for testing evolutionary hypotheses and are especially important for long-lived animals, such as primates. For example, continuous records of group demography, ranging patterns, social behavior, parentage, and vegetative phenology allow us to better understand how natural and sexual selection operate over time. Detailed primate histories also provide the backbone for interpreting molecular data in fields such as functional genetics/genomics, molecular ecology and epidemiology. What is more, continuous field presence allows the documentation of important, yet rare, events (e.g. predation, permanent group fissions, infanticide) and helps ensure the conservation of primate habitats. Despite their importance, long-term datasets are uncommon and, unfortunately, the extended research programs supplying these data are endangered by the current funding environment. Here, on the 30th anniversary of the inception of our research program, we describe our collaborative long-term studies in Sector Santa Rosa, Área de Conservación Guanacaste, Costa Rica and review the types of data we collect on three species of primates (*Cebus capucinus*, *Alouatta palliata*, *Ateles geoffroyi*) and their environment, as well as past, current and future applications of these data. We use this case study to highlight the importance of collaboration in our long-term projects and conclude with estimates of the minimum required funding needed to keep the most fundamental aspects of our research going.

We hope this presentation increases awareness of the value of long-term research endeavors and helps provide the necessary fuel to win continued sponsorship from granting agencies and private foundations.

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Politics by other means: Social networks, community identification, and the "Four Years' War" in the chimpanzees of Gombe National Park, Tanzania

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In 1972, the main chimpanzee study group at Gombe split into two separate communities, Kasekela and Kahama. Over four years, the Kasekela community killed the adult males and one female of the Kahama community. Here we use social network analysis to explore this unique community fission by examining social associations measured by arrival together at the provisioning site. First, we test the hypothesis that the pre-split community was actually two communities brought together by provisioning. Using the Girvan-Newman algorithm, we found no evidence of subgrouping until November 1971, suggesting that the two communities split from one original cohesive community. Next, we explored proximate causes of the fission. Candidate catalysts were changes in the 1) provisioning regimen, 2) male dominance hierarchy, 3) demography. The timing of the fission most closely coincided with a dominance struggle between three high-ranking males that occurred in late 1971-2. Finally, we found that post-split community membership significantly predicted pre-split association patterns in each year from 1968-1972 (MR-QAP Linear Reg: all $p < 0.03$). Thus, initial analysis suggests that the community abruptly split during the course of a dominance struggle, and that individuals remained with others with whom they had preferentially associated in the previous four years. We will use a generalized Louvain community detection code to precisely determine the date of subgroup formation, and the CONCOR algorithm to identify the relationship between pre-fission social roles and post-fission community membership. This project provides vital clues to the importance of individuals in maintaining group cohesion in chimpanzee populations.

Data collection was supported by the Jane Goodall Institute; construction of the long-term database was supported by grants from the NSF (DBS-9021946, SBR-9319909, BCS-0452315, IOS-LTREB-1052693).

Consequences of a male take-over on the male mating skew of wild Sanje mangabeyes (*Cercocebus sanjei*)

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In many primate species living in multimale-multifemale groups, male rank predicts mating success (priority of access model, or PoA). Certain factors, however, such as temporary instability in the hierarchy, can affect a male's ability to monopolize females and therefore reduce mating skew. Here I use behavioral and endocrinological data collected on a wild group of Sanje mangabey to describe the effect of a take-over by two immigrating males on male mating skew.

The analysis was divided into 3 periods: prior, during and after the take-over, as reflected by changes in the Stability index *S*. Prior to the take-over the male hierarchy was stable ($S=0.005$) and highly skewed (binomial skew index $B=0.472$, $P<0.001$), with the two top ranking males accounting for 84% of ejaculatory copulations with females when they were more likely to ovulate. During the take-over, stability decreased ($S=0.045$), as did the proportion of copulations by the alpha and beta males (27.3%), while copulations by subordinates increased to 76.7%. Accordingly, the binomial skew index differed only marginally from a random distribution ($B=0.041$, $P=0.056$). After the take-over, the hierarchy resumed a more stable state (S -index=0.019), with copulations by the alpha and beta males increasing to 70.7%; this was reflected in a lower binomial skew index ($B=0.204$, $P<0.001$).

This study demonstrates that temporary rank instability can decrease the efficacy of the PoA model, allowing low ranking males to have more mating opportunities, and potentially improve their reproductive success.

This study was funded by NSF-DIGG (BCS 0925690), The Leakey Foundation, Margot Marsh Biodiversity Foundation, Primate Conservation Inc., Sigma Xi and Idea Wild.

Ill-Fated? Exploring bioarchaeological links between childhood non-specific indicators of stress and leprosy immunity in Medieval England

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The Developmental Origins of Health and Disease paradigm (DOHaD) postulates that many modern day health concerns can be attributed to underlying, innate immune susceptibilities initiated by prenatal and early childhood stresses. This research explores the DOHaD paradigm (formerly known as the Barker Hypothesis) with a view to the past, specifically by examining non-specific indicators of childhood stress and leprosy in archaeological human skeletal remains in order to identify a potential nexus to the large range in immunity seen in leprosy, both in the past and present. A bibliometric analysis was carried out on a total of 151 individuals with the lepromatous form of leprosy (both non-adults and adults) from published and unpublished skeletal data of the three largest medieval leprosy sites in England: St. Johns (Norwich), St. Mary Magdalen (Winchester), and St. James and St. Mary Magdalene (Chichester). Findings indicate that whilst cribra orbitalia, porotic hyperostosis, and

stature are inconsequential in leprosy form and manifestation, biological sex and dental enamel hypoplasia demonstrate a statistically significant relationship, suggesting that immune reactivity in the past may have been more influenced by maternal and early physiological stress rather than external environments during later periods of growth and development.

Chimpanzee (*Pan troglodytes*) foraging behavior is mediated by food preference, competition avoidance, and social facilitation

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Intragroup feeding competition is a product of group living and, for gregarious primates, the distribution of resources in space and time are key factors that mediate it. To investigate the interplay of competition and food preferences on feeding behavior, we tested whether captive chimpanzees (*Pan troglodytes*) altered their food selections across different socio-ecological contexts. To test for individual preferences in the absence of competitors, we presented six zoo-housed chimpanzees with pairwise combinations of four different foods. To more closely mimic an unpredictable and competitive foraging environment, we also presented the same foods to the group via an artificial termite mound. We found that subjects altered their food selections in the social condition ($X^2=73.5$, $P<0.001$); chimpanzees were more likely to consume less preferred foods in the presence of conspecifics. We observed this shift across the entire group. With respect to competition, while some individuals tended to forage less often than others when more conspecifics were also feeding ($X^2=19.89$, $P<0.001$), the number of group mates present at the artificial termite mound did not affect their food choices ($X^2=7.20$, $P=0.066$). These results suggest that although social pressures may lead certain animals to avoid feeding during periods of elevated competition, in this case, intragroup competition did not drive food selection itself. Instead, social factors encouraged greater consumption of all foods, even those that were less preferred. This shift did not appear to be driven by competition avoidance, but was likely mediated by social facilitation.

Directing new information and abilities into conserved brain architecture

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It is widely assumed that brain evolution has proceeded by direct selection on the number of neurons or organizational features of defined functional modules, spatially discrete or distributed. With the exception of wide species differences in the sensory and motor periphery,

however, the residual variation at the level of single structures (like “visual cortex” or “cerebellum”) is small after whole brain volume is considered. Predictable, coordinated variation across brain regions, resulting from the conserved patterns of neurogenesis and growth of embryonic brain divisions, best captures brain structural evolution. How then does functional brain evolution occur, to generate species-typical functions to generic structures? From research on mechanisms of evolutionary changes of social preferences and social organization in birds and mammals, I will argue that contextual gating of basal forebrain and midbrain reward circuitry should be a central focus of our attention as a critical mechanism to understand how the brain populates itself with species-typical world and social knowledge, and idiosyncratic cognitive capacities. The application of this account to human facial recognition and communication, and to language acquisition will be described.

Dental macrowear analysis in Great Apes

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Chimpanzees (*Pan troglodytes*), orangutans (*Pongo pygmaeus*) and gorillas (*Gorilla gorilla*) rely on different food. The dietary diversity is reflected in their dental morphology, with differences in size and shape of teeth. However, while morphology can suggest what a tooth is capable of processing, tooth wear can tell us how a tooth is used. In this study we apply the Occlusal Fingerprint Analysis (OFA) method using 3D digital models of teeth, to quantitatively compare wear facet patterns in great apes. Unlike microwear, dental macrowear is a cumulative process that occurs throughout the individual's lifetime and thus reflect long-term diet. The results show significant differences between the three groups analyzed: in *Pongo* the occlusal surface is characterized by large and flat phase II facets, while in *Gorilla* there is a minimal development of buccal phase I facets and a steep wear facets inclination. *Pan* is somehow in between, with large lingual phase I facets and moderately steep wear planes. This macrowear pattern variation can be explained with the use of different food sources. In fact, while orangutans rely on hard food objects more than any other apes, showing thus a larger proportion of crushing wear, gorillas exhibit an increase in shearing wear, which is interpreted as an adaptation to a folivorous diet. Finally, the “intermediate” tooth macrowear found in chimpanzees, mirrors their highly variable diet. The OFA method demonstrates to be a powerful tool for better understanding the relationship between food items, mastication and tooth wear processes in living primates.

UNE Partnerships Career Development Awards for Post-Doctoral Fellows/Early Career Researchers.

Preliminary analysis of habitat usage by sympatric greater and lesser galagos (*Otolemur crassicaudatus* and *Galago moholi*) in a montane environment

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Because of their small size and cryptic behaviors, studies of galago behavioral ecology are limited. Especially rare are investigations of sympatric greater and lesser galagos (*Otolemur crassicaudatus* and *Galago moholi*). Both species are found in the Lajuma Reserve located in the Soutpansberg Mountains of northern South Africa. Lajuma is characterized by a mosaic habitat with patches of riverine forest, bushveld, mistveld, mountain thicket, and anthropogenically disturbed vegetation. Given both the size disparity and locomotor differences observed in these two galagos, we expected the two primates would utilize different habitat patches within the reserve.

In order to investigate this hypothesis, we trapped and censused galagos between 10 June and 10 July 2013. When galagos were either trapped or observed during census walks, we recorded their location. Ten galago locations, five for greater galagos and five for lesser galagos, were selected for habitat descriptions. Vegetation plots were established at each point and canopy cover, dbh, tree height, and tree species identity were recorded for each plot.

The results revealed no differences in vegetation structure between the plots in which greater galagos were observed and those associated with lesser galagos. The nature of the mosaic habitat at Lajuma may require that both species utilize a range of habitat types in order to meet their nutritional needs. Alternatively, the two galagos may specialize at the microhabitat level, focusing on different sized supports or different tree species within the habitat matrix at Lajuma. Future research at Lajuma will explore galago behavioral ecology in more detail.

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Male versus female mate choice in primates

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Despite mixed evidence for female mate choice across primate species, the theory that predicts its evolution in this clade is well-developed. In contrast, biologists have only recently turned toward theoretical and empirical research on the evolution of male mate choice in primates. Here, I compare the predictions for the evolution of female choice with those for the evolution of male choice, using a theoretical framework influenced by both population genetic and quantitative genetic theory. I show that in

populations with variance in female fertility, high male-male competition, and high variance in male mating success, male choosiness should evolve. However, rather than choosiness based on intrinsic qualities of the individual female, I suggest that males should bias their mating behavior on the basis of the quality of the reproductive opportunity. I argue for the importance of this distinction, particularly with respect to the evolution of male mate choice. Finally, I close by reviewing the empirical evidence for male mate choice in primates.

Are eastern bamboo lemurs disturbance specialists? Preliminary indications of ecological stress in *Hapalemur griseus*

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Habitat disturbance can have negative effects on ecosystems and species, but certain species are tolerant to, or even adapted to, disturbance. *Hapalemur griseus* may be especially resilient to habitat loss because of dietary specialization on bamboo, many of which colonize gaps and edges; however, little is known about the health and viability of *Hapalemur* in degraded habitats. This study investigated the effects of disturbance on the diet, population density, and morphometrics of *Hapalemur griseus* at Tsinjoarivo, in disturbed/fragmented and undisturbed/continuous forest during two dry seasons. We used all-day focal follows to study four groups (N = 2 to 8) July to September 2011, and two groups (N = 4 to 12) from June to August 2013. Morphometric data show a near-significant decrease in chest circumference in the disturbed habitat (Mann-Whitney U-test, $p = 0.095$). Home ranges measure 6.8-10.2 ha in undisturbed forest, and 1.1-1.8 ha in disturbed forest. Statistically significant variation between habitats was discovered in activity budget (particularly feeding and travel). Four bamboo species are consumed at both sites, making up 74% of the undisturbed groups' diet, and 86% of the disturbed groups' diets. Two of these species were found to contain cyanide; groups in continuous forest ingested bamboo without cyanide more frequently. The top 8 food species constitute 96% of feeding time, indicating very low dietary diversity. These preliminary results, including the combination of reduced body condition and reduced dietary diversity, suggest a cost to living in disturbed habitat, despite the observed increase in population density. *St. Louis Zoo.*

Social network structure in female forest guenons (*Cercopithecus mitis*): Ecological and physiological correlates

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Like other aspects of primate behavior, the structure of social groups and the dynamics of social interactions therein may be adaptive traits that evolved to optimize fitness in response to ecological conditions. Food availability and distribution have long been seen as important selective factors in the evolution of primate social behavior, influencing, for example, the kind and magnitude of competition. As studies have traditionally focused on dyadic interactions among pairs of individuals, the impact of ecological factors on the structure of social networks on a larger scale is still little understood. Here, we used data collected in three groups of African forest guenons (*Cercopithecus mitis*) to describe changes in grooming network structure of adult females in relation to the availability of fruits, the preferred and most contested food type, controlling for reproductive state, rank, and group differences. We found that with decreasing fruit availability, individual females increased their number of grooming partners and distributed grooming more evenly across partners, leading to overall greater social integration as indicated by multiple network centrality measures. In contrast to patterns observed in studies on other species, we found evidence that more focused, less diverse grooming networks were associated with higher, not lower levels of stress hormone metabolites measured in fecal samples, illustrating likely species differences in the physiological consequences of social strategies that remain to be explored further.

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How mechanically challenging are the foods eaten by black horned capuchins (*Sapajus nigritus*) of Carlos Botelho State Park, Brazil?

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The recent division of the genus *Cebus* into two separate genera: *Cebus* (untufted) and *Sapajus* (tufted) capuchins, with the subsequent naming of eight species within the genus *Sapajus* has led to increased interest in the ecological and morphological variation among the *Sapajus* species. A species such as the relatively well studied *S. apella macrocephalus*, exhibits a feeding strategy defined by the fallback use of palm fruits in lowland evergreen tropical rainforest. In contrast, *S. nigritus* exhibits a diet that is defined by the exploitation of seemingly fibrous and hypothetically tough food tissues such as palm pith and the base of bromeliad leaves by limited palm fruit use in upland Atlantic coastal rainforest. The seeming palm fruit dependence of *S. apella* suggests the exploitation of a relatively tougher diet. This study of the food material properties of the *S. nigritus* diet in Carlos Botelho Statue Park, São Paulo, Brazil brings into greater focus the dietary breadth and complexity within the genus *Sapajus*. Food toughness data were collected

using the Darvell portable tester on food tissues that were collected opportunistically during follows from (February) 2011 to (August) 2012. The average toughness (6903.6 J/m²) and maximum toughness (38868.7 J/m²) of the *S. nigritus* diet were found to exceed reported values for *C. olivaceus* and *S. apella*. These findings reveal a dietary pattern for a tufted capuchin species that goes against most assumptions and emphasizes the need to take such variation into account when using *Sapajus* in comparative studies of craniodental morphology and dental microwear.
Support: FAPESP, CNPq.

Biocultural, archaeological, and linguistic too! Modelling an interdisciplinary Anthropology of Health in the classroom and laboratory

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At a time when divisions are ossifying among anthropological subfields, the growing interest in the biocultural study of disease and disability presents an excellent opportunity for interdisciplinary collaboration and partnership. The diversity of methodologies and ideologies within the four fields provides a rich landscape for the contextualization and analysis of illness. This perspective can also provide our students with not only a more holistic view of health, but also a more holistic view of Anthropology. A more integrative model allows students from multiple disciplines to understand the biological, material, linguistic and social mechanisms of disability, disease, health and healthcare.

Examining and presenting cases within a four-field framework encourages anthropologists to engage more broadly with their research and, perhaps more importantly for the field, promotes a more unified and applicable presentation of Anthropology. While medical anthropology is popular in sociocultural disciplines, a wider incorporation of bioanthropological science and research can add tremendously to the applicability and relevance of an anthropology of health. Concurrently, archaeological and linguistic anthropology can highlight the evolution of medico-social ideologies and practices. This poster will present an example of an integrated pedagogical model with respect to congenital disability.

Morphological diversity in cheirogaleid female genitalia

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Studies of the primate urogenital system have traditionally focused on males, especially the role of intra-sexual selection in shaping morphological diversity among taxa. In contrast, comparative female genital morphology of most primate species – especially strepsirhines – remains relatively unknown. For example, detailed descriptions of the female genitalia in cheirogaleids exist only for *Microcebus* and *Cheirogaleus* (Hill, 1953; Petter-Rousseaux, 1960). In an attempt to fill this lacuna, I undertook a comparative analysis of female genital morphology in loriforms, which revealed marked “masculinization” of the female

genitalia across this infraorder (Foley, 2009). Subsequent broadening of my taxonomic sample to include cheirogaleids has revealed that a similar degree of “masculinization” is found in *Phaner furcifer* and *Mirza coquerelli*, the female genitalia of which have not been previously described. *Phaner* and *Mirza* also appear to lack the extreme seasonal changes in clitoral morphology that characterize *Microcebus* and *Cheirogaleus*.

The extreme “masculinization” of the female genitalia visible in *Phaner* and *Mirza* is particularly interesting. Drea and Weil (2008) described the genitalia of *Lemur catta* females as “moderately ‘masculinized’” and, using the spotted hyena (*Crocuta crocuta*) as a model, hypothesized that female genital “masculinization” was a byproduct of selection for female social dominance. However, all strepsirhines display varying degrees of female genital “masculinization” although not all species exhibit female social dominance. The commonality of female genital masculinization among strepsirhines therefore suggests not only that this trait is symplesiomorphic within the group, but that female genital “masculinization” and female social dominance may not be linked evolutionarily.

Geometric morphometrics of second upper australopithecine molars at Sterkfontein Member 4 for taxonomic appraisal

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R. J. Clarke has claimed that the *Australopithecus* fossil record at Sterkfontein Member 4 and Makapansgat represents two distinct species: *A. africanus* and the more *Paranthropus*-like *A. prometheus*. This issue has not been resolved morphometrically.

We assessed the morphological variability of the *Australopithecus* fossil record at Sterkfontein Member 4 by examining the second maxillary molars (M²s). We considered 46 teeth, 24 from South African *Australopithecus*, *Paranthropus* and early *Homo*, and the rest from European Neanderthals and recent modern humans. 3D surface models for data collection were obtained from micro-CT scans.

We carried out a geometric morphometric analysis of 3D landmarks and semilandmarks on the occlusal ridge curves for both the outer enamel surface (OES) and the enamel dentine junction (EDJ), and also an analysis of cervical and crown outlines.

In principal component plots, the landmark-based analyses and crown outline analyses cluster *Homo* separately from australopithecines and distinguish Neanderthals from modern humans well. Thin-plate spline grids show that much of the discrimination owes to relative proportions of trigon and talon and relative heights of cusps. The cervical outlines are not informative.

Within the *Australopithecus* group are two distinct M² shape clusters based on the OES and EDJ. However, the correspondence with Clarke’s species attribution is imperfect, since Sts 52 (*A. africanus* for Clarke) clustered with *A.*

prometheus. The EDJ seemed to provide a clearer separation between groups (only 3 *A. africanus* EDJs were available). In accordance with Clarke’s observations, *Paranthropus* and *A. prometheus* widely overlap in shape.

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Relative enamel thickness and enamel-dentine junction morphology in the Vallès-Penedès hominoids: A 3D approach based on X-ray micro-computed-tomography

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Fossil hominoid discoveries in the Vallès-Penedès Basin have led to the contention that four different genera (*Pierolapithecus*, *Anoiapithecus*, *Dryopithecus* and *Hispanopithecus*) are recorded during the Middle to Late Miocene (ca. 12.3 to 9.5 Ma). These genera are distinguished mostly based on cranial morphology and, to a lesser extent, some dental features, but their taxonomic distinctiveness has been disputed. To further explore their tooth characteristics and possible intertaxic structural distinctiveness, here we rely on 3D analyses based on high-resolution X-ray microCT, with emphasis on relative enamel thickness (RET) and the morphology of the enamel-dentine junction (EDJ).

MicroCT scans of 47 teeth were performed at The ‘Abdus Salam’ International Centre for Theoretical Physics (Trieste, Italy), and processed with a standard semi-automatic, threshold-based segmentation protocol.

Our 3DRET results show that *Dryopithecus fontani* and *Hispanopithecus crusafonti* display a thin to intermediate-thin condition, whereas *Anoiapithecus brevirostris* is intermediate-thin, *Pierolapithecus catalanicus* is intermediate-thin to thick, and *Hispanopithecus laietanus* ranges from a thin to an intermediate thickness condition. Regarding the EDJ morphology, the analyses revealed several subtle differences between the investigated taxa, including the morphology of the dentine horns (more peripherally situated and protruding in *D. fontani*), the mesial fovea, the trigon basin and the crista obliqua, among other features.

Overall, present results refine and integrate our previous 2D-based RET analyses and, most importantly, also provide additional evidence on inner tooth structural micromorphology supporting a taxonomic distinction at genus level among the four Miocene apes represented in the Vallès-Penedès Basin.

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Ontogeny of bipedal traits in an animal model for the quadrupedal-to-bipedal transition

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The evolution of bipedalism in the human lineage involved significant changes in musculoskeletal morphology to accommodate the locomotor shift from quadrupedalism to upright walking. However, the evolutionary mechanisms that underpin this shift remain unclear. This study seeks to better understand how this transition might have occurred by taking advantage of the inherent plasticity of musculoskeletal tissues. Because bone adapts to the predominant forces placed upon it, this study explores the relationship between bipedal loading patterns and skeletal morphology during growth and development. A novel method was used to experimentally induce a locomotor shift during ontogeny in an animal model for the quadrupedal-to-bipedal transition. Rats ($n=10$) were placed in a custom harness system mounted on a treadmill which allowed for bipedal locomotion over 60 minute periods, 5 days a week, for three months. The harness imparts an adjustable upward force on the torso which alters the load experienced by the hindlimbs. A quadrupedal control group ($n=10$) was exercised for the same period. Micro-CT scans were taken every third week to track skeletal changes. At the end of the experiment, bipedal rats had significantly greater growth in relative hindlimb length ($p<0.05$) and significantly larger distal and proximal joint dimensions ($p<0.05$). These findings suggest that initial changes consistent with the evolution of bipedal traits in the human lineage can occur through developmental plasticity in response to bipedal walking and may provide a blueprint for which traits may have occurred first in the earliest hominins.

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Hominin hypolordosis: A functional comparison of Neandertal and modern human lumbopelvic anatomy

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Recent research has revealed that Neandertals lacked the pronounced lumbar lordosis present in modern humans (Been et al., 2012). Variation in hominin lordosis has important implications for lumbopelvic function and specifically for the biomechanics of bipedal gait. To assess the extent to which the Neandertal lumbopelvic complex differs from that of modern humans, I performed a comparative morphological study of lumbar and pelvic traits in 39 hypolordotic, normal, and hyperlordotic adult humans (Hamann-Todd Collection, Cleveland Museum of Natural History) and three fossil Neandertals with sufficiently preserved lumbopelvic regions. Angular variables of vertebral wedging and sacral orientation along with linear dimensions

of the lumbar vertebrae and pelvis were examined. Linear variables were geometric transformed and Wilcoxon tests, regression analysis, PCA, and circular statistics were performed to identify significant differences among lordosis groups and between species.

Lumbar lordosis is largely formed by vertebral wedging. Variation in the mid-lumbar region (L2-L4) explains most of the differences in overall wedging angles between lordosis groups, where hypolordotic individuals are significantly more kyphotic ($p < 0.05$). Hypolordotic modern humans have longer, more ventrocaudally oriented transverse processes ($p < 0.05$) than either normal or hyperlordotic humans. Hypolordotic individuals share a wide sacral shape index ($p = 0.03$). These lumbopelvic characteristics expressed by hypolordotic humans and Neandertals enhance lumbar stability and robusticity, and as such would be biomechanically advantageous in high loading activities such as lifting and throwing. Hypolordosis in Neandertals was likely a response to the combined factors of glacial climate, activity levels, and genetic drift.

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Males who are potential sires show affiliation and tolerance towards infants in *Colobus vellerosus*

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Males in several colobine species commit infanticide in the context of group takeovers. Male-infant relationships outside of the context of male takeovers are poorly documented in colobines, leaving the impression that they occur rarely. Our study aims to provide direct evidence that male colobines indeed engage in affiliative interactions with infants.

This study was conducted on 8 non-natal males in four groups of black and white colobus (*Colobus vellerosus*) at Boabeng-Fiema Monkey Sanctuary, Ghana. Data collection took place between May-September 2013 using focal animal sampling and *ad-libitum* data. Mating events between June 2012 and April 2013 were used to evaluate male perception of paternity confidence. Males present in the group and/or seen to mate with a female at the probable time of conception were considered potential sires (PS); all other males were considered unlikely sires (US).

We expected PS to engage in affiliative interactions with infants more than US. Males interacted affiliatively with infants at a median frequency of 0.1 interactions per hr per infant ($IQR=0.28$). PS interacted more frequently with infants than US ($Mdn=0.50$, $Mdn=0.00$ respectively; $W=15$, $z=-2.24$, $p=0.012$, $r=-0.08$). Infants also played in close proximity to PS ($Mdn=0.38$) more frequently than US ($Mdn=0.00$), indicating tolerance by PS ($W=15$, $z=-2.24$, $p=0.012$, $r=-0.08$). Infants often squealed and jumped on a male's lap in the context of male display behavior targeted at extra-group males. This interaction occurred almost exclusively within PS-infant dyads. Our results confirm the occurrence of affiliative

male-infant interactions and suggest that interactions reflect paternal effort.

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Does an extra premolar increase occlusal area: Comparison of Old and New World monkeys

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This study considers the influence of number of premolars on postcanine occlusal area. New World (NW) monkeys have 12 premolars, whereas Old World (OW) monkeys have 8. Four species were studied: *Cercopithecus albogularis* and *Colobus guereza* (OW), and *Cebus capucinus* and *Alouatta palliata* (NW).

Two pairs of species are classified as having the same general diet: *Co. guereza* and *A. palliata*, and *Cer. albogularis* and *Ceb. capucinus*. Adult, wild caught, female specimens from the Smithsonian's National Museum of Natural History were studied. Sample sizes were as follows: 20 *Co. guereza*, *A. palliata* and *Ceb. capucinus*, and 14 *Cer. albogularis*. Measurements, using sliding calipers, included length and width of premolars and molars, and lengths of the cranium and palate.

Results show the percentage of contribution of premolars to total length of postcanine teeth differs between OW and NW monkeys. Premolars contribute 33% of postcanine length in both OW species, whereas the percentages are 40% for *A. palliata* and 48% for *Ceb. capucinus*.

Although the OW monkeys have significantly longer crania and palates than the NW monkeys in the paired comparisons, *A. palliata* has a significantly larger maxillary occlusal area than *Co. guereza*; there is no significant difference in maxillary occlusal area between *Ceb. capucinus* and *Cer. albogularis*. These results show that the number of premolars, relative to cranial and palatal length, is an important influence on occlusal area.

The functional morphology of the seventh cervical vertebra in extant hominoids and early hominids

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The seventh cervical vertebra (C7) forms the caudal-most segment of the cervical spine. Depending on the type of posture and locomotion, it is subject to diverse directions of forces. The lever arms – transverse and spinous process length – can therefore be used to infer locomotion and posture. Here we analyze the C7 of *Macaca* ($n=15$), *Hylobates* ($n=14$), *Pongo* ($n=11$), *Gorilla* ($n=20$), *Pan* ($n=15$) and *Homo sapiens* ($n=26$), as well as *Australopithecus sediba* (MH1) and *Homo erectus* (KNM-WT 15000). Standard linear measurements were taken and angles and indices were calculated.

The longest spinous processes were found among the great apes. The muscles that attach to the spinous process are involved in extending the

neck as well as related to climbing behavior and counterbalance the weight of the viscerocranium. Extremely long spinous processes among gorillas are explained by the size of the masticatory apparatus. Vertebral body surface area relative to articular facet area was largest in humans and orangutans, which might be associated with axial weight transmission from the skull onto the cervical spine. *Macaca* displayed wide transverse processes, a lever increase for muscles involved in extending and abducting the neck. MH1 showed an ape-like length and horizontal projection of the spinous process. This may relate to the large and heavy viscerocranium of australopithecines and to their climbing behavior. KNM-WT 15000 falls within the range of variation of modern humans except for his relatively long spinous process due to a more prognathous face.

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Building bones: Studies of bone growth in Anthropology

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Adult craniofacial morphology results from intricate developmental processes involving coordinated growth activities. While morphometric studies have elucidated specific craniofacial growth patterns in Great apes and humans, bone histological studies exploring growth dynamics are rare. Moreover, it is generally assumed that bone growth patterns at a microstructural level correspond to large-scale shape patterns.

Here we study postnatal facial development in *Pan troglodytes*, *Gorilla gorilla* and *Homo sapiens*. Methodologically, this project consists of two parts: 1) recording patterns of bone deposition and resorption at the microscopic level; and 2) quantifying morphological shape changes at the macroscopic level. High-resolution molds of the facial skeleton and mandible were analyzed using a reflected light microscope and bone formation and resorbing fields were mapped. Additionally, landmarks and semilandmarks were digitized on surface models and the Procrustes shape coordinates were analyzed using multivariate statistics.

Growth dynamics of the face indicate an anterior-inferior growth direction for all three taxa; facial growth among chimpanzees is predominately in a forward direction and among gorillas it is downward. In general, bone formation occurs on the mandible and face; however among chimpanzees bone resorption occurs on the ramus and in gorillas resorption is observed on the anterior face.

This study establishes a comparative framework of bone growth dynamics at the micro and macroscopic levels for Great apes and humans. Ultimately, this integrative approach can help elucidate bone growth dynamics underlying the morphology of extant and extinct taxa and can be applied to better differentiate ancestral versus derived morphology among our fossil ancestors.

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Preterm delivery as a predictor of diurnal cortisol profiles in adulthood: Evidence from metropolitan Cebu City, Philippines

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Risk of preterm delivery is associated with maternal stress experience and elevated levels of stress hormones, such as cortisol, during pregnancy. Individuals who are born preterm are found to be at increased risk of adverse health outcomes influenced by cortisol later in life, including hypertension and cardiovascular disease. However, the relationship between preterm birth status and adult HPA axis function has yet to be elucidated. This study, using a subset of data collected through the Cebu Longitudinal Health and Nutrition Survey (n=1,402), investigates the significance of prematurity as a predictor of adult HPA function, as indicated by diurnal cortisol profiles at 21 years of age. Individuals born prematurely (<37 weeks) differed from those born at full-term, with a flatter slope in cortisol decline across the day; a pattern that has been linked to increased risk of cardiovascular disease. Furthermore, we found a stronger relationship between HPA-axis function and gestational age among male offspring, consistent with previous work in this population, demonstrating heightened male environmental sensitivity. Results of this study suggest that preterm birth has biological effects that persist into adulthood and may therefore influence development in the next generation.

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Dental modification in modern day Cape Town, South Africa: A link to the past

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People living in Cape Town, South Africa have been practicing dental modification for almost a century. A systematic survey of eight adjoining areas around Cape Town was done to investigate the prevalence, motivation and possible historical time depth of this practice. The survey was conducted by means of a questionnaire.

A total of 2167 individuals participated in this study of which 41% had modified their teeth. More males (44.8%) than females (37.9%) were involved in this practice. Residential area and pay class had an impact on dental modification practices. The incidence increased within lower income areas. There were four stated reasons (peer pressure, fashion, gangsterism and medical/other) for dental modification of which peer pressure (in males) and fashion (in females) were the most popular. Dentists did most of the extractions. Three quarters of the study sample

had family members with dental modifications. More than half of individuals with modifications wore dentures. Most respondents (84%) also indicated that the practice had a negative impact on the rest of their teeth. They often had to extract more teeth later in life which impacted their diet and health.

Race divides populations in terms of collective heredity traits – most commonly, phenotypical differences e.g. skin colour. Often identities are not based on ‘race mixture’ but on cultural creativity shaped by history. Not only ‘colored’ people were modifying their teeth, study subjects who had self-classified themselves as ‘black’ or ‘white’ also practiced it. This showed that ‘race’ was a less important factor than social class.

The nature of interaction at La Sufricaya, Guatemala: Evidence from stable isotope analysis of human tooth enamel

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Six individuals were found interred at the Early Classic Maya site of La Sufricaya in Guatemala during field excavations from 2001 until 2012. Strontium and oxygen isotopic analysis provides insight into the movement of these individuals and thus the role of La Sufricaya in Mesoamerican interaction.

A small elite residential community, La Sufricaya, was located between the two much larger powers of Tikal and Kaanul. Yet material culture, in the form of wall murals, suggests there was a connection with the great city of Teotihuacan in Central Mexico. My hypothesis states that the strontium ratio from the enamel of at least one of the six individuals does not fall within the range of strontium ratios for the local region of La Sufricaya based on a contemporary faunal sample and the local bedrock.

Strontium analyses of human tooth enamel indicate that three of the six individuals at La Sufricaya migrated to the site after childhood. Several lines of evidence indicate that these individuals were migrants from the nearby Northern Lowlands suggesting complex regional relationships within the Maya region. Furthermore, there is no isotopic evidence to suggest that there were physical interactions with Teotihuacan. The presence of material evidence from Teotihuacan at La Sufricaya is much more likely due to political ties to Teotihuacan through the city-state of Tikal. La Sufricaya may have been a smaller center, however, both material culture and isotopic data imply that it was thoroughly involved in the Maya political landscape of the time.

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Fossil monkeys from Woranso-Mille, Ethiopia, and implications for the evolution of *Theropithecus*

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Woranso-Mille is an important mid-Pliocene hominin site in the Afar region, northeastern Ethiopia, and has also produced a large sample of fossil cercopithecids. Vertebrate localities in the Am-Ado, Aralee Issie, Korsi Dora, and Makah Mera areas are all roughly contemporaneous and dated to between 3.6 – 3.8 Ma. The cercopithecids from these localities include a minimum of five species: two cercopithecines and three colobines. *Theropithecus oswaldi* cf. *darti* is the most common species in the assemblage, making up over 90% of identifiable specimens. There is also at least one other species of papionin, which cannot be currently assigned to a genus. The colobines include *Cercopithecoides* cf. *meaveae* and two other species, one smaller and one larger than *C.* cf. *meaveae*, that cannot be allocated to genus.

The Woranso-Mille sample documents the earliest occurrence of the *T. oswaldi* lineage, and is morphologically the most primitive: it is smallest in cranio-dental size, large anterior dentition, and relatively simple molar morphology. The primitive nature of the Woranso-Mille *T. o.* cf. *darti* sample implies a significant amount of parallel evolution in molar morphology between *T. oswaldi* and *T. brumpti*. The predominance of monkeys at Woranso-Mille in comparison to other mammals in combination with the preponderance of *Theropithecus* among cercopithecids at Woranso-Mille is unique among African Pliocene sites and may have implications for understanding the overall mid-Pliocene environment at Woranso-Mille.

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Validation study of the Ubelaker and London atlases

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Biological anthropologists are oftentimes tasked with estimating age-at-death from skeletonized human remains and are sometimes even required to estimate age for living individuals. Common approaches utilize the mineralization and eruption of both deciduous and permanent dentitions. In these instances, investigators utilize recognized atlases to narrow down age estimates. In North American contexts, the atlas published by Ubelaker (1989) and reprinted in Buikstra and Ubelaker (1994) is commonly cited and utilized for generating age estimates from the dentition of juvenile individuals. A recent contribution by AlQahtani et al. (2010) called the London Atlas was developed in the United Kingdom on a sample of 176 individuals. This new tool was published with a supplemental website and is presently available in 17 languages. Moreover, a graphical user interface was designed to aid investigators in generating age estimates from the London Atlas.

In order to compare age estimates from the London Atlas with the atlas published by Ubelaker (1989), 475 panoramic radiographs were drawn from the Orthodontics Case File system curated at the Maxwell Museum of Anthropology at the University of New Mexico. The study sample consisted of 234 males and 241 females with an average age of 12.23 years. Individuals were scored blind to real age for both the London Atlas and Ubelaker (1989) methods. Overall, results indicate that the Ubelaker Atlas produces more accurate results within the standard error at a rate of 80 percent. However when estimating age of individuals developing third molars, the London Atlas estimates age more accurately.

Malposition, circulatory deficiency and traumata – a multi-affected individual as a special case of Legg-Calvé-Perthes disease

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The presented case was discovered in a Bronze Age cemetery, Kudachurt 14 (2200-1500 BC), which is located in the Karbadino-Balkarian Republic, Russia. The anthropological investigations were part of a study of different regional Bronze Age populations. Different lesions were diagnosed for this 35-45 year old male individual. It represents one of the rare cases of Legg-Calvé-Perthes disease in the archaeological record.

The left hip has a strong abnormal morphology. The left femoral head was greater in diameter (59 mm) compared to the right (51 mm) and the acetabulum is correspondingly enlarged. The femoral head joint surface also shows a remarkable lesion caused by Osteochondrosis dissecans. Anteversion of the left femur by 45° initiated an internal rotation of the knee. Additionally, the diaphysis is noticeably narrow and shows underdeveloped muscle attachments, as is typically for disuse atrophy.

As well as this disability, completely healed fractures are observable on the right femur and the left parietal bone. Both are severe traumatic injuries adding yet another facet to the emerging picture of the hard living conditions of people in Bronze Age Caucasus.

The paper discusses different possible connections between these pathologies: One may be the increased anteversion of the left femur which may have led to Osteochondrosis dissecans of the femoral head as well as atrophy of the shaft of the femur because of malposition. It also could have caused Legg-Calvé-Perthes syndrome resulting in Coxa magna and acetabular hypertrophy.

"Seeing the world through their eyes": Analyses of the first National Geographic Crittercam™ deployments on macaques in Singapore and Gibraltar

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In 2012 and 2013, we conducted two field experiments attaching microprocessor-controlled HD camera systems (National Geographic Crittercam™) on free ranging macaques (*Macaca fascicularis* and *M. sylvanus*). We deployed the camera systems affixed to a collar secured around the neck of a macaque on three individuals in Singapore and six in Gibraltar. The initial deployment in Singapore enabled us to make substantive modifications such that subsequent deployments had dramatically improved success. Here we present the methodological challenges and the initial analyses of Crittercam™ potential derived from more than 40 hours of footage. Central outcomes include in-depth assessment of the impacts of capture, sedation and release on individual macaques via visual records of their behavior during recovery and post-release. We also obtained novel views of feeding patterns, including food item selection, arboreal locomotory behavior and path choice, and intragroup social behavior in the absence of human observers. In both deployments the visual data, combined with other remote telemetry approaches, enhance our ability to assess and model primate navigation of diverse landscapes. We propose that our ability to track and assess primates' activity from their own visual perspective can add substantively to the way we study primates by providing access to a broader suite of data on their lives, especially in regard to intra- and interspecific interactions and individuals' interface with diverse environments.

Nutrient intakes associated with serum C-reactive protein concentrations in normal to underweight breastfeeding women in northern Kenya

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Low-grade elevation of C-reactive protein (CRP) is a non-specific marker for inflammation, used as a predictor for cardiovascular disease development and chronic inflammatory disease risks. An emerging interest in chronic inflammatory disease research is dietary influence on low-grade CRP elevation. Much research in this field has focused on well-nourished and over-nourished populations or clinical settings, leaving little information about

normal to underweight populations in ecological settings. This study evaluates possible impacts of dietary nutrients on serum CRP levels in a population of relatively thin adult women. Data from Ariaal women of Kenya collected in 2006 were used, excluding individuals with acute phase reaction (CRP>10mg/L). The mean BMI for the sample (n=197) was 19.6 kg/m². The majority (65%) of women had normal weight, 32.5% had underweight (BMI<18.5kg/m²), and 2.5% overweight (BMI>25kg/m²). Logistic regression models were applied using low CRP elevation (CRP>3mg/L) as the outcome variable and dietary nutrients, age, and BMI as predictors. Models showed that energy intake was a positive predictor of CRP elevation ($p<0.01$; n=197) while folic acid and total vitamin A intake were protective ($p<0.05$) against CRP elevation after adjusting for age, BMI, and serum retinol. Unlike previous studies among higher BMI populations, this study did not find a significant effect of dietary lipids/fatty acids on CRP elevation. These observations suggest that the effects of specific dietary nutrients on inflammatory status may vary with BMI. Further research should investigate the role of dietary fats, fatty acids, and anti-oxidant vitamins across populations with a wide range of BMI.

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A phylogenetic approach to the evolution of anthropoid lumbar number

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Homo sapiens exceeds the modal lumbar numbers (3-4) of all other extant hominids by one to two vertebrae, likely related to the evolution of a supportive lumbar curve important in upright posture. The *Homo* lumbar number may represent either retention of a primitive five lumbar lower back from the last common ancestor of *Homo* and *Pan* or a derived lengthening of the lumbar section from a three or four lumbar last common ancestor. Dollo's Law, which proposes that structures are unlikely to be reacquired once lost, might be evoked in support of the long-back hypothesis.

Here, Dollo's Law is tested with maximum likelihood ancestral state estimation using a consensus gene tree of 22 anthropoid primates obtained from the 10k Trees Project. The likely ancestral states at each node, including the last common ancestor of humans and chimpanzees, are also estimated. Dollo's Law models were significantly less likely than models without any constraint on the directionality of state changes both when all rates were held to be equal ($p<0.001$) and when each rate was allowed to vary independently ($p<0.01$). The maximum likelihood independent rates model also estimated state transition rates inconsistent with the expectations of Dollo's Law, particularly favoring increases from three to four lumbar vertebrae (rate = .82). The ancestral state in the LCA of *Homo* and *Pan* was estimated at three lumbar with 43.5% likelihood and four lumbar with 37.3%

likelihood, with the five lumbar state estimated at only 19.2%, supporting the short-backed LCA hypothesis.

Activity budget, habitat use and diet of squirrel monkeys (*Saimiri oerstedii*) in Southern Costa Rica

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Preliminary research is crucial to understanding any species and their existence in their ecological system. Further, gaining knowledge into how a species can thrive in two very different types of habitats expands not only our understanding of behavioral plasticity of primates and similar species, but will aide in conservation efforts and a better understanding of the coexistence of humans and other animals.

This research was conducted to investigate the basic activity budget, habitat use, and diet of squirrel monkeys (*Saimiri oerstedii*) in southern Costa Rica. These squirrel monkeys are of an endangered subspecies *Saimiri oerstedii* subsp. *oerstedii*. This population of squirrel monkeys is living on unprotected, human impacted lands at a higher altitude than ever previously recorded. We used a series of data collection techniques described previously in Corcovado National Park, a protected lowland area (Boinski 1987). Using this research as a basis we collected comparable data in order to analyze the behavioral adaptability of these monkeys.

We found that the lowland squirrel monkeys used habitat differently than those observed by Boinski (1987). We also found that the high altitude population traveled less than those in Corcovado National Park. These results contribute to a broader understanding of the behavioral plasticity of squirrel monkeys and related species. This broader understanding can help conservation efforts to include more human-impacted environments, which would allow squirrel monkeys and other animals to thrive in human inhabited environments with a decreased likelihood of hunting and deforestation activities. *Supported by an Oklahoma City University CAIRS Undergraduate Research Assistant Summer Research Grant.*

Geographic and diachronic variation among Amerindian crania: A 3D geometric morphometric test of settlement hypotheses

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The peopling of the Americas remains a much debated issue that continues to inspire research in multiple areas including archaeology, genetics and craniometrics. One of the controversially seen questions involves the number of migrations from which all modern Amerindians derive. While craniofacial variation has often been interpreted as showing evidence of several waves, genetic data generally tend to support a single-wave model. The purpose of this study was to re-assess craniometric variation of Amerindians populations using 3D geometric morphometrics. We specifically tested

hypotheses about the number of migration waves and the possible effect of genetic isolation in Fuegians and Pericues. To this effect, a large sample (N=894) of modern adult crania from the Americas, Australasia and the Pacific Islands, as well as 58 Paleoindian and fossils from the Old World were surface-scanned, and 3D coordinates were extracted and submitted to a Generalized Procrustes Analysis. Semilandmarks were also included after adjusting them using Thin-plate spline relaxation. Shape variability was statistically assessed against geographic, chronological and climatic variation. Our results are consistent with most genetic studies suggesting a single founder event at the origin of all modern Amerindians, but do suggest strong isolation effects, especially in Baja California and Tierra del Fuego.

Signatures of selection in immune response genes among Native Latin American populations

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Infectious diseases are among the strongest selective pressures on the human genome; and past selective events influence host susceptibility and resistance to modern diseases. Therefore, searching for signatures of natural selection in genes related to immune function is a particularly attractive strategy to identify host factors for infectious disease. To characterize host risk factors within Native Latin American populations, we interrogated 906,600 SNPs assayed using the Affymetrix 6.0 genotyping array for signatures of natural selection in immune response genes. The populations included: 25 Maya and 14 Mesoamericans from Mexico, 25 Aymara from Bolivia, and 24 Quechua from Peru. Additionally, we used available data from 60 Europeans of northern European ancestry and 90 East Asians from China and Japan. We applied four statistical tests to identify signatures of natural selection: locus specific branch length (LSBL), the natural log of the ratio of heterozygosities (lnRH), Tajima's *D*, and extended haplotype homozygosity. We identified 240 and 129 genes exhibiting genetic differentiation in the Native Latin American population at the 5% and 1% significance levels, respectively. The two genes with the greatest effects were *ISG15* and *IFIT2*. *ISG15*, involved in innate immunity, responds to viral infection through the IFN- γ pathway. Meanwhile, *IFIT2* inhibits viral and bacterial replication by increasing protein synthesis in uninfected cells as part of the interferon family. The results of this study will aide in future association studies looking at infectious disease susceptibility in Latin American populations.

Life history variables and vomeronasal groove length in primates

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Recent studies on the mammalian vomeronasal organ (VNO) suggest it is tuned to detect species-specific odorants that illicit innate responses, while responses to odorants detected by the main olfactory system are conditioned. Given this information, it is possible that innate VNO mediated responses to sociosexual and predator odorants are highly adaptive in mammals that mature, disperse, and reproduce at early ages. Because primates exhibit diversity in life history strategies and VNO development, they offer a good model for testing the hypothesis that fast life history strategies select for a well-developed VNO. This study tests this hypothesis by performing pair-wise phylogenetic least squares comparisons on size adjusted vomeronasal groove (VNG) length (a proxy for VNO length) and eight life history variables in 47 primate species. In the full primate sample, relative VNG length scales significantly with gestation length ($r^2 = -0.2873$, $p < 0.001$) and litter size ($r^2 = 0.223$, $p < 0.01$). However, when strepsirhines and haplorhines were analyzed separately, strepsirhine VNG length scaled significantly and negatively with four additional life history variables (age at first birth, neonatal mass, age at sexual maturity, weaning age) and had higher r^2 values compared to the haplorhine sample. Strepsirhines generally have faster life histories and more well-developed VNOs, a possible result of selection for sensing intrinsically valuable odorants. Additionally, loss or reduction of the VNO in haplorhines could be explained by longer developmental periods that come with slow life histories, which could have increased the relevance of conditioned responses to odorants mediated by the main olfactory system.

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Stable isotopic paleoenvironmental reconstruction of the late Pleistocene Middle Stone Age sites on Rusinga and Mfangano Islands, Lake Victoria, Kenya

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The relationship between environmental change and human evolution has been well documented by paleoanthropologists. However, the lack of detailed paleoenvironmental reconstructions from East African hominin sites during the late Pleistocene has limited our understanding of the evolutionary pressures shaping early modern humans and their dispersals within and out of Africa. Here we present a multi-proxy isotopic reconstruction of

the paleoenvironmental context of early *Homo sapiens*, using data from MSA archaeological sites dated to 33-100 ka on Rusinga and Mfangano Islands, Lake Victoria, Kenya. The unique faunal assemblage from Rusinga and Mfangano includes extant arid-adapted species outside their modern-day range and extinct specialized grazers. Carbon isotope data from fossil mammalian tooth enamel documents the presence of expanded C₄ grassland as well as drier conditions relative to today, consistent with other data indicating a significant reduction in the size of Lake Victoria at this time. The dominance of ungulates with diets of primarily C₄ vegetation provides strong evidence for a significant expansion of C₄ grasslands into equatorial eastern Africa compared to the present. Paleosol carbonate and soil organic matter carbon isotope analyses suggest that the late Pleistocene deposits on Rusinga and Mfangano Islands sample stream- or spring-side woodland settings (64 ± 18% woody cover) within the larger C₄ grassland environment. Our data suggest that, in some cases, humans persisted during intervals of drier conditions with expanded grassland cover in the region by exploiting locally closed and well-watered habitats within the larger grassland communities.

Sociosexuality in Cebu (Philippines): Variation by life history status and paternal care but no correlation to testosterone

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Testosterone helps facilitate competitive behavior and is commonly downregulated in nurturant social contexts, e.g. married fathers have lower testosterone than single non-fathers in many cultural settings. Prior research suggests that men with elevated sociosexuality (interest in casual sex) maintain high testosterone when partnered. Drawing on a large (n = 901) study in Cebu City, Philippines, we use the revised Sociosexual Orientation Inventory (SOI) to test whether sociosexuality relates to life history status and testosterone, particularly during transitions to marriage/fatherhood. Validating the use of the SOI, we found that men with higher SOI scores reported more recent sexual partners, were more likely to commit infidelity, and reported earlier ages at first intercourse (all $p < 0.0001$). SOI scores did not correlate with testosterone ($p > 0.2$). Married fathers had lower SOI scores ($p < 0.01$) and lower testosterone ($p < 0.001$) than single non-fathers, but SOI did not moderate or mediate these demographic differences in testosterone. Similarly, among men who were single non-fathers at baseline, SOI levels were unrelated to changes in testosterone as subjects transitioned to marriage and fatherhood ($p \geq 0.1$). Finally, fathers with higher SOI scores reported lower routine and recent (last week) paternal care (both $p < 0.001$), but SOI and paternal care did not interact to predict paternal testosterone ($p > 0.2$). At Cebu, we found no evidence that sociosexuality moderates relationships between life history

transitions or paternal behavior and testosterone. We consider our results within both parental investment theory and cultural frameworks of masculinity.

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African Plio-Pleistocene biochronology: A reassessment using cercopithecoid taxa

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The geochronological ages of many African hominin sites remain disputed, especially South African karstic sites. Despite recent advances in chronometric techniques (e.g., U-Pb), considerable uncertainty remains. Consequently, biochronology remains prominent in assessments of Plio-Pleistocene geochronology. Cercopithecoid monkeys have proven useful for biochronological assessment in the past, as they are speciose, widely distributed, and abundant members of the African Plio-Pleistocene fossil record, and they are well-documented at nearly all Plio-Pleistocene hominin sites. The last major study using cercopithecoids, however, was published over 25 years ago.

Over the past two years, we have reexamined nearly all of the fossil monkey remains across the African Plio-Pleistocene in an effort to reassess cercopithecoid taxonomy and biochronology. Our results reaffirm previous assessments and offer refinements as well. At older South African sites (e.g., Makapansgat, Sterkfontein Members 2 and 4), *Parapapio* predominates, whereas *Papio* is more common at younger ones (e.g., Swartkrans, Kromdraai). Furthermore, we document previously unrecognized taxa in East Africa that provide a strong link to some of the South African localities. The *Theropithecus oswaldi* lineage shows a strong correlation between molar size and geological age through the Plio-Pleistocene, providing greater age constraint than was possible in earlier analyses. Our assessments suggest that Makapansgat is intermediate in age between the Hadar Formation and Matabaietu (approximately 3 – 2.5 Ma). Swartkrans Members 1-3 and Coopers D, on the other hand, are most likely close in age to the Upper Burgi and KBS Members at Koobi Fora, Bed I of Olduvai, and Kanjera (ca. 2-1.7 Ma).

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Whom to trust? Social bonds and allegiance fickleness among the Gombe chimpanzees

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Social bonds have important fitness benefits in several primate species. Male chimpanzees form long-lasting social bonds that correlate with coalition formation. At Gombe National Park, Tanzania, coalition formation was associated with the probability of ascending the hierarchy and of siring offspring. However, there have also been reports from several sites of “allegiance fickleness”, whereby male chimpanzees form coalitions against previous allies. We use a unique dataset of 33 years of association, grooming and aggression data on wild chimpanzees in Gombe National Park, Tanzania, to test the hypothesis that male bonds provide a foundation for coalition formation during periods when the hierarchy is stable, but when the hierarchy is unstable (i.e. there is a real chance of attaining higher rank), males are more opportunistic in their choice of coalition partners. This predicts that 1) Male social relationships will be stable over time; 2) There will be a positive correlation between bond strength and coalition frequency during periods when the male dominance hierarchy is stable, but not when it is unstable; and 3) Coalitions will tend to be directed down the hierarchy during stable periods and up the hierarchy during unstable periods. In support of prediction 1, preliminary results demonstrate that association patterns from one two-year period to the next were highly positively correlated (GLMM, $p < 0.0001$), with some dyads maintaining above-average relationships for as long as 14 years. Positive grooming relationships were more likely to persist for more than 2 years than relationships defined solely by above-average temporal association.

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Circadian patterns for five species of lemurs at the Duke Lemur Center

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Little is understood about how the role of the 24-hour luminous environment affects wild nonhuman primate circadian patterns, causing difficulty in understanding the photic niche of the ancestral primate. We present the first data on proximate light-dark exposure and the resulting activity-rest patterns in lemurs at the Duke Lemur Center. Four individuals of five species were fitted with a Daysimeter-D pendant that contained light and accelerometer sensors. As expected, all five species were more active between sunrise and sunset, but *Varecia variegata variegata* and *Varecia rubra* were also active at night while *Eulemur mongoz* was not. All five species demonstrated an anticipatory increase in their pre-sunrise activity that peaked at sunrise with all but *V. rubra* showing a reduction within an hour. Four of the five also

stayed active after sunset, but *Propithecus coquereli* began reducing their activity about two hours before sunset. Our results demonstrate a variety of activity patterns in response to light levels and that these five lemur species utilized the light in different ways: *L. catta* assumed the classic ground “sunning” posture in the morning’s full sun while *P. coquereli* would sit at the canopy top. The other three species exposed themselves too much lower light levels and never to full sun.

Light levels and light spectra should be carefully considered for the housing of captive primates and the eventual application of this technology in the wild will help provide scientific “light” on the debate about the evolution of lemurs and ultimately the human ancestor.

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The refugium no one is talking about: Hominin admixture in Central Asia

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One of Alan Mann’s most significant contributions related to Neandertal studies concerns the theoretical development of a model of modern human origins that emphasizes reticulation among late Pleistocene hominin populations. Influenced by Mann’s work, the current research suggests that hominin population structure is inextricably linked to the landscape; making it possible to use biogeographic models to test hypotheses concerning that structure and the conditions under which meta-populations potentially interacted. The present study identifies combinations of abiotic variables that best predict hominin site preferences as a window onto differences in fundamental niche structure among Central Asian hominin groups from Uzbekistan and Tajikistan and those from the Siberian Altai of Russia. This approach informs genetic evidence that identifies at least two late Pleistocene hominin groups within greater Central Asia, the Denisovans and the Neandertals. We rely on ecological niche model theory and GIS methods to build a predictive surface from which hominin ranges can be defined. Our results indicate a hominin presence in both regions during the coldest episodes of the Last Glacial Period and subsequently support an interpretation of the areas as southern and northern refugia, respectively. The utility of refugia concepts in explanatory frameworks of hominin admixture will be discussed. More importantly, these results suggest that the ‘demise’ of the Neandertals requires consideration from a broader geographic perspective than currently employed in our discipline.

Effects of honey consumption and latitude on hunter-gatherer nutritional profiles

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Modern hunter-gatherer diets are critical points of reference in reconstructing the foraging ecology and nutritional environment of Paleolithic hominins. Debate remains regarding the variability in forager diets and the reliability of diet reconstruction from qualitative ethnographies. Our project investigates broad patterns of forager diets in large-scale datasets, comparing them to comprehensive data on hunter-gatherer diets reported in quantitative analyses, and examines the influence and differences in diet composition among datasets. From Murdock’s *Ethnographic Atlas*, we compiled data from 264 hunter-gatherer populations. Results were similar to previous large scale subsistence analyses: over all forager populations, hunted or fished foods accounted for a larger portion of the diet, but the proportion was heavily dependent on latitude, with tropical, temperate, and arctic groups deriving ~50%, ~65% and ~90% of their diet from animal foods, respectively. Consequently, the average percentage of calories from protein increased with latitude. More detailed dietary analysis of six tropical hunter-gather groups revealed similar estimates of protein, carbohydrate and fat intake compared to our large-scale estimations. Nonetheless, population-specific comparisons reveal notably different results of animal/plant and protein/carbohydrate ratios primarily due to the inclusion of honey in our detailed data analyses. Honey data is scarce in ethnographic research from Murdock’s era and the inclusion of current honey research into subsistence ratios may challenge notions of hunter-gatherers animal protein consumption. Our results underscore the nutritional importance of honey in forager diets, suggesting that the diets of tropical foragers may not be as high in animal protein as some large-scale analyses indicate.

Ecological variation in toughness and food selection in Virunga mountain gorillas

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Food material properties are proposed to play an important role in the evolution of hominid masticatory systems. Mountain gorillas have a more robust masticatory apparatus than any living hominid and thus are expected to consume more mechanically challenging diets than other hominids, yet their foods are, on average, not tougher than orangutan foods. Assuming that food choice reflects both energetic return and an

animal's ability to break down that food, one avenue to address this discrepancy is to explore mountain gorilla food choice with respect to toughness.

Mountain gorilla habitat in Volcanoes National Park, Rwanda spans a large altitudinal range. We collected data on the following variables, to determine whether, and if so how, they change with altitude: 1) toughness of three plant species at every 100m increase in altitude (2600m–3700m); 2) toughness of foods comprising 90% of the gorilla diet across 5 vegetation zones; and 3) toughness of nonconsumed plant parts of those foods.

Although plant toughness increased with altitude, toughness of gorilla dietary items remained similar. Consumed plant parts were less tough than nonconsumed parts and toughness of the latter increased with altitude. These results indicate that gorillas select foods based on toughness to maintain a consistent toughness profile. Our results, and the observation that mountain gorillas spend much of their day masticating, suggest that the robust masticatory apparatus of gorillas may have evolved for repetitive mastication of foods that are intermediate in toughness (relative to other hominids) rather than the production of high magnitude bite forces.

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Spinal degenerative joint disease among the late Moche of San Jose de Moro, Peru: A study of social stratification

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This investigation seeks to explore variation in the quality of life among Late Moche individuals at San Jose de Moro, Peru, as reflected in the severity of spinal degenerative joint disease (SDJD). The sample includes 67 individuals excavated from 1995 to 2013. The vertebral elements were examined at several spinal joints for lesions indicative of SDJD, including marginal osteophytes, lipping, surface pitting, sclerotic new bone formation, eburnation and Schmorl's nodes. Specific vertebral articulations analyzed were individual zygapophyseal facets, intervertebral symphyses, and articulations with the costal elements. Severity was visually assessed through an ordinal scale of 0 to 3. Data collection was limited to adult remains from confirmed Late Moche contexts, and individuals were categorized by age and sex in order to control for these variables. The relationship between spinal health, social status and sex is explored. Preliminary analysis suggests higher levels of stress in the cervical and lumbar spine of lower class individuals than in those of middle and elite social status.

The changing landscape of Pliocene Baringo

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The Precession Group of the Baringo Paleontological Research Project (BPRP) has in recent years focused on the Chemeron Formation, Tugen Hills, Kenya (5.6 to 1.6 million years [Ma]) and a sequence of diatomites within it indicative of a fluctuating lake system extending from side to side in the Rift. Many sites are located within the time interval from 5.5 to 2 Ma and are an appropriate comparison to other reconstructions of hominin paleoenvironments during parts of this time and filling in gaps in the record. Two of the earliest sites, dated to ~5.2 Ma, have unusual faunal compositions. Tragulids, chalicotheres and numerous deinothere are present in both assemblages indicating a wooded paleoenvironment. Later sites, 2.7-2 Ma, have higher percentages of alcelaphines suggesting a shift towards drier, open paleolandscapes. Analysis of the largest represented families in the fauna, bovids and hippopotamids, reveals the pattern is not as simple as a steady shift from wooded and wet to open and dry and instead supports paleosol carbonate work that suggested mosaic environments throughout the sequence. Throughout most of the formation there is a high diversity of bovid tribes until 2.7 Ma when there is an increase in alcelaphines. Perhaps changes in abundances of bovid tribes, coupled with the trends suggested by other large mammals, resulted from fluctuating lake levels and habitat fragmentation that altered migration or home range patterns, including those of hominins. Thus the pattern of mosaicism might be directly linked to changing lake margin habitats.

Evidence for regional asymptotes of osteon population density from the femoral midshaft

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Histological techniques for estimation of age at death are concerned with the lifelong accumulation of osteons, the basic structural units in cortical bone remodeling. The number of intact and fragmentary osteons is divided per unit area to calculate osteon population density (OPD). After all primary lamellar bone is remodeled, however, new remodeling events remove evidence of previous events and OPD then approaches an asymptote and hinders age estimation. Using mathematical models, Frost (1987) posited the asymptote at the femoral midshaft would be approximately 50 remodeling events per mm², though the veracity of this claim has never been thoroughly investigated. To address this, composite images of 12 complete femoral cross sections from modern cadavers (7 male, 7 female), aged 30-82 years were analyzed using geographical information systems (ArcGIS 10.1). All remodeling events from each cross section were manually notated (n=83,721); OPD was calculated for each cross-section and failed to reach 30 remodeling events per mm², even into the ninth decade of life. Primary lamellar bone was still found across the cortex even in the oldest individuals, most notably in the anteromedial quadrant. OPD values were then calculated for the anterior, medial, posterior, and lateral quadrants, as well as offset anterolateral,

anteromedial, posteromedial, and posterolateral quadrants. All quadrants, save the anterolateral, yielded OPD values that appear to increase in a linear fashion through the ninth decade of life; OPD in the anterolateral quadrant was consistently higher than other quadrants and may be approaching an asymptote during the seventh decade of life.

The lemur syndrome: How does ancient climate affect our interpretations of lemur evolution?

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Lemurs differ from other primates in a number of unusual traits. The "lemur syndrome" has been explained as a product of Madagascar's "unpredictable" climate, but it remains unclear if it arose within a similarly stochastic environment. We conducted climatic simulations for Madagascar at the K-T boundary, using global (air-sea coupled) models to which the effects of continental configuration were added, in order to assess the environments that arriving ancestral lemurs likely encountered. We used dynamical downscaling to develop "regional" simulations, which enabled us to obtain high-resolution climate information from relatively coarse-resolution global climate models.

At 65 Ma Madagascar was south of the trade winds, and our results suggest that the climate was milder and generally less seasonal than it is today. Temperatures throughout Madagascar were slightly cooler; storms were less frequent and of lower intensity; average precipitation was generally lower. The eastern coast and isolated areas in the north experienced pronounced dry seasons. However, neither the extremely arid nor the extremely humid forests found today in the southwest and east respectively were present.

The lemur syndrome varies among lemur families, and its traits likely emerged at different time intervals in response to different selective pressures. Because environmental conditions have changed dramatically over time, we suggest that lemurs can only be fully understood within the appropriate time/space framework in which they evolved. Molecular phylogenetic data (including ancient DNA), and the climatic simulations presented here, increase our understanding of lemur familial divergence timing and the environmental contexts wherein divergences occurred.

Whole genome sequencing of Turkish genomes reveals functional private alleles and impact of genetic interactions with Europe, Asia and Africa

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Turkey is a crossroads of major population movements throughout history and has been a hotspot of cultural interactions. Several studies have investigated the complex population history of Turkey through a limited set of genetic markers. However, to date, there have been no studies to assess the genetic variation at the whole genome level and without ascertainment bias. Here, we present whole genome sequences of 16 Turkish individuals resequenced at high coverage (32x-48x). Our study provides the first map of common genetic variation in western Asia. We show that the genetic variation of the contemporary Turkish population clusters with South European populations, as expected, but also shows signatures of relatively recent contribution from ancestral East Asian populations. In addition, we document a significant enrichment of non-synonymous private alleles, consistent with recent observations in European populations. A number of variants associated with skin color and total cholesterol levels show frequency differentiation between the Turkish populations and European populations. Our data will help develop population-specific experimental designs for studies investigating disease associations and demographic history in Turkey.

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Modular architecture of human and chimpanzee brains. Implications for hominin evolution

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Cranial and craniofacial integration are fundamental topics in the study of human evolution due to the important role that morphological constraints may have had in hominin variation and diversification. Due to the reciprocal interaction between skull and brain development and evolution, a complete understanding of human cranial evolution requires further examination of the integration between different anatomical systems within the brain. We used a geometric morphometric approach to evaluate morphological integration and modularity in human and chimpanzee brains. We evaluated alternative models of modularity, each involving different assumptions regarding the causes of structural covariation: 1) an EvoDevo model, which explores covariation between brain structures with different developmental and evolutionary origins and trajectories; 2) a structural model, which

evaluates covariation between anatomically separated regions; and 3) a functional model, which explores covariation between brain areas that belong to different functional networks. Only the structural model showed significant modularity in both species, revealing that modules of anatomical covariance are not predominantly formed on the basis of developmental origins or functional networks. Our results demonstrate that spatial adjacency is the best model of modularity in the brain of humans and chimpanzees; separated regions can change relatively independently from other areas, whereas adjacent areas are more strongly constrained to covary together. Similar results observed in chimpanzees and humans point to a common pattern of variation that allows, however, for a substantial evolutionary flexibility that has given rise to the clear morphological and functional differences undergone during hominin and panin brain evolution.

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Conservation of threatened primates in Dassioko Sud and Port Gauthier forest reserves: Use of field patrols to assess primate abundance and illegal human activities

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The Dassioko Sud and Port Gauthier Forest Reserves are among the last remaining forest fragments in coastal Côte d'Ivoire. Surveys conducted in 2011 confirmed the presence of six diurnal primate taxa in these reserves, including three of the most threatened primates in West Africa: roloway monkeys (*Cercopithecus diana roloway*), white-naped mangabeys (*Cercocebus atys lunulatus*), and West African chimpanzees (*Pan troglodytes verus*). Despite their high biological value, habitat destruction and poaching continue to threaten fauna within these forests. In 2012, we initiated a bio-monitoring program to track primate abundances and curb illegal activities. During weekly patrols conducted over the next 13 months, we recorded data on encounters with primates and assessed levels of illegal human activity. Patrol teams typically consisted of wildlife officers, armed policemen, and local villagers. We spent 79 and 72 days in Dassioko Sud and Port Gauthier respectively. Patrols lasted an average of six hours during which we walked an average speed of 3 km/h.

Five primate species were encountered: Lowe's monkey (*Cercopithecus campbelli lowei*), spot-nose monkey (*Cercopithecus petaurista petaurista*), olive colobus (*Procolobus verus*), *Cercocebus atys lunulatus* and *Pan troglodytes verus*. We observed no roloway monkeys. Over the sampling period, illegal

activities declined 44% while encounters with primates increased 37%. Monthly illegal activities and rate of primate groups sightings are negatively correlated ($r = 0.486$, $p = 0.037$). The results support the notion that aggressive, sustained patrols can quickly curb illegal forest activities and assist in conserving endangered primates, including those in the Dassioko Sud and Port Gauthier Forest Reserves.

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New perspectives on cercopithecoid brain evolution based on microCT scans of the *Victoriapithecus* cranium

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A new 3dimensional endocast of the 15 mya *Victoriapithecus* skull KNMB-29100 generated from high resolution CT scans confirms that it resembles strepsirrhines and stem catarrhines in having a smaller endocranial volume (relative to body size) and larger more rostrally oriented olfactory bulb than occurs in extant anthropoids. At the same time, it reveals a modern cercopithecoid sulcal pattern, a derived condition relative to strepsirrhines and *Aegyptopithecus*.

The frontal lobe of *Victoriapithecus* displays a sinuous rectus sulcus diverging away from the orbit as in most cercopithecines and Asian colobines, and a curved arcuate sulcus, as found in cercopithecoids and one platyrrhine (*Cebus*), but not in strepsirrhines, *Aegyptopithecus*, *Proconsul* or hylobatids. Sylvian and superior temporal sulci converge caudally in *Victoriapithecus*, as in most cercopithecines and in the Miocene colobine *Libypithecus* but in few other colobines. The lunate sulcus is very well defined, demarcating a large visual cortex. The interparietal (ip) and lunate sulci are relatively straight and horizontally oriented in the right hemisphere but arched in the left hemisphere. As in *Libypithecus*, the *Victoriapithecus* ip does not fully meet the lunate caudally as it often does in cercopithecines, nor are the two sulci connected by a paroccipital sulcus (absent in both Miocene genera) as in most colobines. The *Victoriapithecus* inferior occipital sulcus terminates caudal to the lunate, unlike the longer sulci of cercopithecines. Neither the *Libypithecus* or *Victoriapithecus* cerebral endocasts is fully cercopithecine or colobine-like, though both are more similar to the former. Implications for cercopithecoid brain evolution are discussed.

Developmental plasticity in craniodental structures: Assessing the response to systemic factors using rodent models

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In the course of their development, phenotypic traits are under the influence of systemic factors with a widespread effect across several structures as well as factors with localized effects. Disentangling the contribution of specific factors to variation in size and shape of morphological traits is difficult to achieve in natural populations due to the overlap of multiple developmental processes during individual ontogeny. Thus, animal models are essential for determining how morphology is modulated by developmental processes. Here, we assess the effect of two systemic factors -nutrient intake and growth hormone level- which coordinate organismal growth by regulating the GH-IGF axis, on the development of the skull and molar teeth. The experimental models used were: a) mice fed on a low protein diet during pre and postnatal ontogeny and b) GH deficient mice. We obtained 3D micro CT images of the skull and digitized landmarks and semilandmarks in order to assess size and shape changes among control and treatment groups. Alteration of normal growth resulted in a significantly rounded braincase and a shorter and wider face. Molar size was significantly reduced, and molar proportions changed according to the predictions of an inhibitory-cascade model of development. Molar shape was also altered due to the differential effect on structures with a later ontogenetic origin. Our results show that GH and environmental stimuli induced similar responses, and that the magnitude and direction of changes depended on both the timing of the perturbation and the intrinsic trajectory of development of the traits.

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Living conditions in Oxtankah Site: a portuary settlement in the Classic Maya period

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Several prehispanic communities on shore coast peninsula of Yucatan share commercial activities, and the same marine and terrestrial resources (crops and fisheries). However, they could be having certain differences cause their geopolitical position under a model core-periphery. The geopolitical position of each community brings consequences in the living conditions of the settlers. Oxtankah, a prehispanic portuary settlement of Quintana Roo, Mexico, could be a primary center with commercial, social, political connections with Calakmul, and other distant localities. Thanks these connections the settlers of Oxtankah could be have a better life conditions than, first, settlers of inland localities of the same term, or second, periphery communities of the northern coastal posclassic settlements of Quintana Roo under

rule of Chichen Itza. To prove the hypotheses we analyze individuals from coastal settlement (19 classic individuals from Oxtankah and 40 posclassic individuals from El Meco), and inland settlement (35 classic individuals from Kohunlich), all from ceremonial centers. We compare frequencies of periostitis, cribra orbitalia, porotic hyperostosis, calculus and caries dental, and obtain Chi square analysis for each one analysis. The results shown higher frequencies of specific stress in posclassic coastal individuals than individuals of Oxtankah. The classic inland individuals have better health conditions than posclassic coastal individuals, but worse than individuals of Oxtankah. The main conclusion is Oxtankah show better life conditions during classic times in compare to coastal and inland communities, thanks their privileged geopolitical position with commercial connections added with local activities to extract marine and lacustrine resources.

Reassessing locomotor signals from morphology in cercopithecoids with implications for fossils

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Based on the morphology of *Victoriapithecus*, anthropologists generally accept that cercopithecoids are ancestrally terrestrial with arboreality convergently evolving in several lineages. Recent work on the likely stem-colobine, *Microcolobus*, documents early adaptations to arboreality, thereby questioning this view of locomotor evolution in cercopithecoids. Here, I present results from morphometric analyses of 15 measurements on the humerus from a sample of 48 cercopithecoid species to reassess the evidence for the locomotor mode of basal cercopithecoids. Phylogenetically informed ANOVAs were used to assess associations between morphology and primary locomotor mode. Humeral head index, height of the greater tubercle, width of the lesser tubercle, and angle of the medial epicondyle exhibit strongly significant associations between morphology and behavior. These findings support previous work on cercopithecoid locomotor adaptations and additionally show that the utility of these features remains when phylogenetic autocorrelation is factored into the analytical model. Two discriminant function analyses were run to classify humeri of *Victoriapithecus*. Proximal humeri of *Victoriapithecus* are classified as arboreal and distal humeri are classified as semi-terrestrial. These findings support previous work that *Victoriapithecus* engaged in terrestrial behavior, but *Victoriapithecus* was also likely to be adept in arboreal locomotion as well. This suggests that regardless of the time spent in terrestrial settings, *Victoriapithecus* exhibited a functional capacity for arboreal behaviors and probably spent some time in trees. Therefore, features adapted for arboreality did not necessarily have to re-evolve in *Microcolobus*, but rather this species may have increased its commitment to an arboreal lifestyle relative to that of *Victoriapithecus*.

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Nutrition transition at the end of prehistory in the Paris Basin: Evidence from bone stable isotope analysis

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For more than ten years stable isotope analysis have been used to study human palaeodiet in France, specifically on Neolithic bone collections. The increase of studies allows nowadays new examine and prospects thanks to comparative approach of data interpretation. Recent carbon and nitrogen stable isotope analysis performed on bone and tooth collagen and apatite of Neolithic and Bronze Age humans and animals (n=58) from sites located in northern France (Gurgy, ca. 5000-4000 BC cal. ; Barbuise, 1400-1200 BC cal.), gave us new elements to discuss intra- and inter-individual dietary variability and diachronic changes at the end of Prehistory. Among other results, Late Bronze Age collagen data underline intralife $\delta^{15}\text{N}$ modification for some subjects and different protein intake within human group. Diachronic comparison of isotopic data shows clear distinct dietary patterns with significant higher $\delta^{13}\text{C}$ values for LBA humans (-18.9±0.7‰, n=11) and some animals compared to Neolithic ones (-20.8±0.2‰, n=42). Important plant consumption and the introduction of C4 resources, as millet, in LBA diet is strongly suspected, particularly for some individuals as well as pig and dog. $\delta^{13}\text{C}$ results of apatite from few LBA humans (-11.0±0.7‰, n=7) would support C4 plant introduction in diet in small quantity (≤30%). Comparison with further archaeological information on botanical remains and grave goods will next time help us to point out individual's social status and agricultural changes in this region.

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Beasts of the southern wild: Lemur catta feeding and nutritional ecology at three spiny forest sites in southern Madagascar

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The spiny forest ecoregion is found only in southern and southwestern Madagascar, and is characterized by low annual rainfall, high temperatures, and xerophytic flora. Few primates are found in spiny forest, and *Lemur catta* is often the only diurnal primate that persists in open canopy portions of this habitat. We compare feeding ecology during reproductive periods between groups of *L. catta* inhabiting spiny forest at three sites: Berenty Private Reserve (BPR), Cap Sainte-Marie (CSM), and

Tsimanampetsotsa National Park (TNP). We hypothesize that the ability for pregnant and lactating females to adequately obtain plant foods high in protein, low in fiber, and with a high water content is crucial to their survival and successful reproduction in this harsh environment. Overall, we found that the CSM group spent significantly less time feeding compared to BPR and TNP groups, which may relate to a greater intake of large fruits, and *L. catta*'s diet at CSM was more diverse compared with that at BPR and TNP. Some overlap in preferred plant food species was found between BPR and the two other sites, but not between CSM and TNP. Most preferred foods at all sites were high in protein, with the exception of *Opuntia*, a key resource for the CSM lemurs. We found favorable protein-to-fibre ratios in 30%-60% of diet items, and preferred foods were relatively high in water content. We suggest that choosing foods high in protein and water content are behavioral adaptations allowing *Lemur catta* to reproduce and survive in spiny forest habitat.

Do species with larger brains live in more complex niches?

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We humans occupy by far the most complex foraging niche of all animals. We are also characterized by slow development, long post-weaning provisioning and a large brain size. Both slow development and extended provisioning were recently shown to allow for extended periods of skill learning, which ultimately allow species to evolve into more complex niches. We define a complex niche in terms of learning what to eat and how to coordinate different steps involved in food acquisition. Thus, we expect not only the learning period to be crucial but also brain size as a proxy for cognitive abilities. To investigate this link with brain size, we divided niche complexity into a knowledge-learning and a motor-learning dimension. We predicted that the knowledge dimension but not necessarily the motor dimension is positively correlated with brain size. Using a comparative approach, we examined these links in three taxa: 78 primate, 66 carnivore and 140 bird species. Consistent with our predictions, we found strong associations between relative brain size and niche complexity in all lineages. Whereas knowledge-niche complexity in general shows strong correlated evolution with brain size, motor-niche complexity shows weaker relationships. We further explore the influence of specific brain regions to identify the specific correlates of motor and knowledge learning. Our results support the notion that ecology plays a role in brain size evolution, and highlight important aspects of hominin cognitive evolution.

Genetic variation in pelvic sexual dimorphism and its implications for human evolution

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Sexual dimorphism in hominin pelvis can provide insights into past selection pressures relating to obstetrics and when a human-like pattern of brain growth evolved, but how pelvic dimorphism itself evolves is unknown. Dimorphism can come about when there are differences in trait variances between the sexes, cross-sex genetic correlations that are significantly less than one, or sex chromosome-related effects. The major impediment to our understanding the genetic underpinnings of dimorphism is that the methods of analysis for exploring it require a large amount of metric data from pedigreed populations. As data to address this question in humans is not readily available, this study investigates sexual dimorphism in the pelvis of a model organism, the mouse (*Mus musculus*), using quantitative genetic methods. Like humans and many other primates, mouse pelvis are highly sexually dimorphic in both size and shape, and differences between the sexes are hypothesized to reflect selection pressures related to obstetrics. Metric data on the hip were collected from almost 1,000 individuals from the F34 generation of an advanced intercross experiment. Results show that highly dimorphic traits such as pubis length have a cross-sex correlation significantly less than one, suggesting the capacity for the rapid evolution of sexual dimorphism. Similar findings for humans, unlike non-obstetrically challenged great apes, would suggest that selection pressures related to obstetrics broke down genetic correlations between the sexes in a way that facilitated dimorphic differences observed across the hominin fossil record.

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Mechanical strategies in primate locomotor switching, and implications for the evolution of locomotor plasticity

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Locomotor plasticity--the ability of an animal to switch easily between different forms of locomotion--has been considered an essential adaptation for movement in an arboreal environment, and is an area of significant interest especially in anthropology. Yet little research has examined the mechanical strategies utilized by primates during locomotor switching. We use the transition from above- to below-branch (suspensory) quadrupedal walking to examine the underlying mechanisms of locomotor plasticity. Four primate species that vary in their frequency of below-branch movement--*Lemur*

catta, *Varecia variegata*, *Propithecus coquereli* and *Macaca mulatta*--were encouraged to walk both above and below an instrumented arboreal runway in order to collect kinetic, kinematic, and spatiotemporal gait variables. Kinematic and spatiotemporal values were similar during above- and below-branch locomotion, with the exception that during below-branch walking there was an overall tendency for increased limb flexion (FL = 87.3° vs. 95.2°; HL = 110.7° vs. 117.9°). In contrast, during below-branch compared to above-branch walking animals demonstrated relatively higher peak vertical forces in the forelimb (FL/HL Vpk ratio = 0.73 vs. 1.30), and the forelimb, rather than the hindlimb, served a net propulsive role. The combination of conserved kinematics and timing and clear differences in gait kinetics suggests that primates experience a very different loading regime during below-branch compared to above-branch walking and likely developed a musculoskeletal or neuromuscular mechanism to effectively execute such locomotor shifts. Selection towards anatomical and neurological features that favor locomotor plasticity may represent an adaptation important for the diversification of primate locomotion.

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Dating and sexual behavior among single parents of young children in the United States

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Theory and research on partnered parents suggests tradeoffs between parenting and sexuality, with those tradeoffs most pronounced among mothers of very young children. Here, we investigate potential impacts of parenting on dating and sexual behavior among single parents of young children. The two-part study draws upon a 2012 nationally representative sample of 5,541 single Americans 21-years of age and older. Dependent variables were sexual desire, frequency of sex, number of sex partners in the past year, dates during the previous three months, and whether one was actively seeking a partner. Covariates included parental age, sex, sexual orientation, education, and income. In the first part, using the entire sample of singles, we tested whether number (0, 1, 2+) of children 5-years of age and younger, and number of children 2-years of age and younger predicted dating and sexual behavior variables. There were no main effects of number of young children on these outcomes. In the second part, using analyses restricted only to single parents, we tested whether those with a child 5-years of age or younger, adjusting for covariates, showed differences in dating and sexual behavior compared to single parents with older children. Single parents of young children reported higher sexual desire and greater frequency of sex, but no differences in number of sex partners, dates, or whether actively seeking a partner. We consider several factors in interpreting the

findings. Given demographic increases in single parents, research on the ways single parents juggle parenting and sexuality warrants continued investigation.

Pongo problems: Reconciling supraspinous fossa shape convergence among the hominoids

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Differences in scapular morphology between modern humans and the African and lesser apes are associated with the distinct locomotor habits of these groups. However, several traits, particularly supraspinous fossa characteristics, are convergent between *Homo* and *Pongo* – an unexpected result given their vastly different locomotor habits. However, many morphological assessments of the scapula rely on the limited number of static landmarks available, and traditional approaches like these may oversimplify scapular shape. Here, we present the results of two geometric morphometric (GM) analyses of hominoid supraspinous fossa shape – one employing five homologous landmarks and another with 83 sliding semilandmarks – alongside those of traditional methods to evaluate if three-dimensional considerations of fossa shape afford more comprehensive insights into scapular shape and functional morphology.

Traditional measures aligned *Pongo* and *Homo* with long, narrow, and transversely oriented supraspinous fossa, whereas African ape and *Hyllobates* fossae were broader and more obliquely situated. However, our GM results highlighted that much of the convergence between *Homo* and *Pongo* mainly reflected their more medially positioned superior angles. These approaches offered a more complete assessment of supraspinous shape and revealed that *Homo* fossae are actually superoinferiorly expanded, as in African apes. Additionally, the semilandmark GM approach found *Pongo* and *Hyllobates* to both have more compressed fossae, something that had not previously been identified through traditional analyses. Thus, the total morphological pattern of the *Pongo* supraspinous fossa appears to be unique among hominoids, one that actually shares a number of characteristics with *Hyllobates* in addition to *Homo*.

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Canalization and facial morphogenesis in FGF8 hypomorphic mice

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Evolutionary processes act upon phenotypic variation. Canalization refers to the ability to produce a static phenotype regardless of genotypic or environmental variation. The use of geometric morphometrics allows the analysis of variance of shape, a measure of phenotypic variance, and can be used to probe shape variation or stability and canalization or developmental integration. While many types of genetic manipulation have been shown to increase morphometric variance this type of increased variance has generally only been shown for a single genetic mutant. Here, using a murine model where we are able to experimentally modulate FGF8 gene expression levels we are able to show that as FGF8 levels decrease from wildtype levels, to a heterozygote (50% expression levels) to a hypomorphic allele (40%) expression levels we observe continually increasing levels of morphological variation and a corresponding decrease in measures of morphological integration. In our data we see an increase in variation in the region of the midface, an area which shows a lot of diversity in early hominids. Together, these data suggest modulating FGF8 expression may decanalize facial morphogenesis. We relate this finding to a model in which variation in canalization is generated through underlying nonlinearities in development. Our data are consistent with this model.

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Clumsiness or hard daily routine? Fractures of hands and feet in Bronze Age people from Northern Caucasus

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Fractures of hand and feet bones are rarely discussed as a special topic in paleopathological literature. Reasons for that fact are: small bones are often missing, the appearance of those fractures is not very spectacular, in many cases it is even difficult to recognize them. Their interpretation is problematic because there is a great number of possible reasons for their mechanisms of injury.

Up to now hands and feet of 88 adult Bronze Age individuals from Northern Caucasus were examined.

The most frequently fractured bones were the metacarpals (17/53 individuals) with the maximum of the right first and left fifth metacarpal bones. The frequency of fractures is decreasing from proximal to distal phalanges. Carpal bones are the less fractured, only two fractures of the hamate bones occurred.

In the feet the most frequent fractured bones were middle and distal phalanges.

Most of the fractures were survived for a longer time and had minor complications like shortening or slight misalignment of the fragments of the joint surface.

Fractures of the hands represent mostly Bennett's fractures which are associated with boxing. One reason could be interpersonal

violence whereas feet fractures affect mostly the distal phalanges which is more often due to unspecific accidents. Compared with recent clinical investigations several reasons of the high amount of fractures will be discussed. One reason can be due to the fact that during that period the first wagons with oxen were used and therefore the risk of accidental fractures of hands and feet was higher.

Primate flower power: Flowers as a seasonally important food item for Central American spider monkeys

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Spider monkeys are generally considered to be ripe fruit specialists, and much of the research on their behaviour and ecology has focused on their behavioural responses to the availability of ripe fruit. However, in the tropical forests of Central America, ripe fruit is often only seasonally available, and can become comparatively scarce for annually reoccurring periods. During these times of ripe fruit scarcity, spider monkeys may rely on non-preferred food types, called fallback foods. Spider monkeys have generally been thought to fall back on leaves, as leaves are their second most common food item. However this hypothesis has been little tested. Seasonal reliance on non-preferred foods can lead to behavioural or social changes in nonhuman primates, if the foods differ in distribution or nutritional value from preferred foods. We examined seasonal variation in the diets of black-handed spider monkeys (*Ateles geoffroyi yucatanensis*) in Central Belize, and found that when ripe fruit was comparatively rare, spider monkeys significantly increased their consumption of flowers, but not of leaves. This increased flower consumption correlated with increases in the proportion of time spent feeding, decreases in travelling, and the formation of smaller subgroups. We interpreted this suite of behavioural changes as an energy-minimizing response to the probable lower per-capita energy available in flowers as opposed to fruit. This research adds to a growing body of knowledge about the plasticity of spider monkey behaviours, and highlights the importance of considering seasonally important foods when studying nonhuman primate ecology.

Human vulnerability to Alzheimer's disease: An evolutionary perspective

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Despite the enormous social burden of Alzheimer's disease (AD), little research has considered AD vulnerability in humans from an evolutionary perspective. Prior work has focused on two points: (1) the evolutionary relationship between apolipoprotein E (APOE) and "late-onset" AD, and (2) the possibility that the inability to link AD pathologies and disease mechanism may be an indication that the pathologies are actually non-injurious. These points fail to consider cases of AD not associated with APOE or to offer a satisfactory explanation for the strong correlation between pathology and

disease in the majority of cases. To generate a more robust understanding of AD evolution, this talk examines the connection between AD and genes responsible for the “early-onset” form. The conserved nature of these genes is especially interesting when considering that humans are uniquely vulnerable to AD. In addition, AD risk associated with APOE status is not as consistent as initially thought – possibly due to the pleiotropic nature of APOE. Finally, from the perspective of evolutionary medicine, the long human lifespan and complex brain reveals evolutionary trade-offs and vulnerabilities not apparent in species with shorter lifespans and less complex brains. The inability to definitively link AD pathologies to a disease mechanism is possibly the result of different classes of AD (i.e. late-onset, early-onset, sporadic) conferring varying levels of vulnerability in conjunction with varying levels of pathology. A bio-cultural model is proposed for future research.

High rate of premature cranial suture closure at Nuvakwetaqa (Chavez Pass), AZ

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Craniosynostosis is the premature closure of one or more of the major cranial vault sutures, and is most commonly observed at the sagittal, coronal, metopic, lambdoidal, and squamosal sutures, respectively. A complex condition with multiple etiologies, it is associated with a variety of complications ranging from plagiocephaly to intracranial pressure and compromised neural development. During preliminary analyses of skeletal material from the site of Nuvakwetaqa (1250-1400AD) in central Arizona, we observed a relatively high frequency of prematurely fused cranial sutures. We scored a suture as prematurely fused when it is completely obliterated and at least one of the remaining sutures exhibits minimal evidence of closure. Since the site is highly looted, we can only analyze the skeletal material as a commingled ossuary rather than a typical burial context. Because the remains are highly fragmented, we focus exclusively on the sagittal, coronal, and lambdoidal sutures. From a minimum of 139 individuals, we observed 13 instances of craniosynostosis (9.3%), twelve of which involved the sagittal suture.

Our observations are substantially greater than reported in Western clinical literature but are consistent with observations from archaeological sites, particularly from the pre-Columbian southwestern United States. Our results may indicate that craniosynostosis was more prevalent in the past, is underreported clinically, or may have developed secondarily to the posterior cranial modification that characterizes the vast majority of the crania recovered from the site. Our presentation will focus on the variable forms of craniosynostosis observed and the possible implications of its prevalence in the region.

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Genetic differentiation in South African vervet monkeys—Landscape features define routes of migration

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Suitable habitat for vervet monkeys (*Chlorocebus aethiops pygerythrus*) in South Africa is interspersed with grassland, semi-desert and mountains that form potential barriers to gene flow. We sampled monkeys from 16 localities to investigate patterns of gene flow and describe the influence of landscape features on patterns of genetic connectivity. This sample provides good coverage of vervet distribution across the extensive distribution range. We also measured fine-grained differences by trapping animals from more than one troop in any given area. A portion of the mtDNA COI gene was used to estimate genetic diversity within and between populations. Twenty-three distinct haplotypes were observed in 191 individual monkeys sampled. Differentiation between most pair-wise combinations of populations was significant. An analogous pattern of genetic structure and connectivity was observed from a phylogenetic tree and a haplotype network constructed from mtDNA data. The populations clustered into three broad groups, the northern and western parts of South Africa, the central Highveld, and the coastal areas along the Eastern Cape extending into southern KwaZulu Natal. This pattern shows close congruence with possible routes of migration and gene flow offered by landscape features such as suitable habitat along river courses, with apparent gaps in connectivity corresponding to large areas of unsuitable habitat or climate. Low levels of genetic diversity were observed within individual populations, which supports the notion of low levels of historic gene flow. Future research should include more fine-grained coverage of the distribution area, specifically in areas where haplotypes are separated by large numbers of mutational steps.

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The impact of genetic variation at the Major Histocompatibility Complex in captive and wild ring-tailed lemurs (*Lemur catta*)

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At the interface between genetic make-up and survival, genes of the Major Histocompatibility Complex (MHC) code for proteins that bind ‘non-self’ peptides and initiate the body’s immune response. Therefore, an individual that is genetically diverse at its MHC genes is hypothesized to be capable of mounting an immune defense against a greater variety of infections than an individual that has little MHC genetic diversity; however greater MHC diversity may also lead to increased auto-immunity and a reduced mature T-cell repertoire. Due to the direct link between MHC and health, MHC diversity is thought to influence differential survival. We investigated the influence of MHC diversity on survival in 60 captive and 230 wild ring-tailed lemurs (*Lemur catta*). Contrary to previous studies, in captive animals, neither heterozygous individuals nor individuals possessing ‘rare’ alleles had a survival advantage over homozygous individuals or individuals possessing the most common MHC alleles. Nevertheless, heterozygous individuals with fewer nucleotide differences between their two alleles may survive longer than individuals with more within-individual nucleotide differences ($p = 0.19$). Our latter results support most studies investigating the influence of MHC on an animal’s survivorship post pathogen infection, suggesting that intermediate intra-individual MHC diversity is optimal for minimizing loss of T-cells and autoimmune reactivity. Captive conditions or health care, however, may release individuals from the pathogenic drivers of MHC-mediated selective pressure; thus, the most accurate assessment of the influence of MHC on survival will derive from our comparisons with the wild population.

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Effects of high altitude on pygmy tarsiers (*Tarsius pumilus*) in the montane forest of central Sulawesi, Indonesia

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Pygmy tarsiers (*Tarsius pumilus*) of Sulawesi, Indonesia are the only species of tarsier known to live exclusively at high altitudes. This research tested the hypothesis that pygmy tarsier behavior and morphology correlates with measurable ecological differences along an altitudinal gradient. In response to high altitude effects on foraging competition and energy intake, pygmy tarsiers were predicted to exhibit lower population density, smaller group sizes, larger home ranges, and reduced sexually selected traits compared to lowland tarsiers. Pygmy tarsiers were only found between 2000 and 2300 m, indicating allopatric separation from lowland tarsiers. As expected, pygmy tarsiers ($N=22$; 6 groups) lived at a lower density (92 individuals per 100 ha) than lowland tarsiers. Contrary to expectation, average home range size (2.0 ha) was not significantly larger than lowland tarsier home ranges, and average nightly path length (365 m) was smaller than those of lowland tarsiers. Insect abundance and biomass decreased as altitude increased, but insects were

larger and more abundant along anthropogenic edges. Pygmy tarsiers within the study area exhibited a nonrandom distribution near these forest edges, which may relate to smaller than expected home ranges. While group sizes were larger than expected, pygmy tarsiers exhibited low sexual dimorphism and small relative testes mass; this is a trend opposite from lowland tarsiers, and may indicate constraints on the development of sexually selected traits. Considered together, these results suggest that pygmy tarsiers have adapted to life in a montane environment with limited resources.

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Exploring the human exception to maternal placentophagy among mammals: Assessing the visual and olfactory aversion to human placental tissue

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Maternal placentophagy, the ingestion of the afterbirth by the mother immediately following parturition, is a ubiquitous behavior among terrestrial mammals – including non-human primates. Humans appear to represent a rare exception to the maternal placentophagy mammalian norm, as maternal placentophagy does not appear as a traditional cultural practice in the cross-cultural or historic records. Despite this, a small but growing number of women in industrialized countries have recently begun consuming their placentas – primarily in encapsulated form for its purported health benefits. The ‘fire hypothesis’ proposes a possible evolutionary explanation for the rarity of maternal placentophagy among humans in the context of an otherwise common mammalian behavior; namely, the fitness reducing effects of maternal placenta consumption once fire was habitually used by *Homo*. Here we explore this hypothesis further by investigating whether or not human subjects display a heightened aversion to human placenta when rating the visual and olfactory appeal of human placental tissue. Results indicate that human placenta invokes neither a heightened appeal, nor increased aversion response compared to control substances. In the last phase of the experiment, the knowledge that the item being evaluated is human placenta does not appear to affect olfactory appeal, but does appear to significantly increase visual aversion to placental tissue. Future studies investigating a possible innate aversion to placental tissue as a mechanism that may have eliminated maternal placentophagy from the human behavioral repertoire, might compare the appeal/aversion of placental tissue of nulliparous versus peripartum women.

Genome-wide patterns of placental methylation are predicted by the proxies of maternal nutritional history in Cebu, Philippines

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Maternal nutrition plays a large role in the determination of fetal nutrition and growth, which are important determinants of biological variation and health. There is currently much interest in the role of environmentally-induced epigenetic changes as a potential link between maternal nutritional history and fetal nutrition. We evaluate genome-wide patterns of methylation in placental tissue, which we relate to placental and birth weights, and mother's stature as a proxy of maternal nutrition during development. DNA was extracted from 21 placentas from third generation participants in the Cebu Longitudinal Health and Nutrition Survey, located in Metropolitan Cebu, Philippines. The DNA was hybridized to the Illumina Infinium 450k methylation array. Differential methylation in the promoter region was determined based on factors including birth weight, placental weight and maternal height. Individuals with lower birth weights show hypermethylation in promoters of genes associated with embryo development such as *ZFP57* and hypomethylation around genes associated with thyroid hormone secretion such as *PAX8*. When the mother was shorter in stature, suggesting early life undernutrition, we see hypomethylation in regions of the genome associated with glycolysis and metabolite transport and hypermethylation in regions associated with neuronal development. Lighter placentas exhibit hypermethylation in areas associated with carbohydrate metabolism and immune response as well as hypomethylation in regions of the genome associated with ion transport. Our results show that variation in factors associated with maternal nutrition predict a range of epigenetic responses in genes involved in placental aspects of fetal growth such as metabolic processes and nutrient transport.

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Quantifying the evolution of human brain development

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Cognitive differences between members of our own species and our closest cousins are often interpreted as a consequence of differences in brain size. However, there is mounting evidence that, at least within groups, the internal organization of the brain is more important for

cognitive abilities than its absolute size is. The brain's internal network is the result of precisely timed sequences of synaptogenesis and the subsequent pruning of connections; it is neither intrinsically predetermined nor static. Timing and rate of growth affect this wiring pattern. It is not known, however, to what extent tempo and mode of brain development also affect the overall shape of the brain and the encasing neurocranium. Here we use 3D geometric morphometrics based on 29 landmarks and several hundred semilandmarks to compare endocranial ontogeny in humans (N=62), chimpanzees (N=64), and Neandertals (N=10).

Our data suggest a link between endocranial shape and the tempo and mode of prenatal and early postnatal development. We find that developmental shape changes of the endocranium are shared among chimpanzees, modern humans, and Neandertals from the eruption of the deciduous dentition to adulthood. However, during a critical time for cognitive development the modern human pattern of early brain development differs not only from chimpanzees, but also from Neandertals. Modern humans and Neandertals therefore reach similar adult brain sizes via different developmental pathways. We explore when, how, and why this developmental pattern evolved, and discuss its potential implications for the evolution of human cognition.

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Association between linear enamel hypoplasias and body composition in rural youths from Yucatan

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Given that nutritionally stressful environments in the first two years of life may bring about thrifty phenotypes, and that Linear Enamel Hypoplasias (LEHs) are associated with these environments, we tested the hypothesis that youths with LEHs would be shorter for their age and have greater Body Mass Indices (BMIs) than those without. We also expected to find bivariate associations between Number of LEHs in the right upper central incisor (*ru*¹), BMI and height for age. We tested 1161 youths between the ages of 10 and 19 from the Yucatan Peninsula: 512 male and 649 female. Women with LEHs had significantly higher BMIz scores than those without them. In addition, women showed positive significant associations between numbers of LEHs in *ru*¹ and BMIz score. Unlike women, men didn't show any significant differences between those with or without LEHs, and no significant associations were found. No significant differences were found in HAZ scores in women or men. While the results with women suggest that events leading to LEHs may also be more frequent in nutritional environments with low micronutrients, the lack of significant results in men and in HAZ scores suggests that the acute events leading to LEHs may have a different etiology. Low LEH frequency may be obtained with high calorie diets and proper sanitation even in nutrient poor environments.

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Examining the potential of dental microwear analysis for determining season of death

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Annual climatic changes are one of the greatest challenges to an organism's survival. Seasonal patterns can dramatically change the distribution of food, water, and shelter in the environment, producing a strongly selective context to which populations must adapt. In Early Pleistocene East Africa, increased precipitation seasonality coupled with spreading savanna-woodland environments created a new suite of challenges for hominins. Did Early Pleistocene hominin meat acquisition vary seasonally? If so, was the pattern of meat acquisition statistically distinct from that of contemporary carnivores, which were subject to the same resource fluctuations? To answer these questions, it is necessary to establish that season of death can be correctly identified in analogous modern prey species.

Enamel microwear results from the abrasive properties of an organism's diet, which can reflect changes in diet composition, as well as grit and moisture content. Here I present the results of a pilot study using scale-sensitive fractal analysis on the dental microwear of East African prey animals killed by Hadza hunters in either the wet or dry season. Single specimens are not sufficient evidence of seasonality, but comparison of the samples from wet and dry season contexts suggests that microwear analysis holds promise for identifying when the samples accumulated. This dataset is unique in containing a variety of wild species with known dates of death. As such, it functions as a source of calibration for microwear seasonality in the East African fossil record, and demonstrates the potential of this method for ascertaining season of death.

The transition from thoracic to lumbar facet joint orientation at T11: Functional implications of a more cranially positioned transitional vertebra in early hominids

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The recent discovery of a partial vertebral column of *Australopithecus sediba* suggests that early hominids differed from most modern humans in transitional vertebra position. The transition from dorsolaterally ("thoracic-type") to dorsomedially ("lumbar-type") oriented facet joints occurs at T11 in all early hominid skeletons that allow assessment of its position, including MH2 (*A. sediba*), Sts 14 and Stw 431 (*A. africanus*), and KNM-WT 15000 (*H. erectus*). In modern humans it more frequently occurs at T12, i.e., the last rib-bearing vertebra. The longer post-transitional region of early

hominids has been proposed to reflect a greater mobility of the lower spine and to provide a greater capacity for lordosis. However, this contrasts to the doctrine of functional anatomy that lumbar-type orientation of the facet joints mainly restricts rotation, while flexion/extension mobility hardly differs to thoracic-type oriented facet joints. Here, we analyse the segmental capacity for flexion/extension at the thoracolumbar border using 100 functional radiographs of modern human spines. Our results show no influence of facet joint orientation onto sagittal segmental mobility. This challenges the functional significance of the position of the transitional vertebra with respect to the evolution of human-like lordosis and bipedalism. The evolutionary advantage of a longer post-transitional spine might rather lie in rotational stability than sagittal mobility. Accordingly, the encroachment of dorsomedially oriented facet joints onto the thoracic region is greatest in springing and climbing primates needing maximal rotational stability. The more cranially positioned transitional vertebra of early hominids compared to modern humans therefore most likely reflects a climbing adaptation.

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Drug toxicity, not reward, explains large age and sex differences in substance use

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Psychoactive drugs are widely used, it is thought, because they inadvertently activate reward-related neural circuitry. Under this model, drugs should be equally appealing to children and to adults of both sexes. Many drugs are plant defensive chemicals, however. We therefore argue there should be important differences in substance use across the life span and between the sexes that are explained by drug toxicity. In particular, children, and to a lesser extent adult women, probably evolved to avoid plant toxins to protect their, or their fetuses', developing nervous systems, respectively.

We test these ideas against national and cross-national datasets, and find virtually no substance use among children; a switch-like transition to substance use in adolescence; and a nearly universal male bias in substance use. We also find that, across nations, greater use of modern birth control and a lower total fertility rate, which decrease the risk that smoking mothers would expose their fetuses to nicotine and other tobacco teratogens, predicts higher female prevalence of tobacco use.

We argue that around the age of 15, the fitness benefits of substance use in ancestral populations, especially defense against parasites and honest signaling to potential mates, started to outweigh diminishing costs of exposure, especially for males.

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Factors affecting the accuracy of forensic photograph identifications: Case study of a jewelry store robbery

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Cameras and other image-recording devices are increasingly being deployed in public spaces to deter criminal activity and to help identify perpetrators. A forensic photographic analysis was conducted to help determine whether an arrested suspect had committed a jewelry store robbery that was recorded by commercial video cameras in Miami, FL. Anthropometric measurements of bodily proportions were collected for both the photographed perpetrator and the arrested suspect. Height, weight, hair length and texture, nose and chin shape, and other physical characteristics were also compared. Height and weight of the photographed perpetrator were estimated prior to meeting the live suspect. Certain similarities were observed and noted, including hair length, nose length relative to head height, and head width relative to distance between the shoulders. Various incongruous traits and proportions, particularly jaw width relative to head width and ear length relative to nose length, contributed to the final judgment of "Not Guilty", despite some statistically significant correlations. The photographed perpetrator appeared to possess straight hair and a pointed nose, while the live suspect had wavy hair and a rounded nose. The photographed perpetrator appeared to be several years older than the arrested suspect, and markers on the store walls suggest several inches of difference in height. The results indicate that further refinements are needed in forensic comparisons of the physical characteristics of live and photographed persons.

New cranium of the endemic Caribbean platyrrhine, *Antillothrix bernensis*, from La Altagracia Province, Dominican Republic

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Recent paleontological collection in the eastern Dominican Republic has yielded new specimens of *Antillothrix bernensis*. We describe a complete cranium of an adult individual (MHD 20) and provide phenetic comparisons to other endemic Caribbean taxa and extant mainland platyrrhines using three-dimensional geometric morphometric methods. Our comparative sample also includes another recently described (subadult) specimen of *Antillothrix* (MHD 01).

Qualitative and quantitative comparisons support previous conclusions based on MHD 01: *Antillothrix* is a mosaic taxon with primitive dentition where known, a pitheciid-like mandible, and an elongated brain case with strong temporal lines. MHD 20 is the adult version of MHD 01; the two crania share a combination of traits including a deep depression at bregma, superioinferiorly elongated orbit shape, relatively deep face, and small relative endocranial volume.

Comparisons to the extant species paint a complicated picture as the results of principal components analyses lack consistent association between *Antillothrix* and any one group. Depending on which PC axes are visualized, the MHD 20 cranial shape is most similar to *Alouatta*, *Lagothrix*, *Pithecia*, or an otherwise empty region of shape space. It never groups with *Cebus* or *Callicebus*, two taxa that *Antillothrix* has been associated with in other studies. The mosaic of traits recalling multiple platyrrhine clades exhibited by *Antillothrix* suggests this taxon preserves a primitive morphology. This also suggests an early arrival of platyrrhines in the Caribbean, with *Antillothrix*-like features possibly indicative of the ancestral morphotype from which the more derived *Insulacebus* and *Xenothrix* evolved their features.

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To gelatinize, or not to gelatinize, that is the question

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A number of methods exist for extracting collagen from archaeological bone for carbon and nitrogen stable isotope analyses. While several studies have examined the effects of specific method differences on the resulting extracts, little attention has been paid to one difference among methods: whether or not the collagen is solubilized (or "gelatinized") through heating. Many methods routinely employ this step, but some do not. This study examined the effects of solubilization of bone collagen on both collagen quality and on $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$. Bone powder samples of well-preserved archaeological human bone from a Medieval site (Kostelisko, Czech Republic, n=10), as well as modern weathered mammal bone from Interior Alaska (n=6), were split and subjected to two collagen extraction methods that differed only in the inclusion or exclusion of the solubilization step. For both archaeological human and modern weathered mammal bone, paired sample t-tests revealed significant mean differences between the two treatments for %C and C:N ratio, which were lower in solubilized samples and closer to the expected values for pure collagen. Mean $\delta^{13}\text{C}$ was significantly higher in the solubilized samples for the archaeological human bone series, but did not differ in the modern weathered mammal bone series. There were no mean differences between the solubilized and non-solubilized samples in %N or in $\delta^{15}\text{N}$. The results suggest that solubilization of bone collagen is an

effective treatment for the removal of exogenous carbon from archaeological bone, and its effects on $\delta^{13}\text{C}$ values could impact dietary interpretations.

Meta-analysis of ontogenetic brain/body growth in primates and non-primate mammals

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Encephalization has long been recognized as central to the evolution of novel cognitive capacities observed in humans and non-human primates. Relative to other mammalian groups, primate brains are roughly twice the size that we should expect relative to their body sizes. Count (1947) first observed that during every observed stage of prenatal development, primates exhibit a higher brain/body ratio (~12%) than those of non-primate mammals (~6%). However, the developmental origins of primate encephalization remain unclear. In this study, we perform a meta-analysis of brain and body growth from published literature on a wide range of primate and non-primate mammalian species. This analysis confirms a prenatal brain/body growth trend unique to primates, and suggests that this higher primate ratio is present as early as the late embryonic period. We also discuss numerous results relevant to current anthropological questions, including the timing of birth across species, the ontogeny of sexual dimorphism in brain/body allometry, and heterochronic alterations to primate development. Finally, we address recent critiques of Count's original hypothesis in light of this meta-analysis.

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The patterning of genetic variation in the collaborative cross and mutant mice

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The genetic basis for variation in the shape of the skull is a key topic of interest in hominid evolution. How genetic variants influence skull shape via developmental processes has important implications for how the hominid skull may have been shaped by natural selection, constraints and drift. We have investigated the developmental and genetic basis for variation in the shape of the skull using a growing database of mouse mutations of diverse origin (N>2000 individuals). In addition, we have also analyzed

the parental and F1 generations of mice from the collaborative cross (N=1250). We demonstrate a surprising level of concordance between the structure of the additive genetic variation in the collaborative cross and that seen in the mutant database. Further, analysis of the non-additive genetic variation in the collaborative cross shows a similar concordance in the structure of variation across F1 crosses between the parental strains. In particular, the directionality of dominance deviations in the F1 crosses deviates significantly from random. The mean direction of deviation is a coordinated morphological pattern that involves facial width, neurocranial size and basicranial length. This result reflects the extent to which developmental processes produce highly integrated variation in the skull. This is surprising in light of the genetic complexity of craniofacial development which may involve, to some degree, up to 5% of the genome. The complexity of epistatic interactions produced by these processes has important implications both for the genetics of craniofacial variation and for the evolvability of this complex structure.

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Differential diagnosis of a unique pathological condition from the Ray Site in Illinois

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There are many of the commonly recorded anomalies and pathological conditions observed in the human remains from the Ray site, located in the west-central Illinois River valley. This report, however, concentrates upon a condition not previously observed or described in archaeologically recovered skeletal remains. Distal aspects of ulnae and radii were observed for 117 individuals, of which eleven display an abnormal process combining both resorption and sclerotic deposition. One individual displaying extensive remodeling of the ulnae, radii, and carpals, also exhibited an asymmetrical progression of severity. Overall, the additional ten individuals display varying degrees of osteolytic activity on the distal ulna accompanied by resorptive and sclerotic processes on the distal radius. An additional consideration during assessment includes the high male to female ratio expressed, and how the observed pathology may relate to additional pathological features on the same individuals. Initial assessments exclude developmental, metabolic, and traumatic pathologies. Exclusion was based on completed development, the affected area, and the unique combination of lytic and sclerotic processes. Included in the differential diagnosis are osteolysis, erosive arthropathies, behavioral processes, and infectious diseases. As this pathological process is unique thus far in the Illinois River valley, the results expand upon the current information of pathological conditions at the Ray site.

The Tonkolili Chimpanzee Project: Implications on chimpanzee conservation strategies in anthropogenic landscapes

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In 2012 we observed a small group of chimpanzees (*Pan troglodytes verus*) living in close proximity to two villages in Central Sierra Leone. At the time of our visit, the group of chimpanzees had been heavily hunted. As we studied the group, we ascertained from the villages that the main reason for the constant hunting was resource competition. The chimpanzees were raiding palm crops, which were the sole source of economy for the village at that time. The palm crops had replaced bee keeping and livestock herding; neither of which presented a source of competition with the chimpanzees, and both of which had been destroyed during the Sierra Leone Civil War. In order to protect this group of chimpanzees, we established a partnership between ourselves, the two villages, and a local NGO in order to enact a moratorium on chimpanzee killing. In return, we would provide the funds to restore pre-war economic practices. This partnership has led to further initiatives and the establishment of the Tonkolili Chimpanzee Project. The project has far reaching implications on the conservation strategies of chimpanzees, a species universally facing increasing threats from anthropogenic effects.

The use of Bayesian-inference stable isotope mixing models to infer niche breadth in the fossil record: An extant study from Kibale National Park

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Carbon and oxygen stable isotopes are informative for reconstructing diets and habitats of fossil species. However, raw isotope values do not necessarily provide reliable metrics of food source proportions or a species' niche breadth; for example, a specialist can have a wide range of isotopic values and appear to be a generalist if its food sources are isotopically distant. Bayesian-inference isotope mixing models calculate proportional contributions of food sources to overall diet. While these models have been used with carbon and nitrogen isotopes in modern ecosystems, here we explore using carbon (d13C) and oxygen (d18O) isotopes instead, because they are available from both fossil and modern species.

We use a Bayesian model to interpret isotopic results from extant species at Kibale National Park and compare results to known diets. Tooth enamel isotopic values from 13 chimpanzees, 13 redtail monkeys, 8 red colobus, and 7 bushpigs were analyzed using Bayesian-inference mixing models. The model returns results compatible with known dietary patterns; bushpig diets are overwhelmingly terrestrial, chimpanzees and redtail monkeys consume primarily canopy fruit sources intermediate in d18O values, and red

colobus are accurately shown to consume mostly forest canopy leaves with high d18O values.

Results show that tooth enamel carbon and oxygen isotopes return reliable estimates of dietary strategies and habitat use when incorporated into Bayesian mixing models. This initial study highlights the efficacy of such models and their potential for use in future paleoecological reconstructions, including changes in niche breadth and dietary proportions associated with extinctions and radiations.

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Significantly larger hip joint abduction and external rotation abilities increases the hindlimb spatial envelope in suspensory anthropoids

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Suspensory anthropoids, which use a spatially complex below-branch environment, are assumed to possess greater hip mobility than non-suspensory species in order to increase the range of positions that the distal limb segment can reach. This assumption has greatly influenced how extant and fossil primate hip joint morphology has been interpreted, despite the fact that there are no available data on hip mobility in suspensory taxa. This study uses *in vivo* measurements to test the hypothesis that suspensory anthropoids have significantly greater ranges of hip joint mobility than non-suspensory anthropoids, and secondarily evaluates whether suspensory taxa have an increased spatial envelope as a result of higher mobility.

Passive hip joint mobility was measured on a large sample of anesthetized captive anthropoids (n=104). Angular data were collected using goniometers. Physical span at the knee, a variable representing the spatial envelope, was measured with a tape measure. Range of motion data was analyzed for differences by locomotor group using ANOVA and regression.

The *in vivo* data demonstrate that suspensory anthropoids are capable of significantly greater hip abduction and external rotation. Degree of adduction was the same across species, and flexion and internal rotation were larger in the non-suspensory primates. Regression indicates little influence of body size on mobility, but the physical span at the knee is a factor of both hip mobility and body size. This study has implications for interpreting hip joint morphology, and brings up important theoretical considerations for how range of motion and morphology determine how primates use arboreal spaces.

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Subadult ages and mortuary treatment at Non Nok Tha, Thailand: A contextual analysis

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Recent scholarship on the bioarchaeology of children has highlighted concerns regarding what constitutes a child, and how children are viewed across various cultures and time periods.

Throughout much of its history (approx. 3,000-900BC), Non Nok Tha, Thailand, functioned as a cemetery. The 1968 excavation of the site revealed 27 subadult and approximately 60 adult burials. Grave offerings were common across all burials. Given the rich archaeological context, mortuary behavior and age-at-death was examined. Findings included the following. Artifacts and artifact types were age-linked. Adzes were associated with subadults (90% of children less than 7). Shell artifacts were only associated with children under 6 years. Adolescents (12yrs-18yrs) tended to be interred with an overabundance of ceramic artifacts, averaging 8.6 ceramics per individual while adults averaged 3.4 ceramics, and children under the age of 12 averaged 3.1 ceramics. These data suggest that the people of Non Nok Tha culturally designated different phases of maturity and growth amongst subadults, with children less than 6 years forming one distinct group and adolescents from 12 to 18 years forming another. The roles of children in ancient societies such as Non Nok Tha can be theorized given these culturally determined categories. Ethnohistoric and other kinds of data on social processes can be used to further understand how these distinctions underlie the multiple and complex identities of children.

Bipedality em natureza: Ground reaction forces during bipedal transport of heavy stones by wild bearded capuchins

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The study of facultative bipedalism in non-human primates may allow for a deeper understanding of obligate bipedalism. *In situ* data may provide the most appropriate approximation of the environment in which obligate bipedalism evolved, yet no kinetic data are available on facultative bipedalism by primates in a wild setting. Bearded capuchin monkeys present a unique opportunity in which to collect wild kinetic data because they carry heavy loads bipedally during foraging activities. This study describes and validates peak force data of wild capuchins' bipedal locomotion during transport of heavy stones.

Four individuals of *Sapajus libidinosus* (mean body mass = 3.28kg) were studied during carrying a stone (0.93kg). The force plate was embedded in the ground using a setup similar to that in a laboratory. Peak forces were determined for bipedal carrying and quadrupedal walking.

Capuchins used various gaits during bipedal transport of stones: a symmetric running gait, and an asymmetric hop. Only the symmetric gait was analyzed. Bearded capuchins exhibit a mean vertical peak force for the forelimb per mass (VpkFL) of 0.78 (sd=0.19) during quadrupedal locomotion; this result is in keeping with previously reported VpkFL in the laboratory setting. Bearded capuchins exhibit a mean Vpk per body mass of 1.17 (sd=0.14) during bipedal transport. Results indicate Vpk can be collected in a natural setting, which may be important for accurate assessments of locomotor biomechanics of wild primates. Such assessments may permit calculation of center of mass mechanics, leading

to a more thorough understanding of facultative bipedalism.

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Evidence for derived cellular organization in the ventral striatum of the human brain

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The mammalian basal ganglia consist of a group of structures in the basal forebrain. Among these, the components of the striatum serve as the principal input nuclei, receiving projections from regions of the cerebral cortex and limbic system. The striatum has been implicated in a wide array of cognitive and motor processes, including attention to stimuli, action selection, and assessing the salience of stimuli in reward-based learning tasks, and further plays a vital role in regulating social behavior through modulation via neurotransmitter systems. Despite the importance of the striatum in higher-order cognitive functions, and as a site of integration of information from cortical and limbic regions, analyses of previously published data have shown that the human striatum scales much smaller than would be expected for a primate brain of its size. From our pilot sample of human and non-human hominoid Nissl-stained brain sections, our analyses have confirmed that the size of the human striatum has not kept pace with volumetric increases in the cerebral cortex. Using design-based stereological methods, our analyses have additionally revealed differences in patterns of cell-packing density between humans and great ape taxa, with a decrease in total neuron density in the ventral striatum in humans as compared to the great apes. Future research will utilize advanced histochemical staining methods to examine the distribution of specific cell types within the striatum to further elucidate how reorganization of this important subcortical structure may be reflected at the level of intrinsic neural circuitry. *Supported in part through funding from a Wenner Gren Dissertation Fieldwork Grant to K.L.H.*

Vertebral pathologies and anomalies in the Erie County Poorhouse: An examination of cinical significance

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The human vertebral column is vulnerable to pathology, and in particular, injury, due to the biomechanical loading associated with bipedalism. Congenital malformations can lead to clinical issues within the neck and back as well. Pathological and degenerative changes to the vertebral column may have had a profound effect on individuals' lifestyles, potentially resulting in physical impairment. Compromised function may have been disabling for individuals in Buffalo, NY, since the primary employment opportunities involved both skilled and unskilled manual labor. It is suggested that these vertebral pathologies resulted in unemployment or

inconsistent employment and likely contributed to the impoverishment of Buffalo residents. Under such circumstances, these individuals would be forced to apply for admission into the Erie County Poorhouse. Through macroscopic examination, this study specifically addresses the frequency and patterning of vertebral pathologies within the Erie County Poorhouse skeletal remains. Among the various types of vertebral pathologies, Schmorl's depressions, osteoarthritis, vertebral osteophytes and intervertebral disc degeneration are common among the Poorhouse inmates. Also present in lesser frequencies are vertebral syndesmophytes, spondyloarthropathies, and spondylolysis. Additionally included in the discussion is the correlation of frequencies, for each pathology, between males and females from different age groups. The etiology of pain as the symptom of vertebral pathologies is complex, and therefore, the the productivity level of these individuals and assessment of the functional abilities they may have had, will be explored.

The Kromdraai "hominin" cuboid KB 3133: A new assignment based on comparative anatomical techniques and 3D geometric morphometrics

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The site of Kromdraai B in South Africa is the Type Locality for *Paranthropus robustus*, and since 1938 has produced a number of important fossils attributed to this taxon. These include cranial and postcranial remains belonging to the holotype, TM1517, and a number of unassociated remains currently assigned to this species with varying degrees of confidence. Among these remains is a left adult cuboid, KB 3133.

In this paper the hominin-status of this specimen was assessed by qualitatively comparing it to a diverse range of extant anthropoid taxa and a number of East and South African fossil hominin and cercopithecoid cuboids. Additionally, we used gemometric morphometric techniques on 3D polygon models (n>250) using semilandmark patches on the distal and proximal articular facets.

Results indicate that KB 3133 is unlike modern humans or that of any known fossil hominins. It is mediolaterally wider than it is proximodistally long, has a more dorsally situated plantar beak, and a large distal lateral cuneiform facet. Based on these characters and the known fauna of the Early Pleistocene of South Africa, we suggest that KB 3133 is likely to belong to one of the cercopithecoid genera found at Kromdraai. Within cercopithecoids the

distinct morphology of KB 3133 is more closely associated with colobines than cercopithecines. The more likely assignment, therefore, is the colobine *Cercopithecoides* rather than the cercopithecines *Gorgopithecus* and *Papio*. We note that this tentative assignment should be treated with caution until we better understand cuboid variation in South African fossil hominins and cercopithecoids.

The study of Tuchengzi skeletal remains to examine stature change in ancient China

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This study employs a well-controlled skeletal collection to test an earlier observed trend of stature change between the Warring State Period (453-256 BCE), and Jin Dynasty (265-420 CE) in China. However since the earlier study is based on published data, it could be subject to inter-observer error. Stature is used as a proxy for general population health.

Tuchengzi is located in southern Inner Mongolia. Archaeological contexts show that the site was occupied between the Warring States Period, and the Tang dynasty (618-907 CE) and its population consisted primarily of agriculturalists of Central Chinese descent. The Tuchengzi skeletal remains are currently curated at Jilin University. The collection consists of 138 individuals (106 males and 32 females). To minimize inter-observer error, one researcher, using the established standard, collected data. Collected data was then compared with previously published femur lengths of individuals (451 males and 338 females) from 18 sites throughout China.

Previous findings show a decline in stature following the Neolithic period, with an increase in male stature during Han Dynasty (202 BCE-220 CE). However, the Tuchengzi remains show no increase in stature during the Han Dynasty. Further analyses indicates that this trend may be caused by either the smaller sample size of Tuchengzi Han individuals, or that these individuals might not be representative of the general population since Tuchengzi was primarily a military settlement. The study has demonstrated that importance of utilizing cultural and archaeological context in bioarchaeological research.

Paleogenetic and paleopathological evidence for leishmaniasis in the New World

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Targeted capture of pathogen DNA in archaeological samples is one of the major advances in the field of paleogenetics, prompting more in-depth studies into the evolution of zoonotic and anthroponotic diseases than previously possible. Coupled with extraction protocols that require less bone while improving the retention of DNA fragments, this avenue of research can be applied to samples of

paleopathological significance, or to diseases that have no known pathognomic skeletal signatures that mainly affect the soft tissue. Here we present the skeletal and genetic evidence for eight potential cases of ancient leishmaniasis from four sites in the Atacama Desert, northern Chile, during the Middle Period (AD 500-1000), four of which have been reported previously as leishmaniasis, three via PCR. Our initial molecular screening indicates preservation of ancient human DNA and *Leishmania* kDNA. Here we use new methods to target larger and thus more informative regions of the parasite genome. The current in-solution enrichment for the pathogen is informed by diversity found in New World taxa, explored through our previous genome sequencing project of modern zoonotic/anthropogenic *Leishmania* species. The current research stimulates discussions of the promising power of molecular diagnoses to aid paleopathological methods and the impact paleogenetics will have on our understanding on disease in the pre and post-contact New World. *Research funded by PEO Scholar Award and NSF Doctoral Dissertation Improvement Grant (BCS-1232582).*

Craniometric and genetic variation as a means of differentiating East Asian populations

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The study of human variation is a key component of biological anthropology. Many of the studies conducted have focused on craniometric or genetic variation on a global scale. The goal of this pilot study is to investigate if craniometric and genetic data covary on a smaller, regional scale. East Asian populations were chosen on the basis of the availability of both craniometric and genetic data for the same subpopulation samples. The craniometric and genetic data for the Buriat, Anyang, Atayal, Hainan, and Japan samples from Howell's Craniometric Database and ALFRED were analyzed using SAS 9.3® and K-Ship. Distance matrices were produced for each data type and compared for similarities and differences. The Buriat are the most differentiated group in both craniometrics and genetics. Both the craniometric and genetic data consistently group the other Asian populations similarly, albeit with small differences that can be explained by sample composition, population structure, and population history. When the Buriat are removed from the analysis, the patterns among the other populations remains similar, but are not clustered as closely as they were when the Buriat were included. The results from these analyses indicate that craniometrics and genetic data do covary. This means that these two types of data can be used together to infer migration patterns, founding events, and population histories in general. The results also imply that craniometrics can be used as a proxy for genetic distances when genetic data are unavailable or unattainable, and vice versa.

Three-dimensional quantification of basic multicellular unit-related resorption spaces using micro-CT: Do mechanics influence morphology?

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Analysis of bone remodeling has numerous applications in anthropology ranging from functional adaptation to aging to disease. While extensively studied in 2D, little is known about the regulation of remodeling in 3D. For example, while it is appreciated that the frequency of remodeling is impacted by biomechanical axes, it is unknown if the 3D morphology of these events, BMU-related resorption spaces, is also affected. Through Micro-CT imaging, an unprecedented number of BMU-related resorption spaces (n=3,144) within the full diaphyses of *Ursus americanus* metacarpals (n=2) and metatarsals (n=4) were assessed to measure BMU range (longitudinal length) and number. Biomechanical axes were defined by combined quadrants opposite the axes of maximum (Imax) and minimum (Imin) second moments of area. Paired t-tests revealed more BMUs were present in the quadrants opposite the axis of Imax compared with those opposite the axis of Imin (p=0.41). Average BMU range was 1.75 mm with no difference (p=0.547) detected between axes.

This 3D preliminary study provides additional evidence supporting reported variation in remodeling rates associated with biomechanical axes. Our results did not reveal a difference in the longitudinal extent of individual remodeling events associated with these axes suggesting mechanics have a greater impact on the initiation than the progression of remodeling events. Nondestructive 3D Micro-CT provided a novel insight into the volumetric extent of remodeling within an entire diaphysis and did so quantitatively. Further development of such methodology promises to advance our understanding of fundamental bone biology and lead to new insights of relevance to anthropological inquiry.

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Erie County Poorhouse Site (UB 2756) artifact analysis and patterns

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Salvage excavations of human skeletal remains associated with the Erie County Poorhouse Cemetery Site (A02940.02949, UB 2756) in the City of Buffalo, New York occurred in the summer of 2012. Excavation and analysis of coffins and artifacts associated with individual interments shows a number of material culture patterns with potential temporal and cultural significance. A line of demarcation between older and more recent sections of the cemetery has been recognized. Analysis results show that

the nature of the coffin construction in terms of shape and materials changed over time, as did the spacing between coffins and the overall organization and alignment of the cemetery. A newer section had better preservation of coffins and human remains and more even spacing between coffins that were aligned slightly to SW-NE. In this area, safety pins were used to attach shrouds to remains at burial. Coffin construction mainly uses wire-drawn nails. The older part of the cemetery has an E-W alignment of burials with a poorer state of preservation of both coffins and remains. White "Prosser" buttons were more as common as remnants of institutional clothing buried with individuals, as were machine-cut nails and screws used in coffin construction. Other patterns are evident in relation to personal items such as jewelry and crucifixes, as well as newspaper fragments and coffin hardware.

Using social network analysis to study the effects of a hurricane on association patterns in Spider monkeys (*Ateles geoffroyi*) in Belize

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In October 2010, a category two hurricane hit the spider monkey research site of Runaway Creek Nature Reserve in Belize, and was followed by extensive forest fires 6 months later. In this study, we use Monte Carlo permutations and social network analysis to examine the effects of the hurricane on the association patterns of a group of wild spider monkeys (*Ateles geoffroyi*). Using association data spanning four years pre- and post-hurricane, we compared the social networks, including individual strength and eigenvector centrality of 7 adult/subadult males and 14 adult/subadult females. Our results show that mean association rates decreased significantly following the hurricane; fifty-four (26%) of the 210 possible dyad combinations were never observed in association during the two-year, post-hurricane period. Permutation tests revealed that after the hurricane female "active companionships" decreased by half, while the number of "active avoidances" among female dyads increased two-fold relative to the pre-hurricane period. In contrast, male-male association patterns were consistent pre- and post-hurricane. Mean eigenvector centrality among female dyads decreased significantly post-hurricane, but increased in males. This suggests that male relationships played a key role in the network's structure after the hurricane by linking individuals together, including females that did not otherwise associate. Studying the effects of major habitat disturbances such as hurricanes on the association patterns of primates provides valuable insights into species' resiliency as well as into the ecological factors that might determine association networks and social structure.

Domestication and modern human evolution: A look at rats selected for tameness and aggression

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The behavioral, morphological and genetic consequences of domestication have been widely studied, and it has been proposed that humans too are a “self-domesticated” species. In fact, many human-like traits are suggested to be a result of selection for ‘tameness’. Researchers in Novosibirsk, led by D.K. Belyaev, conducted an experiment on silver foxes, bred to lack aggressive tendencies towards humans, to test whether behavioral and phenotypic changes in the domestic dog could be due to selection for tameness. Belyaev also had a colony of wild-caught rats selected for either tameness or aggression. While the behavioral and genetic aspects of these rats have been studied, little work has been done on their skeletal morphology. Quantifying phenotypic traits of rats selected for tameness and aggression can provide important parallels for understanding the evolution of modern humans in the context of domestication. Here, we quantify shape variation in 57 adult rats: 24 selected for aggression and 33 for tameness. Three-dimensional landmarks were collected from computed tomography scans to measure craniofacial form; the data were processed with generalized Procrustes analysis and analyzed with principal component analysis (PCA) to explore shape variation. Our results show that the aggressive and tame rats are distinct from each other, and that the pattern of inter-group shape differences does not change when size is regressed out from the PCA. This suggests that the shape differences between the rats are not size related. Thus, changes in skull shape appear to have been a by-product of selection for tameness and/or aggression.

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A biocultural perspective on Jomon dental ablation: Visage, identity, and social status

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Ritual tooth ablation involves the culturally prescribed extraction of healthy anterior teeth. In Japan, this form of dental extraction was extensively practiced by groups from the Middle Jomon to Late-Final Jomon Periods. Ritual

ablation was also practiced by later cultures in Japan, including the Yayoi. At its zenith, 80-100% of the individuals in Jomon populations displayed some form of ablation (Kangxin and Nakahashi 1996). Dental extraction comes in many forms and affects multiple tooth classes. It also varies by sex and age. The extraction of certain tooth classes is correlated with certain rites of passage (Harunari 1973). Concurrent with the epiphyseal closure of long bones, the earliest sign of ablation occurs during “coming-of-age ceremonies” around the onset of puberty (12-13 years). This can be followed by the extraction of different tooth classes at marriage and during mourning periods. By participating in these rites, the visage of an individual would have been altered. As the human face is one of the most interactive parts of the body, the removal of anterior teeth would have drastically changed a person’s appearance. Such changes could signal a transition in social identity and status. This poster illustrates the variation in ablation among individuals of the Jomon Period and suggests how this practice could be associated with newly formed social identities.

An experimental functional analysis of the Laetoli hominin footprints

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The iconic 3.6 Ma hominin footprints at Laetoli, Tanzania offer a rare opportunity for the direct observation of early hominin anatomy and locomotion. However, after 35 years of analyses, much disagreement still exists concerning the anatomy and gait represented by these trackways. This debate exists largely because of a lack of data relating anatomical and functional variables to footprint shape. Here, a novel approach is used to analyze the Laetoli footprints, in which data from biomechanical experiments establish quantitative links between variations in footprint morphology and specific anatomical and functional variables.

A sample of 41 habitually unshod or minimally-shod Daasanach adults and children (25 male, 16 female) created footprints in a clay-silt mud at a variety of speeds. Biometric measurements were taken of each subject and kinetic and kinematic data were collected during each trial. Three-dimensional models of each resulting footprint were rendered using photogrammetry. Measurements of footprint depth were taken from 14 functionally-relevant locations: beneath the medial and lateral heel, medial and lateral midfoot, and all metatarsal heads and toes. The same functionally-relevant depth measurements were taken from the Laetoli G1 trackway footprints. Through resampling, the mean Laetoli G1 footprint configuration was found to be statistically distinct from the distribution of modern human footprint shapes made at similar speeds in similarly compliant sediments. Linear mixed effects models of the human experimental data suggest that the shape differences between Laetoli and modern footprints imply biomechanical differences between the gaits used by the Laetoli hominins and modern humans.

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Investigating population structure and health in late prehispanic Peru using dental morphology

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In this paper, tooth size differences are assessed to better understand community organization in highland Apurimac, Peru. Tooth sizes are contingent on genetics and environment; tooth size will change between generations as people migrate in and out of the population or face chronic health and nutrition problems. One way to determine if tooth size is more strongly shaped by genetic factors (versus environmental factors) is to conduct biodistance analyses of dental metrics. This approach has shown great promise in highlighting different biologically-based groupings. More biological (genotypic) affinity is thought to be represented by greater morphological (phenotypic) homogeneity. Shifts in the relative distance of these groupings thus informs on major changes in population organization.

To further explore these issues, we examine dental metrics from five Peruvian populations affiliated with the Chanka Society (ca. AD 1000-1250). Well contextualized maxillary and mandibular dentition from 217 males and females of all age categories were examined, along with 101 loose teeth. The mesiodistal diameter, buccolingual diameter, and crown heights were recorded using standard methods. Principal Component Analyses and “Mahalanobis D” Distances were performed using RMET software to assess biodistance. From these results, differences in tooth size over time signal increasing stress, while biodistance analyses point to decreased gene flow over time. This research contributes to debates on the synergistic role of genes and the environment in shaping dentition morphology.

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Telomere lengths and attrition rates in our closest living relatives: A comparison of chimpanzee and human females

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Slower rates of aging distinguish humans from other primates although fertility ends at similar ages in women and other great ape females. Chimpanzees rarely survive their forties while large fractions of women are postmenopausal even in high mortality hunter-gatherer populations. Telomeres might play a role in the cellular and molecular mechanisms for these

somatic aging differences. Shortening telomeres have been linked to aging morbidities across multiple vertebrate species and slowed telomere shortening might be among the mechanisms for extraordinary human longevity.

We report blood cell telomere lengths and telomere attrition with age in captive female chimpanzees (65 individuals; aged 6.2 – 56.7 yrs) and compare them to the same measures in women (45 individuals; aged 4.3 – 57.3 yrs). We use a novel monochrome multiplex qPCR method to assay canonical telomere repeats. Our results show little difference in attrition rates between the species (~ 73 nt/year for chimpanzees and ~43 nt/year for humans; overlapping 95% confidence intervals), but telomere lengths were about twice as long in chimpanzees as in humans (8.9 and 4.2 kilobases respectively).

We initially hypothesized that shortening rates would be twice as fast in chimpanzees as in humans. Instead, the derived state in humans, the longest lived of the great apes, appears to be shorter length. This comparison indicates that better characterization of physiological aging in our closest living relatives will be indispensable for understanding the evolution of distinctive human longevity.

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Differentiating diets of New World Monkeys using dental topographic analysis

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New World Monkeys exploit a wide range of diets, albeit with much overlap. Some species consume mostly soft fruit or insects, others eat more leaves and stems or gums and saps. To what extent are these subtle, and sometimes not so subtle, differences in diet reflected in differences in the occlusal topography of their teeth? Here we report preliminary results of a dental topographic analysis of variably worn M²s from a diverse sample of Brazilian monkeys from the Amazon Basin ($n = 225$ specimens representing *Alouatta belzebul*, *Ateles belzebuth*, *Ateles marginatus*, *Callicebus moloch*, *Mico argentata*, *Mico humeralifer*, *Cebus apella*, *Chiropotes satanas*, *Lagothrix lagotricha*, *Pithecia irrorata*, *Saguinus midas*, *Saimiri ustus*). A three-dimensional point cloud (lateral spacing = 25 microns) representing each occlusal table was generated using a laser scanner, and average angularity and surface relief were computed using conventional GIS techniques. Specimens were grouped by diet as reported in the literature and by gross wear score. Topographic relief and angularity were compared between samples using a MANOVA model and data ranks.

Results show no interactions between diet and wear score. Both relief and angularity evince significant variation between diet groups. Post-hoc tests of angularity separate frugivore-

insectivores from primates that include hard objects in their diets. Frugivore-folivores and soft fruit specialists are intermediate. Relief separates frugivore-folivores from soft-fruit and hard-object feeders with frugivore-insectivores between them. Dental topographic analysis separates platyrrhines with variably worn molars by diet, and holds the potential to reveal both marked and subtle dental-dietary adaptations in fossil species.

Using calcaneal morphology to predict medial longitudinal arch height in fossil hominins

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Paleoanthropologists have used the anatomy of various pedal elements to reconstruct whether fossil hominins had a flat or longitudinally arched foot. Describing arch morphology as either present or absent is likely too simplistic, however, given that modern humans exhibit substantial variation in longitudinal arch height, including flat-footedness. Currently, we have limited understanding of whether inter-individual variation in longitudinal arch height may be related to variation in bony anatomy between individuals. This study uses a sample of lateral foot and ankle x-rays ($N=117$) to test the hypothesis that variation in the cuboid joint surface angle of the calcaneus is correlated with variation in the calcaneal inclination angle, a radiographic measure of longitudinal arch height, in modern humans.

ImageJ NIH software was used to measure the angle enclosed between 1) the cuboid joint surface and the plantar-most surface of the calcaneus; and 2) the plantar-most surface of the calcaneus and the ground (*i.e.*, calcaneal inclination angle) in lateral view. Both the orientation of the cuboid joint surface (range=92.05°-127.41°) and the calcaneal inclination angle (range=5.08°-34.82°) are highly variable between individuals. Importantly, there is a statistically significant positive correlation between these measures (Pearson's $r=0.603$, $p<0.01$), in which the cuboid joint surface angle explains approximately 36.4% of the variance in the calcaneal inclination angle, *i.e.*, medial longitudinal arch height. This result suggests that the cuboid joint surface angle of the calcaneus can be used to discern more nuanced variation in longitudinal arch height from fossil calcanei than the simple longitudinal arch presence vs. absence dichotomy.

Modified teeth: Cultural diversity and community building at Cahokia (AD 900-1400)

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In North America, the majority of culturally modified teeth are associated with Mississippian

sites in or near Cahokia, the earliest and largest Mississippian mound center in the eastern Woodlands, and with contemporaneous sites in the Illinois River Valley (IRV). In this poster we consider the biological and cultural implications of the geographic, temporal, and demographic distribution of modified teeth in Illinois in light of recent strontium isotope analysis and morphological studies that provide important new insight into population ancestry and interaction. Modified teeth from Illinois have been known for over 100 years. Recent archaeological excavations in Illinois and documentation of museum collections have not only identified additional examples and previously unrecognized styles of dental modification, but have provided critical contextual and biological information that allows us to re-visit earlier interpretations of these modifications as simply status markers. Recent 87Sr/86Sr analyses suggest individuals with modified teeth were local to the immediate Cahokia region. A recent biodistance study of Cahokia and IRV sites suggests a close relationship between Cahokia and IRV Schild Knoll A, a mound containing individuals with modified teeth. Population movements have always played a role in archaeological interpretations of Cahokian development, expansion, and collapse, but evidence for such interaction has often hinged on proxy data provided by archaeological evidence of material culture and practices. Intentionally modified teeth provide lasting evidence of cultural behavior and when combined with biochemical information, have the potential to provide significant new insight into patterns of interaction and migration at this critical period in prehistory.

Manipulation complexity correlates with brain size and terrestriality across primate taxa

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Primates have a remarkable repertoire of manipulative behaviors used in a broad variety of contexts. More complex manipulations are assumed to be linked to cognitively more demanding activities. Thus, manipulation complexity is expected to increase with brain size, which has been shown to proxy general intelligence in primates. However, manipulation complexity has never been compared in detail across primate species. In this study, we used bimanual and unimanual actions, synchronicity of hand and finger use, as well as possible combinations to categorize manipulation bouts, and validated complexity levels using Guttman scaling. We assessed manipulation complexity in food-related and social contexts in 31 primate species. Our measure of overall manipulation complexity correlated positively with brain size and terrestriality, also after controlling for phylogenetic relatedness. In food contexts, brain mass and terrestriality were both correlated with manipulation complexity, whereas in social contexts only terrestriality showed a significant effect. Our results support the hypothesis that

enhanced cognitive abilities are related to complex manipulations in resource acquisition. However, terrestriality also plays a major role in the evolution of manipulative skills. Together with previous findings that terrestriality is crucial for acquiring and maintaining complex tool variants in primates, this lends support to the notion that the combination of intelligence and terrestriality may have been a major pacemaker of hominin technological evolution.

Passage to India: Do contemporary ethnic groups of northern Pakistan yield evidence of a Bronze Age introduction of Central Asians into South Asia? A dental morphology investigation

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Considerable debate surrounds the biological relationships between ethnic groups occupying the Karakoram and Hindu Kush highlands of northern Pakistan and ethnic groups occupying the lowland Indus Valley and beyond in peninsular India. Some recent uniparental molecular genetic studies have suggested a Late Bronze Age intrusion of Y-chromosome haplotypes from western Eurasia into resident populations of Pakistan and northern India. The current study presents an investigation of a battery of 17 tooth-trait combinations scored in accordance with the Arizona State University Dental Morphology System among 393 individuals of five ethnic groups (Awans, Gujars, Karlaars, Syeds, Tanolis) from the northern periphery of the Indus Valley. These data were contrasted with 22 samples encompassing 2,433 prehistoric and living individuals from Pakistan, northern and southern peninsular Indians, and Late Bronze Age inhabitants of south Central Asia (the purported source of the Y-chromosome variations). Patterns of intersample differences were examined with hierarchical cluster analysis with Ward's method, neighbor-joining cluster analysis and multidimensional scaling with Guttman's coefficient of alienation.

Results are highly consistent across the data reduction techniques. None of the northern Pakistani ethnic groups exhibit any affinities to prehistoric Central Asians, prehistoric inhabitants of the Indus Valley or living ethnic groups of peninsular India. Affinities among the ethnic groups of northern Pakistan are diffuse, especially between Syeds, Gujars and Karlaars relative to all others. Such results not only refute the claim of relatively recent gene flow into South Asia from Central Asia, but suggest the biological origins of northern Pakistani ethnic groups are multiple.

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The LB1 individual from Flores is a result of disturbed evolutionary developmental homeostasis

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The phenotype of each metazoan represents the outcome of shared phylogeny accrued over generations plus a unique ontogeny in which genetic heritage develops in an environment that shapes genomic expression into a given array of characteristics. Sorting influences of ontogeny from phylogeny depends on the extent of evidence available. Abundant data in living individuals render relatively straightforward the parsing of unique ontogeny from shared phylogeny. For fragmentary skeletons from archeological contexts, more limited evidence makes inference less straightforward.

Developmental homeostasis is the result of a set of processes, themselves evolved, in which individuals develop more or less normally despite the existence of genetic variation and environmental challenges not too extreme. The term canalization was developed by C.H. Waddington to refer to this ability of a population to produce relative constancy (not identity) of individual phenotypes across a broad range of genotypes and environments.

LB1 from Liang Bua Cave, Flores, Indonesia, represents a case in which a phenotype has been interpreted by some paleoanthropologists as reflecting a normal ontogenetic outcome in a phylogenetic lineage that produced a previously unknown species, *Homo floresiensis*. Alternatively, other human biologists have identified signs (particularly craniofacial asymmetry and disproportion) of disrupted developmental homeostasis (canalization) in the LB1 individual. Here we summarize extensive cumulative evidence that LB1 represents not evolutionary novelty but rather atavism, and present previously unpublished data on the occipitofrontal circumference of the LB1 skull that show it having a brain size appropriate for a developmentally abnormal individual in a normal population of small-bodied individuals.

Sealed osteons: A pathological consequence or natural circumstance of extensive remodeling?

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Sealed osteons (SeO) are unusual secondary osteon (Haversian system) variants. They are defined as the continuation of osteonal infilling resulting in complete obliteration of the Haversian canal (canal fully sealed with bone) (Congiu and Pazzaglia (C&P), 2011 Anatomical Record). SeO do not represent micropetrosis (central canal "plugging") or osteocyte lacuna plugging with hypermineralized tissue related to aging; SeO are "sealed" with apparently normal bone. SeO are rarely studied; C&P reported 4-5% SeOs of all secondary osteons from three tibiae (post-traumatic amputations; ages 25, 28, 52; all males). They suggest SeO are the natural/physiological consequence of ischemia that sporadically occurs during remodeling (i.e., some osteons seal because their blood supply is diminished or cutoff during formation of nearby/adjacent osteons). We hypothesized a similar prevalence of SeO would be found in

various non-primate, highly remodeled bones (deer, sheep and horse calcanei; sheep and horse radii, sheep tibiae; horse third metacarpals) and from modern human femora where an aging effect might be detected (35-71 years; n=10 male:female=8:2). SeO occurred in <0.1% secondary osteons in non-primate bones even in extensively remodeled regions (i.e., much greater %osteonal bone than humans) and ~1% in human femora, but without an age-related increase. The 4-5 fold higher prevalence of SeO identified by C&P might reflect ischemia preceding and/or caused by the trauma/amputation in the three tibiae that they examined. If correct, then these unusual osteon variants should be viewed as a pathological consequence, not the outcome of ischemia caused by natural extensive osteonal remodeling. Perhaps they represent sealing of the 'closing cone' of some secondary osteons.

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Mayan paleodemographics: What do we know about ancient Maya demography?

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Two decades ago we began to study paleodemography of skeletal series coming from several Mayan archaeological sites. The methodology we have developed over these years is based on the proposal of Weiss (1973) and adapted to prehispanic populations. The raw material for these analyzes is the archaeological context and the age distribution of death. The results have been focused on obtaining information on life expectancy and mortality and fertility trends. Thus, in the case of fertility the average number of children per woman is between 6 and 8 children, which we have confirmed with ethnographic information in modern Mayan groups, including those living in Quintana Roo, who in the absence of birth control have a family of 8 children. Mortality levels vary according to the context, but the general trend is a high mortality in ages between birth and four years of age to decrease between 5 and 14 years. The probability of death rises at the beginning of reproductive life in women and the beginning of adulthood (12 to 14) for men. Mortality trends are closely related to the living conditions of these groups, including infections caused the most damage. The study of population mobility in skeletal series is just in its beginnings because it requires other finer analysis. However, from the archaeological record it is possible to obtain evidence of migration, as in the case of Chac Mool, Quintana Roo.

Variation in cranial morphology of Mexican populations and its role for the human dispersion into the Americas

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Cranial morphology has previously been used to estimate phylogenetic relationships among populations, and as such has been an important tool in the reconstruction of ancient human dispersions across the planet. While some may argue that crania are too influenced by environmental factors to demonstrate biological relationships, many studies have shown that this is not the case. In the Americas, previous morphological studies support a scenario of people entering the Americas and subsequently dispersing into North and South America through Mesomerica. Therefore, Mexican populations are essential for studying the peopling of the Americas. Here, we compare the cranial morphology and phenotypic variation of late Holocene Mexican series to worldwide populations, with the objective of contextualizing the variation seen among these populations with the values observed in other parts of the continent. The crania from Mexico come from Michoacán, Sonora, and Tlanepantla and date to between AD 1200 and 1500. These were compared to ancient and modern crania from North and South America, Australia, and East Asia. Morphological affinities were assessed via Principal Components Analysis, Clustering analysis, within-group variance, and Fst values. Our results show that the between group variation in the Americas is higher than that from the Asian or Australian populations. Similar levels of variation can also be seen just within the country of Mexico, supporting previous admixture estimates. These results support that the high phenotypic variation in the continent is not a result of its size, being found in more constricted areas, such as the Mexican territory.

Millet crop and consumption during the Late Bronze Age in Georgia: First human and animal isotopic evidence

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Located in the Kura valley in Central Georgia, Tbilisi city yielded numerous settlements and funerary sites dated to the Bronze Age. In order to document the development of millet crop and its consumption in the Southern Caucasus area, a multi-proxies approach, including anthropological, isotopic, botanical and archaeological analyses, was firstly intended on Trelis and Treligorebi sites dated to the transition period of Late Bronze Age-Early Iron Age (IInd-

Ird mill. BC). From Trelis site, 25 adults were sampled for carbon and nitrogen isotope analysis. From Treligorebi site, 44 animal bones including wild and domesticate species were analysed to define the isotopic local baseline as well as archaeobotanical remains sampled in dwellings to characterize the floristic context. Carbon isotope values for animals (-16.9±2.4‰) and humans (-16.1±0.7‰) indicate a differential consumption of C₄ plants. The mean enrichment in ¹⁵N between animals and humans of 3.9‰ would suggest a mixed consumption of plant and animal proteins. Macro-botanical remains as well as pollens and phytoliths highlighted the presence of cereals as wheat and also *Panicoides* confirming the role played by C₄ cereals in Late Bronze Age farming activities. Results clearly demonstrate that the Late Bronze Age populations in Central Georgia developed different cereal crops including millet in the vicinity of the Kura valley. Additional isotope data from sites covering the entire Bronze Age period suggest significant millet consumption by livestock since the Early Bronze Age and heterogeneous human dietary patterns according to sites.

This research was funded by the National Agency for Research from the French Government (ANR13-JSH3-0003-01) and LIA Franco-Georgian from the CNRS.

Degrees of freedom: Quantifying the impact of apartheid residential segregation on exposure to toxic elements in urban South African adults

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Exposure to toxic elements and inorganic pollution is a significant threat to public and individual health worldwide. The analysis of archived bone tissue can serve as an invaluable proxy by which to investigate historical exposure to environmental pollution. This project entailed the investigation of bone element concentrations of lead, cadmium, manganese, arsenic and antimony in 215 adult femora from an identified reference collection housed at the University of Pretoria. Individuals included in the analysis lived in urbanGauteng, South Africa, and who died between 1960 and 1999. During this period, the apartheid policies of the South African government severely limited the movements of the African population. Individual residence was determined by strict racial categories. For each element analysed, except manganese, a clear ethnic disparity was evident between rates of exposure between black and white individuals as classified by apartheid policy. African individuals showed significantly higher median bone element concentrations for cadmium, arsenic and antimony ($p < 0.01$). Conversely, white South African individuals had significantly higher median bone lead concentrations ($p < 0.01$). It is posited that these differences arose primarily in response to residential segregation in the urban/suburban environment, with Africans living in close proximity to mine dumps and white individuals living in the high-traffic urban core. These results are among the few data available on urban pollution in South African adults during apartheid. By understanding historical exposure patterns, it is possible to

make meaningful predictions about which populations may be at high risk of future toxic element exposure.

Sex estimation from the greater sciatic notch of the human pelvis: A geometric morphometric approach

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It is widely agreed that the human os coxae holds the greatest degree of sexual dimorphism and is the most useful bone for estimating sex in skeletal remains. And yet, despite the crucial nature of estimating this biological characteristic, methods considered common today rely rather heavily on the experience of the anthropologist and on the presence of more complete coxal bones. Following earlier research by ALBH, this project examines the usefulness of morphometric and geometric morphometric methods in estimating sex from the portion of the os coxa most likely to survive over time, the greater sciatic notch. This method, originally tested on American white and American black samples from the Terry Collection at the Smithsonian Institution, has now been applied to a Mexican sample from the School of Medicine, National Autonomous University of Mexico (UNAM), skeletal collection. Using a 3D digitizer, three landmarks are determined on the greater sciatic notch; the posterior inferior iliac spine, the ischial spine, and the deepest point of the notch. Geometric distances and angles between the points are calculated and define the width and depth of the notch. Discriminant function analyses of the geometric variables were computed with an accuracy reaching 90.4%. Geometric morphometric analysis of semilandmark data taken for the notch is also examined for its practical applications in sex estimation. This approach to estimating sex will hopefully alleviate some of the inconsistencies with user experience and provide a reliable method when a smaller portion of the pelvis is available.

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Confirming burial location in the Erie County Poorhouse Cemetery using death certificates and mortality records from 1880-1913

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The Erie County Poorhouse (Buffalo, N.Y.) cemetery consists of 383 burials and extensive municipal documents representing those who were served by the poorhouse, insane asylum, and hospital.

Mortality records from 1880-1913 were examined and compared to a sample of death certificates to determine how many individuals listed in the records were buried in the poorhouse cemetery. Records include burial remarks and demographic indicators for 7,181 individuals.

The records indicate that 3,512 (49%) individuals were not buried in the poorhouse cemetery. The burial remarks were tabulated as follows: "County Plot" (1,609), "None" (1,138), "Child Space" (356), "Medical College" (473), no remark (93). 525 death certificates were examined and tabulated as follows: buried in the poorhouse cemetery (357), buried elsewhere (51), buried in the County Plot (32), medical college (1), burial place not listed (50), no records found (34).

Death certificates that listed the poorhouse cemetery as the place of burial corresponded to the remarks "None", "County Plot" and "Child Space" in the records. Assuming these remarks indicate burial in the poorhouse cemetery then 3,103 (43%) individuals were originally buried in the cemetery. The lack of these terms after 1911 suggests the cemetery was not used after that date. The burial location of those sent to the medical colleges is unknown. The records also suggest that some individuals in the cemetery were later claimed and buried elsewhere. These data become important for comparisons of demographic patterns and frequencies of pathology in the skeletons to the causes of death listed in these records.

Understanding inter-specific variation in female mate choice

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Female mate choice can take many forms in the animal kingdom depending on the selection pressures acting on females, but little work has been aimed at understanding comparative variation in female mate choice among primates. One potential source of variation might be inter-specific differences in primate mating systems. High monopolisation potential of males over females leads to contest competition for harems or dominance. The resulting strong dimorphism in body size and weaponry may limit the ability of females to exert direct choice. However, in species where males have fought directly over dominance, selection may in any case favor females to prefer these successful high-ranking males. This may lead to female strategies aimed at further increasing their own monopolizability, such as graded-signals of the timing of ovulation that become increasingly accurate as the extent to which male dominance rank proxies male competitive ability increases. When monopolisation potential is low, direct competition over male dominance reduces. Under such circumstances, females cannot rely on male-male competition to identify high-quality males, and should invest time and energy in selecting partners. Reduced competition over male dominance also leads to reduced dimorphism, such that females are also more able to exhibit direct mate choice. As many males are able to obtain matings in such scenarios, sperm competition becomes

significant, allowing females to exert cryptic choice through post-copulatory mechanisms. As such, differences in monopolization potential and male-male competitive regimes may lead to a diversity of female mate choice strategies.

'Omics insights from mother's milk

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Mother's milk consists of hundreds, if not thousands, of bioactive constituents and provides a rich opportunity for investigating the genome, epigenome, and microbiome in humans and non-human primates. Here we showcase collaborative research among anthropologists, microbiologists, food scientists, immunologists, biochemists, bioinformaticians, animal scientists, and lactation biologists using milk collected from rhesus macaques at the California National Primate Research Center. Mother's milk provides a primary vertical transmission pathway for symbiotic bacteria that serve essential digestive and immunological functions throughout an individual's life. For example, in rhesus macaques we have identified many strains of lactic acid bacteria that inhibit the growth of pathogenic bacteria by competitive exclusion and/or through the production of antimicrobial compounds. Milk not only provides bacteria, but also feeds the bacteria. Oligosaccharides, that are indigestible by eutherian neonates, influence the establishment of commensal gut bacteria in the developing infant. Importantly the presence and abundance of milk oligosaccharides vary among individuals and species and much of that variation remains to be explained. Most recently, we assayed the mammary transcriptome via RNA extracted from the milk fat, somatic cells, and mammary biopsies of lactating rhesus macaques. We demonstrated that RNA extracted from the milk fat accurately portrayed the RNA profile of milk-producing cells. Milk collection therefore represents the opportunity to non-invasively explore gene expression that influences milk synthesis, and consequently, the developing infant.

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Development of a new non-invasive method for kinematic analysis of animal locomotion based on the Structure from Motion algorithm

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Kinematic studies of primate locomotion have suffered from two difficulties: 1) it is almost impossible to attach markers to freely moving animals; 2) it is often difficult to calibrate the space used by the animals. The most popular current approach is manual, markerless digitization, but the accuracy is generally not good enough for 3D reconstruction, and this does not overcome any calibration difficulties. We propose a solution based on SfM 3D photogrammetry that uses camera spacing for calibration. This technique is widely used for still images but we expanded its use to video clips. We filmed animals using up to 5 synchronized cameras at either 720p60 or 1080p30. The film streams were converted into sequentially numbered JPEG images aligned on a clear synchronous event. For each frame set we apply the standard open-source tools Bundler (Snaverly et al., 2008) and PMSV (Furukawa and Ponce, 2009) to generate a 3D point cloud representing the animal's body surface. In test sessions, we analyzed various locomotor behaviors of the Japanese macaques and chimpanzees. The results showed that the method works well and generates 3D reconstructed body surface data during locomotor behaviors. The accuracy was less than the resolution of the original film, but was much better than that of the manual digitization. Although there was noise, particularly in the Z axis, and data processing is slow, this technique can obtain data where no other methods can. Our new technique provides a powerful new tool for kinematic analysis outside the laboratory.

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Genetic insights to the evolution of the cercopithecoid dentition

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The fossil record provides the evidence of evolution – what types of organisms were alive when, where, and in what contexts. Our ability to understand evolution by natural selection is improved by an understanding of how genes shape the phenotypic variation upon which selection operates. In the case of fossils, this translates into an understanding of the relationship between genotype and skeletal variation.

To gain insights into the genetic underpinnings of Old World Monkey evolution, we undertook genetic studies of quantitative dental variation in 632 baboons (*Papio hamadryas*) belonging to 11 large, extended pedigrees maintained at the Southwest National Primate Research Center. We made high resolution plaster dental casts for all individuals and collected data on 82 linear, 62 two-dimensional area and 24 angle measurements, and 24 "nonmetric" traits. For each of these traits, we used a maximum-likelihood variance decomposition approach to estimate the proportion of the variance attributable to the effects of genes – i.e., the heritability. Using simple multivariate extensions of this approach, we decomposed the correlations

between all pairs of dental phenotypes into their genetic and non-genetic components to obtain estimates of shared genetic effects – i.e., pleiotropy – on patterns of dental covariation. From these analyses, we developed an appreciation for the genetic architecture underlying dental variation in baboons. In our presentation, we will provide an overview of the results of these analyses and discuss the utility of our observations for the investigation of the phenotypic evolution preserved in the fossil record.

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Functional morphology of the wrist joints of sloths and suspensory primates

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Suspensory locomotion and postures, with the forelimbs under tension and hands adopting hook-like grips, independently evolved in gibbons, spider monkeys, and sloths. Anatomical similarities of the wrist include: (1) highly curved proximal carpal joints and reduced ulnar styloid processes shared by gibbons and sloths (Jenkins & Fleagle, 1975; Mendel, 1979), and (2) half ball-and-socket midcarpal joints shared by gibbons and spider monkeys (Jenkins, 1981). All of these features are believed to increase ranges of hand movement during positional behavior. Still, the functional significance of these commonalities in carpal structure, particularly as they relate to specific hand movements, is supported by few experimental data in living animals. To this end, we radiographed the hand of anesthetized *Ateles geoffroyi*, *Choloepus didactylus*, and *Hylobates lar* in maximum ranges of radioulnar deviation and dorsi-volarflexion to examine changes in wrist joint configuration as hand positioning varies. In all taxa, ulnar deviation is accompanied by radial translation of the scaphoid and lunate on the radius, and further enhanced in primates by rotation of the capitate and hamate at the midcarpal joint. In sloths, the distal triquetrum and radius form a single, highly curved surface congruent with the scaphoid, lunate, and hamate where ulnar deviation takes place. However, the more palmar and proximal position of the cuboidal-shaped triquetrum appears to limit volarflexion compared to primates. Our experimental data suggest that different functional solutions evolved in the wrist of sloths and primates that promote mobility of the hand in specific planes.

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Testosterone mediates the association between phenotypic condition and low voice pitch in Bolivian adolescents: Implications for a costly-signaling model of male voices

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The human voice is one of the most conspicuous and dimorphic human secondary sexual characteristics; males' low fundamental and formant frequencies barely overlap with females'. Researchers often assert that low male voices are costly signals of phenotypic quality; however, no evidence currently exists linking low voices with any indicators of quality such as health or physical condition. In the present study, we examine the relationships between condition, testosterone, and vocal parameters in 91 Bolivian adolescent males. Condition is operationalized as immune function (based on secretory IgA) and energetic reserves (BMI-for-age residuals from Tsimane-specific growth curves), and "masculine" vocal parameters as having low fundamental frequency, narrow formant position, and low fundamental frequency variation. We target adolescents to capture variation in vocal parameters during the canalization period for vocal fold and vocal tract growth. Results indicate that males in better energetic condition have higher testosterone levels and lower voices, even controlling for age. Further, testosterone mediates the relationship between condition and fundamental frequency. We suggest that testosterone plays a key mediating role in the causal pathway linking phenotypic condition to lower fundamental frequency. Our results provide support for a costly-signal model of low male voices.

Biorhythm variations underlying the evolution of human life history: Evidence from tooth and bone histology

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Microstructural evidence from teeth and bone has been used to support the hypothesis that growth, metabolism, and reproduction – i.e., life history – are centrally regulated by a neuroendocrine rhythm, the Havers-Halberg Oscillation (HHO). A broad sampling of HHO rhythms across primates has fleshed out patterns of variation among species as well as among the major taxonomic groups within the order. However, intraspecific variation patterns acting as the basis for natural selection upon life history have not been thoroughly sampled. Humans are important to assess in this regard because they are a natural experiment, with an unusually high range of HHO variation; it is also obviously vital to assess modern human biology to shed light on major questions of hominin evolution.

Therefore, this study assesses dental Retzius line periodicity (a proxy for HHO cycle) and bone osteocyte density data from histological sections, sampled from humans of contemporary Malawi and South Africa. These data are analyzed against known predictors of HHO biology across anthropoids, such as body size. Given the unusual nature of human life history as compared to great apes, we predict that human intraspecific patterns will differ markedly from

those of primate relatives. Regressions show that humans tend to inversely scale HHO rhythms with body size, opposite the pattern seen among anthropoid species as a whole. This suggests the unusual nature of human life history derives partly from tradeoffs between biological timing mechanisms and durations of growth, and thus the underlying physiology coordinating growth and life history in general.

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3D morphometric analyses of human ulnae

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A 3D morphometric study of 53 human right ulnae was undertaken in order to investigate the following functional morphological hypotheses related to diaphyseal bowing in this relatively straight long bone: 1.) ulnae with larger and more proximally-positioned brachioradialis attachments will show a greater degree of bowing than ulnae with smaller or more distally-placed brachioradialis attachments, and 2.) the degree of bowing in the ulna will not be correlated with the biomechanical advantage of triceps brachii, but rather will reflect the strength of the elbow flexors. Principal components of Procrustes shape data derived from 30 type II and III anatomical landmarks reveal the following. First, the vast majority (89.4%) of information in the dataset is related to size, as this is the amount of variance explained by PC1, which shares virtual identity with centroid size ($r^2 = 99.7\%$). PC2, which explains only 1.8% of the total variance, contrasts those ulnae with large articular areas and straight diaphyses with those bearing smaller articular dimensions and bowed diaphyses. PC3 (which explains 1.4% of the total variance) is related to torsion along the bone's long axis, while PC4 (which explains 1.2% of the variance) is related to the relative position of the brachialis scar. Neither relative size nor position of the brachialis scar is correlated with PC2, although the relative moment arm size for triceps brachii is correlated with both torsion and bowing along the bone's long axis. We therefore reject our initial hypotheses and suggest avenues for further research.

The occipital lobes of Neandertal brains, orbit size, and cognition: What is the evidence for Neandertal cognitive inferiority?

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A recent article by Pearce, Stringer, and Dunbar (2013) have claimed that Neandertals did not have proportionately as large parietal association cortices as modern humans because their orbits were larger, and thus they would have had a larger visual cortex (area 17 of Brodmann) than anatomically modern humans (AMH). They thus suggest that Neandertal intelligence would necessarily have been less

evolved with respect to sociality than in AMH. We have obtained CT scans for several of the Neandertals that have occipital lobes intact (La Chapelle-aux-Saints, LaFerrassie, LaQuina, Saccopastore, Skhul V, IX, Tabun, Amud, Forbes Quarry). Analysis of virtual endocasts from these scans does not show reliable evidence to support the assertion of different brain organization in Neanderthal, in the form of enlarged visual cortices or smaller parietal cortices. Limitations of the methods used to infer visual cortex size from orbit size, as well as inferences about cortical organization from endocasts, will also be discussed.

Life history analysis for a population of *Colobus vellerosus* in Ghana, West Africa

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Matrix population models can aid effective population management by allowing us to identify the life-history stages that are under the strongest selection pressure. We compared the impact of vital rates on population change using annual demographic data to control for seasonal effects in a population of a vulnerable primate species, *Colobus vellerosus*, at Boabeng-Fiema Monkey Sanctuary (BFMS), Ghana. We collected data from individually recognizable members of 8 study groups between May 2000 and 2009. We constructed projection matrices for males and females by classifying life history data into four stages using known or estimated birth dates: infant (pre-weaning), juvenile (post-weaning to 3 years), sub-adult (3-7 years for males; 3 years to primipara for females), and adult (≥ 7 years for males; primipara for females). The mortality rate for males was higher than the rate for females (0.12 vs. 0.04 individuals per year respectively). This could be related to the higher philopatry of females than males in this population. This population is growing with annual rates of $\lambda = 1.37$ for females, and $\lambda = 1.17$ for males. A sensitivity analysis demonstrated that selection on survival is greater than selection on fertility for both sexes. Population growth is most sensitive to infant survival, as opposed to adult survival in other primates, which may be linked to a low predation pressure and a high infanticide risk. Continued monitoring of *C. vellerosus* at BFMS will allow us to identify population growth concerns and design approaches for successful mitigation.

Three-dimensional foot kinematics of chimpanzees and humans during bipedal locomotion

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Humans have evolved joint articular surface morphology that limits midfoot mobility during

terrestrial bipedalism at the expense of arboreal locomotor capabilities. However, many pedal remains from early hominins exhibit ape-like joint morphology. Hence, a thorough understanding of ape foot mechanics during locomotion is critical to reconstructing the positional behaviors of early hominins.

In this study we measured three-dimensional kinematics of the foot in humans and chimpanzees (*Pan troglodytes*) during bipedal walking. Kinematic data were collected using a four-camera motion capture system (ProCapture, Xcitem Inc.). A 25-point leg and foot marker set was used to measure motion at the talocrural, subtalar, transverse tarsal, cuboidometatarsal, and metatarsophalangeal joints across stance phase.

We quantified the following previously unreported interspecies differences in foot kinematics. At the subtalar joint, chimpanzees exhibit roughly twice the amount of total frontal plane motion (inversion-eversion) as humans during a step. However, in chimpanzees this motion occurs almost entirely at the beginning of stance phase, as the highly inverted foot is brought into full contact with the substrate. Chimpanzees maintain a relatively static joint posture for the remainder of stance, whereas humans invert the subtalar joint prior to toe-off. Contrary to the expectations of a "midtarsal break," chimpanzees exhibit little to no dorsiflexion at the transverse tarsal joint following heel lift. Instead, chimpanzees evert the hindfoot at this joint during heel lift, causing the lateral border of the heel to leave the substrate before the midfoot. This phenomenon was not observed in humans.

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The origins and evolution of *Mycobacterium leprae*

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Leprosy is one of the oldest human diseases and remains a public health concern in several developing countries. The causative agent of human leprosy, *Mycobacterium leprae*, underwent reductive evolution millions of years ago. The limited genetic variation among human strains of *M. leprae*, suggests a relatively recent host switch to humans from another species. We performed whole-genome sequencing of a *M. leprae* strain isolated from a West African sooty mangabey (*Cercocebus atys*). The genome comprised 3,268,076 bp, with an overall average coverage of 53x. Sequence comparisons between the mangabey strain and the reference genome (*M. leprae* TN strain from India) revealed 99.995% sequence identity. The mangabey strain differs at 153 polymorphic sites from the TN strain and at only 79 sites from the Br4923 strain from Brazil. Single nucleotide polymorphism-based phylogenetic analyses have shown that the Br4923 and mangabey strains are basal to Eurasian strains, suggesting an African origin of leprosy. We are also currently sequencing the genome of a strain of *M. lepraemurium*, the causative agent of murine leprosy. Murine leprosy shows similar clinical and

histopathological manifestations as human leprosy, but unlike human leprosy, the causative agent can be cultured. Comparative and phylogenetic analyses of the strain of *M. lepraemurium* with the human and mangabey strains of *M. leprae* will help to clarify the origins and evolution of leprosy.

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Paleogenomic variation in a CC Chemokine Receptor Gene (CCR5)

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Climate plays an influential role in the distribution of diseases and their outbreaks, hosts, and vectors. Immunologically naïve populations rely on general immune system functioning such as CC chemokine receptors (CCRs) which promote chemotaxis and viral binding. In humans, CCR5 is associated with variation in susceptibility to HIV and West Nile Virus (WNV). HIV and WNV originated in Africa but have now expanded beyond the tropical zone. A 32bp deletion mutation (CCR5 Δ 32) in European populations in CCR5 causes increased resistance to HIV and vulnerability to severe WNV symptoms (e.g., meningitis, encephalitis). A primate-wide analysis of variation in CCR5 suggests balancing and purifying selection as well as different selective pressures in Old and New World primates. The aim of this research was to explore evolutionary human variation in CCR5 using paleogenomic data (Neandertal, Denisova; Saqqaq, a 4000 year old Paleoeskimo) from high latitude populations. Paleogenomes were expected to show similar patterns of variation to modern Eurasians due to geographically differential selection in CCRs and contributions from Neandertals to modern human immune genes. This is true for Denisova who shares with modern humans an upstream variant that may influence gene function. The Neandertal genome, however, contains three unique nonsynonymous single-nucleotide polymorphisms. The Neandertal mutations do not impact protein conformation significantly but may have a subtle effect on gene activity. Understanding evolutionary and geographic variation in genes associated with disease resistance and susceptibility are important avenues of research for epidemiological modeling.

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Reconstruction of Neolithic and Iron Age human manipulative behavior using electromyography

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It has been suggested that decreased humeral bilateral asymmetry detected in European females from Neolithic to Iron Age reflects grain

processing inventions. Particularly, Neolithic grinder is presumed to demand bilaterally symmetrical muscle activity thus inducing no humeral asymmetry in contrast to subsequent Iron Age rotary quern. In this study, we aim to investigate the possible effect of grain processing on humeral bilateral asymmetry. We used electromyography (EMG) to record activity of the right and left anterior deltoid, pectoralis major, infraspinatus and triceps brachii muscle in a sample of seven females while processing grain with Neolithic grinder and Iron Age rotary quern. Peak EMG normalized to maximal voluntary contraction (MVC) and integrated EMG were compared between dominant and non-dominant limbs and between the two grinding devices. When using the grinder, only pectoralis muscle shows significant bilateral differences ($p = 0.018$), however, its mean peak EMG <20% MVC and the lowest integrated EMG among the muscles investigated here puts its effect on humeral asymmetry into a question. When using the rotary quern, no significant bilateral differences in active limb were detected suggesting that behavioral habits (i.e., using one limb more frequently) alone can enhance humeral asymmetry. The rotary quern demands more severe muscle action (mean peak EMG is 41–74% MVC in muscles tested here) than grinder (only the mean peak EMG of triceps brachii exceeds 20% MVC being 52% MVC). Our results thus support the hypothesis that Holocene patterns of humeral bilateral asymmetry in European females reflect the grain processing inventions.

Comparative histology of burned mammals using light microscopy: Examining heat-induced changes in femoral samples of deer, pig and cow

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The positive identification of human remains is a key task most osteologists face in the field, either in order to reconstruct human-animal contact in archaeological populations, or to initiate police investigations through forensic analysis. Cremation can complicate the identification of fragmented material. Histological analysis is used to differentiate between faunal material for unburned skeletal material using metric analysis or observing qualitative characteristics.

This study focuses on the histological comparisons between three mammalian species – *Sus scrofa domesticus* (domestic pig), *Bos taurus domesticus* (domesticated cow), and *Odocoileus virginianus* (white-tailed deer). Five femoral specimens from each species were selected and burned at 600°C, 800°C and 1000°C, and then thin-sectioned for light microscopy. Quantitative techniques focused on the measurement of osteons and Haversian canals dimensions within a given area of cortical bone. The qualitative approach observed the visible differences in histological structures.

Results indicated that histological structures were still visible in burned specimens, although visibility was dependent on the extent of carbonization. Quantitative analysis showed evidence for the smallest Haversian structures in deer and the largest in the cow samples.

Statistical analysis demonstrated changes in osteon dimensions of pig and cow samples at 800°C and 1000°C. The contraction of osteons in burned pig created osteons similar in size to the deer osteons at 800°C and 1000°C. These results suggest that there is limited value in histological analysis of cremated faunal skeletal material for species differentiation.

Molecular anthropological explorations of prehistoric herding

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Hunter-gathers who adopted Neolithic economies are often depicted as having made a choice between foraging and food production. But what about groups that took up aspects of a Neolithic economy, but maintained strong ties to wild resources? At South Africa's Western Cape, local foragers begin herding about 2,000 years ago as marked in faunal assemblages by the presence of sheep and cattle. Far to the east, at A.D. 300, the first Bantu farmers bring their own central and eastern African breeds of cattle in an expansion along the Indian Ocean coast. In this paper, I present ancient DNA data to examine archaeological examples of Western Cape African cattle. The results show the region's first herds were largely replaced by Bantu cattle some time before substantial European colonization ca. 1600. Thus, while archaeological and ethnohistoric data indicate that cattle herding was consistently important through to the modern period, genetic evidence shows that the earliest cattle in the region did not leave descendants. This paper will explore the hypothesis that the strategy of maintaining a diet divided between wild and domestic resources that led to the ultimate extirpation of the original cattle population.

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Validation of qPCR methods for the detection of *Mycobacterium* in New World animal reservoirs

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Zoonotic diseases continue to impact modern human populations. In the Americas, *Mycobacterium leprae*, which causes leprosy, naturally transfers between humans and armadillos, and it, along with other harmful mycobacteria, may jump between additional animal hosts. Thus, identifying accurate methods for detecting mycobacterial infection is critical for proper evaluation of exposure threats. This study tests the efficiency of enzyme-linked immunosorbent assays (ELISA) and probe-based

quantitative polymerase chain reactions (qPCR) for detecting *M. leprae* in infected and non-infected armadillos. Results indicate that ELISAs for *M. leprae* PGL1 and LID1 antigens are extremely specific but not highly sensitive. Conversely, qPCR results are both specific and sensitive for the *M. leprae* single-copy 85B gene and multi-copy rlep gene, respectively. Therefore, qPCR using single and multi-copy genes maximizes detection sensitivity and specificity. Based on these results, potential infection of *M. leprae* and the *M. tuberculosis* complex (MTBC), which causes tuberculosis, was assessed in South American marmosets living in close proximity to humans. Both single- and multi-copy genes were analyzed. For the MTBC, these included rpoB and IS6110, respectively. All eighty-eight tested marmosets are negative for *M. leprae* DNA, but nineteen are positive for the probe targeting the MTBC rpoB gene. As a single-copy gene, rpoB is predicted to be a highly specific target, but not necessarily sensitive. Targeted capture and sequencing of rpoB and other MTBC genes will allow us to confirm the accuracy of this test. Identifying such mycobacterial-infected hosts is important for determining zoonotic transmission pathways that could impact humans.

The humor gender gap: How gender and humor interact to influence social behavior

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Humor is an essential aspect of human behavior and sociality, involving higher cognitive functioning that seems unique among extant primates. Social aspects of behavior involve both the person being funny, as well as the person receiving and/or acknowledging the humor; such reactions further appear to relate to dominance relationships.

Previous studies have suggested gender differences in both humor behavior (telling jokes) and humor responses (laughing at jokes). Here we test whether or not men and women are perceived as equally humorous in a culture in which humor behavior (joke telling) is used to denote social dominance, whereas humor responses (smiling and laughter) are linked with submissive behavior. Since men have increased dominance, we hypothesized that they would be considered funnier, thus eliciting increased smiling and laughter responses. To test this, male and female participants (N=19) listened to an audio recording of the same funny anecdote read by either a male or female reader. Both innate responses (spontaneous smiling and laughter) and reported responses (questionnaire ratings of humor) were collected. Though no significant differences between the male and female recordings were found, males found the male recording more humorous than the female recording, both in innate and reported responses (71% more smiles; 11% higher survey responses).

By determining whether there is a fundamental difference in how funny men and women are viewed, one can better understand how humor has been used in the acquisition and maintenance

of social relationships, and thus humor's relevance to group cohesion, social dominance and mixed-gender interactions.

Morphological affinities of the shellmound populations: Testing models for the coastal occupation of SE Brazil

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The shellmounds of the SE Brazilian coast (locally known as Sambaquis) represent a long standing tradition of fisher-hunter-gatherer populations that occupied the region from Early-Mid Holocene to the last millennia BP, with over 900 sites described so far and hundreds of associated skeletal remains. Prof. Neves was among the first researchers to study the morphological diversity of these populations in a comparative framework, suggesting that two biologically different populations might have occupied the coast of the states of Paraná (PR) and Santa Catarina (SC). Here, we explore the morphological affinities among coastal and riverine shellmound series from the states of Rio de Janeiro (RJ), São Paulo (SP), Paraná, and Santa Catarina and test different geographic dispersion scenarios to better explain the origins of these groups. Mantel and Dow-Cheverud tests were applied to test the goodness of fit between each of the geographic dispersion models and the morphological distances. The morphological affinity among the series, assessed via complementary multivariate analyses (Principal Components Analysis and Cluster Analysis), indicates a strong division between series from the northern (RJ and SP) and southern coast (PR and SC), and a less marked difference among ceramic and pre-ceramic series in Santa Catarina. These results favor two different biological groups occupying different regions of the coast, with restricted gen flow between these areas. This biological differentiation supports the cultural differences seen among these regions in the archaeological record, and indicates that the human occupation of the SE Brazilian shore was a complex process involving multiple dispersion events.

Age-dependent multiple regression analysis of trabecular bone morphology in the subadult human proximal tibia

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Ontogenetic changes to trabecular bone structure associate with locomotor maturation and increasing body mass. The purpose of this study is to quantify developmental changes in several morphometric features of human

trabecular bone and to evaluate the relative contribution of each to structural variation in metaphyseal trabeculae of the proximal tibia. High-resolution x-ray CT scans were collected for 45 tibiae from the Norris Farms #36 skeletal collection, specimens ranging in age from neonate to adult. Resolution-corrected morphometric analysis of trabecular bone structure was performed for 11 cubic volumes of interest (VOIs) using the BoneJ plugin for ImageJ. Stepwise multiple regression analysis was performed to test the association between age and each of six structural parameters: bone volume fraction (BV/TV), mean trabecular thickness (Tb.Th), mean trabecular spacing (Tb.Sp), structure model index (SMI), connectivity density (Conn.D), and degree of anisotropy (DA). Separate regression models were generated for VOIs positioned within the tibial condyles and for those located between them. The strongest age associations for within-condyle VOIs are Tb.Sp, BV/TV, and DA (adjusted $R^2 = 0.804$, $p < 0.001$); and for between-condyle VOIs are Tb.Sp, Tb.Th, and DA (adjusted $R^2 = 0.748$, $p < 0.001$). These findings indicate that age-related changes in mechanical loading have heterogeneous effects on trabecular bone morphology within the proximal tibia. Specifically, BV/TV is a significant predictor of age in within-condyle, but not between-condyle VOIs. These differences likely reflect age-independent differential load distribution to trabeculae within the heavily loaded tibial condyles versus the relatively unloaded trabeculae located between the condyles.

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The recording and analysis of a behavioral vocal repertoire for the Red Ruffed Lemur, *Varecia rubra*

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The meanings and purposes of the unusual vocalizations of our nonhuman primate relatives have long fascinated anthropologists and primatologists; careful observation of these animals' behaviors and vocalizations may help anthropologists understand the evolution of our own human language and conservation biologists remotely and more accurately assess the health of a troop of endangered species. The goal of this five-week study of five, male, captive red ruffed lemurs (*Varecia rubra*) was to create a behavioral vocal repertoire for this species. Of the 977 recorded vocalizations, 898 of these were grouped into ten definitive categories: the bray, chatter, growl, growl-snort, grunt, mew, pulsed squawk, roar-shriek chorus, sniff, and squeal. A comparison of the contexts of these calls to the contexts of the calls of the closely related black-and-white ruffed lemur (*Varecia variegata*) revealed marked similarities and differences. Future studies of this nature should include both captive and wild lemurs and implement qualitative analysis techniques and playback experiments.

The peopling of South America: Analysis of dental morphology

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The number and patterns of dispersal events that settled the Americas have been debated for decades without resolution. Studies that have addressed this question based on dental morphology have focused primarily on North rather than South America. Here, we tested the hypothesis that dental morphological change from the Late Pleistocene to Late Holocene in South America is best explained by gene flow rather than by in situ microevolutionary forces. We analyzed a geographically and temporally diverse sample, applying a distance statistic (Mean Measure of Divergence or MMD) to Late Pleistocene (n= 61), Middle Holocene (n= 46), Late Holocene (n=25) populations from Brazil, Late Holocene South Americans (n= 75), Northeast (n= 116) and Southeast (n= 84) Asians.

Results of the Mean Measure of Divergence (MMD) indicate that Late Pleistocene Brazilian populations are most similar to Southeast Asians (MMD=.018), Middle Holocene Brazilian populations most similar to Late Pleistocene Brazilians (MMD=.016), Late Holocene Brazilian population most similar to Middle Holocene Brazilians (MMD=.082) and Southeast Asians (MMD=.081), and Late Holocene South Americans are most similar to Northeast Asians (MMD=.022). The MMD distance matrix was compared with two geographic distance matrices to test: 1) one dispersal event and local microevolutionary differentiation among later South American populations and 2) two dispersal events where both early and late South Americans represent distinct dispersal events from East Asia. The results of the dispersion scenarios were inconclusive, suggesting that simplistic models such as the ones tested here do not sufficiently explain the dental morphological variation present on the continent.

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Examining the effects of genetic ancestry on the accuracy of predicting hair color using the HIRISplex prediction tool

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HirisPlex (Walsh et al., 2013) is a statistical prediction tool of hair and eye color using 24 DNA variants influencing pigmentation. The tool was developed using European samples, with presumably predominantly European ancestry. Validation was performed using samples from the 51 worldwide HGDP-CEPH populations, who generally represent a single locale and single ancestry. Because HirisPlex is targeted as a tool useful in forensic applications, it is imperative that its accuracy be tested on samples that represent the range of casework demographics.

Here, the prediction tool is used on a sample encompassing individuals with genetically estimated ancestries comprised of single origin ancestries (> 0.90) and individuals comprised of multi-origin ancestries (no single ancestry > 0.85). Mean accuracy of hair color (brown, black and blond) is lower (~71.2%) than reported in Walsh et al. (~78.5%). Mean prediction accuracy was greater for single-ancestry individuals than for those multiple-ancestry individuals. When exploring the effects of ancestry proportion on accuracy, Asian ancestry was significant, increasing accuracy. Although European ancestry was expected to demonstrate the greatest odds for misclassification due to the broad range of hair pigmentation, no significant impact on accuracy was found. These preliminary results indicate that 1) HirisPlex does not perform with similar accuracy across broad ancestry groups and 2) individuals genetically estimated as having multiple ancestries potentially decreases the accuracy of the prediction tool. Therefore, genetically estimated ancestry likely influences the ability of HirisPlex to accurately predict hair color, and integrating it as a variable in the prediction tool may increase accuracy.

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The influence of morbidity and socioeconomic status on the relationship between stature and mortality in industrializing London

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This study explores the relationship between skeletally estimated adult stature and mortality, and the effect of controlling for non-specific indicators of stress (cribra orbitalia and porotic hyperostosis, skeletal inflammation, and linear enamel hypoplasia) on that relationship, in two early-industrial skeletal samples from London, England (high status Chelsea Old Church, and low status Saint Bride's Lower), using the Cox proportional hazards model.

In the combined sample, short stature is associated with significantly elevated risk of death. The association does not persist when the effects of morbidity are removed, except in the case of skeletal inflammation. When sex and socioeconomic status are considered, short stature is associated with increased risk of mortality only in high status males. Again, the association is diminished by controlling for non-

specific indicators of stress, with the exception of skeletal inflammation.

Results suggest that the relationship between stature and mortality may not be universal, and is likely dependent on sex, social status, and morbidity. An additive model that takes into account biological interaction between non-specific indicators of stress may help clarify the nature of the relationship between morbidity, stature, and mortality. Exploration of the juvenile component of mortality is warranted to determine if low status juveniles whose growth was severely disrupted were more likely to die before adulthood, and therefore not be included in this sample, than high status juveniles who were presumably better buffered from metabolic insult, as this could explain the lack of association between stature and mortality in the low status sample.

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Slaves at Stonebridge: Diet and health at the Stonebridge Site, Virginia

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The Stonebridge site in Midlothian Virginia is an unmarked African-American cemetery that dates from the mid to late 19th century. Although small with just six burials, its analysis represents an important addition to the growing body of information on the enslaved African experience in Virginia. This study uses stable isotope analysis of carbon and nitrogen from bone collagen to reconstruct diet, as well as evidence of antemortem pathologies to reconstruct the health of those interred at this cemetery. The health indicators employed here (enamel hypoplasias, dental caries, antemortem tooth loss, evidence of non-specific infection, and osteoarthritis) as well as the analysis of markers of occupational stress indicate that these individuals suffered from multiple episodes of stress and disease during their early developmental years and considerable musculoskeletal stress during their adult years. The results of both the health and dietary analysis are then compared to other African-American cemetery samples from Virginia. While broadly similar, the diet and health of the Stonebridge individuals in comparison to other samples helps demonstrate the regional variability in diet and health in enslaved African-American populations in Virginia, and provides both a larger sample and a more comprehensive understanding of the experience in this dark period of American history.

Non-uniform osteocytic lacunae distribution across the femoral cortex

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Osteocytes, the most prolific of the bone cells, have increasingly been the focus of clinically based studies into bone health over the past few decades. As a major regulator of metabolic activity, these cells are fundamentally linked to the bone's ability to withstand normal and pathological insults. Osteocytic lacuna density (Ot.Lc.N/B.Ar) is used as a proxy for osteocyte cell density as empty lacunae are mineralized following apoptosis of its inhabitant. Previous studies have employed sampling methods limited to a specific anatomical region of the femoral cortex to examine age related changes. However, remodeling events demonstrate nonuniform distribution across the femoral cortex as well as variation with age. For this study, twenty male cadaveric mid-diaphyseal cross-sections were chosen based on nonsystemic causes of death subdivided into four age categories (<50, 51-59, 60-69, 70-79). Under bright field light, 40x total cross sectional images were obtained and divided into anterior, medial, lateral and posterior regions of interest (ROI) of standardized size. Using cellSens Dimension, osteocytic lacunae were automatically counted (and manually verified) over the entire cross-section as well as per ROI and normalized by cortical bone area (B.Ar). Results demonstrate intra-individual variation across the cortex as well as inter-individual variation in total count per sample and ROI density distribution based on age. Future research includes comparisons between intra-individual sampling sites (including rib and distal radii sections) and regional OPD. This approach has implications for the study of skeletal health maintenance in past and present populations.

Endocranial regions associated with deception in nonhuman primates

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Possible examples of deception have been reported in several species of nonhuman primates. Though exactly what constitutes deception has been heavily debated, some authors believe that unequivocal examples are prevalent throughout the literature. True deception requires knowledge of another individual's mental world and is often thought to be diagnostic of higher brain function and social complexity. The goal of this project was to assess if there are any features of endocranial shape that are predictive of the level of deception reported anecdotally in non-human primate species. Non-rigid deformation techniques were used to quantify localized variation in endocranial morphology across 16 non-human primate specimens using CT scans from the Open Research Scan Archive and the Smithsonian Institution. Examples of deception were taken from Byrne (1990) and correlated with the degree of localized distortion required to morph each species' endocranial form into a common atlas (*Pan troglodytes*). Initial results suggest areas of particular association with reported deception in the following endocranial regions: Broca's cap, temporal pole, lateral occipital, orbital frontal and occipital pole. Possible corrections for multiple comparisons

will be discussed, as well as the possibility that these patterns are largely driven by *Pan troglodytes*, which has both relatively large cranial capacity and high levels of reported deception in this sample. Possible implications for assessing cognitive evolution in fossil hominins will be discussed.

Intrinsic shape variation in the human femur: Evidence from Late Pleistocene Eurasia

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Recent research has shown that the shape of the human femur provides taxonomic information, even at low taxonomic level (Hutchinson 2013; Holliday et al. 2010). Three-dimensional morphometric assessment can differentiate archaic human and modern human femora most reliably when the entire bone is present while shape differences in the femoral articular ends are less distinct between these groups. This analysis investigates the levels of intrinsic shape variation in the proximal and distal femur among Neandertal and modern humans in order to better understand the low-level variation in the femoral articular complexes that consistently distinguish the femora of Neandertals and modern humans.

Twenty proximal and twenty-six distal landmarks were registered on Neandertal and Late Pleistocene to recent modern human femora. Generalized Procrustes Analysis (GPA) was applied to standardize the shape data and create mean group 'shapes' using Procrustes residuals. Principal Components Analysis (PCA) and wireframe models were used to assess shape variation within and among the different human subsamples. Finally, Procrustes distances between specimens and samples were used to provide more rigorous statistical evaluation of the significance of shape differences within and among subsamples.

Variability in isolated portions of a skeleton is essential to understanding the morphological basis of systematic and functional differences between taxa. Further, compartmentalizing the sources of shape variation is important for identifying those portions of the postcranial skeleton that most reliably indicate taxonomic status.

An overview of intentional dental modification in Micronesia

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Intentional dental modification observed in bioarchaeological samples from Micronesia includes multi-linear incisions and horizontal abrading of the labial tooth surfaces in the Mariana Islands and tooth blackening in Palau.

The social implications of deliberate tooth alteration have been the focus of past studies in the region, with little attempt to explore the biological implications, due to the small number of affected individuals. Cultural practices that expose the dentin or the dental pulp chamber, such as incising and abrading, are expected to increase an individual's risk of oral-dental infection. When protective tooth enamel, the hardest tissue in the body, is removed, dental decay can advance more rapidly in the underlying soft dentin, exposing the pulp. When the pulp is invaded by pathogenic microorganisms and their toxins, it can become inflamed. If left untreated, this will progress to pulp necrosis and infection, and subsequently spread to the surrounding alveolar bone (e.g., periapical abscess formation). To understand the biological impacts of intentional modification, we examined over ten pre-European Contact (pre-1521) dental samples from the Mariana Islands to test for a correlation between intentionally modified teeth and two indicators of oral-dental health, carious lesions and periapical abscesses. Although differences in data collection methods and poor bone preservation prevented the use of both indicators across the board, our preliminary results indicate that horizontal abrading in at least one sample appears to be associated with carious lesions while dental incising is not. We contextualize these results by comparing them with bioarchaeological data from the Pacific-Asia region.

Changes in fat and muscle patterning among Maya groups in the context of the epidemiological, nutritional and behavioral transitions

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The Maya families living in the urban areas of Merida, Mexico have been undergoing a rapid epidemiological, nutritional and behavioural transition. The aim of this poster is to analyse changes in muscle and fat patterning among Maya groups in Merida taking into account: i) age-related changes, ii) intergenerational changes (i.e. differences between children, mothers and maternal grandmothers and, iii) changes in the ratio of lower to upper body fat distribution.

Previous research suggests that central adiposity is more closely related with immune function and less susceptible to environmental modification than extremity fat. Our sample is composed by 109 Maya children (7.00-9.00 years old) their biological mothers and their maternal grandmothers from urban areas of Merida, Mexico. Fat and muscle patterning (obtained by measuring triceps and subscapular skinfolds) is analysed using the method of Healy and Tanner (1981) that involves logarithmic transformation, regression analysis, and principal component calculations to determine the changes in body size and shape. Results show significant differences in fat and muscle patterning among the generations that may be associated with the epidemiological, nutritional and behavioural

transition. Results on regional fat distribution and central adiposity patterning also differ among generations and should be further clarified by adding additional sites of skinfold measurements.

The Holly Project: Continuing behavioral changes in a young adult female chimpanzee (*Pan troglodytes*) identified with sensory-integration difficulties

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In 2009, a young adult female chimpanzee (*Pan troglodytes*) was identified with sensory integration and processing difficulties at the Saint Louis Zoo. Holly was conspicuous in range and frequency of stereotypies, restricted social interactions, lack of rest times and poor occupational performance in routine activities. Holly's abnormal behavior tended to isolate her and affected group social dynamics, for example through avoidance behavior. A plan providing therapeutic intervention (TI) for Holly using human sensory integration theory was implemented during 2010 and 2011. Periodic monitoring of Holly's activities using interval sampling of focal individuals continued, allowing examination of changes in behavior and peer comparisons.

Throughout this project, stereotypies and social behavior were used as indicators of Holly's functioning. Following initial TI, Holly's stereotypic behavior dropped from 22% of activity to 6.5%, then rose again to 20%. Two years post-TI, the frequency was 12% of her observed activity. Holly's proximity to others increased following TI, with time spent alone falling from 20% pre-TI, to 7% at 2+ years post-TI. Social grooming increased from 20% pre-TI, to over 30%. Time being groomed remained low, but rose from 1.88% pre-TI, to 5.28%. One marked social change for Holly was time spent interacting with adult males, increasing from 5% pre-TI to 16% two years post-TI. Interpreting these changes in Holly's behavior can be problematic. Some appear related to TI, others to changes in social dynamics or Holly's maturation, though her behavioral profile remains distinct from peers. Differences continue to be observed between enclosure types.

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Can we predict mandibular kinematics from patterns of EMG activity in primates?

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The muscular system that controls mandible movement in mammals is highly redundant. For example, for a particular mandibular motion,

there are multiple ways that a set of muscles can be activated to produce a desired movement. However, little work has quantitatively evaluated how differences in patterns of muscle activation relate to differences in mandibular movement. Using a large dataset of 3D mandible kinematics and muscle activation patterns, we investigated the relationship between these factors in three species of non-human primates (macaques, capuchin monkeys, and baboons). We found that each species used different strategies to modulate lateral mandible displacement. Capuchin monkeys used differences in timing and magnitude of activity between working- and balancing-side muscles. Baboons used differences in magnitude but not in timing of muscle activity. Macaques presented strong differences between individuals in their modulation of lateral movement, with some individual using differences in timing of activity while other individuals used differences in magnitude of activity between working and balancing side. After controlling for these confounding effects we found weak but significant relationships between the timing of peak muscle activity and magnitude between working and balancing sides and the amount of lateral displacement during feeding. We suggest that mandible kinematics can be predicted from patterns of EMG activity. However, to further improve our understanding of motor control during feeding in primates, we still need to investigate how species-specific and individual differences in morphological and physiological constraints, such as differences in articular morphology or muscle architecture, affect the modulation of mandibular movement.

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Knocking, filing, and chipping: Following the paths of dental modification across sub-Saharan Africa

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The African continent is home to both the earliest and latest (i.e., present day) examples of intentional dental modification. Within the subcontinent, pre-modern anterior tooth removal and alteration was widespread. One form or the other, or both, were practiced throughout the Holocene, within all major geographic regions, among groups from the three sub-Saharan language super-families, and across the economic spectrum, i.e., from foraging to state-level. Such modification appears to have had numerous, independent places of origin depending on the intended function, the most common of which are: 1) personal adornment, 2) sign of affiliation, 3) rite of passage, 4) punishment, and 5) treatment of various health-related concerns.

The purpose of this presentation is twofold. First, an overview of the practice among sub-Saharan Africans is provided, with a focus on biological cause and effect. Methods for removal and alteration are described. The short- and long-term effects are then presented. Oral trauma was not uncommon, ranging from mild to life threatening. Yet continuation of the practice indicates that the intended results outweighed any risks, including both perceived and plausible

benefits to: individual reproductive fitness (e.g., Kikuyu, Batonga), internecine competition (Ashanti, San), and prevention (Aholi) or treatment of disease (Masai). The second goal is to document an observed proliferation of modification types emanating from western Africa. Intrusive "Bantu" migrants, who began (4,000-3,000 BP) a gradual, subcontinent-wide expansion from this region, brought their own specific methods. These styles, which can be tracked, came to influence and replace the practices of indigenous peoples.

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Falling short: Minerals as nutritional challenges in diademed sifakas (*Propithecus diadema*)

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Minerals, though needed in small quantities, are essential to metabolic processes; deficiencies can cause serious challenges to health, reproduction and survival. Despite this, few studies have measured mineral composition of wild primate foods and fewer have quantified mineral intake. We measured mineral content of 134 foods of diademed sifakas (*Propithecus diadema*; four groups) in disturbed and less-disturbed habitats at Tsinjoarivo, estimated mineral intakes using focal-animal feeding data and intake rates over one year, and measured serum concentrations in captured animals. Sifaka foods exceeded National Research Council recommendations for Mg, K, and Mn, but fell short for P, Na, Fe, Zn, Cu, and especially Ca (foods: 0.30%, recommended: 0.80%; lowest reported for any primate). Fruits had lower concentrations of many minerals, compared to leaves. The abundant season (high-fruit/seed) diet had lower concentrations of most minerals (% dry matter) but higher overall mineral intakes due to the overall increase in food ingested. Concentrations of some minerals (especially Ca and K) were highest in weedy/heliophilic, edge and climbing plants (which were more abundant in disturbed habitat). Disturbed habitat groups had highest calcium and potassium intakes when expressed as percentage of diet, but not in overall intakes since they ate less overall. Despite low Ca intake (below osteoporosis-causing levels in growing primates), serum levels were within reference ranges, suggesting that sifakas have adaptations for efficient absorption. Further research defining mineral intakes and requirements should distinguish percentages and absolute intakes; this will help in understanding effects on food selection, managing habitats and formulating captive diets.

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Genetic responses to life at high altitude: Arterial oxygen saturation in Peruvian Quechua

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High altitude native residents provide a unique opportunity to study human evolutionary adaptation. Their physiological adaptations in response to hypoxia (caused by the lower levels of oxygen in the blood and organs at high altitude) have been well documented, and recent research has begun to unravel the genetic bases for the observed physiological traits. Genome scans for natural selection have identified several selection nominated candidate genes or gene regions for high-altitude adaptation. We selected ten single nucleotide polymorphisms (SNPs) from Andean high-altitude adaptation candidate regions to be genotyped in a sample of n=141 Peruvian Quechua with associated resting and exercise phenotypic data. The subject participants comprised two different study groups including Q-SL subjects (Quechua sea-level) who were lifelong sea-level residents transiently exposed to hypobaric hypoxia and Q-HA subjects (Quechua at high-altitude) who were lifelong residents of high-altitude. Significant associations were identified for arterial oxygen saturation (SaO₂) and genotype at *PRKAA1* and the candidate region on chromosome 15 (repeated measures ANOVA, p<0.05 after FDR correction). We then replicated our findings in a cohort of n=301 Peruvian Quechua, again comprised of two study groups, Q-SL subjects and Q-HA subjects. These markers, along with the group effect (i.e. born high or born low), display relatively large effects on SaO₂ with each explaining ~6-8% of the variance in this phenotype. Furthermore, the genotypic effects on SaO₂ are broadly similar between the Q-SL and Q-HA groups. The results provide key insights into the physiological mechanisms underlying high SaO₂ in Quechua.

The ecological roles of large-bodied monkeys in Plio-Pleistocene Africa

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During the African Pliocene, cercopithecoids occupied many herbivore niches and, at some localities, were the most common mammals present. Large-bodied species (>15 kg estimated female body mass) of *Cercopithecoides*, *Rhinocolobus*, and *Theropithecus* were particularly widespread and successful. By the

late Pliocene and Early Pleistocene, this situation had changed, especially for the large-bodied terrestrial monkeys, which mostly had been replaced by suids and ungulates. Colobine monkeys and ungulates can exploit relatively low-quality vegetation because of their independently evolved capacities for foregut fermentation of cellulose, but colobines are at a competitive disadvantage relative to suids and ungulates because of slower life histories and generalized limb structure. The cercopithecine *Theropithecus oswaldi* competed successfully as a terrestrial grazer through the Middle Pleistocene thanks to the large size and complex occlusal relief of its molars, but it too became extinct before the Late Pleistocene. Compared to suids and ungulates, monkeys require higher quality foods because of their relatively large brains. Monkeys also are limited in their abilities to range widely for preferred foods because their grasping cheiridia provide versatility in locomotion and foraging on the ground and in the trees, but are inferior to hooves for covering long distances. By the Late Pleistocene, all the large-bodied monkeys of the Plio-Pleistocene were extinct, but subspecies of the relative newcomer, *Papio hamadryas*, had become widespread because of their highly opportunistic feeding preferences and practices.

Bide your time: Method of alpha male replacement, infant deaths, and time to conception in *Cebus capucinus*

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The manner in which a male primate attains alpha status is highly variable; extragroup males can aggressively usurp top dominance (takeovers) or "peacefully" assume an alpha male vacancy (waltz-ins), while resident males can aggressively overthrow coresident alphas (rank-reversals) or peacefully assume an alpha male vacancy (successions). Despite this variability, we know surprisingly little about the process of alpha male replacements (AMRs) and how the mode of rank acquisition influences the rate of infanticide and male reproduction. We examined 19 AMRs in five groups of *Cebus capucinus* in Sector Santa Rosa, Costa Rica. White-faced capuchins display female philopatry, frequent male dispersal, and high reproductive skew, despite relaxed and cooperative relationships among coresident males. AMRs involved resident males (rank-reversals, n=3, and successions, n=6) and extragroup males (takeovers, n=7, and waltz-ins; n=3). Infant mortality in association with AMRs was higher at 52% (n=26 of 49 infants died) than during periods of group stability (20.65% n=20 of 96 infants died). Infant deaths/disappearances were associated with all types of AMRs, though mortality of non-paternal infants was higher for resident male AMRs (69.5%) than those associated with extragroup AMRs (43.5%). Time to conception (TTC) for replacements associated with infant deaths was only slightly shorter (110

days, N=14) than those where no infants died/disappeared (132 days, N=5). However, TTC following resident AMRs was shorter (76 days, n=9) than extragroup AMRs (171.3; n=10). These findings indicate that biding one's time as a subordinate may be a good strategy for attaining alpha status and acquiring more rapid reproductive opportunities.

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Metabolism's influence on maternal energy transfer durations: Are primates unique?

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The Metabolic Theory of Ecology (MTE) contends that developmental durations are governed by resting metabolic rate. However, recent work shows that neither gestation duration nor lactation duration scales with body mass as predicted by the MTE in primates, while their sum, development duration, does. Here, we test whether primates are unique in their departure from the MTE's predictions by comparing the scaling of gestation duration, lactation duration, and development duration in Primates and Artiodactyla (who bear precocial young like primates), and Carnivora, and Rodentia (who both bear primarily altricial young).

Using phylogenetic least squares regression, we found that none of the gestation durations or lactation durations conformed to the MTE. Development duration allometries in artiodactyls, carnivores, and rodents were substantially shallower than that of primates and therefore were also inconsistent with the MTE. The latter difference is due primarily to lactation duration: primates gestate for similar times as artiodactyls of the same mass, but they wean later in life at all body sizes and later per unit body mass than all the other orders. Thus, primates are not unique in departing from the MTE's predictions but they do differ markedly from artiodactyls, carnivores, and rodents with respect to lactation duration.

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Reciprocity and trade in food sharing and other services among Tsimane forager-horticulturalists

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Reciprocity has long been a major explanation for the evolution of cooperation, as help provided to other individuals can either be

reciprocated in kind or traded for other services. Primates are known to exchange food, grooming and coalitional support, but human behavioral ecologists have traditionally focused on reciprocal food sharing only, with hardly any quantitative studies on other forms of help. Here we compiled information on food sharing, labor sharing, child care, sick care, and support in conflicts among 2624 dyads of Tsimane forager-horticulturalist families, resulting in the most extensive behavioral database on human cooperation. Our analyses show that each form of help is significantly reciprocated in kind, controlling for kinship, proximity, and need. Including other forms of help improved the fit of the models in each case, and some forms of help were better explained by trade than in-kind reciprocity, highlighting that trade is an important component of human cooperative relationships. Future work will focus on incorporating the relative value of different goods and services to gain a better understanding of the cognitive processes underlying reciprocal exchange. Finally, differences in the extent of reciprocity and trade between Tsimane communities are related to community-level differences in market integration or wealth inequality. We discuss these findings in light of cooperation among other human societies and primates more generally.

Evidence for trachoma in historic and prehistoric human skeletal remains?

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Medical observations and texts are available from Egypt, China, India and Europe dating as far back as the 3rd millennium BCE describing conditions that affect the eyes. The authors refer to clinical signs and symptoms of chronic conjunctivitis and trichiasis (inward growing eyelashes) that have been interpreted as evidence for trachoma. Trachoma is an infectious disease caused by *Chlamydia trachomatis* and even today, if left untreated, is still one of the leading causes of blindness in underprivileged populations worldwide affecting over 21 million people. Despite its long history and magnitude, only few paleopathological examples have been reported.

This presentation aims to raise awareness of the possibility to identify trachoma in human skeletal remains by discussing a case from al Khiday 2, a site in central Sudan dated to the Meroitic period (1st century BCE-1st century CE). Of the 39 Meroitic individuals excavated so far, 30 (21 adults and 9 non-adults) had at least one observable orbit. One individual, an older adult female, showed a remodelled lytic lesion on the orbital plate consistent with a possible diagnosis of trachoma. A detailed differential diagnosis is provided to better understand this orbital lesion taking intrinsic and extrinsic factors, such as biological parameters as well as climate and environmental conditions, into consideration. A review of published and unpublished evidence for skeletal changes of the orbital roof that could be attributed to trachoma will add to our knowledge of an underreported disease.

Diurnal blood pressure variability is uniformly narrower in healthy women classified as non-dippers

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Women whose blood pressure (BP) declines less than 10% from waking to sleep (non-dippers) are at greater risk for cardiovascular disease (CVD) morbidity than women whose pressures decline more than 10% (dippers). Dipping is defined as the proportional difference in average BP between waking and sleep. Interestingly, whether non-dippers maintain lower BP while awake and higher BP throughout sleep or whether there are particular troughs or peaks during specific times of day that inordinately influence the aggregate averages is unknown. The purpose of this study, therefore, was to compare patterns of diurnal BP variation between dippers and non-dippers. The pattern of heart rate (HR) variation was also assessed. The subjects of the study were 134 healthy women (77 dippers, age=43.1±9.6, 57 non-dippers; age=35.0±9.6), who all worked in clerical or technical positions at a medical center in NYC and who wore an ambulatory BP monitor over the course of a typical mid-week workday. BP was measured every 15 minutes while awake and every 30 minutes while sleeping. Comparisons between dippers and non-dippers were evaluated using ANOVA. The results show that for both systolic and diastolic BP, dippers maintained uniformly higher pressures for the majority of the night 12AM to 6 AM ($p<.005$) and generally lower pressures uniformly over the day (9AM to 9PM; $p<.05$). There were no definitive peaks or troughs that dominated either waking or sleep periods. There were also no differences in HR. These findings suggest that non-dippers have a uniformly narrower range of BP variation than dippers.

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The generation of continuous phenotypic variation in skeletal morphology

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The three-dimensional shapes of bones are complex traits that are of particular interest to biological anthropologists. The study of the genetics of complex traits has been revolutionized in recent years by the advent of genomic technologies and analytical approaches. While vast amounts of data have been generated in the past decade, understanding of the genetic and developmental bases for variation in skeletal morphology remains elusive. Here, we pull together morphometric, genetic and developmental analyses of cranial, limb and human stature datasets compiled and conducted by our group. Based on these analyses, we argue that genomic approaches have tended to fail because of the developmental and genetic complexity of skeletal morphology as complex

traits. In particular, epistatic interactions caused by the interplay of key developmental processes produces a many to many relationship between genetic and phenotypic variation that is difficult to resolve. We argue that genomic approaches hold promise only when combined with mechanistic studies of variation for unraveling the developmental-genetic basis for variation in skeletal morphology. Doing so has important implications both for understanding the interaction of development and evolution but also for the genetics of structural birth defects that involve skeletal morphology.

Hind limb and dental ontogeny in *Propithecus coquereli* and *Lemur catta*

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Multiple factors may influence the rate of maturation of the dentition and skeleton. In this study, we compare hind limb bone ossification and dental development at infancy in two lemuroids, *Propithecus coquereli* and *Lemur catta*. A cross-sectional sample of cadavers at similar ages (late fetal, newborn and one month) were microCT scanned. Hind limb and dentition were segmented and then reconstructed using Avizo software. Despite sharing similar gestation lengths, these two large-bodied lemuroids differ greatly in skeletal and dental maturity at birth. *L. catta* is more accelerated in hind limb ossification. For example, at one month four tarsals are ossified in *L. catta* compared to only two in *P. coquereli*. In contrast, *P. coquereli* is far more advanced in dental development than *L. catta*. In newborn *L. catta* gingival eruption of maxillary teeth has not commenced, whereas in *P. coquereli* nearly all deciduous teeth are erupted and by one month some have fully formed roots. The disparity in rate of dental development is well explained by the dependence on folivory in *P. coquereli*. The differences in rate of limb ossification may relate to duration of dependence (e.g., riding). However, it is also possible that these differences correspond to the disparate types of locomotion employed by adults of these species. To that end, our ongoing analyses are investigating ontogenetic differences in long bone material properties between the two taxa.

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Trade-offs between reproduction and health: High reproductive effort is related to faster immuno-aging in women

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Pregnancy, lactation and childcare are not only energetically expensive for women but cause

significant changes in maternal physiology. Pregnancy is called a "controlled state of inflammation" with elevated levels of pro-inflammatory cytokines. It is not clear, however, if reproductive processes have long-term effects on maternal immune function. We propose a hypothesis that chronic low-grade systemic inflammation (a.k.a. "inflamm-aging", considered a normal aspect of aging) is more advanced in women with high reproductive effort.

172 post-reproductive women (with 0 to 11 children) from Mogielica Human Ecology Study Site in rural Poland had lifetime reproductive effort assessed by questionnaires. In these women, levels of inflammation markers (C-reactive protein [CRP], interleukin 6 [IL-6] and tumor necrosis factor- α [TNF- α]) were all elevated in connection with higher reproductive effort. Number of pregnancies was a significant predictor of levels of TNF- α . Number of children, and especially number of sons, was positively related to maternal IL-6 levels. Number of sons was also positively correlated with CRP levels.

Our results indicate that costs of reproduction in women with high parity may last well beyond reproductive years; such women experience higher levels of mild inflammation, which might be related to higher rate of aging. The fact that number of sons (more energetically expensive for mothers) significantly predicts higher levels of inflammation supports the hypothesis of energetic trade-offs between reproduction and health at older age. Variation among women in health status, aging and ultimately in lifespan, can be partially explained by differences in their lifetime reproductive effort.

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Biological resources for genomic investigation in vervet monkey (*Chlorocebus*)

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The vervet monkey (*Chlorocebus*) is widely used as a model species in biomedical research. The utility of this species for investigations relevant to human health is twofold. First, extensive conservation between vervets and humans at the genomic, behavioral, and physiological levels makes the vervet excellent for studying the phenotypes involved in human diseases. Second, several adaptive traits relevant to disease resistance (e.g., SIV/AIDS) have emerged in vervets, providing the opportunity to better understand the biological mechanisms of protection against these diseases. To maximize this species' utility for investigations relevant to human health, we created extensive biomaterial and data resources from more than 1,200 captive and 1,500 wild vervets handled by the UCLA Systems Biology Sample Repository (SBSR). To facilitate correlational studies between phenotypes and genomic mechanisms, we created the vervet genomic assembly (available through NCBI), assessed various phenotypes, and employed state of the art approaches to comprehensively characterize the vervet genome [using whole genome sequencing (WGS)] in 728 captive vervets and 130 wild vervets from major African subspecies and Caribbean populations. We also assessed the transcriptomes [using microarrays and RNA-sequencing (RNA-seq)] in over 400 vervets. Using these resources, we identified the genetic loci and transcriptomic networks associated with brain neuroanatomy, behavior, and handling of SIV/AIDS. In conclusion, the UCLA SBSR resources from vervets that have been extensively sampled, and genetically and phenotypically characterized, facilitate genomic investigations in this model species. Investigators interested in specific phenotypes can assess them in SBSR samples and relate them to existing phenotypic and genomic data.

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Older age mortality in medieval Denmark

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Analysis of mortality is arguably one of the most important topics in paleodemography, but there are a variety of problems in obtaining reliable results. One of the primary issues concerns the characterization of mortality at older age. The main purpose of this study is to estimate and compare long term patterns of mortality of older adults in Medieval Denmark (1050-1550 AD) by applying different statistical and demographical methods. The primary source of information is skeletal remains from the five largest Medieval Danish archaeological cemeteries that are stored at the Laboratory of Biological Anthropology, University of Copenhagen (Denmark). Based on the method described by Lovejoy et al. (1985) well

preserved auricular surfaces of 755 individuals were studied as the main source of information regarding biological age. Computation of chronological age at death structure was made by three methods within the framework of stationary and stable population models. The first one is by applying the age intervals provided by Lovejoy et al. (1985). However, due to the problems of "age mimicry", two different paleodemographical versions of Bayesian inversion were applied to remove the bias. As expected, only a very small proportion of adults survived more than 70 years of age according to results based on the traditional method. Conversely, by using the two latter methods statistically significant results were calculated, which likely enable the reduction of traditional overestimation of mortality rates at older ages and hence gain a more realistic picture of the demographic situation in Medieval Denmark.

The taphonomic and paleoenvironmental contexts of early Miocene catarrhines on Rusinga Island, Kenya

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The early Miocene deposits on Rusinga Island, Kenya are home to a diverse assemblage of stem catarrhines and hominoids, including *Proconsul*, *Dendropithecus*, *Nyanzapithecus*, and *Limnopithecus*, and are routinely used as a baseline comparison for early Miocene fossil assemblages. Despite nearly 100 years of fossil collection and the exceptional preservation of numerous vertebrates, invertebrates and plant taxa, there has been little consensus on the paleoenvironmental context of this primate community. This is due in part to a lack of large-scale systematic taphonomic studies directly associating ecological proxies with fossils and a general assumption that the Rusinga deposits represent a homogenous Miocene "Pompeii" for community analysis.

New collection protocols, excavations, and taphonomic analyses (bone surface modifications, *in situ* bone orientations, skeletal parts) were used to assess site formation processes on Rusinga. Results show varied and complex depositional histories within and among collecting sites: (1) predator accumulations of primates and other taxa within the Hiwegi formation (R1, R3, R5, R106), (2) fluvial transport at Kawanga (R5), (3) time-averaged terrestrial accumulations at R1, (4) catastrophic death assemblage in the Kulu formation (R4), and (5) stratigraphic averaging at all sites. Thus, taphonomic processes must be taken into account before reconstructing paleo-communities as surface-collected fossil assemblages are unlikely to evenly reflect living assemblages at any given locality. Likewise, identifying site formation processes across Rusinga allows for a more comprehensive discussion of paleoecology and interactions among fossil taxa. This research lays a strong foundation for comparisons between the early Miocene catarrhine sites.

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Phylogenetic resolution with mtDNA D-loop vs. HVS 1: Methodological approaches in anthropological genetics utilizing four Siberian populations

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The majority of research on mtDNA in anthropology has utilized the hypervariable segment 1 (HVS 1) to reconstruct population history and structure, build phylogenies, and answer questions about population origins. Sequence data from the D-loop of four Siberian populations (Altai, Evenki, Yakut, and Udehe) was analyzed using multivariate statistics to investigate the utility of sequencing the entire D-loop versus solely the HVS 1. The purpose of this project was to investigate whether the additional SNPs sequenced: 1.) revealed different phylogenetic relationships between populations; 2.) uncovered additional genetic variation; and 3.) underscored stronger relationships between genetics, linguistics, and geography than using the HVS1 alone. Results indicated that the addition of the remaining D-loop segments only sometimes aids in further characterizing populations. No significantly different results were observed by adding the HVS 2 and 3 for gene and nucleotide diversity, AMOVA, Neighbor-joining trees based on FSTs, neutrality tests or mismatch analysis. Full D-loop data allowed for better resolution of MDS, NJTs based on haplotypes, and haplogroup characterization. The Altai, Evenki, and Yakut were predominately characterized by mtDNA lineages C and D, whereas the Udehe were categorized by haplogroup C, and the Eastern Asian lineages of M, N, and Y. Findings suggest that the debate over whether resources should be used to analyze the entire D-Loop or the seemingly standard HVS1 is not as simple a question as whether one is better, but that it depends on the research questions, the types of analyses conducted, and the size of the samples used.

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Morphology of the humeral capitulum in primates: Three-dimensional morphology of the humeral capitulum and implications for reconstructing locomotor behavior in fossil catarrhines

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The changes in habitual posture associated with variation in locomotor behavior have well-documented effects on the skeleton. This paper focuses on the humeroradial joint and specifically the capitulum, part of a joint complex that is often functionally significant in bipedal, quadrupedal, and knuckle-walking

locomotion. The humeral capitulum has been hypothesized and qualitatively described as having specific morphologies that reflect these changes. Using a sample of 43 great apes, 59 cercopithecoids, and 31 humans, 3-D images were used to take measurements of the area, length, and angle of the capitulum to test if differences in joint area occurred with different locomotion patterns, then the results were compared with six fossil specimens. The capitulum was significantly more anterior for humans versus other groups, which may be related to non-locomotor, eccentric activity. Area and length measurements were significant for great apes versus other groups, though ratios of difference proximal and distal sections of each measurement found a significantly larger upper areas for humans and lower lengths for apes. Fossil measurements conformed to an intermediate pattern between human and ape values.

Individuality, territoriality and troop division in *Lemur catta* females: 20-year consequences of a bad choice

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In the A-Team, a troop of *Lemur catta* in the tourist/botanical garden area of Berenty Reserve, Madagascar, dominant matrilines harassed a subordinate subgroup throughout the birth seasons of 1989-91. The troop divided in 1992 with inter-group aggression led by a rising beta female. The dominant group (A1), then lost the main part of their territory to the subordinates (A2), in part due to the energy of a young adult A2 female backed by older females, and also the inertia of the A1 alpha who soon lost her position to the beta and then died. In 1996-7 the difference in intra-troop aggression between A1 and A2 was highly significant. A2 was internally peaceful. A1's disputes and targeted aggression were driven by a highly aggressive daughter of the 1992 beta. Her A1 matriline remained in its small range until the 2012 disappearance of two females and the death in childbirth of another, leaving only one old (19 yrs) female and one young female. As a troop with small territory under constant pressure from A2, their successful rivals, the probable extinction of the dominant A1 female matriline can be traced back to their grandmother's bad "choice" to evict A2 in 1992. Troop history is thus an interplay of stochastic births and deaths, territorial ownership, and importantly, individual personality.

Evaluating a reputation for violence: Paleopathological evidence for interpersonal violence in ancient Peru

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Andahuaylas, Peru is known as the homeland of the Chanka, whose prowess in battle is celebrated in early colonial ethnohistoric accounts, local oral history and living culture. Recently excavated skeletal remains from a massive Chanka hillfort (AD 1000–1100), offer new insight on the accuracy of portrayals of the Chanka as inherently bellicose. At 4,000 meters above sea level, this prehistoric settlement is situated in mountainous terrain, remote from any water source. Evaluating the prevalence of disease, trauma patterns, and health experiences of individuals informs on the tumultuous milieu in which the Chanka lived and died. The 1170 commingled bones analyzed in this study represent at least 20 individuals from a part of a larger, unexcavated grave; ages-at-death range from infants to older adults and seem to be predominantly male. At least 6 out of 20 (30%) individuals bear evidence of cranial blunt force trauma, direct evidence of conflict. Results of paleopathological analyses suggest 20% of the population suffered from debilitating diseases—likely the result of crowded living conditions and complications from violent injury—but survived. Their survival speaks to sophisticated medico-social structures that mediated the care of “war wounds” and illness in an ancient society largely defined by endemic conflict and deprivation.

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How travel time influences sexual dimorphism

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The function of sexual dimorphism in humans remains elusive and is likely the result of interacting pressures. While a smaller female size has ramifications for energy requirements during reproduction, the thermoregulatory benefits of being small when faced with heat loads are extensive. A growing body of evidence shows that fitness is heavily influenced by heat load, independently of energy availability. One way women may decrease their heat load is by performing their daily mobility in a series of bouts, broken up with resting periods for cooling—as evidenced by multiple hunter-gatherer groups. Here we tested how bout-travel influences thermoregulation by having men and women (N=8) row a canoe in a series of bouts while their core temperatures and rowing speed were monitored continuously. The bouts were two short (6-minute) and one long (12-minute), interspersed with equivalent length rests. Men were bigger than women ($p < 0.001$) and women had higher Surface-Area:Volume ratios ($p = 0.013$). Men rowed faster than women ($p = 0.001$) and their temperatures regularly rose above the heat shock protein threshold of 37.7°C; female temperatures never rose above 37.7°C. There were no significant differences between speeds during any of the bouts for either sex; however, female core temperatures were dramatically higher during their second short

bout than either the first short bout or the long bout, whereas male core temperatures remained within the same range during all three rowing bouts. This suggests that if women use bouts to reduce their heat load, the rest between the bouts must be extensive.

Isotopic investigation of subsistence and residential mobility in the Lambayeque region of Northern Peru during the Spanish contact period

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Relatively little is known about patterns of subsistence and regional movement among indigenous populations in northern coastal Peru during the Spanish Contact Period; this limits a fuller understanding of the effects of conquest and colonization in the Andes as a whole, given that (1) the majority of the Spanish Chronicles focus on highland regions of Peru and (2) there is abundant archaeological evidence for longstanding differences in economies and political systems among highland and coastal regions of the Central Andes. This study presents preliminary results of carbon and oxygen stable isotopic analyses of bone and tooth enamel carbonate from individuals interred in two cemeteries in the Lambayeque region of northern Peru (N=60, out of 488 total). Stratigraphic and archaeological evidence dates one cemetery (CSMME) to the Early/Middle Colonial Period (A.D. 1535-1620) and the second (CSMME-CNS) to the Middle/Late Colonial Period (A.D. 1620-1750). This study compares overall diet (using $\delta^{13}\text{C}$) and residence (using $\delta^{18}\text{O}$) between the two time periods. Moreover, isotopic data are characterized in both tooth enamel and bone for each individual; these tissues respectively reflect early life and late life diet and residence, permitting intra-individual comparisons and elucidating changes in diet and/or residence during an individual's lifetime. Preliminary results suggest an increase in C₄ resources between the Early/Middle and Late Colonial Periods, and varying degrees of change in diet over the lifetime; $\delta^{18}\text{O}$ data also suggest changes in immigration patterns, though ecological factors complicate this interpretation. These results underscore the importance of regional and temporal studies of colonial Peru.

Assessing British cranial trends during the Norman and Medieval Periods: A geometric-morphometric approach

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The degree of population variation in Norman and Medieval London (1066-1500) is one usually discussed with reference to linguistic and archaeological data. The influx of French influence during the Norman period changed the culture of London, but the amount of biological influence remains unknown. Using a geometric morphometric approach, this study examines the amount of biological variation in four Norman and Medieval period cemeteries (Merton Priory,

Bermondsey Abbey, Spital Square, and Guildhall Yard) in London, England.

Nine type I and II standard craniofacial landmarks were used to assess patterns of craniofacial morphology from a sample of 46 individuals. The three-dimensional data were analyzed using Klingenberg's MorphoJ geometric-morphometric software program. The data were scaled to a common coordinate system and new shape variables were calculated using a generalized Procrustes superimposition, allowing data to be analyzed using standard multivariate statistical procedures.

Vector plots illustrate that the most significant cranial changes occur at landmarks lambda, porion (paired), and bregma. Mahalanobis distances indicate that all groups differ significantly from each other ($p < .05$), with the exception of Merton Priory and Spital Square. Results from the Procrustes ANOVA show significant shape differences ($p < .0001$) between the four cemeteries. The sample from Bermondsey Abbey, which is partially comprised of individuals from a religious order originating in France, is the most disparate. The canonical variate plots for CAN1 and CAN2 illustrate the separation of this French religious order. The morphological variation observed with Bermondsey Abbey could represent a source of the heterogeneity of modern British populations.

Women, worms and work: Implications of conservation management and declining biodiversity on subsistence practices and health of Aka populations in the Congo Basin

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Conservation zoning coupled with declining biodiversity in the Congo Basin may increase food insecurity for forager populations. We examine how changing access to forest resources affects subsistence and health among BaAka foragers in the Dzanga Sangha Protected Areas (APDS), Central African Republic. Transitioning economies and reduced access to animal proteins have intensified gendered subsistence strategies among the BaAka at APDS. Rather than foraging in the forest with their husbands, women now typically work in the agricultural fields of their non-Aka neighbors. Hemoglobin, anthropometric data ($n = 88$ men, 90 women), and fecal samples ($n = 55$ men, 46 women) were collected among adult BaAka in two villages (MS and YD), that had varying access to community hunting zones. While BMI was similar across genders, women had lower hemoglobin values (mean = 11.29 g/dL) than men (mean = 12.76 g/dL), and 90% of participants tested positive for intestinal

helminthes. Further, women in MS were more likely to be infected with *Ascaris lumbricoides* than men ($r = -0.45$, $p > 0.01$). Although low hemoglobin may confer some resistance against malaria, helminth infections and low hemoglobin levels are widely thought to reduce work capacity. APDS was zoned as a multi-use area, yet changes have negatively impacted the BaAka's efforts to maintain a hunting-gathering lifestyle. The impacts of declining biodiversity and conservation zoning are not evenly distributed and women in villages without adequate access to healthy wildlife populations appear to bear the highest costs, with implications for reproductive health and the nutritional base of children and families.

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Creating the Mexican isoscape : Water isotopes, and human hair help identify region of origin for deceased undocumented Mexicans

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The use of oxygen and hydrogen isotopes in human drinking water, hair, bone, fingernails and teeth has demonstrated the ability to track movement and identify the region of origin for modern populations^{2,3}. Results from such studies can be complicated by bottle water consumption. Mexicans have the highest bottle water consumption in the world⁴. The purpose of this study is to explore the utility and effectiveness of water isotopes in determining region of origin for Mexican populations.

Forty-three samples of bottled water, forty-nine samples of tap water and thirteen samples of bulk hair were collected across central Mexico. Bottle water values spanned a range from -11.45 ‰ to +4.36 ‰ and -79.79 ‰ to +26.34 for $\delta^{18}\text{O}$ and $\delta^2\text{H}$, respectively. Tap water values spanned a range from -11.86 ‰ to -3.90 ‰ and -83.3 ‰ to -20.14 ‰ for $\delta^{18}\text{O}$ and $\delta^2\text{H}$, respectively. The $\delta^{18}\text{O}$ and $\delta^2\text{H}$ data were strongly correlated for both tap $r = .987$ and bottled water samples $r = .990$. The local meteoric water line for tap waters was $\delta^2\text{H} = 8.688X \delta^{18}\text{O} + 14.945$ $r^2 = 0.975$, which is almost indistinguishable from the global meteoric water line with slope of 8. The local meteoric water line for bottle waters was $\delta^2\text{H} = 6.797X \delta^{18}\text{O} - 2.856$ $r^2 = 0.97$. This difference in slope for bottled samples may indicate an arid origination. Region of origin for hair data were analyzed using the predictive model developed by Ehleringer et al. 2008. An independent t test confirmed that tap waters were not significantly different from the mean values for source location generated from hair $p = 0.001$.

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Regional pattern of dental chipping in two ancient populations (A.D. 3rd - 7th century) of Korea

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The purpose of this study is to investigate the regional pattern of dental chipping in two ancient Korean populations (i.e., people from Imdang site located inland, and people from Yean-ri site near the southern coast) and to evaluate dental chipping as an indicator reflecting a life style related to diet and tooth-tool use behavior in the past. Furthermore, based on the archaeological data that Imdang population belonged to higher social class than Yean-ri population, we tested the hypothesis that the latter would reveal higher frequency of dental chipping than the former. To test the hypothesis, we examined 82 individuals (44 males and 38 females) from Imdang and 48 individuals (17 males and 31 females) from Yean-ri. The frequency of dental chipping by tooth type in two populations was compared using the Chi-square test.

The results showed that the frequency of dental chipping was significantly higher in Yean-ri population (79%) than in Imdang population (55%). For both populations, males had more chipping than females, and, with an exception of the Imdang males maxillary teeth, posterior teeth tended to reveal more chipping than anterior teeth in both maxillae and mandibles. In addition, more chipping could be observed in the maxillary teeth than in the mandibular teeth. These results indicate that the frequency of dental chipping may not only be related to their masticatory or non-masticatory activities of past populations, but also, when combined with archaeological and cultural evidence, gives an insight into the sex role and social hierarchy of past societies.

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Patterns of cultural nestedness in humans, chimpanzees, and orangutans

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The cultural evolution of humans is well-known from archeological and fossil records, but similar information is not available for other primates. Instead of relying on data from extinct populations, we can use geographic patterns of cultural variation in modern populations as a proxy for cultural change through time. We used this latter approach to quantify the degree of nestedness across human and great ape 'cultural repertoires' to better understand the accumulation of putative cultural variation in these taxa. Significant patterns of cultural nestedness occur when sites with small cultural repertoires are a proper subset of increasingly larger repertoires. This pattern can arise if some cultural traits are gained or lost in a sequential fashion, which may be the result of differential dispersal or extinction of traits. We utilized quantitative methods borrowed from ecology to examine the degree of nestedness in three human data sets that quantified the presence and absence of cultural traits from indigenous populations in

North America and New Guinea. We then performed similar analyses on the putative cultural traits found in both chimpanzee and orangutan populations. We found that within-species cultural variation is highly non-random, showing significant nested structure for all human and chimpanzee datasets examined. In contrast, we found no evidence for nestedness in orangutans. These patterns are consistent with a sequential 'layering' of cultural variation in humans and chimpanzees, but not orangutans. Our results suggest that the biological traits needed for sequential cultural evolution first appeared in the last common ancestor of chimpanzees and humans.

Slow cardiovascular aging and rare infarcts among Tsimane forager-horticulturalists

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In this paper, we document cardiovascular aging among Tsimane forager-horticulturalists. Using data from electrocardiograms and echocardiograms conducted in a representative sample of 925 people over the age of 40, we find that compared to western populations: a) heart rate is lower and increases more slowly, especially among men; b) systolic function, as measured by ejection fraction, decreases more slowly and remains intact through the eighth decade of life; c) diastolic function, as measured by tissue Doppler, is higher and decreases more slowly; and d) infarcts are much less frequent. Tsimane, especially men, showed signs of an athletic heart; 30% of men over the age of 75 still had heart rates below 60 beats per minute. Systolic function only decreased by one percentage point per decade. The average diastolic function of a Tsimane 70 year old is equivalent to a 50 year old Londoner. We found evidence of infarcts in only 2 women and no men. These results have implications for epidemiological transition theory. It is not only that in pre-transition populations, mortality from chronic diseases, especially cardiovascular disease, is less common because people die at early ages from infectious diseases, but also that among those who do live to old age, cardiovascular disease is less common and cardiovascular aging is slowed.

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Commingle human remains: A new approach of pair matching using mesh to mesh comparison of 3D surface models

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Commingle remains present a significant challenge to the forensic anthropologist's task of creating a biological profile to aid in the identification of human remains. Segregation techniques are mainly based on visual pair-matching which often proves to be both subjective and unreliable. The purpose of this study is to develop a method of pair matching based on the quantification of morphological similarities of long bones using virtual 3D models.

A total of 61 3D surface models of humeri were created using CT and light scans. The sample included 23 known pairs and 15 commingled humeri which were associated using visual methods. Measurements were taken on the 3D models using AMIRA 5.3.3 and data was analyzed with principal component analysis and Euclidean dissimilarity matrices. 3D images of the right humeri were created with NetFabb basic software and compared to each one of the left humeri using 3d3 Flexscan software (mesh-to-mesh matrix comparison). The three methods were compared using specificity and sensitivity measures. Statistical analysis was carried out in SPSS and Excel.

Of the three different assessment methods principal component analysis performed worst with a sensitivity of 60% and a specificity of 55%. The most effective method by far was the novel mesh-to-mesh matrix, which accurately pair-matched humeri with a sensitivity of 97.73% and a specificity of 100%.

Despite the small sample size mesh-to-mesh matrix comparison of the 3D surface models gave encouraging results. Further testing is needed to explore the efficiency of the new method in the individualization process of commingled remains.

Evidence of behavioral plasticity in genus *Saimiri* via interactions with humans in Suriname and Costa Rica

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As human population expands and the climate changes, primate species will survive based on how well they are able to acclimate and adapt to new environmental challenges. Further, human economic needs necessitate unique conservation strategies that move beyond traditional protected areas. Understanding the limits of behavioral plasticity in different primate species can contribute to their conservation.

Views on the level of behavioral plasticity in squirrel monkeys (genus *Saimiri*) differ. Some research has found they are slow to habituate to human presences and timid when placed in new environments. Other research, however, demonstrates flexibility in their diet and adjustment to disturbed areas.

I studied squirrel monkey behavior in Costa Rica (*Saimiri oerstedii*) and Suriname (*Saimiri sciureus*). In Suriname, I investigated the response of squirrel monkeys to tourist presence. In Costa Rica, I looked at the daily behaviors of squirrel monkeys in a rural area characterized by

pastures, regenerating coffee plantation, and a busy road. In both these locations the monkeys exhibit an ability to adjust to human presence and survive well in human-impacted environments. These results can help conservationists focus squirrel monkey protection on diverse areas that may include more innovative strategies such as conservation areas that allow for human use via agriculture or nature based tourism.

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Urban and rural dietary patterns in early Medieval Central Europe (9th-10th century AD, Czech Republic)

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The 9th century in the central European context shows a period of rapid cultural and social changes connected to the growth of Christianity and creation of the state formation. The goal of this research is to provide preliminary evidence of diet for different groups of a medieval population facing this substantial transformation of society.

Stable carbon and nitrogen isotopes of bone collagen from 72 individuals from two Czech archaeological sites, representative of both an urban and rural context, are interpreted. Isotope values from 42 animal bones including 6 freshwater fish from the same archaeological sites are also examined. Results of isotope analyses suggest the diet of this medieval population was omnivorous and terrestrial-based. Freshwater fish were not a significant source of protein in the great majority of the population. The $\delta^{13}\text{C}$ from most human bones is enriched beyond what might be expected from an exclusively C₃ diet. Associated mammal bones do not exhibit similarly elevated $\delta^{13}\text{C}$ values, suggesting enrichment among humans is not due to consumption of animals foddered on C₄ plants but due to the direct consumption of a C₄ plant, such as millet. Even if isotope data highlight a higher consumption of animal proteins in urban population, the suggested higher social stratification of urban population is not reflected in a higher heterogeneity of diet of this group compared to the rural one.

The results of this study contribute to a better understanding of dietary adaptations and the development of socio-economic structure in Medieval Europe.

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Spatial association of the dermatocranium with the chondrocranium in early skull formation

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In vertebrates, including primates, early skeletogenesis of the head is integral to its subsequent morphogenesis and phylogenetic differences. The skull comprises the chondrocranium, splanchnocranium, and dermatocranium. Principally, the chondrocranium (cartilage and endochondral bone) underlies and supports the brain, whereas the splanchnocranium supports the pharynx. The dermatocranium is composed of dermal (intramembranous) bones; some of these associate with the chondrocranium and form the braincase, and others encase the splanchnocranium. In the mouse skull vault, the four rostral dermatocranial elements consist of the nasal, frontal, parietal, and interparietal bones. For these bones, we determined the location of their initial formation in the mouse. The chondrocranium begins to form by embryonic day 12.5 (E12.5). By E13.5, osteoblasts differentiate at two locations adjacent to the growing chondrocranium, the dorsal edge of the frontal cartilage and the parietal cartilage, and secrete the matrix of the frontal bone and the parietal bone, respectively. The matrix then initiates mineralization as early as E14.5. Mineralization of the interparietal and nasal bones begins later at the anterior edge of the supraoccipital cartilage by E15.5 and immediately above the paranasal cartilage by E16.5, respectively. Notably, osteoblasts forming these bones initially differentiate only 3-5 cells exterior to the edge or the surface of the chondrocranium. Although the relative positions of specific dermatocranial and chondrocranial elements have previously been explained by the head segmentation theory originally proposed by Goethe and Oken, our observations suggest a mechanistic interpretation wherein the chondrocranium has a regulatory role in initiating dermatocranium formation.

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Use of osteon circularity to determine species affiliations can be confounded by habitual load complexity

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Osteon circularity (On.Cr) is useful for studying load history in limb bones, especially to distinguish high complexity loading (e.g. torsion+bending) from simple complexity loading (e.g. unidirectional bending). On.Cr is also useful for determining species affiliations. We hypothesized that load complexity influences On.Cr in ways that can confound species determinations. Using ImageJ we examined bones representing a spectrum of load complexities: low, intermediate-A, intermediate-B, and high. Specimens included skeletally mature: (1)sheep, deer and equine calcanei

(simple), (2)sheep and equine radii (intermediate-A), (3)human, chimpanzee femora at proximal shaft, and equine third metacarpals (intermediate-B), and (4) sheep tibiae (high); n=7 each non-primate; n=8 chimpanzee; n=12 human (25-71yrs; avg 53 years; 22-71; male:female=3:9). Results showed that even in the "simple" category, differences in On.Cr based on regionally habitual (prevalent/predominant) strain-mode (tension, compression, neutral axis) are inconsistent: only 3 of 9 bones that can be considered in this context showed significant differences for habitual tension vs. compression regions. Additionally, On.Cr based on load-complexity category was inconsistent, as shown in both sheep and horse bones: statistically significant differences were found between load-complexity categories of the sheep bones but not the equine bones. Consequently, a fragment of a sheep tibia could inadvertently be identified as being a horse bone. These data raise concern in studies that use On.Cr to distinguish species without also considering the influence of load history. Specifically, the possible confounding influence of load history should be considered when comparing these bone 'types': ribs (load complexity likely simple), humerus and tibia (likely intermediate), and femur (likely intermediate in proximal shaft vs. high complexity in mid-shaft).

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When ring-tailed lemurs find lemons and make lemonade: The dependency on *Opuntia* at Cap Sainte-Marie and the increasing use of *Opuntia* at Berenty

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Varieties of *Opuntia* cacti have pervaded the southern landscape of Madagascar since the 1700s. While some varieties are known critical sources of nourishment for the human population, the general impact of *Opuntia* on the native flora and fauna and recommended management of the cacti have been debated since Decary. From August 2007 through July 2008, Kelley conducted an intensive study on two groups of *Lemur catta* in the semi-desert region of Cap Sainte-Marie. Over 1,019 hours of behavioral data and 70 plant species were collected for feeding behavior and nutrient analyses. Kelley found that two varieties of *Opuntia*, *O. monacantha* and *O. stricta*, were integral components of ring-tailed lemur ecology. Specifically, *O. monacantha* hedges were the groups' sole nightly sleeping sites and were the primary substrate used for temperatures < 20°C. The fruits of *O. monacantha* and *O. stricta* were top-quartile foods for half of the year and were the primary sources of water during the austral winter. In addition, both varieties were rich in multiple micronutrients and essential sources of magnesium. Health assessments indicated healthy individuals. Conversely, the population density of *L. catta* at

CSM was extremely low, there were indications of seasonal malnutrition, and there was no base line to compare changes in the population associated with historical cactus introduction. However, the recent increased feeding on *Opuntia* in the tamarind depleted forests at Berenty is providing this baseline. Preliminary results there indicate that *Opuntia* is becoming major food source, with consumption percentages comparable with that at Cap Sainte-Marie.

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Variation in age at M1 emergence and life history in wild chimpanzees

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Age at first molar (M1) emergence is commonly used to infer the general pace of life history in extinct ape and human species. However, there is essentially no information on variation in age at M1 emergence within species to complement the growing body of knowledge on intraspecific variation in life history. Recently reported ages at M1 emergence in living subjects from the Kanyawara community of *Pan troglodytes schweinfurthii* in Uganda range from <2.5 yrs to 3.3 years, substantially less than the age from a single deceased *Pan troglodytes verus* individual from the Taï Forest in Côte d'Ivoire (~3.7-3.8 years).

Using standard histological methods, we determined ages at death for two wild-shot juveniles of *P. t. verus* from central Liberia, both with erupting M1s, and estimated their M1 emergence ages at ~4.2-4.4 and ~4.5 years. The combined M1 values from just the Kanyawara and Liberian chimpanzee populations thus span nearly the entire range of values known for captive and wild great apes as a whole, a surprising result.

While little is known about Liberian chimpanzee life history, data for *P. t. verus* from the Taï Forest and *P. t. schweinfurthii* from Kanyawara suggest somewhat longer interbirth intervals and perhaps later ages at first reproduction in Kanyawara females. These observations are the reverse of what would be expected based on the M1 emergence ages in the two subspecies, as viewed in the context of broader primate trends. We examine these results with respect to ecological and other factors impacting the different populations.

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Rates of homoplasy in the mammalian skeleton

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The utility of a morphological trait for inferring evolutionary history or reconstructing

phylogeny is related to its probability of exhibiting homoplasy. This trait lability can be quantified within a clade using the Consistency Index (CI). However, no previous study has found a significant difference in CI values between cranial, dental and postcranial classes of morphological traits in mammals. We use data from a single recently published matrix to calculate CI values for 1240 dental, 1175 cranial and 912 postcranial traits on a phylogeny of 46 extant mammalian taxa. Power analyses were used to determine appropriate significance levels given the large sample sizes. Trait class has a significant influence on CI in a one-way ANOVA ($p < 0.005$), indicating that there is a significant difference in the evolutionary lability of trait types. This result is driven by the very low CI values (high lability) of postcranial characters. Using the CIs calculated above, it is possible to evaluate competing hypotheses about primate evolution. As an example, we evaluated the synapomorphies of clades associated with two competing basal primate phylogenies. The first set of synapomorphies are those used to unite Primates to the exclusion of Plesiadapiformes. The second set are those synapomorphies used to unite Euprimates and Plesiadapoidea into Euprimatiformes. CI values are significantly higher for Primate synapomorphies than for Euprimatiformes synapomorphies ($p < 0.05$). These results indicate that the former are less likely to exhibit homoplasy and support the evolutionary hypothesis that Primates and Plesiadapoidea are not sister taxa.

Modeling the origins of mammalian sociality: Matrilineal signatures in mouse lemur vocalizations

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Kin selection is a driving force in the evolution of mammalian social complexity and requires that kin are distinctive from nonkin. The transition from the ancestral state of asociality to the derived state of complex social groups is thought to have occurred via solitary foraging, in which individuals forage alone, but, unlike the asocial ancestors, maintain dispersed social networks via scent-marks and vocalizations. We predict that matrilineal signatures in vocalizations were an important part of these networks. We use the solitary foraging gray mouse lemur (*Microcebus murinus*) as a model for ancestral solitary foragers. We test for matrilineal signatures in their calls, thus exploring whether such signatures could have facilitated the kin selection thought to have driven the evolution of increased social complexity in mammals. We determined pairwise relatedness using microsatellites, matrilineal relatedness by sequencing the mitochondrial D-loop, and sleeping group associations using radio-telemetry on mouse lemurs in Ankarafantsika National Park, Madagascar. We analyzed the acoustic structure

of 10 calls for 16 females from six matrilineal groups. Calls were assigned to matrilineal groups at a rate higher than chance (pDFA: correct=47.1%, chance=26.7%, $P=0.03$). Lower acoustic distance showed a trend (Mantel Test, $g=-1.61$, $Z=4.61$, $r=-0.13$, $P=0.058$) to be related to greater genetic relatedness. Mouse lemur calls are distinctive by matriline, though whether this is due to genetics, social learning, or both could not yet be determined. Similar signatures in the vocalizations of ancestral solitary foragers may have been a crucial part of the social networks from which more complex forms of sociality evolved.

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Archaeological implications for the colonization of the New World by two distinct biological populations

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Neves and colleagues have done important contributions for our understanding of the human colonization of the New World. Based on the study of the cranial morphology Neves has turned his attention towards an assessment of the affinities of some of the older New World skeletal material in an effort to find out who these first intercontinental migrants may have been. The results of Neves' studies are intriguing. According to comparative morphological studies the earliest South Americans tend to be more similar to present Australians, Melanesians, and Sub-Saharan Africans. In order to explain the similarities between these populations Neves and colleagues have put forward a hypothesis suggesting that the Americas were successively occupied by two morphologically differentiated human stocks, with the *archaic* (older) morphology entering first during the Pleistocene/Holocene transition, and the population displaying the morphology similar to late and modern Northeastern Asians and Amerindians entering later, during the Holocene. Neves' model can be operationalized in order to be tested archaeologically: a) populations displaying *archaic* morphology dated to the late Pleistocene should be present in northeast Asia; b) material culture associated with these populations should be found throughout the Americas prior to the development of formal lithic industries such as Clovis and Folsom; c) populations displaying *archaic* morphology and displaying late/modern Northeastern Asian morphology should have cohabited northeast Asia during the Pleistocene; d) populations displaying *archaic* morphology and Amerindians should have cohabited in the Americas during part of the Holocene. Here we review the literature to test the archaeological expectations.

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Facial trauma and female philopatry: Contrasting baboons and chimpanzees

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Skeletal trauma patterns are useful indicators of primate social behaviors, especially when behavioral observation data are unavailable. If sex differences in trauma patterns can be explained by sex-biased dispersal, skeletal trauma studies can provide insight into mating strategies and social relationships in more detail than sexual dimorphism alone. Unfortunately, data on skeletal trauma in species with well-studied behaviors are scarce, making interpretation of trauma patterns for less intensively studied species problematic. To address this deficit, I present a pilot study contrasting facial trauma in 50 baboon (*Papio sp.*) skulls from Kibwezi, Kenya with previously published findings on baboons (*Papio cynocephalus*) from Darajani, Kenya and two groups of chimpanzees (*Pan troglodytes*) from Cameroon and Liberia. I predicted that 1) facial trauma rates vary between samples and 2) female philopatry in baboons contributes to lower incidence of facial trauma relative to female chimpanzees, despite higher levels of sexual dimorphism in baboons. Facial trauma incidence is 8% for baboons from Kibwezi and 21.6% for Darajani. The pooled female baboon sample has a facial trauma incidence of 5/43 (11.6%), while the pooled female chimpanzee sample has an incidence of 30/184 (16.3%). A Chi-square test indicates that there is a significant difference in facial trauma incidence between female baboons and chimpanzees ($X^2=17.858$, $df=1$, $p<0.001$), which provides preliminary support for the prediction that female baboons experience less facial trauma. Future investigation of sex differences in trauma patterns among many primate species will create a valuable interpretive framework for data on skeletal trauma.

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Functional implications of semicircular canal non-orthogonality in mammals

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It is generally assumed that the three ipsilateral canals of an inner ear exist in orthogonal planes (orthogonality), that corresponding left and right canal pairs have equivalent angles (angle symmetry), and that contralateral synergistic canals occupy parallel planes (coplanarity). However, published descriptions of vestibular anatomy reveal that some mammals (e.g., *Oryctolagus* and *Cavia*) have semicircular canals that depart substantially from orthogonality and coplanarity. Studies of locomotor kinematics in strepsirrhine primates further suggest that semicircular canal orthogonality varies predictably with the typical angular head velocities encountered during locomotion. These findings raise the possibility that the common characterization of mammalian semicircular

canals as orthogonal is inaccurate, and that deviations from this normative model could have significant functional consequences. In order to test these predictions, we measured bilateral semicircular canal morphology in 39 mammal species using high-resolution X-ray computed tomography. These CT scans were then used to estimate vestibular sensitivity with Bubbles.mat software. We found that substantial deviations from canal orthogonality, angle symmetry, and coplanarity are the rule rather than the exception for the mammals in our comparative sample. Furthermore, the degree to which the semicircular canals of a given species deviate from orthogonality is negatively correlated with estimated sensitivity to angular accelerations. These findings reveal that much of the received wisdom regarding orthogonal semicircular canal orientation in mammals is not strictly correct, and that interspecific variation in canal orientation has important functional consequences for vestibular sensitivity.

How short is short? A possible case of dwarfism from Egypt's Third Intermediate Period from the Dakhleh Oasis, Egypt

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This study presents the description and differential diagnosis of a probable pituitary dwarf from a Third Intermediate Period cemetery at Ain Tirghi in the Dakhleh Oasis, Egypt. The skeleton is an adult female estimated to be in the third decade of life. Most medical literature defines a variation of 2 standard deviations below the population mean as an indicator for clinically short stature, with some identifying severe short stature at 3 standard deviations from the population mean. Some bioarchaeologists have chosen not to make this distinction, and prefer to use only the more cautious level of 3 standard deviations to designate shortness. In any case, the individual at Ain Tirghi presents a difference satisfying either criteria when compared with the adult female population mean for measurements of the radii and femora, as well as the summed measurements of the femora and tibiae. Further calculations, however, revealed that her limb proportions fell within the normal range. Normal proportions and a lack of morphological abnormality were also observed during macroanalysis of the skeletal remains. Consequently, conditions leading to disproportionate short stature could be ruled out. A differential diagnosis for an individual with short stature, normal proportions and a lack of osteoporosis indicates this individual represents a probable case of pituitary dwarfism, or hypopituitarism, in the Egyptian archaeological record.

Determining architectural function using human skeletons buried therein

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Located 3,886 m above sea-level, Achanchi, built in the 10th-12th century, AD, is one of the

largest Chanka sites in the highland region of Andahuaylas, Peru and host to more than 300 stone buildings on over 15 ha. But what was the site used for? Two possibilities exist: 1) as a peaceful, integrative agro-settlement, or 2) as a defensive hill fort. Examining the health of those buried at Achanchi may help address these hypotheses. We evaluated 1107 bones and several hundred fragments including: three articulated skeletons, 14 crania, 87 complete long bones, and 106 vertebrae. We assessed these remains for sex, age, pathology and trauma. Aging the remains yielded a result of: 60% adults (35+ years), 25% young adults (aged 18-35 years), 11% subadults (12-20 years), and 1% children (3-12 years). Fifty percent of the skulls showed trauma, likely the result of a violent encounter. The high prevalence of caries and abscesses, as well as 15 incidences of periostitis and 13 cases of osteoarthritis point to compromised health. Overall, osteological data indicate Achanchi residents experienced violence and deprivation, which in turn suggest that the site's purpose was mostly likely defensive in nature.

Functional correlates of structural asymmetries in the human brain

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The human brain is both structurally and functionally asymmetric. However, there have been relatively few studies assessing both structural and functional asymmetries in the same subject population. One behavioral asymmetry of particular interest to human evolution is right-handedness, which is much more pronounced at the population level in humans than in other species. It has been postulated that this may be related to the evolution of tool manufacturing and use, and potentially also to language (which, like control of the right hand, is also lateralized to the left hemisphere). Analyses of fossil hominin endocasts have revealed anatomical asymmetries that are assumed to reflect asymmetries in underlying brain regions. Handedness has been shown to be associated with brain petalias in at least one study, but its association with other structural other areas of the brain have not been extensively investigated. Knowing the extent to which neuroanatomical asymmetries in different regions of the brain are associated with handedness will allow better assessment of handedness in fossil specimens. We report here the results of a study of 72 healthy, female subjects in which degree of handedness was correlated with neuroanatomical asymmetry at each point, assessed via non-rigid deformation (morphing) methods of their MRI scans. Areas of highest association between right-handedness and neuroanatomical asymmetry included: 1) the left motor cortex corresponding to control of the right hand, 2) left occipital pole and adjacent regions, 3) left parietal-occipital-temporal region (Wernicke's area), 4) right middle temporal sulcus, and 5) left orbital frontal.

Fossils, trabeculae and finite element modelling: A holistic approach to reconstructing behaviour in the past

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The internal structure of bone – cortical and trabecular bone – remodels throughout life in response to stress and can offer more clear insight into bone function and joint loading during life than analyses of external morphology alone. Furthermore, micro-finite element (FE) modeling of trabecular and cortical structure allows for a more detailed reconstruction of bone function. Here we apply a new method (MedTool) of analyzing internal structure throughout the bone and micro-FE to the third proximal phalanx and the head of the third metacarpal in extant hominoids (*Hylobates*, *Symphalangus*, *Pongo*, *Gorilla*, *Pan* and *Homo*) and two *Australopithecus africanus* (StW 382 and StW 394) metacarpals.

The micro-FE analysis of the proximal phalanx loaded in a suspensory posture reveals the functional role of trabecular bone, curvature and the flexor sheath ridge, as well as the effects of variations in these morphological features across hominoids. Trabecular analysis of the metacarpal head reveals that the regions of greatest trabecular density and stiffness (max. E-modulus) within the proximal epiphyses are consistent with the predicted area of peak loading during the most common joint posture across knuckle-walking African apes, suspensory Asian apes and manipulative humans. Both *Au. africanus* specimens show high trabecular density most similar to *Pan*, but peak loading in the palmar-distal region consistent with both suspension and manipulation. The methods used here build upon traditional analyses of volume-of-interest-based trabecular studies or homogenized FE modeling and can provide a more detailed and holistic reconstruction of locomotor and manipulative behaviour in extant and fossil taxa.

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Making a 'short bone' short: Human pisiform reduction results from the loss of a growth plate

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The wrist is fundamental to reconstructing hominoid phylogeny and behavior but limited understanding of the relative contributions that genetics verses remodeling play in determining skeletal form hinders these analyses. The human pisiform is a small, nodular bone. However, in most other mammals, including apes and likely *Australopithecus afarensis*, pisiforms are

elongate and form from two ossification centers. We hypothesize that 1) the presence of a secondary center in mammalian pisiforms indicates the existence of a growth plate and 2) human pisiform reduction results from growth plate loss. To address these hypotheses, we first conducted a survey of hominoid pisiform ossification that confirms the presence of secondary ossification centers in all extant apes. Identification of the initial ossification center occurs substantially earlier in apes relative to humans, raising questions concerning homology of the human pisiform and the two mammalian ossification centers. Second, we conducted histological and immunohistochemical analyses of pisiform ossification and gene expression in juvenile mice. We confirm the presence of two ossification centers in mice separated by a cartilaginous growth plate. Growth plate marker expression localized appropriately to distinctly organized columnar (PCNA) and hypertrophic (Collagen X) chondrocyte zones. In addition, reduction of *Hox11* and *Hoxd11* results in pisiform shortening similar to humans, raising the possibility that human pisiform growth plate loss may be attributable to altered *Hox* expression. Thus, examination of pisiform reduction can serve as an entry point to better understand the patterning of hominoid wrist evolution and development.

Covering the rock: GPS collar informed management of Barbary Macaques

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GPS collars have become increasingly important tools in the study of primate ranging. With larger scale studies, researchers can begin expanding questions on ranging to include applications to management. For primates who live in highly anthropogenic habitats such as Barbary macaques on the Rock of Gibraltar, it is crucial for researchers to be able to assess, with a high degree of accuracy, the primates' landscape use and ranging patterns in order to pinpoint which groups make the most forays into town areas and how frequently these forays are. In this study, six Telemetry Solutions Quantum 4000 medium GPS collars were deployed across six separate social groups for 1-5 months in the Upper Rock Nature Reserve, Gibraltar. Data were assessed to examine the impact of collaring on the animals home and daily ranging patterns as well as movement rates. For all metrics no significant increases or decreases in range size or movement rates were observed across days or weeks for any individual ($p > 0.05$). Next range boundaries and spatial overlap in territories was assessed. This showed only two of the six groups shared a significant spatial overlap. Finally, two groups were highlighted as those which primarily took forays into town, targeting them as the troops where management action will be

the most effective at reducing human-macaque conflict.

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More masculine 2D:4D predicts better biological condition, higher testosterone levels and higher number of children in men

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Objectives: Digit ratio (2D:4D) is thought to reflect exposure to androgens during fetal development and to play a significant role in programming male's future biological condition. We test a hypothesis, that 2D:4D predicts biological condition at different life stages, adult's testosterone levels and number of children in males.

Methods: The study participants were 688 men from Mogielica Human Ecology Study Site located in Polish rural area with a high birth rate, surveyed between years 2003-2009. Life history data, anthropometric measurements and morning and evening saliva samples were collected.

Results: More masculine 2D:4D (indicator of higher prenatal testosterone concentration) in right hand was related to higher birth weight ($p = 0.04$), higher birth length ($p = 0.01$), higher body mass during childhood and adolescence ($p = 0.02$), higher testosterone levels during adulthood ($p = 0.04$) and higher number of children ($p = 0.04$).

Conclusions: This study, for the first time, documents that men's digit ratio (a putative measure of prenatal androgen concentration) is associated with several life history traits in a single population. We show that 2D:4D is a good predictor of body size at different stages of life, adult testosterone levels and number of children. This indicates a long-term effect of prenatal androgens on male life history, possibly due to multilateral testosterone influence. Summarizing, we suggest, that 2D:4D should be further tested as a prenatal indicator of subsequent male condition.

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The evolution of teaching in humans and other animals: A new comparative approach

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Humans are heavily reliant on cultural adaptation, and have coevolved with culture for millennia. Teaching enhances the fidelity of cultural transmission and should be common in such a culture-dependent species. While biologists have documented teaching in a

number of non-human animal species, extant ethnographic work suggests that teaching is rare in non-Western human societies. Both sets of findings are hotly debated, and I argue these disputes can be resolved within an evolutionary framework that focuses on the fitness-relevant social learning problems teaching can solve, rather than on theory of mind capacities, or on strict requirements about the costs of teaching. This new comparative framework predicts that in humans, some teaching behaviors should be common across societies, within particular relationships, and for the learning of particular kinds of skills. Here I present this new theoretical framework and confirm a number of its predictions using data sets from fieldwork with fishing-horticultural villages on Yasawa Island, Fiji.

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Canine bending strength and fracture in durophagous platyrrhines

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Canine tooth size is understood to correspond with diverse competitive regimes and mating strategies among primates. Canine bending strength, however, does not vary accordingly among primates, and is relatively higher in platyrrhines that routinely harvest protected fruits and seeds with their canine teeth. The genus *Cebus* and the pitheciins (*Pithecia*, *Chiropotes*, and *Cacajao*) exhibit relatively stronger canines than other primates, and may consequently experience a lower risk of canine fracture. Morphologically, pitheciins are distinguished further from *Cebus* by exhibiting canines that are triangular in transverse-section and laterally splayed, rather than conical and upright. Museum collections of wild caught small to large-bodied platyrrhines were inspected for canine teeth broken before death. Results suggest that higher canine bending strength found in *Cebus* and the pitheciins does not lessen the frequency of fractures in these taxa. Alternatively, stronger canines may serve to retain a low frequency of fracture while experiencing the greater mechanical challenges of feeding on resistant foods. Further, no differences were found between *Cebus* and the pitheciins. Fossil pitheciids exhibiting robust, conical canines can be found in the early middle Miocene of Patagonia while the triangular, splayed canines of modern pitheciins first appear in the younger *Cebupithecia* from La Venta, Colombia. These results suggest that canine robusticity among *Cebus* and the pitheciins is a tightly constrained response to the greater mechanical stress on these teeth while feeding on resistant foods, though the modern pitheciin crown morphology may serve a relatively new, ancillary purpose involving harvesting large, sclerocarpic fruit.

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Pauper diet, pauper dentition: An analysis of oral health at the Erie County Poorhouse

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Dental pathologies are important indicators of diet and dental care. Data were collected from a 2012 recovery excavation of the old Erie County Poorhouse cemetery in Buffalo, New York. The 383 individuals recovered represent those that died at the poorhouse, not necessarily those who lived there. Meals at the poorhouse included highly cariogenic foods. It is likely a similar diet was consumed by the poor outside the poorhouse; relying on cheap, high energy foods.

We would expect such a diet to result in high rates of caries, periodontal disease, abscesses, and calculus. Juvenile and adult individuals were scored for degree of wear, carious lesions, abscesses, periodontal disease, and calculus. Younger individuals (15-19), had the highest rates of carious lesions (32.7 % of teeth affected). Males and females have similar rates (23% and 20%) of teeth affected by carious lesions. Abscesses occurred more often in older males (50+) than other subsets of the population. Periodontal disease of varying degrees was noted in older individuals (36-50, 50+). Teeth present in older adults were affected more severely by calculus (100% in females 50% in males). These frequencies appear to be consistent with what we would expect from a poor, older population. However, evidence of dental care was found with the remains—bridge work, dentures and fillings—that may be suggestive of a wider subset of the population; men and women who may not have been poor, but died at the Erie County Hospital and subsequently were buried in the poorhouse cemetery.

Demography, rank dynamics, and reproductive success of male Phayre's leaf monkeys

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Changes in the alpha male position are often linked to changes in infant survival rates and male reproductive success. However, non-alpha males may use alternative tactics, and female choice may also lower the success of alpha males. Here we investigated male demography, rank changes, and reproductive success in a population of Phayre's leaf monkeys (*Trachypithecus phayrei crepusculus*) in which males either matured and reproduced in their natal group or dispersed to form new groups. Observations and genetic sampling took place from January 2000 to January 2009 on four habituated groups at Phu Khieo Wildlife Sanctuary, Thailand (277 group-months).

Overall, groups were characterized by a skewed adult sex ratio (1:3.8; birth sex ratio 1:1.5). With one likely exception, immigrations of unfamiliar males were not observed. Instead, male rank changed from within, with young-adult, natal males taking over the alpha position. This resulted in hierarchies determined by male resource holding potential, with young-adult males at the top of the hierarchy and old males at the bottom. Rank changes usually included severe fights that could be preceded or followed by temporary absences of males. Reproductive success was mainly rank dependent, with alpha males siring most infants during stable periods. In contrast to other primates, infant mortality was not higher following a change in the alpha male. Overall, while this social system is rather unusual, the pronounced male reproductive skew is similar to many other primates. The likely absence of infanticide is unexpected and points to males benefiting from restraint or effective female counter-tactics.

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The interface between biology and culture: Description of a culturally deformed microcephalic cranium

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Culturally deformed crania are plentiful archaeologically and have been employed in studies of functional cranial matrices and geometric morphometric assessments of shape change. Archaeologically-derived microcephalics have had a similar focus, although their rarity has limited our understanding. We provide the first description and analysis of a microcephalic skull that was modified culturally.

The individual derives from the Silver Creek region of Arizona and is housed at the PHMA, UC Berkeley. This unprovenanced individual is believed to date to the Pueblo period (AD 1000-1400). Normal ($n=32$) and microcephalic ($n=2$) comparative skulls are housed at the Institute for Craniofacial Study, UOP. The deformed individual is aged at 11.0 years, while the normal sample ranges from 10.0-13.0 years. Individuals were CT-scanned, and isosurfaces/volumes were reconstructed with Amira. Morphological change in osseous units was examined metrically and via comparisons of triangular meshes. Shape and anatomical deviations from normal brains were assessed by comparisons with reconstructed endocranial volumes.

The skull is anteroposteriorly short, broad, and tall as a result of cradle-boarding. The endocranial volume is ≈ 750 cc, indicating a primary microcephaly. The typically flat

microcephalic frontal is now vertical due to an anterior rotation of the vault relative to the face. The basal frontal lobes were compressed into the orbital plates and olfactory pocket while portions of the temporal lobes posterior to the sphenoidal border were forced laterally. The facial mask is broad for a microcephalic. Compensatory changes in the nasal cavity and palate (long, narrow) are intermediate between the two conditions.

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Hamstrings, moment arms, and gait mechanics in early hominins

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The hamstrings muscles are important hip extensors in both vertical climbing and bipedal locomotion, and variation in ischial morphology among humans, apes and fossil hominins may reflect adaptation to different locomotor repertoires. Here we examine estimated hamstring mechanical advantage at different degrees of flexion for *Ardipithecus ramidus*, *Australopithecus afarensis*, and *Australopithecus africanus*. To determine hamstring moment arms, three-dimensional pelvic landmarks and maximum femur lengths were collected for skeletal samples of extant hominoids and for reconstructed or modeled pelves and femora of fossil hominins. Pelvic orientations of extant hominoids were determined by comparison with published data of cadaver dissections and moment arm measurements. In humans, the hamstrings moment arm has a lower peak value and remains more constant across a wider range of hip flexion (including full hip extension) than in the great apes. Results show that both *Australopithecus afarensis* and *Australopithecus africanus* resemble humans in having a lower maximum moment arm and an effective moment arm in complete hip extension. Like extant great apes, *Ardipithecus* has a large maximum moment arm, but the effective range of its hamstrings group is dependent on the degree of pelvic tilt assumed. If ape-like, full hip extension would be limited. If human-like, the hip extensors would maintain an effective moment arm even at full hip extension. In either position, *Ardipithecus* would have a larger moment arm in a more flexed position than other hominins, consistent with powered hip extension during vertical climbing.

Cooperative foraging networks and egalitarianism of Batek hunter-gatherers in Peninsular Malaysia

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Cooperation between individuals is important for the survival and reproduction of many species. In humans, many foraging tasks rely on the contribution of multiple individuals, yet cooperation networks for human foraging in natural environments have been subject to little empirical study. We used a historical dataset from the mid 1970's to examine cooperation during rainforest foraging by Batek hunter-gatherers in Peninsular Malaysia. We performed social network analysis to evaluate cooperation during hunting, honey harvesting, fishing, and gathering fruit, tubers, or vegetables. We generated foraging networks for each activity and analyzed network centrality for Batek individuals using eigenvector centrality and betweenness. Although both men and women participate in all foraging tasks, men dominate the central positions in hunting and honey harvesting networks, and women dominate the central positions in fishing and gathering networks. We found significant correlations (Kendall's $\tau=0.25-0.43$, $p<0.001$) between eigenvector centrality of hunting/honey harvesting networks and fishing/gathering networks, indicating that the same individuals tend to occupy central positions in those activities. The role of kinship in structuring Batek foraging networks is also discussed. Our results indicate that for the Batek, cooperation decisions are resource-dependent and foraging networks are not strictly egalitarian. Our study also demonstrates the promise of social network analysis for examining the nature of human cooperation in pre-industrial societies. *TSK and VVV are supported by NSF Graduate Research Fellowships.*

A 3D quantitative comparative analysis of wrist morphology among western and eastern gorillas

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Gorillas inhabit a range of central African habitats that differ in altitude and forest ecology. While all gorillas are primarily terrestrial knuckle-walkers, western gorillas (*Gorilla gorilla*) eat fruits and climb more frequently than do eastern gorillas (*Gorilla beringei*), a consequence of their respective lowland and highland habitats. Here we test the hypothesis that western gorillas, being relatively more arboreal, may display morphological features that increase wrist mobility and pollical grasping ability in comparison to those of eastern gorillas. A three-dimensional methodology was used to measure angles between articular surfaces and relative articular and nonarticular areas in all eight carpal bones, as well as curvatures of the mid-carpal joint. Our results indicate that western and eastern gorillas show significant differences from one another in all carpals except the pisiform. The bones from the radial side in particular show key differences in the mid-carpal joint and joints of the thumb, which follow the predictions of a more mobile mid-carpus and grasping thumb in western gorillas. In contrast, our radial-carpal joint measurements do not

significantly differ among gorillas, possibly suggesting a functional constraint related to knuckle-walking. Multivariate analyses of these data show that combinations of any two or more carpals are particularly strong at distinguishing gorilla species and subspecies (e.g., *G. b. beringei* and *G. b. graueri*) from each other. These results highlight the often overlooked morphological variation among gorilla taxa, while providing a useful comparative model for interpreting carpal variation in the fossil hominoid record.

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Stable isotope canopy and dietary effects in sympatric monkeys from Taï Forest, Côte d'Ivoire

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Bone chemistry studies of extant primates yield important insight into primate feeding ecology. In this paper, we present light stable isotope ratios of modern bone from seven sympatric cercopithecids from the Taï Forest, Côte d'Ivoire. Rib samples from each species were analyzed: *Colobus polykomos* (n=7), *Procolobus verus* (n=4), *Procolobus badius* (n=7), *Cercocebus atys* (n=6), *Cercopithecus diana* (n=6), *Cercopithecus campbelli* (n=3), and *Cercopithecus petaurista* (n=1). Carbon ($\delta^{13}C_{co}$) and nitrogen ($\delta^{15}N_{co}$) values from bone collagen and carbon ($\delta^{13}C_{ap}$) and oxygen ($\delta^{18}O_{ap}$) values from bone apatite are reported.

Results are consistent for C₃ feeders in a closed-canopy habitat. Dietary and habitat utilization (preferred feeding locations in the canopy) patterns emerge due to vertical gradients in carbon and oxygen isotope systems in the understory. Low irradiance and evapotranspiration coupled with high relative humidity and recycled (depleted) CO₂ are important factors in explaining the variance among taxa. For example, $\delta^{18}O_{ap}$ values show significant correlation to preferred feeding location (mean observed height [m]) by species. With respect to carbon, $\delta^{13}C_{co}$ and $\delta^{13}C_{ap}$ values are correlated across the sample, but neither correlates with mean observed height. For nitrogen, $\delta^{15}N_{co}$ values suggest increased entomophagy in *Cercopithecus campbelli* and enriched $\delta^{15}N_{co}$ values for all colobines sampled plausibly reflect their specialized digestive morphology. Isotopic data from Taï Forest primates demonstrate the potential by which bone chemistry studies can model and test dietary variability and habitat niche separation of sympatric primates in the past.

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Jaw adductor muscles in treeshrews: Implications for Plesiadapiforms and Primate origins

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Whether the origin of primates was marked by a shift in diet remains controversial. The pattern of jaw muscle fiber architecture in closely-related nonprimate mammals (e.g., treeshrews) has the potential to shed light on food-processing changes at the origin of primates. Plesiadapiforms (?stem primates) possess a tremendous diversity of jaw morphologies, suggesting a great variety of approaches to food processing. To begin phylogenetically bracketing plesiadapiform jaw morphologies, we examined the jaw adductor muscles of two species of treeshrew (*Tupaia glis* and *Tupaia belangeri*). We compared our findings to published data on strepsirrhine primates (as example primitive primates). In agreement with previous studies of tupaiid jaw musculature, we found that basic anatomy differs little from that seen in strepsirrhines: all muscle divisions are present as are all major fascial sheets and tendons. When compared to a broad sample of strepsirrhines, the jaw adductor muscle mass in the tupaiids is great relative to body mass; fiber length is also relatively great in tupaiids - perhaps related to a greater emphasis on gape. Where muscles insert via tendon or aponeurosis, there is a clear attachment scar on the skull. Such instances include the origin of the superficial masseter, the insertion of the deep masseter, and the insertion of the zygomatic temporalis (among others). MicroCT scans of *Tupaia* specimens allowed us to map the muscle attachments in three dimensions. These maps will serve as a guide when reconstructing jaw adductors in plesiadapiforms.

Diet and the evolution of brain growth patterns in anthropoid primates

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Primates are unique in their possession of unusually large brains. The evolution of the primate brain is a problem of great interest to biologists who have attributed it to selective pressures derived from social and ecological demands. The expensive tissue hypothesis, which proposes that a reduction in energy allocated to various tissues such as the gut alleviated metabolic constraints on brain growth and facilitated encephalization, has also become prominent. Work stemming from this hypothesis has drawn links to diet, showing that diet quality is negatively correlated with gut size and that species with higher quality diets tend to possess larger brains. Yet little work has attempted to address the ontogenetic relationships between diet and brain growth patterns. In the present study we examine the relationship between diet and brain growth in anthropoid primates and test the hypothesis that higher quality diets were associated with an ontogenetic shift in brain growth that allowed species with higher quality diets to produce larger brains. We find evidence that diet category is more closely associated with brain developmental patterns than phylogenetic proximity. Our sample of frugivorous primates appeared precocious; pre-weaning individuals already possessed brain size statistically indistinguishable from post-weaning members of their species. In contrast, our folivorous sample

exhibited significant difference in brain size between pre- and post-weaning individuals. Differences in growth curves suggest that heterochrony may contribute to patterns of variation in adult primate brain size.

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Does hominid dental microstructure carry a phylogenetic signal?

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Dental microstructure preserves a record of cellular events involved in the growth and development of teeth. Traditionally, this method has been used for reconstructing the evolution of life history, but the preserved growth record in teeth may also contain phylogenetic information that can be used to reconstruct evolutionary relationships between taxa. We propose that within the family Hominidae, dental microstructure is conserved and taxonomically distinctive. To test this hypothesis we investigated the dental microstructure of previously sectioned mandibular second molars from the following species: *Pan troglodytes*, *Gorilla beringei*, *Pongo pygmaeus*, *Hylobates* sp., and *Homo sapiens*. The variables we focused on were A) the daily enamel secretion rate, and B) a proxy for the rate of ameloblast differentiation. The former was quantified by measuring the spacing between cross striations. The latter by measuring the angle formed between the Striae of Retzius and the enamel-dentine junction; a narrow angle indicates a high extension rate, whereas a wide angle suggests a low extension rate. Preliminary results suggest these microstructural traits distinguish among taxa. They also suggest that *Pongo* appears to retain the presumed plesiomorphic condition while the African apes appear to be derived. These findings suggest that dental microstructure may have a role in systematic analysis as well as in life history studies.

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Investigating the molecular mechanisms underlying pelvic differences between humans and great apes

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Recent advances in genetics and genomics have revealed that much of inherited phenotypic diversity in vertebrates has its basis in the non-coding regulatory portion of the genome. With the advent of high-throughput sequencing, large genomic data sets, e.g., those generated via the ENCODE Project, have begun to identify functional regulatory elements (enhancers, promoters, etc.) throughout the genome. When coupled with datasets focused on molecular signals of natural selection in the genome, among several others, they give power to target regions underlying biological adaptations in humans and primates. Once targeted, functional

interrogation of identified regions is ultimately the most critical step to clearly ascribing the role of a cis-regulatory element (and the exact base-pair variation within each element) to a specific biological consequence. We are currently focusing on using two types of datasets to identify the regulatory changes that underlie pelvic differences between great apes and humans, with the ultimate goal to identify the specific genomic and/or epigenetic elements (and base-pairs) that control trait formation. These two datasets include: 1) ChIP-seq studies with mouse (and human tissues), to predict conserved and evolutionarily divergent enhancers and other novel regulatory regions, that build unique parts of the pelvis and 2) intersections of ENCODE, amongst other genomic and bioinformatics databases, to identify regions of the genome that have markedly diverged between primates. The intersections between these datasets provide targets to functionally test in model organisms, such as the mouse, to begin to glean insight into the traits that separate humans from other primates.

Pelvic shape variation: What does it tell us about obstetric adaptation?

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Under the Obstetric Dilemma (OD) hypothesis, selection acts on the human female pelvis to ensure a sufficiently sized obstetric canal for birthing a large-brained, broad shouldered neonate, while bipedal locomotion selects for a narrower and smaller pelvis. In this context of female-specific stabilizing selection, however, variability of linear dimensions of the pelvic canal and of overall size (geometric mean of canal dimensions) are not reduced in females, suggesting that shape may instead be variable among females of a population. Female pelvic canal shape has been shown to vary among populations, while male canal shape does not. Within this context, we examine intrapopulation canal shape variation in comparison with that of non-canal aspects of the pelvis and the limbs. Nine skeletal samples (total female $n = 101$, male $n = 117$) representing diverse body sizes and shapes were included. Principal components analysis was applied to size-adjusted variables of each skeletal region. A multivariate variance was calculated using the weighted PC scores for all components in each model. Nonparametric tests were used to compare within-sample variances ($n = 9$) between the sexes and between each skeletal region. Multivariate shape variation is not different between the sexes in any of the skeletal regions. Within both sexes, canal shape variance is significantly greater than non-canal pelvis and limb variances. Limb variance is higher than the non-canal pelvis, but this difference does not reach statistical significance. Under the action of obstetric selection, canal shape may vary to meet obstetric requirements, thus increasing variation in morphospace.

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Carbon isotope analysis on tooth enamel to reveal relationships between diet and tooth ablation types of the Jomon in Japan

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Ritual tooth ablation was extensively practiced among the hunter-gatherers in the Late-Final Jomon period (ca. 4000–2500 BP) in Japan. This tradition includes two patterns, type 4I and type 2C, referring to extraction of the mandibular incisors and canines, respectively. The cultural reason for tooth extraction might be rites of passage or group identification, while the extraction of living teeth might result in difference of diet between type 4I and 2C individuals. To test the hypothesis that the dietary dependence on marine resources differed in relation to tooth ablation types during late childhood/adolescence, we measured carbon isotope ratios of tooth enamel of the human skeletal remains of the Jomon period. A total of 93 individuals from three shell mounds were investigated. Tooth enamel was drilled from third molar, and carbon isotope ratios of enamel powders were measured by an isotope ratio mass spectrometer. Carbon isotopic results indicate that the individuals mainly consumed C₃ foods. Tooth ablation types and sex were related to diet in two sites. In Tsukumo, type 2C males consumed more marine foods, while type 4I females consumed C₃ foods. In Inariyama, type 2C males consumed more marine food than type 4I males. These results indicate that the diet during late childhood/adolescence might be affected by one's sex and/or tooth ablation types. This finding is important for providing evidence that tooth ablation had a biocultural consequence of dietary differences in relation to ablation types among the hunter-gatherers of the Jomon period.

Population affinities of Early Holocene crania from Chile: A 3D morphometric study

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Much attention has focused on using morphological assessments of Paleoamerican crania in North and South America to reconstruct colonization events that occurred during the initial peopling of the Americas. Some researchers contend that North and South American Paleoamericans exhibit cranial morphologies distinct from later populations. In South America, cranial forms have been used to argue for separate migrations and distinct biological populations, which contradict archaeological evidence indicating biocultural continuity over several millennia. This study investigates cranial variation among prehistoric Chilean populations where early coastal skeletal remains have been discovered. To examine population affinities, four Paleoamerican crania >8,000 years BP from northern and southern Chile were compared to six prehistoric and historic groups from the same regions. 3D images were created with a laser scanner to examine shape variation among the Paleoamericans and comparative samples. Cranial landmarks were superimposed to remove variation in position, scale, and orientation, and

imported into R for ordination, statistical, and cluster analyses. The cluster analyses and Mahalanobis distances show that Paleoamericans from northern Chile have biological affinities to each other and later groups from the same region. The ordination and cluster analyses show that the southern Paleoamerican is distinct from the late period sample excavated from the same region in southern Chile. Computed distances indicate that the southern Paleoamerican has closer biological affinities to northern archaic-period Chileans. These results provide new insights into the cranial variation of South American Paleoamericans, and aid in a more nuanced understanding of Chilean population history over an 8,000-year period.

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Genetic regulation of amelogenesis and implications for hominin ancestors

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Cross striations are markings observed in mineralized enamel associated with daily fluctuations in the development of enamel. Although these incremental markings have been widely used in studies of hominin growth and life history, the biological mechanism associated with such fluctuations remains elusive. This study reports on recent advances made in the understanding of the molecular regulation of enamel development by the circadian clock. We report on antiphase mRNA levels of the circadian clock genes period (*Per*) and cryptochrome (*Cry*) in vivo and in vitro over 48 hrs. We also discuss oscillations in the main constituent enamel matrix protein amelogenin (*Amelx*) over 48 hrs. These results and others reported elsewhere strongly indicate that the circadian clock modulates enamel formation. It is hypothesized that periods of low *Amelx* expression are associated with the formation of the cross striations. Differences in daily cross striations that distinguish some early hominin taxa likely derive from changes in the genetic regulation of *Amelx* production by the circadian clock.

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The effect of plastic remodeling on mandibular lingular morphology: Implications for paleoanthropological population studies

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The lingula, located on the medial mandibular ramus, is a highly variable osteological feature of uncertain functional significance. One form of extreme lingular bridging, called the horizontal-oval form of the mandibular foramen, has a much higher frequency in Neandertal samples than any in other hominin group. This trait has been used in morphological comparisons between Neandertals and modern humans as evidence of admixture or continuity. However, the etiology of this trait has never been satisfactorily investigated and therefore its

efficacy for population studies is questionable. This study presents a new hypothesis that the morphology of the lingula is at least partially developed as a plastic response to heavy use of the masticatory apparatus.

An analysis of modern human and Neandertal samples demonstrated a significant correlation between the extremity of lingular bridge expression and severity of dental attrition (including non-masticatory use of dentition), indicating that the morphology of the lingula is at least partially influenced by pressure placed on the masticatory apparatus. Still, the frequency of the trait is significantly higher in Neandertal samples, which suggests that there may also be a genetic influence on the rate and intensity of osteological growth in this anatomical region. However, due to the apparently significant influence of behavior on its morphology, we conclude that this trait should be used in studies of genetic relationships among samples only with caution.

Periodontal disease and health in western Eurasian Late Pleistocene humans

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Temporal changes in health through the Late Pleistocene have been investigated through a number of different data sources, but never from periodontal disease. In modern humans, periodontal disease is associated with a high carbohydrate diet in the short term and systemic disease in the long term. Therefore differential periodontal disease and its severity could provide a new window onto the morbidity of Late Pleistocene peoples. 120 individuals with sufficient alveolar bone preservation were sampled from European and west Asian sites and analyzed for cemento-enamel junction to alveolar crest heights (CAC) and interdental septa condition (shape and porosity). A status of none, mild, moderate, or advanced periodontal disease was assigned to each individual based on the most severe portion of the dental arcade. Periodontal disease presence and severity increased through the aging process, which mirrors other skeletal studies. Neandertals and Middle and Upper Paleolithic modern human groups do not differ significantly in their periodontal disease distribution—though Neandertals have a higher percentage of advanced cases. Overall the presence and severity of periodontal disease in the Late Pleistocene is much higher than has been suggested; only 18.3% of individuals show no signs of periodontal inflammation. The significant differences were regional: Atlantic Europe and the Mediterranean have significantly less severe periodontal disease than Continental Europe. This contrast has implications for the health and diet of Late Pleistocene peoples in Continental Europe relative to their neighbors to the south and west.

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Seasonal ecology of ring-tailed lemurs: A comparison of spiny and gallery forest habitats

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Until recently the ecology of ring-tailed lemurs has been primarily studied within gallery forests, with very little research focusing on the other habitat types in southwestern Madagascar where ring-tailed lemurs persist. Here, we compare patterns of feeding and nutrient intake for ring-tailed lemurs in the spiny forests of the Tsimanampetsotsa National Park (TNP) and the gallery forests of the Beza Mahafaly Special Reserve (BMSR). Our data span the synchronized lactation period (Sept-Mar) that includes both the dry and wet seasons. The forests differ in the amount of average annual rainfall (TNP < 300mm, BMSR = 700mm) and the duration of the dry season (TNP = 9-11 months, BMSR = 5-7 months). Of the top five foods consumed by ring-tailed lemurs in spiny and gallery forests only *Gyrocarpus americanus* (Kotipoke) was common to both. We found no significant habitat-specific differences in the type of plant part consumed per month (i.e. flower, fruit, leaf), or between the intake of acid-detergent fiber or soluble carbohydrates. However, the spiny forest lemurs ingested significantly less crude protein ($t=4.725$, $df=12$, $p<0.001$) when compared to the gallery forest lemurs. The presence and use of *Tamarindus indica* foods elevate protein intake in the gallery forest lemurs, while high-protein resources appear limited in the drier spiny forests. Protein is especially important for reproductive females who have the added metabolic costs associated with lactation. If or how protein availability, or lack thereof, affects fitness in these lemur populations needs to be further explored in future studies.

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Morphometric and functional analyses of a new colobine tibia from Laetoli, Tanzania

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A complete left tibia of a fossil colobine (EP1100/12) was discovered in the Upper Laetoli Beds between Tuffs 6 and 7 at Locality 13 during the 2012 field season at Laetoli, Tanzania. Comparisons of the specimen to extant and fossil cercopithecoïd tibiae using three-dimensional geometric morphometrics allow inferences about its locomotor behavior and taxonomic affiliation. Thirty-nine landmarks

were recorded on the proximal and distal articular surfaces and midshaft of EP 1100/12, and on 119 tibiae of extant cercopithecids using an Immersion 3D Microscribe. Landmarks were subjected to generalized Procrustes analysis and principal components analysis. The first principal components from analyses of proximal and distal landmarks explained approximately 30% of the variation and captured differences in the width and angularity of the articular surfaces. From these results, discriminant function analyses were run with reference to taxonomic and locomotor classifications of extant primates. Proportions of quadrupedal, climbing, leaping, suspensory, and arboreal locomotor behaviors were collected from the literature for each extant taxon. Discriminant function analyses of these proportions indicate that the fossil is most similar to the tibiae of highly arboreal cercopithecids, particularly those that employ quadrupedal, climbing, and leaping locomotor behaviors. Analyses of taxonomic affinity found that the morphology of EP 1100/12 was closest to tibiae of the extant colobines, *Nasalis* and *Procolobus*. Based on these results, and overall size of the fossil tibia, EP 1100/12 is best attributed to the fossil colobine, *Rhinocolobus* sp., which is known from cranio-dental and other postcranial remains at Laetoli.

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Taphonomic histories and ecomorphological implications of fossil bovids limb elements in construction of hominin habitats at Pliocene Laetoli in northern Tanzania

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Unlike many other PlioPleistocene paleoanthropological sites in East Africa, the depositional and taphonomic history of vertebrate fossil faunal remains at Laetoli differs significantly in that it is time-averaged with low to moderate energy depositional events. The skeletal representation in the Laetoli bovids' faunal remains is characterized by a high number of limb elements, especially astragali and calcanei that can be used not only in reconstructing depositional and taphonomic histories but also their locomotor and habitat preferences which provide proxy data for hominin paleoecology at Laetoli during the Upper Laetoli depositional events. We here present some taphonomic, depositional history and paleoecological construction of bovid habitat preferences in relation to hominin distribution and habitat utilization at select localities at Laetoli. Furthermore we use taphonomic and depositional history of the mammalian faunal assemblage at Laetoli to demonstrate how different Pliocene Laetoli was from other comparable sites in East Africa. Bovid astragali and calcanei in this study are used as ecomorphological indicators to piece together habitats that may have been utilized by hominins within the Upper Laetoli Beds depositional events.

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To die so far from Dixie: Confederate mortality in two Civil War prison camps

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Despite renewed interest in the Civil War, the prisoner-of-war camps established by both sides during the conflict remain a tragically understudied aspect, despite the very real and long-lasting effects they had on the men they incarcerated. For this study, I compared the infectious disease mortality distributions of two Civil War prison camps: Camp Douglas, in Chicago, and Elmira, in southeastern New York. Though the camps shared many features, the housing available to prisoners differed, with Elmira housing prisoners of war primarily in tents and out in the open, whereas Camp Douglas nominally offered more regimented barracks housing. Kaplan-Meier survivorship curves were estimated for four primary disease categories (Bronchial, Lymphatic, Abdominal, and Hematic) for both camps. We found that survivorship curves for typhoid illnesses were significantly different than for other mortality causes; additionally, different housing strategies between the camps resulted in differing survivorship patterns between the camps. Outcomes of demographic hazard models allow insights into the impact of sheltering arrangements of health in more modern circumstances, which can potentially be expanded to offer a deeper understanding of disease transmission in similarly circumscribed modern housing situations, such as refugee camps.

A comparison of premolar dental chipping patterns between two Icelandic assemblages

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Dental chipping in relation to diet is an under-explored form of dental wear, but has a high prevalence among some populations. This paper compares two Icelandic archaeological skeletal assemblages – an earlier medieval inland cemetery at the farm of Hofstaðir, northeast Iceland, and a later medieval coastal parish cemetery on the island of Haffjarðarey, west Iceland. The latter population has a very high rate of dental chipping in the premolars (84%). Both populations have high rates of dental chipping and dental fractures. These high rates of dental chipping are likely the results of the manipulation and eating of *harðfiskur* (stockfish), a coarse and tough staple of the diet. However, the consumption of soured whey (*mýsa* and *sýra*) likely also played a role in weakening and accelerating micro-trauma to the enamel. The patterning of the dental chipping, focusing on the premolars is also suggestive of the consumption of *harðfiskur* by forceful mechanical breakdown. The results of this study suggest that the Icelandic repast contributed to traumatic damage of the dentition in the medieval period.

A geometric morphometric study of craniofacial variation in an East African Bantu population

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The face is the most recognizable, yet perhaps the most variable human physical feature. Using a sample of over 3600 children (aged 4 to 20 years) of Bantu ethnicity from Northwestern Tanzania, we explored variation in craniofacial shape to further the understanding of normal human variation. This is the first large-scale study of 3D facial shape variation in an African population. Three-dimensional (3-D) facial images were taken using the InSpeck Megacapturor system and were then subjected to an automated landmarking protocol, which calculated 29 biologically relevant facial landmarks corresponding to bony underlying landmarks and soft tissue maximums using a curvature map. The resulting 3-D landmark coordinates were used in geometric morphometric analyses to explore craniofacial shape. Age and centroid size were included as covariates to control for effects of growth and body size on craniofacial morphology. Principal Component Analysis was used to examine total craniofacial shape variation of the sample. Despite the genetic complexity of the human face, it is surprisingly integrated with first three Principal Components (PCs), which account for approximately 55% of the total variation in the dataset. Little of this variation is due to ontogenetic or static allometry; only 6.14% of the total variation in facial shape is due to both sources of allometry combined. This differs from similar analyses in other species and points towards a surprising degree of individuality in the shape of the human face.

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Social network dynamics of a group fission event in free-ranging rhesus macaques (*Macaca mulatta*)

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Although the social life of female rhesus macaques (*Macaca mulatta*) is characterized by stable linear dominance relationships, sudden bi-

directional aggression between low and high ranking individuals can result in rank reversal or the fissioning of a group. In 2012, we observed a fission event in a group of macaques living on Cayo Santiago island ($n = 62$ adult females members of three matriline). In the course of the fission, some females from the highest ranking matriline were evicted from the group. We performed a dynamic analysis of the female grooming networks from the two years (2010 and 2011) leading up to this fission event. We assessed changes to global properties of grooming networks: density – the strength of grooming ties present in the group – and clustering coefficient – the tendency to form cliques. We found no differences in how densely females in each matriline were connected across years. In contrast, the matriline whose females were evicted was significantly more clustered in 2011 compared to 2010; no such difference was observed in the other two matrilines. We used the Quadratic Assignment Procedure and relational contingency tables to confirm that evicted individuals directed more grooming amongst themselves and less grooming toward non-evicted individuals in the year that directly preceded the group fission. Our analysis shows that while matrilineal fissioning might appear sudden according to aggressive interactions, they are preceded by deeply seated changes in grooming patterns. This is consistent with the idea of grooming as a social glue mediating within-group competition.

Individual muscle function in chimpanzee bipedalism: I. EMG patterns

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As our closest living relatives and facultative bipeds, chimpanzees have provided important insights into the evolution of bipedalism in humans. Although there is a growing body of kinematic and kinetic data on chimpanzee bipedalism, documentation of their hind limb muscle activity patterns has been limited. In addition, some observations seem at odds with biomechanical predictions. For example, it has been reported that biceps femoris is active during support while semimembranosus is not. Inactivity in this large hamstring muscle raises questions about the accepted interpretation of changes in ischial orientation observed in early hominin hip bones as related to the ability of the hamstrings to produce an extensor moment with an extended thigh. Besides the need to validate such inferences, the absence of a comprehensive dataset on muscle function in a facultative biped is a significant limitation to current model-based studies of fossil hominin locomotion.

To facilitate functional interpretation of hominin fossils including that based on computational modeling, we have undertaken documentation of the bipedal EMG activity patterns of all major hind limb muscles of two juvenile chimpanzee subjects.

As the flexed hip posture of chimpanzees would predict, the major hip extensors, including

biceps femoris and semimembranosus, display high levels of recruitment during bipedal walking. Other predictions, however, such as high levels of activity in gastrocnemius due its inability to act isometrically as in humans, are not borne out. Besides addressing specific muscle activity questions, these EMG datasets can be used to explore reciprocal and complementary muscle interactions during facultative bipedalism.

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Drivers of high infant mortality in *Propithecus edwardsi*: The role of resource availability

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Infant mortality in *Propithecus edwardsi* is as high as 57% per year, but the primary causes are unknown.

P. edwardsi is primarily folivorous, but exhibits frugivory based on fruit availability, which may coincide with key phases of the reproductive cycle. To examine the role of nutrition availability and kind on infant mortality, we compared availability of *P. edwardsi*'s common food resources (fruit, young leaves, flowers) to infant mortality rates and survival time. Birth and mortality data were collected continuously between 1988 and 2010 in Ranomafana National Park from three *P. edwardsi* groups during daily focal follows. We chose a survival cutoff of one year to encompass time to weaning and juveniles' first months of foraging. Tree phenology data were collected over the same period and recorded ripe and unripe fruit, young leaves, and flower availability.

We examined resource availability's effect on mortality by comparing percent mortality to the year's deviation of resource abundance from the all year average, for resource categories All Fruit, Ripe Fruit, Young Leaves, and Flowers. Similar comparisons were performed for survival time of infants that died within one year.

No relationship was found between yearly resource abundance and infant mortality or survival time.

Since *P. edwardsi* fits the profile of relaxed income breeders, we expect that further analysis may reveal a relationship between resource abundance during lactation and infant mortality. However, some deaths are attributable to infanticide and predation, and these factors may play a more important role than nutrition in infant mortality.

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Foot bones to footprints: Estimating skeletal and fleshy-foot lengths from isolated pedal elements

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Hominin feet are rare in the fossil record, typically known from a few isolated elements. Even when multiple elements are known, the only foot length estimate that can be made from the fossil record is skeletal length. Skeletal length is, however, not the actual length of the foot because skeletal length does not include the contribution of soft tissue. Soft tissue is necessary to recreate the fleshy-foot that represents the functional foot structure. Fleshy-foot length is necessary for interpreting fossilized footprints and the kinematics of gait. This study aims to determine if skeletal and fleshy-foot lengths can be estimated from isolated pedal elements.

Weight-bearing radiographs of 50 randomly selected people from an urban US Level 1 trauma center were used to collect length measurements of these elements: talus, calcaneus, calcaneal tuberosity (posterior surface of tuberosity to posterior facet), and first through fifth metatarsals. Skeletal (posterior surface of the calcaneal tuberosity to distal tip of the distal hallux phalanx) and fleshy-foot (posterior skin line of the heel to the distal tip of the distal hallux phalanx) lengths were also measured. Linear regression was used to determine the predictive ability of the lengths of the elements in determining skeletal and fleshy-foot lengths.

All elements are predictive of both skeletal and fleshy-foot lengths (all p 's < 0.001). These elements explain 55-72% of variation for skeletal length and 59-77% of variation for fleshy-foot length. In modern humans, skeletal and fleshy-foot lengths can be estimated from isolated pedal elements.

An analysis of fitness and fitness components in a wild population of Verreaux's sifaka

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Evolutionary biologists often use different definitions of fitness depending on the system under study and the time scale involved. In evolutionary ecology a common distinction is that of rate-sensitive versus rate-insensitive conceptualizations of fitness. In this study I compare different estimates of individual fitness that were based on long-term demographic data of a wild population of Verreaux's sifaka (*Propithecus verreauxi*) that reside at Beza Mahafaly Special Reserve, southwest Madagascar. Specifically, I analyze lifetime reproductive success (LRS)—a rate-insensitive measure of fitness—and the “population growth rate of the individual” (PGRi), a rate-sensitive measure. I also examine the variation and covariation among components of fitness that contribute to PGRi. Results indicate that LRS shows much more skewness than PGRi (1.93 vs. 0.51), the difference likely due to the fact that PGRi takes into account survival and reproduction whereas LRS is simply a tally of

offspring production. The opportunity for selection calculated from LRS equals 2.38 and when calculated from PGR_i it equals 0.99. Large variation exists with respect to first-time reproduction. Positive covariation occurs mainly among fitness components pertaining to fertility; variation/covariation among survival components was negligible. There was no significant negative covariation between fertility and survival. I discuss the methodological and theoretical implications of these different fitness measures, and I also discuss how the pattern of phenotypic variation specifies the fitness surface that is traversed by the sifaka population over microevolutionary time.

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Dental development of the *Australopithecus sediba* juvenile MH1 determined from synchrotron virtual paleohistology

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The recent discovery of the *Australopithecus sediba* partial juvenile skeleton (MH1) has yielded an important source of information for exploring the radiation of Pleistocene hominins. Initial assessment of dental eruption and epiphyseal fusion suggested that MH1 died at 12-13 years of age if it had followed modern human developmental patterns.

Here we use propagation phase contrast X-ray synchrotron micro-tomography to non-destructively investigate the dental microstructure and calcification of the preserved MH1 permanent teeth.

Virtual histological slices and 3D renderings of the outer and inner dental surfaces were combined to assess the long-period line periodicity, long-period line numbers, cuspal enamel thickness, crown formation times, and calcification stages. Despite the advanced stage of first molar wear, the neonatal line was identified, and subsequent stress events were used to match teeth and to estimate the age at death. The long-period line periodicity is 9 days, which is similar to other hominin values. Additional developmental comparisons with australopithecids or early *Homo* are limited due to the lack of available histological information. Third molar calcification is particularly advanced relative to modern human standards, which would suggest an age of 10.5-11.5 years. Preliminary results indicate that MH1 died at a younger age than suggested by modern human eruption or calcification standards. This rapid developmental pattern is similar to other Pliocene and Pleistocene hominins, including early *Homo*.

These findings will also allow more nuanced studies of the associated cranial and post-cranial material, as they are independent of living ape and human developmental standards.

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Tracking interindividual biological proximity in the burial space through the analysis of enamel thickness and dental tissue proportions

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Enamel thickness and dental tissue proportions have been studied to discuss taxonomy, phylogenetic relationships, and dietary habits in extinct and extant hominoids. Here we employ a microtomographic (microCT)-based record of teeth from individuals of the Neolithic necropolis of Gurgy (Yonne, France), to assess the intrasite variation in enamel thickness and dental tissue proportions and compare it to organizational and cultural parameters. The Neolithic necropolis of Gurgy was used continuously for around a thousand years (ca. 5000-4000 cal. BC) and is situated at the crossroads of multiple cultural influences. 110 teeth from 22 individuals were scanned using high-resolution microCT at the MRI platform (Skyscan 1076 X-ray microtomograph). Acquisitions were performed with an isotropic voxel size ranging from 17.93 to 36.18 μm^3 . Semi-automatic threshold-based segmentation was conducted using Avizo v.7 (VSG) and crowns were digitally isolated from roots. For each crown, 15 linear, surface, and volumetric 2D and 3D variables describing enamel thickness and dental tissue proportions were digitally measured or calculated. Results show global proximity in enamel thickness and dental tissue proportions between individuals buried at Gurgy. Whatever tooth type analyzed, the same groups of individuals are obtained. In most cases, these groups correspond to those found considering the localization of the individuals in the necropolis, as well as radiocarbon dates and burial structures. These results suggest that the characterization of tooth internal structure could be used to discuss interindividual biological proximity in burial spaces. Ongoing research focuses on comparison with paleogenetic data and nonmetric traits. *Research supported by the DHP project (dir: S. Rottier; Université Bordeaux I, LaScArBx; ANR program of prospects investments ANR-10-LABX-52). We thank Renaud Lebrun (Université Montpellier 2) and the MRI platform.*

Popularization of the modern cesarean section in the United States and its effects on pelvic morphology

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The shift in locomotion of our predecessors to obligate bipedalism caused significant changes in our pelvic morphology. However, these morphological changes had an adverse effect on the ability of women to successfully give birth without complications, referring specifically to

the issue of obstructed labor. AL 288-1 had a platypelloid pelvis, making it extremely difficult for neonates to pass through the birth canal due to an ovalar inlet with a long transverse axis. Anatomically modern females have a gynecoid pelvis, consisting of a rounded inlet with a larger subpubic angle. This shape better facilitated natural birth, but obstructed labor was still a significant issue in modern populations. The advent of the modern cesarean section throughout the United States in 1882 revolutionized labor processes, allowing women who would not have survived the natural birthing process to contribute to the morphology of future generations. Research has acknowledged changes in female pelvic anatomy, but has yet to be detailed, especially within the scope of the United States.

This research utilized two samples from the United States (pre and post introduction) to determine if the popularization of the modern cesarean section has any correlations with changes in female pelvic anatomy. The collected pelvic data was put through statistical analyses to test for significant changes. Principal component analysis and F-tests were used to explore shape variation and levels of diversity. The results detail changes in female pelvic morphology following the introduction of the cesarean section.

Constraints on feeding biomechanics in *Australopithecus sediba*

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of Anthropology, Indiana University, ¹⁸Department of Engineering, University of Hull, ¹⁹Department of Anthropology, University of Massachusetts.

Most australopith species are characterized by derived craniodental traits including large postcanine teeth and bony facial buttressing. *Australopithecus sediba* departs from the australopith norm by exhibiting a reduction in the size and robusticity of the feeding apparatus, suggesting that the cranium may not have been configured to withstand heavy loads associated with forceful mastication. However, the molar microwear patterns of MH1 have been interpreted to suggest the presence of hard foods in its diet, thereby implying the generation of high bite forces. This study uses finite element analysis to test the hypothesis that the relative lack of facial “robusticity” exhibited by *Au. sediba* is associated with lower structural strength and lower efficiency of bite force production relative to *Au. africanus*. Results show that the facial skeleton of *Au. sediba* specimen MH1 is strong, with strains from homologous locations being consistently lower than in *Au. africanus* specimen Sts 5. Strength appears to be conferred by a deep and anteriorly placed zygomatic root. However, unlike in Sts 5, molar biting in MH1 generates a distractive reaction force at the temporomandibular joint that “pulls” the mandibular condyle inferiorly on the working side, increasing the risk of joint dislocation. This distractive joint force can be eliminated by reducing muscle force on the balancing side, but this in turn results in a reduction of bite force. Thus, although mechanically strong, the *Au. sediba* cranium does not appear to be optimized for forceful molar biting.

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Missing teeth in late Neolithic China: Intentional ablation or hereditary agenesis?

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Dental ablation is a rare occurrence in ancient China. The vast majority of recorded cases are from the Late Neolithic Dawenkou culture on the eastern coast. Previous studies have looked at cultural reasons for this practice; this study examines possible biological causes. Were there any distinguishing dental anomalies from the Dawenkou population which might have been the original source for a cultural marker? The dentitions from 243 individuals were examined representing five late Neolithic archaeological cultures. The five sample populations include the northern frontier with Mongolia (Ordos), the northwestern frontier with Tibet (Qijia), the eastern coast (Dawenkou), and two different samples from central China (Yangshao, Longshan). Each individual was scored for evidence of dental ablation, dental agenesis, and supernumerary teeth. The Dawenkou population had the lowest rate of dental agenesis within this study. The highest rates of dental agenesis were found along the northern frontier of China.

Therefore, patterns of dental agenesis were probably not the inspiration for dental ablations among the Dawenkou population. The one distinguishing trait among the Dawenkou was a higher frequency of supernumerary teeth. In conclusion, the Dawenkou sample had some biologically distinguishing features in their dentition, but their relationship with dental ablation is not supported.

Wenner-Gren.

Isotopic variability and dietary flexibility of western lowland gorillas and sympatric chimpanzees in Cameroon: Implications for assessing behavioural ecology from a Museum collection

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Overlap between the diets of *Pan troglodytes* and *Gorilla gorilla* is widely recognised but its extent in areas of sympatry has been difficult to assess in modern populations. We determined the effects of sympatry on early 20th century western lowland gorillas with chimpanzees in Cameroon using isotope ratios in hair from a museum collection. Samples are from an interior west-east transect in Cameroon, similar in altitude and rainfall, but the great apes were sympatric only in the eastern zone. Great ape isotope data were compared against fauna in the same collection. $\delta^{13}\text{C}$ shows exploitation of different zones - dense, shaded forest (Bongo), forest/woodland (most animals including all the primates), and a component reflecting open wetlands (Kob, Waterbuck). Great ape $\delta^{15}\text{N}$ values fall within a broad forest herbivore grouping (including Sitatunga, duikers, and manglebeys), all consistently lower than forest carnivores. Gorilla hair $\delta^{13}\text{C}$ is significantly lower than chimpanzees in the sympatric zone but similar in $\delta^{15}\text{N}$, and shows shifts to higher $\delta^{13}\text{C}$ and lower $\delta^{15}\text{N}$ where non-sympatric. This suggests partitioning in the former case, with gorillas exploiting the denser forest zones, while they exploit more open forest but lower $\delta^{15}\text{N}$ resources in the non-sympatric areas. In the latter case we cannot determine whether this is due to food preference or subtle isotopic differences at the base of the foodweb. Overall our results suggest that gorillas are more flexible than chimpanzees, and that factors such as competition may drive small shifts in the micro-habitats they exploited and their resultant isotope values.

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The stable isotope ecology of *Pan* and fossil hominoids

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Chimpanzee behavior and ecology has figured prominently in studies of early hominin paleoecology due to our shared phylogenetic

heritage. The stable isotope ecology for chimpanzees living in “savanna” environments has been used as a comparative analogy for early hominins because many of our early ancestors occupied similar environments. Published stable isotope data for *Pan* (chimpanzees and bonobos) living in both “savanna” and forested environments show considerable variation among habitat types, suggesting that *Pan* might be a useful ecological analog for fossil hominin and hominoid taxa which utilized more closed environments as well. Here, we report stable carbon and nitrogen isotope ratios measured in hair from six modern “forest” chimpanzee communities in Kibale National Park and Chambura Gorge in Uganda. Carbon isotope differences among the communities likely reflect variation in environmental characteristics among the sites and/or access to agricultural foods. The Kibale and Chambura Gorge communities have carbon isotope values that overlap with “savanna” chimpanzees despite living in much more closed, forested environments. Nitrogen isotope patterning in the Ugandan communities is likely driven by local variations in the nitrogen isotope composition of preferred foods. We also compared the carbon isotope data to three fossil taxa, *Ardipithecus ramidus*, *Sivapithecus* sp., and *Gigantopithecus* sp., to explore how an expanded *Pan* stable isotope dataset might prove useful in paleoecological reconstructions of extinct hominoids.

Comparative perspectives on primate microbiomes

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Next-generation sequencing is yielding unprecedented advances in our ability to explore microbiomes. We apply next generation sequencing (16S rDNA and metagenomics) to analyze microbiomes of the primate vaginal tract and large intestine to understand the evolution of humans and their associated microbiomes.

Results for microbiomes at both sites show 1) considerable variation in host-microbe relations across primates in and 2) humans differ significantly from nonhuman primates. Lactobacilli ssp. dominate the human vaginal microbiome, in stark contrast with other primates. Human gut microbial communities are also distinctive, with humans presenting less microbial diversity than other primates. However, microbiomes in some primates are also

highly specialized, with low diversity. Metagenomics analysis reveals that gene function in the human microbiome stands out from other hominoids.

The contrasts between the human microbiomes and those of other primates complement established differences in anatomy, behavior, and culture. The distinctness of the human vaginal microbiome may be driven by a birth process that is highly complex from energetic, anatomical and locomotor perspectives. "Simplification" of the human gut microbiome relative to nonhuman primates may reflect key food processing adaptations, including cooking. Overall, microbial community composition and function seem to differentiate humans from nonhuman primates and can be interpreted as components of other adaptations that distinguish humans from other primates.

Host-microbe interactions have been important to human evolution. We discuss these findings in light of ideas regarding human evolution, and provide perspectives on future studies of the human microbiome in evolutionary contexts.

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Male strategies for changing group membership in Verreaux's Sifaka

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Males of many group-living mammals disperse to avoid inbreeding and improve their mating opportunities. Different strategies may exist for immigrating males: assuming dominance in a takeover or entering as a subordinate. Verreaux's sifaka (*Propithecus verreauxi*) are highly seasonally breeding lemurs characterized by male-biased dispersal and high within-group reproductive skew. We hypothesized that (1) fighting ability affects immigration strategy, (2) males prefer groups with greater reproductive opportunities, and (3) males time transfers so that they can gain immediate mating opportunities (pre-mating and mating season). We examined six years of demographic, morphological, and behavioral data for five social groups of Verreaux's sifaka in the Kirindy Mitea National Park to assess male dispersal strategies. Both sexually mature subadult males and adult males were observed to transfer between known social groups. Transfers occurred individually and in pairs. Not all adult males entered groups as the dominant male. Body mass and canine size did not significantly influence immigration strategy. Males were never observed to transfer into a group with fewer sexually mature females or more adult males than their previous group. Contrary to expectations, 43% of transfers occurred during the gestation period and an additional 29% occurred during the birth season. Our results suggest that male transfer strategies are influenced by group composition and reproductive season but not fighting ability. Interestingly, males do not seem to time their transfers for immediate reproductive opportunities, suggesting that being established in a social group prior to the mating season may be important.

Plant microremains in dental calculus and diet breadth

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Starch granules and phytoliths recovered from dental calculus are increasingly used as markers of diet in ancient human populations, but it is not clear how well these plant microremains reflect overall diet breadth. This project examines how well starch granules in dental calculus from Ovatie forager-horticulturalists of Northwestern Namibia record the breadth of plant foods consumed. We collected dietary data through observation and interview over three months between August and October 2012 and April 2013, and obtained calculus samples from 88 individuals between the ages of 20 and 83. Of the thirty plant foods commonly included in the Ovatie diet, only ten contain appreciable amounts of starch. This means that many important plant food resources are not represented in Ovatie calculus. Preliminary analysis shows that only half of the starchy foods in the Ovatie diet are present in Ovatie calculi. These results indicate that analysis of starch granules in dental calculus may not give a complete picture of the breadth of plants consumed. This is the first study to test how well plant microremains in dental calculus reflect diet breadth from a population with a known diet. Results from this project have implications for interpreting plant microremain data from archaeological dental calculus samples.

Social insects and cultural origins

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Alan Mann's 1972 article in *Man*, "Hominid and cultural origins," concluded that one of the significant changes towards becoming human is modification of the diet toward foods requiring a tool for acquisition and that an individual with a stick could have obtained many of these resources. This viewpoint has been embraced by primatologists more than it has by paleoanthropologists, but it is important for current discussions in paleoanthropology to embrace that hominid reliance on tools does not necessitate the preservation of artifacts. In this poster, Mann's argument will be reinvestigated paying specific attention to the dietary contributions of social insects. Of all the possible foods that become more easily available with the use of a stick (tubers, roots, etc.), insects such as ants and termites provide some of the most identifiable and reliable high quality resources. Reconstructions of the nutritional and isotopic contributions of these resources, however, must recognize that both termites and ants are from taxonomically diverse clades and that variation in their contributions exists at even the caste level. Using the termite genus *Macrotermes* and the ant genus *Camponotus* as examples, these insects may provide good sources of energy and protein and would mainly contribute to a C₃ carbon isotope signature. Utilizing these resources more intensively than extant

nonhuman great apes could account for the dietary shift that supported brain size increase in the australopithecines.

Hominin and cercopithecoid diet and niche partitioning at 3.8–3.2 Ma: New insights from Woranso-Mille, Ethiopia

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Dietary expansion and the use of C₄ resources among australopithecines in the mid-Pliocene is a critical transition in human evolution because it marks the emergence of post-canine megadontia and divergence from the dietary patterns of extant apes. In eastern Africa, this transition occurred amidst indications of increasing C₄ plants and the appearance of grass-adapted mammalian lineages, such as the large-bodied primate *Theropithecus oswaldi*. Recent isotopic studies indicate that *Australopithecus afarensis* consumed significant amounts of C₄ vegetation by 3.4 Ma, distinguishing it from its putative ancestor *Au. anamensis*, whose diet was dominated by C₃ vegetation. The hominin fossils at Woranso-Mille (ca. 3.8–3.2 Ma) fill a gap in the fossil record between *Au. anamensis* and *Au. afarensis* and provide indications that the transition between these australopithecines included multiple morphological expressions of increasing terrestriality and adaptation to hard object feeding. Here we present carbon and oxygen isotope data of fossil teeth from Woranso-Mille, including teeth from hominins (n = 16), *Theropithecus* (n = 44), other papionins (n = 10) and colobines (n = 9). Isotopic data from these groups show that the primate community occupied a range of dietary niches, from nearly completely C₃- to C₄-dominated, and that both australopithecines and *Theropithecus* were using C₄ resources at least as early as 3.7 Ma. These data indicate that dietary change in australopithecines coincided with or preceded morphological adaptations to increased terrestriality, whereas in *Theropithecus oswaldi* behavioral change to a grass dominated diet preceded morphological specialization for grazing.

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Does head size influence metabolism: A test of the Expensive Tissue Hypothesis using data from the Indigenous Siberian Health and Adaptation Project

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The scaling relationship between basal metabolic rate (BMR) and body mass has been widely studied in humans and other mammalian species. Recent work has demonstrated the improved predictive power of incorporating variation in body composition (e.g. fat-free mass [FFM], organ weights) in estimating BMR. The Expensive Tissue Hypothesis (ETH) posits that the large brain size of humans has important consequences for overall energy expenditure and allocation due to the high metabolic demands of this tissue. This study aimed to test the predictions of the ETH by incorporating anthropometric measurements not commonly used in estimations of human BMR, including head size measurements. Data on body mass, FFM, sitting height, maximum cranial breadth (MCB), and maximum cranial length (MCL) were collected on a sample of 202 adults (>18 years; 101 men, 101 women) from the village of Berdygestiakh, Sakha Republic/Yakutia. MCB and MCL were used to calculate cephalic index. Mean body mass was $71.2 + 13.9$ kg for men and $60.2 + 10.5$ kg for women, and mean FFM was $54.3 + 7.2$ kg for men and $40.4 + 4.0$ kg for women. Regression results indicated that, along with body mass and FFM, MCL was positively correlated ($p < 0.05$) with BMR, and cephalic index was negatively correlated ($p < 0.01$) with BMR. Sitting height and MCB, however, were not significantly correlated with BMR. These results suggest that the incorporation of head size data may improve estimations of human BMR, as predicted by the ETH.

Human microbiomes and non-traditional molecular archaeology

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Human are a complex superorganism or holobiont, a macrobe-microbe-viral functional unit. If we treat a biological cell as a unit of analysis, then among those trillions of cells that impact the human body, only 10% are human cells, the remaining are microbial. Much of what has been learned about the human holobiont has come from microbiome research. It has become increasingly clear that our microbial self is vital for health, is pervasive on and within the human body, and is a critical player in human evolution. Yet, our relationship with microbes has clearly changed in recent history through the pervasive use of antibiotics, chlorinated water, antimicrobial food preservatives, and general aseptic practices. We still know very little about the ancestral state of the human microbiome, and by extension, our ancient selves. To access such information, our research group has explored non-traditional methods and approaches in molecular anthropology, including archaeological metagenomics and metaproteomics. Here we provide an overview of two such studies, one focused on oral ecology and included a total of 93,677,545 shotgun genomic sequence reads from two Medieval European adult dental calculus samples, and the other focused on the gut ecology and included 60,000 16S RNA gene reads from two 1300 year old human coprolites from northern Mexico. Our analyses demonstrate that ancestral microbiome information is retained in archaeological

materials. We conclude with a view of the future and a greatly expanded picture of molecular archaeology and human evolution.

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Evaluating the need for population-specific equations when assessing non-metric cranial sex traits

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Non-metric sex estimation techniques utilizing the skull rely on morphological traits present across all populations. However, previous research indicates that trait expressions and sexual dimorphism vary among different groups. Such population variation was reported by Walker (2008) when he scored five cranial sex traits across U.S. White, U.S. Black, and English samples. Despite evidence of population differences in trait scores and dimorphism, Walker pooled these diverse groups into one "modern" sample discriminant function equation.

In this study, five cranial traits were scored according to Walker (2008) in a sample of U.S. White individuals from the W.M. Bass Donated Collection (n=62) and U.S. Black individuals from the Hamann-Todd Collection (n=59). Sex was estimated using Walker's pooled discriminant function and the accuracy rates obtained were then compared to results obtained using population-specific equations derived from the samples in this study.

Cross-validated correct classification rates of 76.3% (Hamann-Todd) and 93.5% (Bass) were achieved using population-specific equations, compared to 67.8% (Hamann-Todd) and 83.9% (Bass) using Walker's pooled equation. These results indicate the need and utility for population-specific equations and suggest that U.S. Whites (Bass) are more highly dimorphic in cranial sex traits than U.S. Blacks (Hamann-Todd) with possible secular trend effects. Step-wise discriminant functions revealed that the glabella and mastoid process scores accounted for the majority of variation between the sexes, with the other three traits removed from the functions due to minimal contribution. Ultimately, these results show that population-specific models of sexual dimorphism are fundamental to the improvement of cranial sex estimation methods.

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Postcranial mosaicism in the hominin fossil record: Resolving locomotor adaptive signal from morphological noise

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Adaptive interpretation of hominin postcranial morphology is difficult in the presence of mosaicism, in which species exhibit a mix of plesiomorphic and apomorphic characters. Among australopithecines, some aspects of postcranial

indicate the use of arboreal behaviors (vertical climbing and suspension) as prominent features of locomotion, while others suggest obligate terrestrial bipedality. In addition to morphological mosaics, paleoenvironmental reconstructions of hominin habitats throughout eastern and southern Africa during the Plio-Pleistocene are also mixed, generally fluctuating between open and closed woodlands. This combination of both mosaic morphologies and habitats makes it difficult to differentiate between the positional behaviors hominins likely used, and those they were capable of using (e.g., primitive retentions). This study 1) provides a synthetic review of hominin postcranial adaptation, 2) explores how to accurately infer positional behavior from the conflicting signals derived from paleoenvironment and morphology, and 3) uses the pelvis as a case study to evaluate mosaic morphology in fossil hominins. Pelvic dimensions calculated from 3D landmarks in a comparative sample of 25 species of haplorhine primates were combined with published data from *Australopithecus afarensis*, *A. africanus*, *A. sediba*, and *Homo erectus*. Univariate ANOVA and multivariate partial least squares analyses assessing the relationship between positional behavior and pelvic form suggest that locomotor function is reflected in multivariate results but is less identifiable from single trait analyses, supporting the total morphological pattern approach to identifying adaptation. Integrating multivariate analyses of shape with research on traits that only arise through use is likely to increase the adaptation signal-to-noise ratio.

Mitochondrial DNA analysis reveals substantial population structure in Hecun, a shell mound in South China

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The Hecun site, located in the southern of Guangxi province in China, is characterized by a shell mound and belongs to the late Neolithic Age, dating to approximately 4,500 ~ 4,000 years ago. Genetic analysis of the Hecun population will provide novel insight into the ancient population structure in South China.

The genetic variations of hypervariable sequence I (HVS-I) in mitochondrial DNA (mtDNA) of 17 human remains from the Hecun site were analyzed. Our results showed that some predominant haplogroups in Southern China, such as B4, F1, and M7, have relatively high frequencies in the Hecun site. Haplotype sharing analysis suggested that the haplotypes belonging to haplogroups B4 and M7, which were found in Hecun, also can be found in the extant population in East and Southeast Asia, mainly in northern Thailand, and the Philippines. Median network analyses revealed that the Hecun ancient population shares closer genetic affinity with extant southern Chinese populations, especially sharing the same node with Baiyue and Miaoyao. Combining the fresh data of mtDNA analysis and previous archaeological research, we conclude that the Hecun population were native residents in southern part of East Asia and contacted with other people in a small area.

Today, some genes in the Hecun population still can be found to be widespread in East and Southeast Asia.

Socio-environmental influences on growth in a sample of Tanzanian children

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Using a sample of 5921 children and adolescents aged 5-20 years from schools in urban and peri-urban environments in northwestern Tanzania, we explored the relationship between growth and various socio-environmental factors. Height-for-age z-scores (HAZ) and body mass index z-scores (BAZ) were calculated using National Health and Nutrition Examination Survey (NHANES) references. Males had a mean HAZ = -1.09 +/- 1.20 and a BAZ = -0.94 +/- 0.91 while females had a mean HAZ = -0.84 +/- 1.11 and a BAZ = -0.80 +/- 0.88. T-tests showed that females were significantly higher than males for both HAZ ($t=-8.121$, $p<0.0001$) and BAZ ($t=-5.9816$, $p<0.0001$). While we lack sufficient data to explain this outcome, we suspect that it may be explained by either greater parental investment or better developmental buffering in females. Linear regression found age is explained significant variation in HAZ ($R^2=0.185$, $p<0.0001$) and, to a lesser extent, BAZ ($R^2=0.039$, $p<0.0001$), with older kids being further below NHANES averages than younger kids. A nested linear mixed-model analysis that included age and sex as covariates was used to test for significant effects of additional socio-environmental factors (such as access in terms of type of and distance to water and healthcare facilities, employment type (agriculture, wage labor, or small business), and hygiene-related factors such as restroom access and cleanliness) on growth in these children and results suggest that certain environmental factors may be associated with the growth of these children and adolescents.

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Ancient Native American genomic diversity: Evolution, pathogens, and the environments of the Americas

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Ancient Native American genetic predispositions have long been postulated as a major factor for the disease-related population decreases suffered after European colonization. However, this concept has not been explored on

a genome wide level, utilizing both living and ancient individuals. Instead, most of this evidence is either indirect or based on genetic studies of living populations, making it difficult to examine to what extent genetics contributed to this presumed susceptibility.

Recent advances in ancient DNA techniques have allowed us to reconstruct the entire coding region (i.e., the exome) of ancient Native Americans for comparison with living individuals from the same geographic region. In this study, we utilized the Population Branch Statistic to examine relevant genetic differences in pre- and post-colonization populations, allowing us to scan each population for signatures of selection. We identified unique immune gene configurations that, when modeled in a signaling pathway, suggests that pathogen pressures were indeed present that were not experienced in other parts of the world. These changes may explain aspects of the historical experiences of Native peoples with European-borne pathogens. Furthermore, several other evolutionary signals suggest a more complex suite of adaptations relating to various ancient environmental variables, as well as incomplete selective sweeps occurring after European colonization. Thus, this work helps to illuminate the dynamics of adaptation to new environments, in both the context of isolation and rapid merging of two populations.

Using GIS to visualize external taphonomic features on human remains inside chullpas: Marcajirca, Peru

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This study explored taphonomic factors that contribute to the preservation of human skeletal remains from chullpas, the above ground tombs used in some ancient Andean populations. This study examines chullpa burials from the Late Intermediate Period (1200-1532 AD) site of Marcajirca in Peru, where burials had been disturbed, with commingling. This study incorporates approximately forty samples from the first hand-drawn map layer of bones of three different chullpas. Layers inside each chullpa, which were drawn and analyzed by Geographic Information System (GIS), the process of visualizing and understand patterns. Remains were examined for three taphonomic factors: weathering stages, plant pigmentation, and root presence. GIS was utilized to identify taphonomic patterns in chullpas to study the effect taphonomy has on the preservation of remains. It was hypothesized that each chullpa would show similar taphonomic frequencies because preservation of the similar mortuary pattern would lead to similar taphonomic processes. Among 35-40 bone samples analyzed from each chullpa, plant pigment was more prevalent in one chullpa with 68% of pigment present versus 16% and 11% in the other two. This was also the case with 59% presence for root occurrence in that one chullpa versus 41% and 6% in the other two. Weathering was scored 0-5, 5 being most severe. The most prevalent was stage 3, 47% and 57% being the most prevalent in two and stage 0, 30%. Comparisons from each chullpa indicate that the frequencies are not similar. GIS will help researchers

document taphonomy on human remains in a faster, simpler way.

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The antiquity of child abuse: A case of Battered Child Syndrome from the Agora of Athens

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While child abuse is all too frequently seen in modern forensics, few cases have been documented in historical literature or archaeological remains. Identification of abuse in modern cases includes the presence of patterned, repeated trauma with differing stages of healing, often termed Battered Child Syndrome in forensic and medical literature. Abuse often is, and was, a hidden crime, and in antiquity its victims may have been disposed of outside of formal cemeteries, making recovery and documentation difficult. The oldest infant from the "Baby Well" found in the Athenian Agora excavations provides evidence of a possible case of child abuse from the 2nd century C.E. This skeleton was identified among the assemblage of 450 infants and fetuses recovered from an abandoned well located just outside of the Agora. Many of these remains are commingled, and the evidence suggests that most died of natural causes soon after birth. This study, however, focuses on a 6-12 month old infant in the assemblage. The skeleton is clearly larger than all others, facilitating the identification of the individual. This infant's skeleton preserved evidence of a partially healed cranial fracture, healed rib fractures, and asymmetrical periosteal bone deposits on the humeri and single preserved right femur. On the left distal humerus there is also a possible corner fracture, an injury often caused by violent twisting of an infant's lower arms. The pattern of multiple traumatic injuries with differing degrees of healing suggests this infant is one of the earliest identified victims of Battered Child Syndrome.

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The effects of habituation on chimpanzees: Monitoring fecal glucocorticoid levels at a new field site

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Past research on the habituation of chimpanzees has primarily focused on behavioral responses to neutral human contact in a variety of situations. The biological aspects of these behaviors, however, also need equal attention. This pilot study addresses the issue by monitoring Fecal Glucocorticoid Metabolite (FGM) stress levels throughout the habituation process of a small, but densely populated, group of wild chimpanzees (*P.t. verus*) one year into a community-based conservation and habituation initiative. We assayed the group's FGM levels

while simultaneously collecting behavioral data to compare to previously published data. This allowed us to establish the progress of habituation. The results of our pilot data reveal that after one year of this initiative, the group has entered into the first stage of habituation. This is remarkable, as the group was actively hunted until the onset of the conservation project. Pilot data has also established a baseline FGM for this group. Future studies will proceed by continually collecting behavioral data relevant to the habituation process while concurrently collecting and assaying fecal samples. Results will be compared to the baseline FGM established by this pilot data. These studies will ultimately test the hypothesis that FGM levels are inversely correlated to the stages of habituation. If FGM stress levels, and thus individual physiology, are greatly affected by the process of habituation, it may indicate that the behaviors of habituated primate groups—exhibiting behaviors that have been recorded and studied as normative for decades—may not be as void of human effects as previously assumed.

Nolla's longitudinal dental study revisited

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Nolla's study of the development of permanent teeth was the first of its kind assessing tooth formation from longitudinal dental radiographs. It was a breakthrough in design and analysis, expressing dental age using a score as a measure of maturity. This sample is also important because it is from the 1930's and 1940's and is longitudinal. The aim of our study was to reconstruct Nolla's longitudinal dental data and compare the timing of tooth formation with a contemporary group. The material for this study was Nolla's thesis (1952), specifically graphs of developmental curves for maxillary and mandibular teeth of 25 boys and 25 girls aged 2-18. We calculated mean age entering 38 mandibular tooth stages (transitional analysis) in boys using probit regression and compared these with data from 491 boys, aged 3-16, in London, UK. Ages of third molar crypt, initial cusps and crown complete stages were compared with published results of the same contemporary group. Our results show that 32 of 38 tooth formation ages from Nolla's data were not significantly different to contemporary boys. Incisors, canine and second premolars stage 10 (root apex mature) were later in contemporary boys. A possible explanation for some of these differences is the type of x-ray used. Peri-apical x-rays have been replaced by a single panoramic radiograph and roots of anterior teeth are less clearly imaged. Our results suggest the lack of a secular trend in timing of tooth formation and provide new results from a rare longitudinal study.

Flexibility in within-group spatial position, individual spacing and feeding success in the Sanje mangabey (*Cercocebus sanjei*)

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Animal species may respond to fluctuations in food availability by altering aspects of their sociality. Primates may be able to maintain low feeding competition and prevent declines in food intake by varying spatial position within the group and altering inter-individual spacing. This paper specifically tested whether seasonality in the availability of ripe fruits affects the spatial position preferences and inter-individual spacing of different age/sex classes within a Sanje mangabey (*Cercocebus sanjei*) troop, and their subsequent foraging success. Behavioral data of adults, sub-adults and juveniles were collected using focal animal sampling between December 2010 and November 2011, from a fully habituated mangabey group (n=69) inhabiting a highly seasonal and mosaic environment in the Udzungwa Mountains National Park (UMNP), Tanzania. Spatial position preferences of the different age/sex classes were significantly different between periods of high and low ripe fruit availability ($p < 0.0001$). Mangabeys were predicted to space themselves further apart when feeding and foraging during the low fruit period but average inter-individual distances for all individuals were significantly lower during the low fruit period in front-center, center and back-center positions ($p < 0.0001$). Foraging success varied significantly by ripe fruit availability, with front-center and center positions experiencing significantly higher feeding-foraging ratios during the high ripe fruit period, as expected (FC: $p = 0.036$, C: $p = 0.011$). Behavioral flexibility may be a critical influence on levels and types of intra-group feeding competition experienced by a primate group and thus can obscure predicted relationships between resource availability and social relationships.

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Social constructs, health and burial strategy: Mortuary variation and skeletal analysis of First Intermediate Period Mendes

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In 2012 and 2013, the Pennsylvania State Expedition to Mendes excavated eight First Intermediate Period interments. Seven interments contained single individuals, and the eighth was a mud brick tomb containing five individuals. Of the twelve individuals, eight were classified as "adult," four as "sub-adult," and two as "infant." The very poor skeletal preservation, due to centuries of saturation and dehydration, made age estimation difficult, and sex estimation impossible. These burials do, however, offer new information about health and burial strategy in a period of Egyptian history underscored by significant political, economic and social change.

The majority of information about health and stress came from the teeth. Linear enamel hypoplasia were noted among most adult individuals, and in sub-adult individuals. Contrasting the wide-spread appearance of LEH, one individual displayed dental calculus and no observable LEH.

The burials of Mendes generally follow patterns established by Egyptologists. That there appears to be a family unit in the mud brick tomb

surrounded by satellite burials, possibly of extended family members, aligns with the pattern noted by Egyptologists among cemeteries of this time period.

Despite adhering to pattern, these burials show distinctions which could be attributed to socio-economic differentiation irrespective of age. In the tomb, the infant was interred the same way as the other individuals both within the tomb and the wider cemetery. The infant outside of the mud brick tomb, however, received no burial accoutrement whatsoever. This demonstrates a clear difference in social position starting in infancy, even amongst the non-elite class.

Tough times don't last, tough lemurs do: Using $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ to examine the responses of *Lemur catta* to natural disasters at the Beza Mahafaly Special Reserve

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Ring-tailed lemurs (*Lemur catta*) are a resilient species that live throughout southern Madagascar in many habitats that are harsh and unpredictable. At the Beza Mahafaly Special Reserve, we used stable carbon ($\delta^{13}\text{C}$) and nitrogen ($\delta^{15}\text{N}$) isotope values from lemur hair to examine how *L. catta* responded to natural disasters from 2003-2006. We present $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ values for 36 lemurs from 12 social groups for which have multiple years of data. In 2004 and 2006, this region experienced a drought, in 2005 a cyclone, while 2003 was considered a normal year. Comparing normal, cyclone, and drought years revealed significant differences in $\delta^{13}\text{C}$ ($F_{2, 92.1} = 8.28$ $P < 0.001$) but not $\delta^{15}\text{N}$ ($F_{2, 97.3} = 0.86$ $P = 0.43$). Mean $\delta^{13}\text{C}$ values were highest and most variable during the cyclone ($-24.6\% \pm 1.0$) in comparison to the drought ($-24.5\% \pm 0.5$) and normal year ($-24.1\% \pm 0.5$). There was slightly more variability in $\delta^{15}\text{N}$, but little overall change in mean values. The drought year exhibited the highest values ($7.2\% \pm 0.7$) while the cyclone ($7.0\% \pm 0.8$) and normal years ($7.0\% \pm 0.7$) were similar. Groups inhabiting regions of the reserve that were most impacted by the cyclone showed the more divergence in feeding patterns and for $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$. This study is the first to use $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ values to understand how a nonhuman primate responds to natural disasters and environmental uncertainty, and underscores the importance of interpreting isotope values in an ecological context through time.

A morphometric analysis of subadult sciatic notch shape

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This study is an examination of the correlation between age and sciatic notch morphology in subadults. Using both visual and metric assessments, 57 ilia from the Scheuer Collection

were examined. Ages of the specimens ranged from neonate to 19 years. Particular focus was given to the degree of symmetry in this feature, while attributes such as depth, width, angle, overall shape and placement of the notch were evaluated as well. Age was observed for variation at one year intervals, and later five age groups were constructed based on similar morphology.

Results indicate a correlation between age and the levels of asymmetry in the sciatic notch, with certain age groups consistently exhibiting a greater degree of asymmetry than others. The direction of the asymmetry was also significant, as younger individuals most often exhibited asymmetry to the anterior side and older individuals exhibited asymmetry to the posterior side. With the exception of a few neonates, posterior asymmetry did not emerge in this material until approximately 12 years of age. This may directly relate to the fusion of the ischium, as a portion of the ischium then becomes a component of the sciatic notch. The influence of this fusion has not been noted before; however, these results suggest a significant shift in the shape of the sciatic notch around the time of fusion. This examination investigates a previously neglected area of study and presents a foundation for future research in this area.

Premolar lost, variation gained: Posterior dental proportions in anthropoids and testing adherence to a mammalian developmental model

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Increased understanding of the developmental processes that influence posterior tooth crown size and proportions has resulted in models that can be used to predict molar patterning within and among species. Recently, an inhibitory cascade (IC) developmental model, validated in several families of mammals, has been proposed that predicts progressive increase or decrease in tooth size along the molar row and explains loss of M3. However, premolar loss in some rodent and canid taxa has been found to result in lower predictability of IC. The loss of P2 in catarrhines compared to platyrrhines provides an excellent test of the applicability of the mammalian IC model to anthropoid primates. This study examines occlusal areas of the maxillary and mandibular postcanine dentition in a taxonomically diverse sample of extant anthropoid primates (n = 184). Results show that (i) of the four molar proportions known in mammals, platyrrhines exhibit three and catarrhines exhibit all four, (ii) proportions of molars are influenced by the presence or absence of P2, and (iii) M1 and M3 are the most variable teeth in the molar row, whether or not P2 is present. The majority of sampled platyrrhines (72.5% maxillary, 64.2% mandibular) adhere to the developmental morphospace predictions of the IC model, whereas the majority of

catarrhines do not (38% maxillary, 34.3% mandibular). We hypothesize that P2 loss in the evolutionary history of catarrhines released developmental constraints on the posterior dentition, thereby allowing for increased phenotypic variation of the dental proportions on which selection could act.

Comparing the molar proportions of *Sahelanthropus tchadensis* to australopiths and extant hominoids

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Maxillary and mandibular molars are associated with *Sahelanthropus tchadensis* from the late Miocene of Chad. The dental proportions of *S. tchadensis* should resemble those of the South African australopiths more than extant hominoids given the smaller temporal interval separating the Miocene and Plio-Pleistocene forms. To examine this assumption, mesiodistal and buccolingual dimensions of the molars of *S. tchadensis* (TM 266-01-060-1 and TM 266-02-154-1) are compared to those of *Australopithecus africanus* (Sts 53, Stw 11, Stw 384, Stw 404 and TM 1511) and *Paranthropus robustus* (SK 6, SK 13/14, SK 23, SK 48 and SKW 5). Comparative data include *Gorilla gorilla* (n = 11), *Hylobates lar* (n = 8), *Pan paniscus* (n = 3), *Pan troglodytes* (n = 9), *Pongo pygmaeus* (n = 9), *Homo sapiens* (n = 7) and *Samburupithecus kiptalami* (KNM SH 8531). It is expected that *S. kiptalami* will resemble *Gorilla*. Canonical scores axes from a discriminant function analysis with 68% confidence ellipses around group centroids for each taxon show *S. tchadensis* falls within the range of South African australopiths when maxillary mesiodistal molar lengths are compared. *Samburupithecus kiptalami* is distinct from both *S. tchadensis* and the South African australopiths and partially resembles *Gorilla* males. When mandibular molar mesiodistal lengths as well as buccolingual widths of the first and third molars are compared, *S. tchadensis* again resembles australopiths, and secondarily, *H. sapiens*, more than it does any of the apes. These results indicate that *S. tchadensis* is australopith-like in its molar proportions and does not resemble extant hominoids.

Landscape ecology of fruiting trees in Kibale National Park, Uganda: Effects of logging history and implications for tree population genetics and primate seed dispersal

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The distribution and population biology of fruiting trees have important implications for frugivore feeding and seed dispersal, although few studies have integrated information on spatial ecology, genetic structure and disturbance history on specific primate-plant interactions. Here, we use Global Positioning System (GPS) and molecular analyses to examine the role of logging history on distribution and population

genetics of a primate-dispersed tree species, *Cordia abyssinica*, in adjacent forest compartments of Kibale National Park, Uganda. We mapped all mature *C. abyssinica* trees in one 10ha plot in both an unlogged (K30) and logged (K14) forest compartment, and calculated tree density (n/ha) and dispersion (I_d) for each. Additionally, we sampled bark (n=39) and leaves (n=23) of all 59 adult *C. abyssinica* trees to evaluate relatedness and spatial genetic structure. *C. abyssinica* was randomly distributed in both forest types ($I_d=1.11$, $\chi^2=7.88$, $p>0.05$); however, density differed significantly between compartments (d=5.8/ha, K14; d=0.1/ha, K30; $p<0.01$), with more trees in the logged plot. We also found a significant increase in *C. abyssinica* density (d= 5.8/ha; $p<0.01$) since cessation of logging (1992, d=0.2/ha; 1972, d=0.0/ha; Chapman et al. 1997). Extractions of DNA for microsatellite genotyping have been successful and primer screening is underway. These results illustrate the role of anthropogenic disturbance on tree recruitment and demonstrate that disturbance effects may not be evident for many years. We aim to integrate these data with results of microsatellite genotyping to evaluate the interactions of spatial ecology, genetic structure and disturbance history on specific primate-plant interactions at a landscape level.

Non-ornamental dental modifications in Viking Age Denmark

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In the Nordic countries dental modifications of maxillary incisors for ornamental purposes were unknown until 2005, when filed grooves were found in some male Swedish Vikings.

The purpose of this study was to examine maxillary incisors for filed grooves on facial surfaces of the crowns and distinguish such grooves from linear enamel hypoplasia of furrow type (LEH). The material studied was dentitions belonging to male and female skeletons dating from Danish Late Iron Age and Viking Age (ca. 600-1050 A.D.). The teeth were examined under slight magnification and the prevalence of LEH in the dentitions in general was high based on affected canines (59%).

The dentitions with horizontal grooves on maxillary incisors were divided in two groups: 1) Facial grooves associated with LEH on other teeth in the dentition; 2) Facial horizontal grooves without macroscopic hypoplastic grooves on other teeth in the dentition. Horizontal grooves were observed in both males and females in adult and mature age. Two thirds of the affected maxillary incisors belonged to group 1 (28%). LEH appeared as single or multiple shallow grooves which often had perikymata grooves in the floor of the grooves. One third of the affected maxillary incisors belonged to group 2 without associated LEH (10.5%). These were filed teeth but horizontal striation was not always present. Usually the central incisors only were affected with more or less superficial grooves of various width and depth. The grooves were not deeper in mature than in adult individuals.

Sex differences in the development of long-term association patterns among wild chimpanzees (*Pan troglodytes schweinfurthii*)

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Among adult chimpanzees, males are more gregarious than females. Adult male-male dyads show increased party association, proximity and grooming rates with one another compared to female-female and male-female dyads. This pattern is likely because male chimpanzees are philopatric and rely on strong social relationships to facilitate cooperative behaviors, such as boundary patrols. Data on the development of this sex difference is limited and it is unclear if young males are more gregarious than females even at very early ages. To examine these patterns, we used 24 years of behavioral data (1988-2012) from 36 non-adult males and 35 non-adult females living in the Kanyawara community of chimpanzees in Kibale National Park, Uganda. We tested the hypothesis that young males show earlier and increased levels of gregariousness compared to young females. We first examined sex differences in patterns of association (party association, proximity and grooming) with mothers and found that males start reducing their association with their mothers at the age of 8 while females continue to maintain strong association rates with their mothers until they transfer to new communities around the age of 13. Between the ages of 8 and 12, males continuously decrease the frequency of association with their mothers while increasing their association with adult males. We also examined differences in the social networks of non-adult males and females and found that young males increase the number of connections in their social networks as they age compared to young females who concentrate their association with family members.

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Consequences of habitat partitioning by *Pan* and *Gorilla* from Cameroon for life histories

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An isotope study on hair has shown distinctions in isotope composition between gorillas and chimpanzees from an interior west-east transect of equatorial Cameroon, emanating from the same altitude (Lee-Thorp & Macho, 2014). Where the areas overlap the two taxa differ in $\delta^{13}\text{C}$ but not $\delta^{15}\text{N}$, while adjacent groups differ in both $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$. This was interpreted as gorillas inhabiting more closed areas where they are sympatric with chimpanzees. To assess the biological consequences of such habitat partitioning, an ontogenetic series of 35 gorilla and 44 chimpanzee skulls was analysed for patterns of tooth mineralisation/eruption and brain size increase. Evidently, gorillas develop more slowly than chimpanzees such that only

about 87% of adult brain size is attained by the time first permanent molars come into occlusion (93% in chimpanzees). Even when M1s are already in full functional occlusion, gorilla brains lag behind those of chimpanzee (91% versus 99%). The findings are consistent with the "risk aversion hypothesis" for frugivorous species, and with life history theory that predicts delayed development when non-density dependent mortality is low, i.e. in closed habitats. This highlights the plasticity of hominoid life histories, although -regrettably- this study cannot be extended to the gorillas preferring more open habitats (Lee-Thorp & Macho, 2014) due to lack of skeletal material. Nonetheless, the findings caution against simplifications when interpreting early hominin life histories and highlight the importance of dietary ecology and habitat preference for life histories.

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The scapula of *Australopithecus sediba* in the context of orthograde climbing

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Previous efforts to characterize hominin positional behavior have focused on morphological affinities to living hominoid genera, rather than the mechanics of locomotion. For the current study, we analyze variation in wild chimpanzee orthograde climbing, and compare this to variation in chimpanzee scapular morphology. Morphological features associated with specific climbing postures were then evaluated in the scapula of *Australopithecus sediba* (MH 2). Analysis of nearly 40 hours of video shot at Gombe National Park, Tanzania of over 20 individuals indicates that overhead reaching varies across chimpanzees. Video stills of climbing bouts were measured with ImageJ. We hypothesize postural variation is related to body mass. Stabilizing postures are relatively constant across individuals; we find that features associated with this posture, such as spine projection beyond the joint, scale positively with body mass, consistent with the mechanical demands of supporting greater body mass. During initiation with the substrate, smaller bodied chimpanzees reach and grasp trees significantly higher than large chimpanzees. A morphological study of 50 wild-shot chimpanzee scapulae was performed to determine lengths and areas calculated from three-dimensional landmark data of the fossae, spine, and glenoid. High overhead reaching seems to be more accessible to smaller individuals; morphological features such as infraspinous fossa size scale negatively with overall size, suggesting that these individuals may be better mechanically organized to accommodate this posture. The Malapa specimen is comparable to small bodied chimpanzees, suggesting that *Au. sediba* may have engaged in similar overhead reaching during orthograde climbing.

Femoral and tibial cross-sectional morphology reflects complex change in sex roles, mobility, and division of labor across ~6200 years of agriculture in Central Europe

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The plasticity of lower limb bone diaphyses to changes in mobility associated with behavioural variation at the transition to agriculture has been well-documented. Subsequent cultural change should continue to drive functional adaptation, yet long-term diachronic trends in lower limb robusticity remain poorly understood. This study uses cross-sectional geometric properties to compare bone rigidity (*J*) in response to changing divisions of labour, technology, and task specialization following the transition to agriculture in Central Europe. Properties were obtained from laser scans of adult femora (N=226) and tibiae (N=200) across four time periods (~5300 BC-900 AD). Among males, the Neolithic through Iron Age saw tibial gracilization but no change in femoral rigidity. In the Medieval period, femoral rigidity increased but tibial rigidity remained similar (all $p < 0.000$). In females, *J* consistently increased in the femur and decreased in the tibia through time with the exception of significant but temporary interruption in these trends among Bronze Age femora and Iron Age tibiae (all $p < 0.003$). These differing patterns of change in rigidity between limb segments imply region-specific adaptive capacity to mechanical loading, supporting previous research indicating greater constraint on femoral diaphyseal responsiveness to loading. Results suggest that, despite the expansion of trade networks, male mobility decreased through time alongside technological advancement and mechanization. Female mobility was more varied, being particularly low in the Bronze Age then rising to equal male levels in the Iron Age. Sex roles appear to have changed in complex ways through time and were particularly variable among females.

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The elbow morphology of a short-tailed platyrrhine (*Cacajao calvus*) and its bearing on the evolution of tail loss in early hominoids

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It has formerly been hypothesized that hominoid tail loss was functionally related to an increased mobility of the forelimb, which would have theoretically replaced the tail as a mechanism of balance during arboreal quadrupedal locomotion (Cartmill and Milton, 1977; Kelley, 1997). The uakari (*Cacajao*) is one of the few arboreal quadrupedal anthropoids that has undergone a functionally significant reduction in tail length in parallel with the hominoids, and represents an ideal taxon for use

in testing this hypothesis that has not been considered previously.

Therefore, to more thoroughly test this functional relationship between forelimb mobility and tail loss, 14 linear and two angular measurements were collected from the elbow joints of *Cacajao calvus* (n=4) and *Chiropotes satanas* (n=8), the long-tailed arboreal quadrupedal sister taxon of *Cacajao*. Linear measurements were used to calculate seven indices that with the angular measurements reflect forelimb mobility at the elbow. A Mann-Whitney U test was used to compare the indices and angles between these two closely related taxa to determine if the short-tailed *Cacajao* possesses an elbow morphology indicative of greater forelimb mobility than the long-tailed *Chiropotes*.

The results of these analyses indicate that *Cacajao* and *Chiropotes* are quite similar in terms of their elbow morphology. However, *Cacajao* has a significantly more circular radial head ($U=3.5$, $p=0.028$), which suggests that this short-tailed arboreal taxon has a greater range of forearm rotation than its longer-tailed relative. Thus, the results of this study provide support for the relationship between tail loss and forelimb mobility.

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The Bones and Behavior Project protocol for the standardization of human skeletal measurements

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The Bones and Behavior Project evolved from a mutual recognition by scholars from a range of sub-disciplines that biological anthropology is hindered by the lack of standardization of measurement techniques and comparability of datasets across studies on human and non-human primate biology. This gap arguably inhibits our ability to conduct comparative research and, moreover, hinders efforts to address overarching evolutionary questions. We focused on a set of core measures (Integrative Measurement Protocol) from across the sub-disciplines that address issues of universal concern and that could be made maximally comparable. The protocol includes 'nonskeletal' measures (e.g., body weight, stature and frame size) and 'proxies for key skeletal measures' that can be approximated on both living and skeletal samples.

Here, we present the protocol for standardized approaches to human skeletal measures and their non-skeletal proxies. To develop the protocol we reviewed a wide array of texts/publications, and synthesized and refined descriptions for the most commonly applied cranial and post-cranial skeletal measurements. We developed a description of each measurement, including anatomical landmark terminology and high

resolution images/illustrations, and recommend the best equipment and kinds of populations (i.e., skeletal human, skeletal non-human primate, and/or living human, non-human primate) for each measure. Current efforts focus on providing video links that demonstrate the correct technique for collecting each measurement. This user friendly reference guide is freely available from the project website (http://www.bonesandbehavior.org/human_skeletal_protocol.pdf). The protocol will minimize intra- and inter-user variability among scholars of varying levels of expertise and increase comparability between human biology and skeletal studies.

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Factors associated with spontaneous multiple pregnancies in a sample of women who delivered pre-term, low birth weight babies

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Twin pregnancies in humans are of interest to biological anthropologists because twinning may increase or decrease maternal evolutionary fitness. There is agreement that population differences in twin birth frequencies are due to more frequent polyovulatory events and/or the ability to sustain pregnancies resulting from polyovulatory events. In this study we determine which demographic characteristics and SNPs are associated with multiple pregnancies in a sample of 227 mothers of infants with extremely low birth weight (401–1000 g and <72 hours of age). We found that maternal smoking during pregnancy was more common among mothers of multiple pregnancies (odds ratio = 4.154, $p=0.021$, 95% CI = 1.24, 13.96). Eight genomic areas had SNPs significantly associated with multiple pregnancies, where the significance was established with Fisher's exact test using Bonferroni's correction. Specifically, two SNPs associated with the MTHFR gene (rs3737966 AA $p=0.006$; rs6541003 AA $p=0.005$), the MDM4 gene (rs4846049 GG $p=0.001$; rs10900595 AC $p=0.0050$) and the PT53 gene (rs8079544 TT $p=0.025$) were associated with multiple pregnancies. Some of these same genomic areas have been reported in other populations (Tagliani-Ribeiro et al., 2012). Given that most human genetic variants are shared across populations, we expect to find at least some of these genetic markers among women who produce multiple pregnancies in other human populations. We discuss likely evolutionary scenarios which maintain these markers at their current frequencies.

Mating behavior and female choice in wild northern pigtail macaques

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Northern pigtail macaques (*Macaca leonina*) live in multi-male multi-female social groups characterized by steep dominance hierarchies and non-seasonal promiscuous mating. Male infanticide has been reported in captive groups. We studied mating behavior in a group of wild northern pigtail macaques in Thailand. The group included 8 adult males and 13 adult females. A total of 343 consortships between male and estrous females were observed during the 15-month study period. Females of all ranks consorted more with the alpha male than with other males, but this bias toward the alpha male was significantly greater for high-ranking females than for the other females (chi square = 63.16; $df=2$; $p<0.0001$). During consortships, proximity was mainly maintained by the male, suggesting intense mate guarding. Copulation calls occurred in 11.5 % of all observed copulations (n= 1,778) and were given more frequently by high-ranking females ($F_{2,234}=28.098$, $p<0.001$). Mount series containing copulation calls were more likely to end with ejaculation ($F_{1,473}=6.29$, $p=0.01$) than those without calls. Although copulation calls elicited the interest of other males, females were less likely to change mating partners after calling. Our results suggest that northern pigtail macaque females prefer to mate with the alpha male and that this preference is particularly evident in high-ranking females. Copulation calls appear to encourage male ejaculation and mate guarding. Copulation calls express high-ranking females' post-copulatory choice for dominant males, thus facilitating the concentration of paternity in the alpha male and presumably benefiting from his protection against infanticide.

Population dynamics among the Classic and Postclassic period Maya in the Northern Maya Lowlands: The analysis of dental morphological traits

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Previous regional studies have shown that models like that of "isolation-by-distance" do not apply to ancient Maya populations, at least within the limited geographical space of the Yucatán peninsula, where intense population mobility was linked to trade and political sphere of influence of city-states. Nonetheless, the question about continuity or replacement in the shift from the Classic to the Postclassic still needs to be thoroughly investigated. The present analysis addresses the question of morphological affinities through the lens of dental morphological traits, analyzing eighteen skeletal collections from the Northern Maya Lowlands, dated to the Classic and Postclassic periods. Dental morphological traits have been scored following the ASUDAS standardized scoring system. Patterns of morphological affinities were calculated using thirty-six variables extracted from twenty-four traits. Cluster Analyses -UPGMA and Ward grouping methods- Principal Components and Maximum Likelihood, tested with bootstrap, have been

performed. Results indicate a great deal of homogeneity among all sites, which once again witnesses the existence of intense population dynamics across the peninsular landscape. Nonetheless, a certain degree of similarity is noted among sites involved in the inland corridor that connected the Northern Peten to the Northern Maya Lowlands during the Classic. On the contrary, the Posclassic sites do not stand away from the Classic ones, but instead tend to group among one another within the distribution of the Classic period sites. This pattern is interpreted as representing some similarity related to chronology within a trend of biological continuity through time without highlighting specific geographical patterns

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The trajectory of human prenatal enamel growth slows through the trimesters

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Typically, human fetal growth rates change through the trimesters depending on the tissue type. Linear growth in long bones peaks in the second trimester and increases in fetal weight are greatest in the third. Human deciduous tooth enamel starts to develop at different times in utero, commencing with the central incisor and lastly with the second molar. But whether the trajectory of prenatal enamel growth remains the same for each tooth type is poorly understood. Here, I use histological methods to determine how long it takes a 250µm (in 25µm increments) thick layer of prenatal enamel to form in maxillary incisors, canines, and molars ($n=88$). I also calculate prenatal extension rates to assess how quickly these teeth grow in height. I relate the trajectory of growth in thickness and height to the trimesters. Findings are tested on mandibular lateral incisors and second molars ($n=33$).

Results show that the growth trajectory changes through the trimesters. Incisor enamel initiated early in the second trimester and 250µm formed over 52-57 days. Canines and second molars initiated closer to birth and required 60-64 days to form the same depth of enamel. Although initial extension rates were positively correlated with crown height within each tooth class (incisors, $r=0.714$; molars, $r=0.676$), they were significantly greater ($p<0.005$) in incisors when compared to the taller canines and second molars. These findings provide evidence that initial prenatal enamel growth is faster in incisors than all other deciduous tooth types. I infer this is related to their early postnatal eruption.

Identifying homologies among claws and nails: Implications for primate evolution

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The digits of most living primates possess flattened nails, which are thought to be derived from an ancestral mammalian claw. Claws and nails follow the shape of the underlying distal phalanx, but the distal phalanges of primates bear little resemblance to those of claw-bearing

mammals. Therefore, studies of the evolutionary transition from claws to nails are difficult to conduct. Identification of homologous parts of primate and non-primate distal phalanges is needed to better inform such analyses.

In this study, nail-bearing primate digits ($n=7$ species) and claw-bearing non-primate digits ($n=6$) were microCT scanned with a Scanco VivaCT75 scanner and/or dissected to determine potentially homologous structures using soft tissue insertions. Tendon and ligament attachment sites and relationships between the apical pad, claw/nail, and bone were studied and compared among digits.

Two significant structures are identified in both claw- and nail-bearing digits: the volar process and the ungual process. The former is related to the apical pad, while the latter projects above and/or beyond the pad to support the claw or nail. Primate nails must have been acquired through an expansion and elongation of the volar process and a mediolaterally widening of the ungual process. This is in contrast to other mammals that have lost claws, but do not retain nails (e.g., the manual digits of the claw-less otter). These species have reduced and/or lost an ungual process. Finally, the presence and form of the ungual process can be used to infer the presence of claws or nails in the fossil record.

The Black Sheep of Europe: Dental odontology in Medieval, Post Medieval, and Modern Basque populations from Vitoria, País Vasco, Spain

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The linguistic, cultural and biological uniqueness of Basques has long interested anthropologists. Although studied extensively for genetic markers, including mtDNA and Y chromosome haplogroups, little attention has focused on the Basque dentition. A recent study of dental morphology shows Basques have a classic European dental pattern but they are an outlier in the context of other European populations. To follow up on the study of Basque crown and root morphology, mesiodistal (MD) and buccolingual (BL) crown diameters were obtained for living Basque, Spanish, and Spanish-Basque samples along with medieval and post-medieval samples from the Cathedral of Santa María in Vitoria, País Vasco, Spain. Excluding third molars, total crown areas (MDxBL) for premolars and molars were plotted to assess temporal variation among living and historic Basque populations and also determine where Basques fall on a world wide scale against diverse samples. For genetic markers and dental morphology, Basques are outliers in the context of other Europeans. The same is true for odontology as Basques have low total crown areas comparable to other small-toothed populations, including Lapps (Sami), Bushmen (San), and Ainu. For comparisons among Basque samples, the modern population had the smallest teeth. While the European character of the Basque dentition is evident, their status as an outlier is indicated once again in tooth size.

Cooperative breeding and maternal energy expenditure among Ngandu farmers of Central Africa

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Throughout human evolutionary history and among natural fertility populations today, mothers face tradeoffs in energy allocated towards subsistence and childcare. Scholars have proposed cooperative breeding as a method to mitigate the risks associated with rearing highly dependent offspring. Here we examine the effects of non-maternal helpers on maternal energy expenditure (EE), caregiving patterns, and nutritional status among the Ngandu farmers of the Central African Republic. We hypothesize that non-maternal helpers will assist mothers in subsistence activities, allowing them to allocate more energy towards childcare, or they will help mothers with childcare, allowing them to invest more energy in subsistence activities. We test these predictions among 32 Ngandu mother-child (<40 months old) dyads. We utilize detailed quantitative behavioral observations to determine maternal time allocation and EE as well as maternal and allomaternal caregiving patterns. Results indicate that allomothers differentially affect EE in domestic versus non-domestic activities. Additionally, leisure activities, the presence of high investing caregivers, and seasonality were positively associated with maternal nutritional status. Our results suggest that grandmothers and high investing caregivers alter maternal EE and subsistence-childcare tradeoffs. These findings provide support for cooperative breeding as a strategy to mitigate costs associated with maternal life history tradeoffs. We discuss the implications for maternal reproductive strategies and health.

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Influence of variation in arthropod availability on the foraging ecology of white-faced capuchin monkeys (*Cebus capucinus*)

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The influences of spatial and temporal variation in resource availability on foraging behavior are well studied in many primate species. However, little is known regarding the influence of changes in arthropod availability on the foraging ecology of insectivorous primates. *Cebus capucinus* are a highly insectivorous primate, with invertebrates accounting for much as much as 68% of time spent feeding or foraging. In order to better understand how variation in arthropod availability influences the activity budget and foraging behavior of capuchins, a group of 23 *C. capucinus* was followed for a 12-month period at La Suerte Biological Field Station in northeastern Costa Rica. Using instantaneous focal sampling with a 2-minute interval, information on activity budget and diet were collected for adult female ($n=5$),

adult male (n=4), and juvenile (n=13) *C. capucinus*. Arthropod availability was measured as the number of arthropods collected in canopy insect traps (n=10) and sweep nets (n=10) at 2-week intervals. Preliminary results indicate that arthropod availability was positively correlated with the percentage of invertebrates in the diet (Pearson correlation, $r=0.66$, $p=0.01$), and negatively correlated with total time spent feeding or foraging (Pearson correlation, $r=-0.70$, $p=0.007$). In contrast, there was no association between arthropod availability and time spent feeding or foraging for invertebrates (Pearson correlation, $r=-0.34$, $p=0.26$). These results indicate that seasonal changes in arthropod availability in addition to seasonal variation in fruit availability may shape *C. capucinus* foraging behavior.

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Bonobo sociality in context: A critique of the self-domestication hypothesis

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The self-domestication hypothesis (SDH) posits that behavioral, psychological, and morphological characteristics of bonobos (*Pan paniscus*) emerge via mechanisms of *natural selection* that are functioning in an analogous manner to processes of *artificial selection*. That is, natural selection for reduced aggressiveness and/or increased social tolerance accounts for not only the differences in the intensity of aggression within bonobo and chimpanzee (*Pan troglodytes*) societies, but also the presence of additional traits associated with the process of traditional animal domestication (e.g., reduced cranial size). Here we present a critique of the SDH based on a combination of semantic, analytical, and theoretical bases. We present a synthesis of supporting data from both field- and captive-based bonobo studies, and describe a social world that is both flexible and context dependent, and importantly, includes many complex behavioral patterns not easily dichotomized as either "peaceful" or "violent". Next we contextualize these findings against a backdrop of social system variants within the Superfamily Hominoidea. This represents a critical step in our critique as it establishes the basal pattern of evolutionary forces and processes at work within the hominoid clade. As such, demonstrating that plasticity in group composition and social dynamics is a phylogenetic heritage of the extant hominoids means that significant behavioral changes in any particular ape lineage does not necessarily involve *de novo* evolutionary innovations (i.e., self-domestication), but rather represent the enhancement and modification of preexisting patterns; specifically those patterns of plasticity and behavioral complexity noted as shared among the hominoids.

Grips and hand movements of chimpanzees during feeding in Mahale Mountains National Park, Tanzania

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Comparison of chimpanzee and human manipulative capabilities has been central to debates about the evolution of the human hand. Until now data on chimpanzee manipulative behavior have been drawn almost entirely from observations of captive subjects. This study analyzed data on food retrieval and processing from videotapes of chimpanzees in the Mahale Mountains National Park, Tanzania. Data were analyzed for 11 grips and 2 hand movements (finger probe and palm thrust) by 44 chimpanzees. These occurred during arboreal and terrestrial feeding involving 10 foods and associated vegetation. It was predicted that (1) a wider range of manipulative behaviors would be found in wild than in captive subjects, (2) precision grip forces would not be high, and (3) precision handling capability would be observed. Results were consistent with the first prediction and, with a few possible isolated exceptions, with the second, but precision handling was not observed. New grips involving the full thumb and index finger, and a new integrated pattern of grips and forceful hand movements were discovered, associated with feeding on large fruits and meat. Participation of the full thumb in these grips, which often involve high force, throws light on feeding behaviors that may have become increasingly significant factors in the evolution of derived hominin thumb morphology. The isolated qualitative observations of possibly strong pinch by the thumb and side of the index finger highlight the need for comparative quantitative data to test whether humans are unique in forceful precision gripping capability.

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Navicular remains of *Anchomomys frontanyensis* (Adapoidea, Primates) from the Middle Eocene of Sant Jaume de Frontanyà (Northeastern Spain)

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The Robiacian (MP14-15) locality of Sant Jaume de Frontanyà has yielded an exceptional assemblage of primate dental remains and postcranial bones of adapiforms and omomyiforms. In the oldest levels of this site (3C and 3D), three different taxa have been recovered: a currently indeterminate and possibly new species of *Adapis*, the anchomomyin

Anchomomys frontanyensis and the omomyoid *Pseudoloris pyrenaicus*.

Here we report the recovery of eight complete and one incomplete primate naviculars from these levels. These bones are assigned to *A. frontanyensis* based on an appropriate size relative to dentitions and a calcaneus known for this taxon, as well as the presence of a diagnostic adapiform/strepsirrhine feature: a cuboid facet in contact with both the ectocuneiform and mesocuneiform facets. *A. frontanyensis* is especially interesting because of its small size, overlapping with many omomyiforms. Previously, differences in distal tarsal elongation between omomyiforms and adapiforms could not be resolved as an allometric effect or as reflective of a more basic difference between the two groups, differences in body size notwithstanding.

Preliminary analysis reveals proximodistal elongation greater than in naviculars of *Cantius* and *Notharctus*, but substantially lower than in those of omomyiforms such as *Teilhardina* and *Hemiacodon* for which data is available in the literature. Morphology is similar to extant *Cheirogaleus*, suggesting that *A. frontanyensis* might have been a small cheirogaleid-like primate in locomotor behavior. These results indicate that differences in distal tarsal elongation diagnostically separate adapiforms from omomyiforms, regardless of body size, possibly due to different histories of locomotor adaptation.

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Interproximal grooves reflecting habitual behavior and health in the Lepenski Vir culture (9500 - 5500 BC): Evidence from the Danube Gorges, Serbia

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Interproximal grooves in the vicinity of cement enamel junction of teeth have been observed in a numerous skeletal collections from 1.84 million years ago to the present. Many hypotheses have been presented to explain the etiology of these grooves. Even though their form and positioning are most consistent with tooth-picking behaviors, it is possible that they are caused from palliative probing. In this research interproximal grooving is examined on 89 individuals (1308 teeth) from the Danube Gorges anthropological collection (Lepenski Vir culture, eastern Serbia, 9500 - 5500 BC). Both macro- and microscopic (scanning electron microscope) descriptions of these lesions are provided in this study.

Interproximal grooves were detected in 12,3% (11/89) of individuals. They are detected on mesial or distal surface of molars (with exception of two canines). In 5 individuals grooves derived from palliative probing - either from the cleaning of caries lesions or as response to gingival irritation, since localized resorption of the alveolar bone have been detected. These individuals are dated back from the Mesolithic to the Neolithic, and it suggests palliative probing

has been practice in this culture over time. Interproximal grooves are also found in 6 individuals' dentitions with no signs of caries neither of periodontal disease which suggest that they resulted from diverse habitual or task-related activities.

By this research interproximal grooving is for the first time reported and analyzed in prehistory of the Danube Gorges, and has implications for our understanding of cultural behaviors practiced by this population.

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Rank effects on social stress in lactating chimpanzees

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Given the deleterious consequences associated with chronic stress, individual differences in stress susceptibility can have important fitness implications. These differences may be explained in part by dominance status because high rank is typically associated with decreased aggression and improved nutrition. Here, we examine the relationship between dominance and social stress in lactating chimpanzees (*Pan troglodytes schweinfurthii*) at Gombe National Park, Tanzania. We did so by pairing daily demographic and behavioral data with fecal glucocorticoid metabolite (FGM) concentrations collected over 37 months. While there was no main effect of rank, interesting differences emerged by adult subgroup size (LMM, $F_{1, 95.953}=5.049$, $P=0.027$) and adult sex ratio (males/females; LMM, $F_{1, 57.585}=5.174$, $P=0.027$). We found that differences in FGM concentrations between high- ($N=4$) and low-ranking ($N=10$) females were most pronounced as adult subgroup size and sex ratio increased. Low-ranking females had higher FGM concentrations in larger subgroups and in subgroups biased towards adult males; we observed no comparable change in FGM concentrations amongst high-ranking females. Because low-ranking females were the recipient of significantly more male aggression relative to females of high rank (Mann-Whitney Test, $U=2.5$, $P=0.008$), these patterns may be driven by psychosocial stress in low-ranking females. There was no significant change in diet quality across subgroup sizes; this finding suggests that nutritional stressors were not driving differences in female FGM concentrations. Being susceptible to social stress has important fitness implications as it may constrain low-ranking females from "choosing" optimal subgroups to take advantage of food resources and/or for the socialization of their offspring.

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Runs in the family: Osteoarthritis among biologically related individuals in Roman Turkey

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Commingle remains present challenging obstacles for anthropologists, as de-individualization of skeletal elements may encumber comparative palaeopathological research. However, palaeopathological and palaeoepidemiological pursuits should not be abandoned when commingling circumstances are encountered. This study compares the prevalence of osteoarthritis (OA) between two Roman period (second and third centuries AD) mass graves in Oymaağaç-Nerik, Turkey. Previous analysis of non-metric traits (i.e., *os tibialis externum*, OTE) has indicated biological relatedness among several individuals in 7384:009, while OTE prevalence was significantly lower among 7484:021 individuals. This relatedness variable enables comparisons of OA distribution between familial (7384:009) and non-familial (7484:021) groups at Oymaağaç. Ten synovial and fibrocartilaginous joints were selected for comparison among adults from 7384:009 ($n=17$) and 7484:021 ($n=23$) graves. Sample sizes varied for each joint, a result of diagenesis and excavation procedures, yielding a low survival rate for some joints (e.g., 7384:009 left sacroiliac joint, 12%). Employing paired t-tests, significant ($p<0.05$) differences in OA prevalence were calculated only for the right temporomandibular joint. Unfortunately, these results are primarily the outcome of small sample sizes for representative joints; adults buried in 7484:021 had higher prevalence values for both left and right sides in 8 of the 10 joints, but these differences are inflated by sample size. Therefore, there is currently no significant data to suggest correlations between osteoarthritis and different burial groups or correlations between osteoarthritis occurrence and related individuals in 7384:009. Nevertheless, this case study demonstrates a future approach for evaluating genetically, and contextualizing sociohistorically, osteoarthritis in commingled, and discrete, human remains.

Metric sex estimation in ancient Egyptian skeletal remains: A test of modern and population-specific methods

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Human skeletal remains can provide important insights into the civilisation of ancient Egypt. Sex is an essential component of the biological profile of an individual, and the demographic profile of a population. Metric sex estimation methods are frequently used when skeletal remains are fragmentary; however, metric techniques are prone to error as a result of

population differences in skeletal size and proportions. The purpose of this study is to test the accuracy of 12 metric sex estimation equations created using modern population samples, and two previously-created population-specific methods, when applied to ancient Egyptian skeletons.

The sample consists of 318 adult individuals dated to Old Kingdom ($n=106$) or Late Period ($n=154$) Giza, Pre-dynastic Period Keneh ($n=43$), Middle Kingdom Sheikh Farag ($n=13$), and New Kingdom Thebes ($n=2$). The sex of each individual was estimated using standard morphological methods. A total of 63 dimensions of the skeleton, or as many as was possible, were measured for each individual in the sample.

Intra-observer error tests revealed that the majority of measurements used are replicable. Testing of 12 modern metric sex estimation methods revealed total accuracy rates as low as 41.4%; many of the methods were exceptionally poor at correctly estimating the sex of males. Previously-created population-specific metric equations produced total accuracy rates ranging from 82.3% to 100%. New population- and time period-specific equations created using data from the study sample produced predicted rates of correct sex classification in excess of 90%. These results are relevant to all researchers working with ancient Egyptian skeletal remains.

Alpha male takeovers by immigrant males in crested macaques

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In primate species with high reproductive skew and male contest competition over access to females, migrations and alpha-male takeovers are high risk/high benefit events regarding predation, injuries and reproductive success. Migration strategies and their impact on male careers are poorly understood and existing data are mostly anecdotal. We therefore studied the influence of different migration strategies on male success in taking over alpha-male position. We analysed the migration behaviour of male crested macaques, a species with female philopatry and high male reproductive skew, to investigate when and how males immigrate into a new group and how this resulted in top dominance. All alpha male takeovers were observed upon immigration. We found two different immigration strategies. Either males migrated as "explorers" into a group and achieved high rank (often alpha-rank) or males migrated as "followers" and normally gained a low rank in the new group. In addition, we found that males emigrated from their natal group as heavy adults and were more likely to immigrate into a new group for the first time as explorers. We propose that male crested macaques delay their dispersal until they have reached a bodyweight that physically allows them to challenge established alpha-males. Our results thus indicate that the timing of migration is an

integral part of a male's career and strongly affects his future reproductive success.

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Morphometrics showing genetics: New approaches on evo-devo research

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Evo-devo research has made significant progress in revealing how specific developmental mechanisms affect the evolution of phenotypes. However, we are still far from a thorough understanding of the genotype-phenotype map. Genetics or morphometrics alone cannot bridge this gap. Here we combine molecular biology techniques, such as whole-mount in situ hybridization (WISH), and geometric morphometrics to visualize and quantify spatiotemporal dynamics of gene expression domains of two relevant genes for proximo-distal limb patterning, *Hoxa11* and *Hoxa13*, in association with limb morphology. Gene domains were segmented from WISH experiments in 212 limb buds from C57Bl6 mouse embryos between 10 and 12 post fertilization days using a semi-automatic multiple thresholding method. Principal Component Analyses based on Procrustes-aligned coordinates of 42 curve semilandmarks recorded along the outline of the limb bud and the gene expression domains described *Hoxa11* and *Hoxa13* ontogenetic trajectories as mainly driven by allometric shapes changes coupled with upregulation at specific key timepoints. Partial Least Squares showed that *Hoxa11* and *Hoxa13* are strongly integrated with limb morphology, except for *Hoxa11* after day 12. Modularity testing suggested an anterior-posterior compartmentalization of the limb bud early in development. Our method, besides performing accurate phenotyping of the genotype, can contribute to deciphering the complex gene regulatory network underlying limb patterning and have potential applications on biomedical and evolutionary research. It may provide testable hypotheses about the evolutionary processes and genetic changes that from a common ancestral pattern led to the great diversification of the primate limb and the unique evolution of human bipedalism.

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Analysis of lateral asymmetry in frontal, temporal, and occipital brain volumes in relation to right-frontal left-occipital petalia torque

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Petalia torque asymmetries are common in humans and various non-human primate species. However, their relationship with lateral asymmetry in different brain regions has not

been widely investigated. In this study, right-frontal left-occipital petalia torque asymmetry is examined with regard to cerebral gyrus volumes in the frontal, temporal, and occipital lobes, to investigate whether petalia torque is associated with increased volume and lateral asymmetry in areas of greater hemispheric projection.

MRIs from 134 individuals were used to evaluate degree of cerebral torque in the axial plane at 5 equally spaced slices beginning 10mm above the anterior cranial base using AMIRA. Gyrus volumes were calculated using BrainParser in the Laboratory of Neuro Imaging's LONI Pipeline. Linear regression analysis was used to test whether frontal, temporal, and occipital volumes were asymmetrical (Right - Left), and vary in relation to cerebral torque.

Lateral asymmetry for each frontal volume was found to be positively associated with cerebral torque. However, this relationship was only statistically significant for the middle orbitofrontal gyrus ($p=0.05$), which increases in volume more in the right hemisphere in association with greater right-frontal petalia. The superior temporal gyrus ($p=0.000$) and total temporal lobe ($p=0.002$) were also positively correlated with torque. The middle and inferior occipital gyri were strongly negatively associated with petalia ($p=0.001$, $p=0.011$ respectively), indicating that as left-occipital torque increases, volume of these more inferior gyri increase to a greater extent on the left side. These results have implications for understanding structure-function relationships in the brain and neighboring physiological systems.

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Assessing the demographic effects of Aztec Imperialism: Ancient mitochondrial and nuclear DNA evidence from Xaltocan, Mexico

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Between AD 1428 and 1521, the Aztec empire conquered numerous polities in the Basin of Mexico. At Xaltocan, an influential Otomi town, historical and archaeological evidence provide conflicting accounts of the demographic effects of Aztec imperialism. While colonial documents state that the Aztec conquest led to a replacement of the Otomi population, archaeological finds suggest a substantial degree of population and cultural continuity.

To evaluate whether genetic evidence is more consistent with population replacement or continuity, we previously analyzed ancient mitochondrial DNA (mtDNA) from 10 pre-Aztec and 16 Aztec Xaltocan individuals. We found that the Aztec transition was associated with a replacement of matriline, suggesting that Aztec imperialism might have had important

demographic consequences. In this study, we expanded our previous research by extracting ancient DNA from 16 additional pre-Aztec individuals. For all 42 samples from Xaltocan, we performed analyses to determine mtDNA haplogroups, mtDNA haplotypes based on 372 bp of HRVI sequence, autosomal genotypes for 15 short tandem repeats (STRs), Y-chromosome haplogroups, and Y-chromosome haplotypes based on 23 Y-chromosome STRs. All results were verified through multiple independent extractions and amplifications.

We identified kin groups in the pre-Aztec period and in the Aztec period, but no close biological relationships between pre-Aztec and Aztec individuals. Network analyses also showed that the pre-Aztec and the Aztec residents exhibited distinct mitochondrial haplotypes. Altogether, these results are consistent with a genetic shift across the Aztec transition. This study suggests that Aztec imperialism was associated with significant demographic changes at Xaltocan, yet substantial cultural continuity.

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Species identification and evolutionary history of slow lorises (genus *Nycticebus*) as inferred by nuclear introns

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Slow lorises are a group of strepsirrhine primates endemic to South and Southeast Asia, and are threatened by habitat loss and also wildlife trade in traditional medicines and for pets. All species within the genus *Nycticebus* are classified as either vulnerable or endangered by the IUCN. As cryptic nocturnal species, little molecular genetics research has been done to understand the evolutionary history of this enigmatic group. We sequenced 15 nuclear introns from nine individuals belonging to either *N. bengalensis* or *N. pygmaeus* obtained as smoked skins confiscated by the U.S. Fish and Wildlife Service. Augmented with publicly available sequences from other lorisiform species, we inferred a molecular phylogeny using parsimony, maximum likelihood and Bayesian inference, and compared methods of sequence concatenation to gene tree-species tree reconciliation to investigate the patterns of evolution within this radiation. We found support for *N. pygmaeus* as basal to the *Nycticebus* clade, consistent with previous studies. We also identified several single nucleotide polymorphisms (SNPs) and indels that serve as diagnostic characters between *N.*

bengalensis and *N. pygmaeus*. Molecular tools for species identification such as those developed here will greatly aid conservation efforts for these threatened taxa, as these tools can help support enforcement of wildlife trade laws and guide the reintroduction of confiscated animals to their proper habitat in the region.

The polemic question of Neandertal cannibalism from the perspective of the Mousterian site Les Pradelles (Charente, France)

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Since 2002, Les Pradelles is the subject of a joint collaboration between the CNRS and Princeton University. The excavations at the collapsed endokarstic gallery have resulted in the discovery of Quina Mousterian artefacts, a mammalian fauna dominated by reindeer. At the boundary between OIS 4 and 3, Neandertals used the site as a hunting camp. Eighty three hominin remains have been unearthed representing, at least, eight different individuals.

From this perspective, the site is one of the richest from southwest France. Most of these remains are represented by fragmented parts of skulls, isolated teeth and mainly shaft fragments from the upper and lower limbs, elements of hands and feet of adults as well as juveniles. Many pieces present evidence of anthropic modifications (i.e., fresh breaks, cutmarks in areas of muscular insertions) perhaps indicative of dismemberment and defleshing, percussion pits, and incipient fracture cracks. Moreover, with the exception of the skull, the anatomical representation of the Neandertal body is similar to that of the reindeer.

If cut-marks on human bones are difficult to interpret in terms of intentionality, the complete set of anthropic modifications on this hominin collection could be considered as good evidence of Mousterian cannibalism. Nevertheless, there is no consensus among the members of our scientific team concerning this interpretation. The present work will address the issues related to identifying cannibalism in the Neandertal fossil record.

Penis size interacts with body shape and height to influence male attractiveness

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Compelling evidence from many animal taxa indicates that male genitalia are often under post-copulatory sexual selection for characteristics that increase a male's relative fertilization

success under sperm competition. There could, however, also be direct pre-copulatory female mate choice based on male genital traits. Before clothing, the non-retractable human penis would have been conspicuous to potential mates. This, in combination with claims that humans have a large penis for their body size compared to other primates, has generated suggestions that human penis size partly evolved due to female choice. We presented women with digitally projected, fully life-size, computer-generated animations of male figures to quantify the (interactive) effects of penis size, body shape and height on female assessment of male sexual attractiveness. We generated 343 male figures that each had one of seven possible values for each of the three test traits ($7 \times 7 \times 7 = 343$). All seven test values per trait were within two standard deviations of the mean based on a representative sample of males. We calculate response (fitness) surfaces based on the average attractiveness rank each of the 343 male figure received. We discuss our findings in the context of previous studies that have taken a univariate approach to quantify female preferences. We discuss the hypothesis that pre-copulatory sexual selection might play a role in the evolution of genital traits.

Assessing ancestry through genetic sequencing of dental, osteological, and brain tissues recovered from the Erie County Poorhouse excavation

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The remains recovered from the Erie County Poorhouse Cemetery at the University at Buffalo offered a unique opportunity for the use of nondestructive analysis of remains for DNA isolation. Of the 383 skeletons collected from the cemetery, 166 brains were present. Following a protocol outlined in Rohland, et al 2004, the isolation of DNA from bone, tooth, and brain tissue was performed in order to determine which sample set could best yield DNA from nondestructive methods. Select brains, along with bone and tooth samples from matching individuals, were taken to the Paleo DNA Laboratory at Lakehead University for analysis in their clean lab facility. The samples were placed in Guanidinium Thiocyanate buffer and DNA was extracted. Quantitative Polymerase Chain Reaction (PCR) was run on nuclear DNA (nuDNA). Mitochondrial DNA (mtDNA) was examined via PCR and Sanger sequencing. Mitochondrial DNA isolation for teeth was the most successful, with 95% of samples yielding positive results, followed by brain tissue at 50%, and bone at 37%. Nuclear DNA was present in 65% of teeth, 12.5% of bone, and 0% of brain, but was never present in amounts high enough for further analysis. Mitochondrial DNA was sequenced in a total of 26 individuals, and the sequences used for assignment of mitochondrial haplogroups and ancestral analysis. Destructive analysis would likely have yielded nuDNA in greater amounts, but nondestructive analysis must be further investigated, since with protocols optimized, this avenue of study may provide physical anthropologists with a critical tool for analysis of past individuals.

Dental modification as a mirror for social constructs: A test case from Oaxaca, Mexico

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A review of four archaeological sites from the Lower Rio Verde Region of Oaxaca, Mexico (700 BCE-250 CE) shows an increase in the frequency of both dental modifications, as well as in the number of individuals whose burial practices suggest differing social status. Both males and females were identified in this study. Additionally, a range of variation in the types of modification may suggest both intra-and-inter regional influences. Dental modification can be observed in people both globally, and over time. Dental modifications are symbolic representations permanently inscribed into the dentition with different cultural interpretations. Often done for aesthetic purposes, these modifications may reflect status, be symbolic of inclusion or exclusion, indicate tribal affiliation, or display regional variation. They may be limited to a segment of a population, or be accessible to everyone. Dental modification is a practice the evolution of which may be traced over time in a single population, and may reflect changing social behaviors and rules. The variation in dental modification observed in the Lower Rio Verde Region of Oaxaca, Mexico appears to mirror other evidence of increasing social complexity.

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Covariation of locomotor behavior and vertebral shape in Cercopithecidae

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The spine is an integral part of the locomotor system and the influence of locomotor behavior on vertebral shape has been demonstrated for a variety of mammalian orders, including Primates. The ability to distinguish between locomotor modes and the substrates which were used by fossil species could help to better understand the paleobiology of fossil primate taxa. In this study, covariation of observed locomotor modes (categories: leaping, climbing, quadrupedal walking, other) and vertebral shape data in the family Cercopithecidae is evaluated.

This study applies 3D geometric morphometrics (using a 44-landmark protocol) of the first post-transitional thoracic vertebra ($n=38$) and employs a two-block partial least-squares analysis to investigate the relationship between vertebral shape and locomotor behavior in select extant cercopithecoids (*Chlorocebus pygerythrus*, *Colobus guereza*, *Lophocebus albigena*, *Macaca fascicularis*, *M. mulatta*, *Mandrillus sphinx*, *Nasalis larvatus*, *Papio anubis*, *P. hamadryas* and *Theropithecus gelada*).

Terrestrial species have craniocaudally shortened vertebrae with longer and farther

splayed vertebral processes compared to arboreal species. The tips of their transverse processes also protrude farther caudally and interlock, contributing to a more rigid vertebral column. The spinal canal is more dorsoventrally constricted in non-leaping species compared to leaping species, suggesting a reduction of spinal nerves possibly due to reduction or loss of a tail.

Additionally, a canonical variates analysis allowed for a differentiation between preferred substrates with high probabilities (Wilk's $\Lambda=0.005$, $F=12.5$, $p<0.0001$), suggesting that this approach can be used to predict locomotor behavior and substrate use in fossil primate taxa.

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Efficacy of the use of small scale funding sources for long-term monitoring of the Sanje mangabey in Tanzania

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Given that the availability of larger grants for field projects has been in decline in the last few years, it has become increasingly difficult to maintain funding for long-term field projects. This is particularly challenging at sites where research fees significantly compound field costs leading to substantial monthly expenses. Applying for multiple small grants and the use of social media, such as crowd-sourcing, have become important alternatives to the acquisition of large grants for continued monitoring at established research sites. For the Sanje Mangabey Project in the Udzungwa Mountains, Tanzania, we have successfully used small grants and crowd-sourcing to maintain a relatively constant research presence, allowing us to collect near-continuous demographic data for over 3 years. Our reliance on small grants, however, has required frequent time-consuming re-application for additional funds, which has led to gaps in the monitoring of our study group and hence, data collection. We have also experienced an inability to cope with unexpected additional costs that have arisen, such as the replacement of equipment and increasing research fees. For example, at present, in-country research fees in the Udzungwa Mountains comprise more than 50% of our monthly budget. These limitations, due to the necessity of our reliance on small grants, have hindered our ability to expand our research agenda beyond basic group monitoring, the result of which is a loss of potentially valuable data on this endangered and little-known species.

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Acoustic characteristics of Neanderthal vowel-like sounds: A comparison with American English speakers

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In modern humans, a long, descended tongue and 1:1 ratio between horizontal and vertical segments of the vocal tract facilitate production of “quantal” vowels that improve speech perception. Previous vocal tract reconstructions for Neanderthals and other archaic hominins match a long, projecting face with a tongue confined largely to the oral cavity. Acoustic characteristics of vowel-like sounds estimated from these reconstructions fall outside the published range of variation for modern humans.

One roadblock to interpretation of Neanderthal vowel-like sounds is the lack of a large dataset of modern human formant frequencies. The largest study to date, by Hillenbrand et al. (1995), included data for a geographically-restricted sample of 45 males and 48 females mixed with 46 children, complicating interpretation of results. In this study, we analyzed acoustic data for 16 vowels produced by 200 adult speakers. We recorded subjects reading a list of 16 words containing 12 vowels plus four diphthongs in /h- d/ contexts, and used the programs Praat and Akustyk to extract and analyze vowel formant frequencies.

Our data expand the published range of formant frequency variation for several vowels, including the quantal vowels /i/ (the vowel of “he”), /a/ (the vowel of “ha”), and /u/ (the vowel of “who”). However, estimated formant frequencies for Neanderthal vowel-like sounds still fall outside the range of variation of modern American English speakers. Future research will investigate the relationship between vowel acoustic characteristics and vocal tract size and shape in a small subset of this larger sample.

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Geometric morphometric and trabecular bone analysis of the Kalamakia Neanderthal navicular bone: A comparative study

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Here we investigate the navicular shape and trabecular architecture of the KAL14 Neanderthal specimen from Kalamakia, S.Greece. Differences in navicular shape between Neanderthals and modern humans have been inferred from studies using qualitative and traditional methods, but no geometric morphometric shape and trabecular architecture analyses have been attempted. We collected 3D coordinates of six landmarks on isosurfaces from computed tomography (CT) and surface scans of 22 recent humans, representing 4 populations (German Medieval, German Neolithic, North African, and Sub-Saharan African), Skhul V, and four Neanderthal specimens. Data were processed using GPA and analyzed using principal components analysis (PCA) in

MorphoJ. Shape changes along PC axes were visualized using the EVAN Toolbox. Additionally, where high resolution CT scans were available, conventional trabecular bone parameters were collected using CT-Analyzer (Skyscan/Bruker) and analyzed with PCA in MorphoJ to identify patterns in the trabecular architecture that may reflect differences in function or habitual activity levels. The PCA of the landmark coordinates revealed a clear separation between Neanderthals and modern humans along PC2, reflecting a decreased lateral thickness in Neanderthals compared to modern humans. Skhul V falls at an intermediate position. KAL14 falls close to the other Neanderthal specimens included. The trabecular architecture results indicate an overall separation of the German Neolithic population on all PC axes, with the only Neanderthal specimen that could be included (KAL14) following the German Neolithic population. This might indicate a similarity in their levels of activity, although larger samples are required to test this hypothesis.

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After the earthquake: Dietary resource use at Helike, Greece

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The Classical city of ancient Helike, located on the northern coast of the Peloponnese, is perhaps best remembered for its destruction following an earthquake and tsunami in 373 BC. Archaeological excavations indicate that the areas surrounding the submerged city were resettled during the subsequent Hellenistic period and remained continuously inhabited through to the late Byzantine period. In order to reconstruct general dietary resource use at Helike and to detect any changes that may have occurred over time, bone collagen from 24 individuals from the Hellenistic, Roman, and Byzantine periods was analyzed for stable carbon and stable nitrogen isotope ratios. The results indicate diets were based mainly upon C3 terrestrial resources, including domesticated animals. Some individuals, primarily from the Hellenistic period and a few from the Byzantine period, also show evidence of marine dietary contributions. The apparent differences in resource consumption between the time periods may reflect the changing landscape of the Helike Delta. Seismic activity contributed to the formation of a lagoon over top of the ruined Classical city, which could have been accessible to the Hellenistic period individuals, and archaeological evidence suggests that transient freshwater lagoons and lakes may have been present at various points in the site's history. These results contribute to the current knowledge about diet during the Hellenistic, Roman, and Byzantine periods in this region of Greece and

provide a reminder that dietary resources are not necessarily constant over time.

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Cortical and trabecular iliac crest histomorphometry in an ancient Andean population

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This study examines cortical and trabecular bone microstructure of the iliac crest to test significance of sex and increasing age, in an ancient Andean population. Two general hypotheses are tested: H₁: significant differences exist in histomorphometric areal and perimeter measurements between the sexes, and H₂: significant differences exist in histomorphometric areal and perimeter measurements among age categories due to the effects of increasing age. The results demonstrate methods for examining the iliac crest in past populations, and offer a histologic sample from a geographic area lacking in such studies.

Bone wedges were removed at the site of clinical autopsy from 62 individuals and embedded into small blocks using an epoxy resin. Thin sections were prepared using standard histological methods, leading to a final section thickness of ~70-100 micrometers. A 9 mm region of interest, comparable to the site of clinical biopsy, was marked on each prepared section. Data from the following variables was collected using compiled photomicrographs and ImageJ® software on a PC tablet: total area of section, area containing trabecular bone, cortical area, relative cortical area, area of trabecular bone, relative trabecular area, mean trabecular width, total section diameter, total cortical diameter, and marrow cavity diameter.

Sex differences were examined using a series of t-tests, noting significance in four variables. One-way and two-way ANOVAs compared young, middle, and old adults, with no variables demonstrating significance. These results may reflect the difficulty in accurately aging individuals from past populations, or indicate a lack of very old individuals among old adults.

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Behavioural and physiological flexibility in vervet monkeys: potential adaptive responses to changing climates

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Climate change is expected to have a profound impact on the geographic distribution and phenotype of organisms and will exert strong

selective pressures on their ecology, behaviour and physiology. The survival of individual long-lived mammals is likely to depend in large part on physiological and behavioural flexibility. Vervet monkeys (*Chlorocebus pygerythrus*) are ideal model organisms, because they are obligatorily social, experience a wide range of ambient temperature in arid environments, and manifest an array of specialised behavioural thermoregulatory adaptations. While homeothermic mammals are commonly considered to maintain body temperature within a narrow range, we show that vervet monkeys demonstrate increased heterothermy in response to environmental stress. Specifically, higher 24h amplitudes in body temperature were observed in the winter (mean=3.2±0.4°C, max=5.6 °C) compared to the summer (mean=2.5±0.1°C, max=4°C: $t=5.47$, $P<0.01$, $N=6$), resulting primarily from the lower minimum body temperatures observed in the winter ($t=7.45$, $P<0.001$). We also show that sociality reduces this stress – females with more social ties were more efficient thermoregulators, maintaining tighter amplitudes ($Z=-7.33$, $P<0.001$, $N=1285$), higher minimum ($Z=3.86$, $P<0.001$) and lower maximum ($Z=-6.61$, $P<0.001$) body temperatures, compared to females that were less integrated – adding to the debate that sociality holds adaptive value for individuals. We discuss the importance of behaviour and micro-climate selection (i.e. huddling, shade-use and sun-basking) to the maintenance of stable body temperatures in extreme environmental conditions.

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Skull and brain anatomy of a trigonocephalic juvenile: Description of the first known prehistoric case

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Instances of premature fusion(s) of cranial sutures are well-represented in prehistory. The frequency of sutural fusions generally mimics those in recent populations. Premature fusion of the *sutura frontalis* resulting in trigonocephaly occurs at a very low frequency today (1 in 25-70,000 live births), but it is undocumented in prehistoric contexts. Here we describe the first prehistoric case of trigonocephaly and discuss previously unavailable details of skull and brain morphology and pathology associated with this condition.

This individual is housed in the PHMA, UC Berkeley, and was recovered from Santa Rosa Island, CA (CA-SRI-24). Radiocarbon dating and artifact seriation provide a date of 1500-1650 AD. The age at death was assessed from the

dentition to be 8.0 years ±24 months. For descriptive and analytical purposes we CT-scanned crania ($n=43$) developmentally aged at 6.0-8.5 years. Isosurfaces and volumes were reconstructed with Amira®. Examination of morphological change in osseous units was examined via comparisons of triangular meshes. Shape and anatomical deviations from normal brains were assessed by comparisons with reconstructed endocranial volumes.

Skull morphology indicates a complex, possibly syndromic, form of trigonocephaly. A series of typical features including hypotelorism, superoinferiorly tall orbits, thickening and ridging of the midfrontal region, flattened frontal eminences, short anterior cranial fossa, and a heart-shaped transverse cranial outline contribute to this diagnosis. The endocranial volume was determined to be ≈700 cc. Microcephaly resulted from maldevelopment of the frontal lobe and inferolateral portions of the temporal lobes. This individual possesses features consistent with a diagnosis of complex trigonocephaly.

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Growing a large, social brain: Tying together life history, behavior, and primate brain evolution

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Many of the details surrounding primate brain evolution are still debated, with different hypotheses attempting to explain how and why brains evolved as they did. In particular, the nature of the relationship between brain reorganization, developmental constraints, life history and socioecology is not fully understood. Socioecology and behavior, both of which have sexually dimorphic elements, have been proposed to underlie both primate life history variation and brain evolution. It is therefore plausible that the sizes of specific brain structures (e.g., those related to learning and forming social bonds) are related to life history measures characteristic of a slow-paced life with long learning and developmental periods.

PGLS analyses of a suite of detailed brain structure, life history, and behavioral data across primate species reveal significant highly positive correlations between variables (e.g., juvenility, gestation) that characterize a “slow” life and the size of brain structures (e.g., left prefrontal cortex) linked to social information processing. These results are interpreted within the context of the high energetic demands of growing large brains and raising large-brained altricial offspring, with the longer developmental periods associated with larger left prefrontals presumably linked to the emergence of complex cognitive processes and the acquisition of learned behaviors. The significant correlation of the left, but not right, prefrontal to the aforementioned life history variables further demonstrates an apparent role of sexual dimorphism in the evolution of primate brains and life histories and a connection between the evolutionarily female-dominated left prefrontal and the lasting social bonds required to raise demanding offspring.

Genetic simulations of natural selection – Implications for hominin evolution

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In order to test the limits of natural selection, computer simulations of a multiple locus, multiple allele model were designed using matrix software. Each locus for each individual was given a randomly and evenly distributed allele number, one through five, reflecting the number of offspring that a gene would contribute to the probable fertility rate for the next generation. Each of 10,000 generations were modeled with random monogamous mating, effectively equal male/female distribution, random recombination across two chromosomes, and a constant population size. All populations improved viability for most loci, as expected. Important findings include that there is remarkable sensitivity of the models to initial conditions; the slightest change early on can result in shifts for all allele frequencies. Also, the more loci undergoing selection, the less effective is natural selection; this is true even in large populations of 5000 breeding couples or more, and for highly beneficial alleles, i.e. those contributing to more offspring. In other words, genes at alternate loci effectively ‘compete’ with each other, and result in frequency patterns through time that resemble the effects of genetic drift. The complexity crisis that ensues among competing gene loci can be overcome in part by evolving few features at a time, hence the mosaic nature of hominin evolution. That this competition often keeps highly adaptive alleles at low frequencies for considerable lengths of time, may account for some homoplasies that come to dominance later in time among distinct hominoid species.

The impact of diet composition on cross-national variation in prevalence of nausea and vomiting of pregnancy (NVP)

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Cross-national variation in the prevalence of nausea and vomiting of pregnancy (NVP) has been shown to relate to the amount of meat in a nation’s diet. Given that animal tissues are more prone to rapid spoilage than plant foods, such findings are consistent with the maternal embryo protection hypothesis, which holds that NVP evolved to motivate women to minimize exposure to potential sources of pathogens when they are immunologically compromised by pregnancy. However, previous studies have focused predominantly or exclusively on Western populations, so it is unclear whether this pattern characterizes the full range of variation in human NVP prevalence and thus whether the protection hypothesis can account for why NVP evolved and was maintained in a wide variety of socioecological contexts.

With this shortcoming in mind, we carried out a new test of the prediction that variation in NVP prevalence is negatively associated with the amount of meat in a country’s diet, using data from 15 non-Western populations. We found that, in a simple bivariate model, a country’s meat consumption accounts for ~one third of the variation in NVP prevalence. But, when other

factors such as a country’s level of development are controlled, this relationship does not hold. Our results suggest that while women’s risk of experiencing NVP may relate to the pathogen riskiness of their diets, other factors connected with food security may be equally or even more important in explaining the variation.

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How ‘semi’ is the capuchin prehensile tail?

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The capuchin prehensile tail often is described as ‘semi’ prehensile despite the fact that anatomical and behavioral data suggest the tail is capable of sustaining the entire body mass of adults. The goal of this research was to document details of tail use changes in growing capuchins (*Cebus capucinus*) inhabiting a tropical rainforest in Costa Rica. We collected 164 hours of behavioral data during 2013 at Estación Biológica La Suerte in Northeastern Costa Rica. At each one-minute instantaneous sample, we recorded age, activity, positional context, tail position/ angle, proportion of tail wrapped, diet, crown location, and substrate information. All age groups engaged in mass-bearing tail positional modes (tail-only suspend, tail hindlimb suspend, vertical tripod). The youngest infant (birth-2 mos.) tails were primarily observed in a non-grasping position (89%). Juveniles and preadults were observed to use their prehensile tails significantly more often than adults during feeding/foraging and social behavior ($p < 0.05$ in all comparisons). Juveniles and preadults were observed to wrap their tail using relatively distal tail segments significantly more often while older adults were observed to engage the proximal segments. Our behavioral results support recent morphological and behavioral studies that suggest that juvenile capuchins experience an early peak in tail use and complex positional modes. However, the tail is rarely used in the first few months following birth. Finally, we conclude that despite documented anatomical and behavioral differences in *Cebus* and ateline prehensile tails, the term ‘semi’ prehensile does not reflect the ecological role of the capuchin tail.

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Research on East African catarrhine and hominoid evolution: Results from the first year

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Early Miocene deposits in East Africa provide the richest source of evidence on the origin and early diversification of the hominoid clade. Yet, critical questions about the adaptive morphology and phylogeography of early apes and their catarrhine contemporaries cannot be answered from the perspective of any one fossil site. On the contrary, locality density, taxon diversity, depositional variation, and temporal depth in East Africa provide a unique opportunity for assessing catarrhine adaptive evolution across geographic and chronological ranges. For this reason, we established a research consortium designed to fully develop a regional geochronology, paleoecology, paleoenvironment, and biogeography of early Miocene catarrhine and hominoid evolution.

Here we report results from the first year of the REACHE project (elaborated in the title). New fossils from Karungu expand the known catarrhine community from this locality, and include important new mammal species that inform our understanding of the paleoenvironment. Reconnaissance at the Napak volcano resulted in the discovery of new fossil localities, and both Napak and Moroto were subjected to extensive taphonomic analyses. Preliminary work in the Tinderet region re-located most of the primary fossil sites and revealed several new ones, resulting in thirty new primate specimens. Likewise, Buluk produced a number of new specimens including more complete fossils of previously recorded catarrhine primates. Together, these results greatly expand our knowledge of early Miocene catarrhine paleobiology, and lay the groundwork for important geochronological, taphonomic, and paleoecological analyses in upcoming years.

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Evidence of crocodile predation on the giant lemurs of Madagascar

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Madagascar’s giant lemurs have historically been viewed as having had few predators because of their body size. Large raptors and the giant fossa, *Cryptoprocta spelea*, have been viewed as having been too small to pose much of a threat to the larger-bodied lemurs, and terrestrial predators like crocodiles have been largely discounted because even the largest lemurs show adaptations for arboreality. Some researchers have questioned the extent to which giant lemurs such as *Megaladapis* and *Palaeopropithecus* descended to the ground.

Understanding which animals were important predators of these giant lemurs is critical to reconstructing aspects of their life history strategies.

Two species of crocodiles are known from Quaternary and modern communities of Madagascar: the larger-bodied *Voay robustus* dominates subfossil sites, and the modern Nile crocodile (*Crocodylus niloticus*) may be a recent introduction. Here we present evidence of crocodile predation on the extinct lemurs at the subfossil localities of Beloha (southern Madagascar) and Ampasambazimba (central highlands). Our sample (from the subfossil collection at the University of Antananarivo, Madagascar) includes skulls and femora of *Megaladapis* (MNI = 73) and *Palaeopropithecus* (MNI = 20). Evidence of crocodile predation includes partially digested bones and teeth, tooth marks on bone, and bone breakage consistent with crocodile taphonomic signatures. The erosion of dental enamel and bone on some specimens is indicative of partial digestion by crocodiles. We show that crocodiles were important predators of these "arboreal" giant lemurs, which may have been more terrestrial than previously thought in both southern and central Madagascar.

This study was funded by the Paleontological Society and the University of Massachusetts.

Recognizing and resolving inconsistencies and inaccuracies in determining osteon circularity: Can methods be standardized?

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Osteon circularity (On.Cr) might help in distinguishing species, interpreting load history, and estimating age. When studying On.Cr using archived backscattered electron (BSE) and circularly polarized images of various primate/non-primate bones, we recognized that inaccuracies can occur when there are seemingly inconsequential differences in scale of actual/physical images used in osteon tracing (although all taken at 50-62.5x). For example, errors might occur if non-digitized Polaroid images (500microns=26mm) from 1980s-1990s are compared to modern digitized images in larger format (500microns=53mm). How closely must image 'sizes' be to achieve <2% error (arbitrary cutoff)? Additionally, do manual and semi-automated computer-mouse-based tracing provide similar data, and how do these compare with tracing using pen on plastic transparencies vs. a digitizing tablet/stylus? Ten osteons (50x BSE images; human femur, 60years) were manually pen-traced on plastic sheets and scanned for analysis (ImageJ). Quantifying On.Cr this way is highly accurate when using ImageJ (Skedros 2000, J.Bone&Mineral Research). The images were reduced ~25% (500micron=39mm) and ~50% (500micron=26mm) to resemble our archived/unadjusted images, and the osteons were manually re-traced/re-scanned. Differences ("errors" vs. 100% size) included: (1) 25% reduction 3±2% (max 6%); (2) 50% reduction 2±2% (max 7%). Using the "Quick Select" tool in Photoshop (instead of pen tracing/scanning)

resulted in even greater error (average 14±9%). Additional analysis showed <2% error when reduction is <15%. Because achieving accuracy when quantifying scanned pen-tracings in ImageJ can be challenging (as shown when using computer-generated perfect circles), additional studies will be conducted to determine if a digitizing pad and stylus, as used by Crescimanno and Stout (2012, J. Forensic Science), increases accuracy and efficiency. *Supported by the Department of Veterans Affairs, USA.*

Calcium and carbon stable isotope ratios as paleodietary indicators

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Studies using calcium isotope ratios ($\delta^{44/40}\text{Ca}$) as a tool for understanding dietary ecology are in their infancy, yet $\delta^{44/40}\text{Ca}$ has been shown to vary by trophic level. The abundance of calcium in enamel raises the possibility that stable isotope analysis of calcium could be valuable in paleoecological contexts, and shed light on competing hypotheses on the ecologies of early euprimates. To lay the groundwork for this application, we investigated whether $\delta^{44/40}\text{Ca}$ values differentiate animals that consume principally invertebrate versus angiosperm foods. The stable isotope composition of an extant community of mammals in Costa Rica was used as a model system. We sampled animals that have phylogenetic or functional relevance to primate origins, as well as trophic end-group members. We first confirmed that a bone collagen-derived δ -space ($\delta^{13}\text{C}$ and $\delta^{15}\text{N}$) reveals niches associated with dietary behaviors ($F_{2,24} = 15.86$, $p < 0.01$). This result was partially reinforced by analysis of bone and enamel bioapatite ($\delta^{13}\text{C}$ and $\delta^{44/40}\text{Ca}$). Faunivores (carnivores, insectivores) were ^{13}C -enriched ($F_{1,28} = 9.84$, $p < 0.01$). Carnivores, but not insectivores, were ^{44}Ca -depleted. Overall, we detected no significant differentiation in $\delta^{44/40}\text{Ca}$ values between primary and secondary consumers, which may be attributable to the negligible calcium content of insects. Despite this outcome, the tandem analysis of $\delta^{13}\text{C}$ and $\delta^{44/40}\text{Ca}$ values holds promise for informing paleoecological studies; we highlight this by drawing attention to the Early Eocene primate taxon *Cantius*. Adding $\delta^{44/40}\text{Ca}$ values to existing isotopic data for this taxon may determine if *Cantius* was primarily frugivorous or omnivorous.

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Lab contamination avoidance in molecular palaeontology: Starch grain analysis

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Starch consumption is an evolutionary landmark. It has been claimed that archaic hominins ate tubers, that the reason cooking appeared so early in human evolution was to enable starch assimilation, and that this kind of diet led to the emergence of modern body traits and cohesive social systems. Whether these hypotheses refer to primitive, archaic, or modern humans, however, they lack direct palaeobotanical evidence for starch processing or consumption, such as starch granules. Yet, inferences made from starch analysis depend on authenticating these molecules.

Currently, there are no systematic anti-contamination procedures to assess pollutants, contamination vectors, and decontamination techniques in ancient starch laboratories. We observed laboratory consumables directly under the microscope or extracted and concentrated contaminants through rinsing, sonication and centrifugation. Environmental contamination was recorded on passive and active traps where airborne starch granules landed. The efficacy of oxidation, boiling, autoclaving, and torching as decontaminating techniques were also studied.

Contamination from corn, wheat, and potato is pervasive ($n=10,942$). Methodologically, we demonstrate that the most common procedure to test for contamination ('standard' passive traps) generates unreliable proxies and unacceptably low statistical confidence. Non-powdered gloves and commercial clay dispersants should be carefully controlled for their high risk. Employing acids and bases to decontaminate work surfaces does not always eradicate starch. This collaboration between the Universities of Calgary and Oxford establishes contamination sources, types, and quantities, in order to avoid it in our future studies and develop better authenticity criteria at least for the materials processed in these two laboratories.

Anchoring the clade: Insights from *Lemur catta* on primate-wide sex-typed behavioral development

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Ring-tailed lemurs are often championed as an ideal comparative taxon to some haplorhine primates because they are similarly matrilineal, matrilineal, female-bonded, and characterized by multi-male, multi-female social groups and stable male and female dominance hierarchies while being dissimilarly monomorphic and strictly female dominant. Female-biased interest in infants and male-biased propensity for rough and tumble play among subadult catarrhines are thought to be behavioral adaptations to facilitate learning of maternal behavior and competitive skills for later male contests, respectively. Using data gleaned from the literature, a consensus tree from the 10kTrees Project, and parsimony models, I performed character state

reconstructions in Mesquite to assess how adding *Lemur catta* to the comparative primate dataset changes character state reconstructions of subadult female-biased infant interest and subadult male-biased rough and tumble play. Adding *Lemur catta* did not change character state reconstructions across primates, suggesting that female-biased infant interest and male-biased play patterns characterize the gregarious primates in general, including the strepsirrhines. Pairwise comparisons of correlated characters indicate that subadult male-biased play is independent of adult intra-sexual dominance patterns (not significant; $p=0.5$). These results suggest that, as in haplorhines, strepsirrhine subadult female infant interest has probably been under positive selection because it improves later maternal behavior and that selection on the development of male competitive behavior is high even in female-dominant species. These results affirm the potential for ring-tailed lemurs' utility as a model system for studies of the development of some primate sex-typed behaviors, despite their unusual female-dominant social organization.

The author's data on Lemur catta used in this study was funded by the Leakey Foundation, Sigma-Xi, and the Graduate and Professional Student Association and SHESC at Arizona State University.

Health and hypoplasia: Lines from Northeast China

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With growing awareness that multiple centres of domestication and increasing cultural complexity are the norm in China, the importance of sites outside the Yangtze and Yellow River Valleys is increasing. In Northeast China the boundary between sedentary agriculturists and nomadic pastoralists has fluctuated over the vast Dongbei plain providing opportunities to explore relationships between health, subsistence, and cultural complexity.

The human remains for the present study were recovered from the upper level of the Houtaomuga site on the Dongbei plain, Northeast China (2250-2050BC), and dated to Hanshu II cultural period of the Bronze Age (Warring States Period). The inhabitants practiced mixed agriculture. The dental expression of stress episodes in this period of social unrest and increasing cultural complexity is explored.

Data were collected from labial/buccal casts from 105 teeth from 30 individuals from the upper level of the site. Duration of growth disruption, counted as numbers of perikymata in the occlusal wall of each hypoplastic defect, ranged from 2-10. Stress episodes, ranging from 14-20 days at the low end to 70-100 days for the longer duration events, are consistent with values reported from sites in other parts of the world.

Material culture evidence from lower levels (pre-Bronze Age) of Houtaomuga suggests that the occupants were pastoralists. Examination of

enamel hypoplasia from these individuals will, in future, provide time depth to this study of population health, and facilitate our understanding of the lifeways and adaptive strategies across subsistence transitions in Northeast China.

Muscle, fat, and bone: How body size could revolutionize our understanding of past populations

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Studies consistently assess the life expectancy of past populations as 30 to 35 years of age. This interpretation of the archaeological record has significant implications for our understanding of fertility and death rates, mortality curves, and overall population health. However, past populations were typically shorter in stature and lighter in body mass than current populations. This is the first paper to demonstrate that body size influences skeletal aging.

Most researchers estimate age using the Suchey-Brooks pubic symphysis method, the Lovejoy et al. auricular surface method, and the İşcan et al. rib method. This study applied these methods to 764 skeletons from the Hamann-Todd and William Bass Collections. Individuals ranged from 1.30m to 1.93m and 24kg to 99.8kg.

Individuals with low body mass are under-aged by 5 to 15 years across all methods. Individuals with high body mass are under-aged by 3 to 4 years using two of the methods and are over-aged by 1 year using the third. The joint surfaces of obese individuals show increased surface texture degeneration and osteophytic lipping compared to all other groups, while underweight individuals show fewer age markers than average-weight individuals. Physical activity and mechanical loading may be factors. High lean muscle mass slows the rate of bone remodelling, providing a potential protective effect against skeletal aging.

These findings suggest a higher presence of older adults in the skeletal record and some important new directions for researchers. With redefined age estimations, new interpretations of paleodemographic parameters will change our understanding of human history.

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Lemur catta mating behavior at Berenty Reserve Madagascar: Mating synchrony, indirect female choice and the operational sex ratio

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We examine three potential female *Lemur catta* strategies for influencing the operational sex ratio: altering the temporal distribution of sexual activity, advertisement, and mate choice. Estrus occurs annually within a three-week period; however, studies by Pereira on free-ranging troops indicate asynchrony of estrus within troops, with only two instances of same-day synchrony occurring amongst 55 estruses in 11 years. We gathered twelve years of mating season data from nine researchers observing 60 estruses in wild gallery forest troops at Berenty Reserve, Madagascar. These indicate an April 21 median date of onset of estrus (range April 8-May 2), a reserve-wide median duration of 13.5 days (range 4-23), but only three instances of within-troop same-day synchrony. Although simultaneous copulations occurred in different troops throughout the reserve, asynchrony within troops is supported.

Because female scent marks are placed in troop overlap areas in gallery forest, inter-troop advertisement is available. Females typically lead troop progressions, and we hypothesize that positioning mating in overlap areas may permit indirect female mate choice and increased male-male competition. Based on *ad libitum* dawn to dusk observations of troops containing multiple males, copulations did not consistently occur more often in overlap areas. However, on three occasions when troop leadership was noted in groups with only one male, an estrous female led the troop outside of its typical range. On two of those days, copulations occurred in the neighboring ranges. This indirect female mate choice by location effectively altered the operational sex ratio and increased male-male competition.

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Global patterns of human orbit size: Implications for Neandertals

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Pearce and Dunbar (2011) suggest there has been independent selection for larger orbits in lower light conditions, as they find larger orbits in humans in progressively higher latitudes (N=55). As large eyes necessitate relatively larger visual cortices, Pearce et al. (2013) posit Neandertal brains skewed proportionately more towards vision, and were cognitively limited compared with modern humans.

Our sample from the Morton Collection (N=440) confirms a weak correlation between

latitude and orbit size ($r^2=.004$, $p<.001$). But contra Pearce and Dunbar, using their method of controlling for body size (foramen magnum), we find the reverse pattern, with slightly smaller relative orbit sizes by latitude ($r^2=.0028$, $p<.001$).

By comparison we find much clearer positive relationships between orbit size and splanchnocranial structures, especially those derived from neural crest cells (i.e., facial height: $r^2=.27$, $P<.0001$, facial geometric mean: $r^2=.26$, $P<.0001$, nasal height: $r^2=.27$, $P<.0001$). The association between orbit size and facial variables is stronger than cranial variables (i.e., orbit size and cranial length, $r^2=.0048$, $p<.001$), signaling the integrated expression of splanchnocranial structures of neural crest cell origin and not independent selection on orbit size. These associations support the hypothesis that environmental adaptation in humans is expressed in structures of neural crest origin (Irmak & Özcan 1997) rather than the hypotheses of Pearce and colleagues concerning humans and Neandertals.

Pearce, E., & Dunbar, R. (2011). *Biology Letters*; Pearce, E., Stringer, C., & Dunbar, R. (2013). *Proc. Royal Society B: Biological Sciences*, 280(1758); Irmak, M.K., & Özcan, O. (1997). *Medical Hypotheses*, 48(5), 407-410.

Phenotypic patterns of rib and pelvis covariation in Old vs. New World human populations

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Sexual dimorphism and ecogeography are known to influence pelvic form, but little is known about the influence of these factors on rib shape. This study examines population and sex differences in patterns of covariation both within the ribcage and between the thorax and pelvis to test the modular nature of the human trunk skeleton and the selective pressures influencing underlying patterns of integration. Using a Microscribe G2X digitizer, I collected three-dimensional coordinate data from ribs and articulated pelves of adult individuals from Old World (modern Ugandans) and New World (Point Hope, Indian Knoll, archaeological Peruvians) skeletal populations ($n=332$) and performed analyses in MorphoJ. Matrix permutation tests demonstrate overall strong correlation among the ribs (all matrix correlation values $>.85$ and significant at $p<.01$) but show rib 2 to exhibit relatively weaker correlations with the lower ribs than these ribs show with each other, perhaps due to functional demands of the upper limb influencing the superior ribcage or the potentially stronger relationship between the pelvis and inferior ribcage. Matrix correlations are higher in the NW groups than in the Ugandan sample, and these populations in general possess shallower ribs (anterior-posterior elongation / medio-lateral compression), likely inherited from wide-bodied NW-founding ancestors. Principal components analyses reveal separation by both population and sex for the pelvis, separation by population (OW-NW) only for the lower ribs, and little distinction by population or sex for the upper ribs. These results suggest the human trunk skeleton

possesses a modular structure, allowing populations to respond to local selection pressures.

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Sex or power? The function of male displays in rhesus macaques

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Male behavioral displays (e.g. branch-shaking) are common across Anthrozoidea, but their function remains unclear. We examined free-ranging rhesus macaques (*Macaca mulatta*) on Cayo Santiago, Puerto Rico, to test three major hypotheses for the function of male displays: 1) mate attraction, 2) mate guarding, and 3) male-male dominance competition. The mate attraction hypothesis predicts that males should display in front of fertile females to impact female mate choice and that displays should sometimes be followed by copulation. The mate guarding hypothesis predicts that males should display after copulating with a female to advertise their presence to other males and discourage their mating attempts. The dominance competition hypothesis predicts that displays should be directed to other males regardless of mating or consortship activities and be more frequent when male-male aggression is frequent, e.g. when rank relationships are unstable. Focal and *ad libitum* behavioral data were recorded for 21 adult males across 7 groups during the mating season. Display rates were calculated for each male in each context (i.e. feeding, intergroup interactions, mating). In stable groups, males with high mating success displayed more during consortships than in other contexts ($p=0.042$, Wilcoxon Signed Rank Test) and displays were more likely to follow than to precede copulation. In unstable groups displays were less likely to be associated with mating than in stable groups ($p=0.049$, GLM). These results suggest that mate guarding and male-male dominance competition are the primary functions of male display behaviors in rhesus macaques.

Parity and hemoglobin in US women (National Health and Nutrition Examination Survey, 1999-2002)

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Reproductive-related hemoglobin depletion occurs when women cannot replace iron stores that are allocated to the fetus during pregnancy. Previous research among rural Kenyan pastoralists found evidence of long-term hemoglobin depletion in breastfeeding women, with an inverse relationship demonstrated between hemoglobin levels and parity. The current study tests the hypothesis that US women also experience hemoglobin depletion across their reproductive lifespan despite routine iron supplementation during pregnancy. Data were compiled from the National Health and Nutrition Examination Survey (NHANES) 1999-2002, a structured survey of health and nutritional status of adults and children in the United States. After selecting reproductive-aged women with non-

missing responses for iron- and reproduction-related questions, the final n for this subpopulation was 2996. Survey models were adjusted for sample strata and clusters, 4-year exam weight, and the subpopulation domain of reproductive aged women. Multivariate analysis was adjusted for age, BMI, pregnancy status, C-reactive protein level, and current breastfeeding status. There was a statistically significant relationship between parity and hemoglobin level ($p < 0.01$), although the size of the relationship is small compared to Kenyan women. This research shows that there is a relationship between long-term reproductive effort and iron status in US women, a relationship that may not have been recognized without a sufficiently large sample size. However, the degree of the effect may not significantly impact women's long-term reproductive functioning. Because this effect size is small, it is unclear whether recommendations for iron supplementation during pregnancy should be reevaluated in high-parity US women.

Competing for space: Female chimpanzees are more aggressive inside their core areas than outside

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Space use can play an integral role in fitness outcomes for mammalian females. Within social species, mechanisms for negotiating shared space are not well understood. In this study, we explore the spatial correlates of female aggression among East African chimpanzees (*Pan troglodytes schweinfurthii*). Female chimpanzees maintain individual but overlapping core areas of concentrated space use within the larger community range. Core areas quality is positively correlated with reproductive success, suggesting that females engage in spatial competition. To test this hypothesis, we investigated differences in female-female aggression as a function of space by comparing aggression rates inside versus outside individual female core areas. We used 14 years of aggression and ranging data on adult female chimpanzees from Gombe National Park, Tanzania. Females were significantly more likely to engage in aggression inside their core areas than outside ($T = 2.32$, $N = 11$ females, $p = 0.03$). This pattern was due to aggression context; there was no difference in the location of food-related aggression ($T = 1.12$, $N = 11$ females, $p = 0.29$), suggesting that securing food is equally beneficial regardless of location. Female chimpanzees were significantly more likely to engage in non-food related aggression inside their core areas than outside ($T = 2.44$, $N = 11$ females, $p = 0.05$), suggesting that female aggression is beneficial independently of immediate resource acquisition. These results indicate that female chimpanzees employ a two-fold strategy of short-term competition for food throughout the community range, and in the long-term for access to desired core areas.

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Craniofacial asymmetry, subsistence behavior, and developmental stress: A comparison of facial form between hunter-gatherer and non-hunter-gatherer populations

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Fluctuating asymmetry is generally considered to be an outcome of developmental stress. While variation in facial form can be directly tied to environmental or genetic effects, mechanisms for fluctuating asymmetry in the face are less clearly understood. This study examines the relationship of facial asymmetry with subsistence patterns in hunter-gatherer (HG) and non-HG groups.

A diverse sample of 147 crania, including 23 individuals belonging to Australian and Sub-Saharan African HG groups, were photographed in *norma frontalis* and digitized with 19 2D coordinate landmarks using tpsDig2. RWA, CVA and procrustes ANOVA procedures, ran in MorphoJ, were employed to analyze symmetrical and asymmetrical shape variation across the sample.

RWA results highlight shape variation between HG and non-HG groups in facial height, upper facial width, and in the zygomatic and alveolar regions of the face. Results from the CVA show highly significant (procrustes distance=0.0636, $p<0.0001$) differences in symmetrical shape between HG and non-HG groups and only marginally significant (procrustes distance=0.0074, $p=0.0448$) differences in asymmetrical shape variation. Results from the procrustes ANOVA demonstrate that fluctuating asymmetry only constitutes a small proportion of the overall asymmetrical variation with no significant differences ($p=0.2888$) found in the degree of fluctuating asymmetry between HG and non-HG groups.

While these results provide some preliminary evidence for craniofacial asymmetry as a function of subsistence behavior, this variation is minor compared to the overall level of symmetrical variation identified. This implies that factors other than developmental stress are responsible for the majority of craniofacial differences between HG and non-HG groups.

Examining the efficacy of visual measures of coat condition, body mass and health in wild ring-tailed lemurs at the Beza Mahafaly Special Reserve, Madagascar

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In this study we explore visual indicators of coat condition, body mass and health in 36 (23♀, 13♂) wild ring-tailed lemurs (*Lemur catta*) of

the Beza Mahafaly Special Reserve, Madagascar, collected from July 2012 to March 2013. Coat condition was scored twice-monthly using a system devised for use in *L. catta* by Berg et al. (2009), while body mass status was recorded twice-monthly using methods derived from those of Berman and Schwartz (1988). Health indicators including vomiting, diarrhea, coughing, wounds, alopecia and low weight were recorded based on their presence or absence during behavioral focal follows conducted twice monthly for each individual. Coat condition generally worsened from the dry season to the onset of the wet season (November-December), before improving until the end of the study in March. Body mass varied little across the study, although some individuals did become visibly thinner during the late dry season, particularly lactating females. Males also gained mass following the onset of the wet season when food resource availability increased. Poor health indicators were observed infrequently, with the exception of alopecia which increased in frequency during the transition from dry to wet seasons. Our data suggest that coat condition varies seasonally in BMSR ring-tailed lemurs. Coat condition and alopecia also appear to be related to toothcomb wear and to infant carrying among females. The lack of variability in body mass may reflect the coarse nature of our scoring system, suggesting that a more refined system should be used in future research projects.

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Evaluating old and new skeletal age indicators – which ages of transition pass the “box test”?

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Since the nineteenth century, osteologists have attempted to produce accurate, precise, and unbiased age estimates for adult skeletons. Unfortunately, standard age-estimation procedures and the skeletal features they are based on mostly fail the “box test” – the results do not justify the time and effort required to open a box of bones.

We plot ages of transition for a number of traits, based on ca. 250 known-age modern Americans from the Tennessee Bass Collection plus forensic cases, to show how traditionally used age indicators often fail the box test. More importantly, we highlight skeletal features that actually provide useful information, even though specimens are usually only classified as “young” or “old” for a particular characteristic. They include several commonly examined age indicators, as well as an array of other bony features. The ages of transition can be combined to produce age estimates, building on existing Transition Analysis, tailored to the specific characteristics displayed by individual skeletons.

This work highlights the need to shift our focus from a few anatomical structures that can be divided into multiple stages (e.g., the pubic symphysis) to many skeletal features, each typically having only two stages. While the latter

individually contribute little to age estimates, collectively they address long-standing problems that have plagued skeletal age estimation, hence paleodemography. These results underscore the importance of basic osteological work, along with an equally pressing need for better analytical procedures, in order to tackle the vexing problems posed by skeletal age estimation.

Exploring the relationship of Neanderthals and modern humans at various population levels through an analysis of body proportion indices

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Analyses involving postcranial comparisons of Neanderthals to other hominins tend to lump all Neanderthals into a single group without considering the potential variation that exists within this group. This research aims to explore the variation within the Neanderthal group by treating European Neanderthals and Southwest Asian Neanderthals as different sample groups that represent different populations with different temporal, geographical and genetic histories, and examine the relationship of these and other fossil *Homo sapiens* to worldwide populations of modern humans. This study utilizes postcranial measurements and body proportions to examine the variation within and between the sample groups in order to make better inferences about genetic and ancestral relationships. Descriptive statistics and box plots were created, and the data were further analyzed by assessing the variation between large geographically defined regions, as well as examining the variation between the populations within each region. Discriminant function analyses were conducted, comparing the fossil hominins to populations within each region. The results of the discriminant function analyses revealed interesting geographical and temporal patterns of variation. The European Neanderthals were consistently outliers, while the Southwest Asian Neanderthals more often fell within the range of *Homo sapiens*. These results clearly support the idea that Neanderthals should not be assumed to be a homogenous population in analyses involving other modern and fossil groups.

Defining the origins and spread of leprosy using molecular biomarkers

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Studies on extant strains of lepromatous leprosy (LL) have allowed construction of an evolutionary scheme and insights into the global dissemination of the disease. Leprosy seems to originate in Eastern Africa or the Near East with

global spread linked to human migrations. A multidisciplinary approach was used to examine cases of LL from sites in southern Britain and continental Europe. An integrated extraction protocol allowed both aDNA and mycobacterial lipid biomarker analysis. Real time PCR, conventional SNP and MLVA typing were used to genotype strains of leprosy. Robust cases were identified for next generation sequencing (NGS) and full genome retrieval.

European human remains provided evidence of *Mycobacterium leprae* SNP types 2 and 3I, in the classification scheme for modern strains. Type 3I strains persist to the present day in the Americas, indicating a European origin. Rare type 2 strains are closest to the most recent common ancestor of the four main *M. leprae* genotypes which disseminated across Europe, Asia and Africa. Identification of medieval European type 2 strains may reflect separate incursions of the disease from the Middle East or South-East Asia. Reconstruction of nearly complete genomes from six cases confirmed the clonal nature of medieval leprosy and the high level of conservation over the last millennium. The lack of changes in virulence-related genes or any new pseudogenes suggests that social condition changes may explain the slow decline of leprosy in medieval Europe from the 14th century onwards and indeed for 19th century resurgences in infection in several countries. *Leverhulme Trust supported (F/00094/BL).*

New material of *Necrolemur* (Microchoerinae, Omomyidae, Primates) from the Middle Eocene of the Pyrennes (Northeastern Spain)

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In the last decades, the study of Eocene primates from the Iberian Peninsula has received a great deal of attention, due to the existence of continuous and well-exposed continental sections from this epoch, yielding abundant vertebrate remains. One of the most significant Iberian Eocene localities with primate remains is Sant Jaume de Frontanyà (Eastern Pyrenees, province of Barcelona), which includes several levels with an extraordinary abundance of mammal remains assigned to the Robiacian (Middle Eocene). The most abundant primate material comes from the oldest levels, named SJF-3C and 3D, in which three different taxa have been identified, including two new species (*Pseudoloris pyrenaicus* and *Anchomomys frontanyensis*). On the contrary, the material from the youngest levels (SJF-1 and SJF-2), notably more scarce, is still unstudied in detail. Here we report new material of *Necrolemur* (Microchoerinae, Omomyidae, Primates) from the levels SJF-1 and SJF-2. The material from SJF-1 consists of a mandible with p4-m1 and ten isolated teeth, whereas that from SJF-2 only includes a p4 and an m1. A preliminary observation of this material allows us to observe that it is notably smaller than the type species of the genus, *N. antiquus*. Moreover, the lower dentition displays several morphological

differences with the holotype and single material of *Necrolemur zitteli*, the unique other species of the genus described until now. Further analysis is required in order to make a specific ascription of this material, which constitutes the oldest record of the genus *Necrolemur* from the Iberian Peninsula.

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Proximity of age-at-death estimates among aging sites of the pelvis

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The pelvis is useful for aging because it contains multiple age diagnostic sites: the pubic symphysis, auricular surface, and acetabulum. The latter site has a newly introduced aging technique that ages older individuals more accurately than other sites. The closer an age estimate is to an individual's known age-at-death, the more accurate biological profiling and population demographic data will be. It is important to assess the applicability of acetabulum aging standards because the degenerative changes and influence of physical activity on the joint are variable.

In this study, the Suchey-Brooks pubic symphysis, Osborne auricular surface, and Rissech and Calce acetabulum aging methods were used to age 68 White male pelvises of known age from the medical collection at American Museum of Natural History. Student's paired t-tests were applied to determine if the resulting age estimates were significantly different from the known ages-at-death and from one another. Results demonstrate all aging methods to be different from the known age, with the exception of data derived from the Rissech standard. The average age estimate was calculated from the four standards and found to be significantly different from the known age-at-death as well.

These data suggest that the acetabulum is an accurate estimator of age. The accuracy should be considered cautiously, though, as the Rissech reference for age estimation was derived from the sample itself. Larger sample sizes and multiple reference collections are required to confirm the Rissech standard's accuracy.

Histological variation in modern human robust and gracile femur

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Bones respond to mechanical stimuli by altering their internal and external structure. Bioarchaeologists routinely use this knowledge to infer ancient human behaviour. However, the extent to which human bone robusticity reflects its microstructural properties is still largely unexplored. Here, histological variation was examined in an archaeological sample of adult human femora (n = 450) dating to the medieval period in the UK.

Femoral midshaft circumference (Mid.C) and posterior cortical thickness (Post.Cort.T) were recorded and used to create five robusticity

groups. Histological sections from the posterior aspect of each femur were prepared following standard methods. Osteon population density (OPD), Haversian canal area (H.Ar) and diameter (H.Dm), osteon area (On.Ar) and osteocyte lacunae density (Ot.Dn) were compared between the groups.

Histology values differed significantly between the five robusticity groups, though variation with age and between sexes was not consistent. A multivariate discriminant function analysis revealed that Ot.Dn, On.Ar, Ot.Dn, and H.Dm were the best predictors of Mid.C and Post.Cort.T in each of the five groups.

Results indicate increased remodeling activity in larger and thicker bone. Small osteons and Haversian canals imply a highly strenuous loading history in robust femora. It is suggested that studies which infer ancient human behaviour from comparisons of femoral bone microstructure should account for histological variation that occurs with increased bone robusticity.

This study was undertaken as part of a PhD studentship funded by the School of Anthropology and Conservation, University of Kent.

Within-group infanticide and infanticidal attempts by the alpha male chimpanzee at Gombe National Park, Tanzania

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Infanticide by males has been documented in a variety of mammals, including primates. Such cases often involve an immigrant or newly dominant male, and are often explained by the sexual selection hypothesis, which proposes that a male may gain genetic benefits by committing infanticide provided three conditions are met: (i) he is not the father of the infanticide victim, (ii) killing the infant advances the onset of the female's next fertile period, and (iii) he has a high probability of siring the female's next infant. Recently at Gombe National Park, Tanzania, the alpha male of the Kasekela community (Ferdinand) killed an infant (Tarime), directed apparent infanticide attempts at three others (Tabora, Shwali, and Fifti), and led an attack on a mother (Eliza) during which the mother's newborn infant was snatched, killed and eaten by females (Sandi and Sparrow). These attacks are unusual in several respects. First, few other Gombe males have committed within-group infanticides, much less made multiple attempts within a single year. Second,

genetic evidence indicates that Ferdinand is the father at least one of the infants he targeted (Tabora). Third, Ferdinand has been alpha male for five years, during which he has frequently monopolized matings with fertile females. Here we examine the contexts of these events, including genetic evidence for paternity, observations of mating behavior, and competitive interactions among males and females in an effort to understand this unusual state of infanticidal attacks.

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Pelvic inlet shape and sex determination from a fragmentary fossil pelvis

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Determining sex and pelvic inlet shape in fossil hominins provides important clues to their biology, but these attributes are often difficult to assess on fragmentary specimens. Here we describe techniques for determination of pelvic inlet shape and sex in the fragmentary fossil pelvis KNM-ER 5881, dated to 1.88 Ma from Koobi Fora, Kenya. KNM-ER 5881 has previously been attributed to *Homo* based upon other features of the pelvis and femur (CV Ward et al. 2011. *AJPA* 552:305). Using a comparative sample consisting of *in silico* models built from laser scans of hipbones from modern humans (n=90) and fossil hominins (n=8), we evaluated pelvic inlet shape using a modification of Ruff's method (CB Ruff. 1995. *AJPA* 98:527-574). We show that the KNM-ER 5881 specimen falls clearly outside the range of variation of *Australopithecus* but within the range of modern *Homo* for pelvic inlet shape. To determine sex of the specimen, we used multiple measures to quantify sciatic notch shape on KNM-ER 5881. Sex determination was unsuccessful, as the specimen falls in the male/female overlap range for all measures of sciatic notch shape. However, we show that this technique is useful for determining sciatic notch shape in fragmentary specimens. The described techniques for the assessment of pelvic inlet and sciatic notch shape may provide a means to evaluate these characteristics in other fragmentary specimens and thus give further insight into the evolution of the pelvis in hominins.

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A non-invasive methodology for monitoring physiological and endocrinological responses to stressors in correlation to skeletal protein breakdown in wild orangutans

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Due to human disturbances that directly affect orangutan habitats, wild orangutans are endangered and face possible extinction within the next century. Developing an understanding of physiological and endocrinological responses to ecological stressors can contribute to promoting health and survival in orangutan populations. We introduce a non-invasive methodology for monitoring immunological response, physiological stress, and actin-myosin breakdown in Bornean orangutans (*Pongo pygmaeus wurmbii*) from urine samples collected in a remote field setting.

Over an eight-month period in the Tuanan Research area (Central Kalimantan, Indonesia), 99 samples were collected from 23 individuals. Samples were collected in the forest, frozen, and transported to the United States for analyses. We tested for the prevalence of seven urinary pro-inflammatory cytokines (G-CSF, IL-10, IL-1ra, IL-8, MCP-1, TNF α and IP-10), ran validations, and assessed skeletal muscle breakdown by quantitative measurements of urinary 3-methylhistidine (3MH). Four cytokines (G-CSF, IL-10, IL-8 and MCP-1) could be detected in greater than 50% of the samples. We found significant positive correlations among seven different cytokines (p<0.05). 3MH could be detected in 98 samples and concentrations ranged from 2 – 384 nmol/ml. 3MH was also correlated with G-CSF (r=0.58, p=0.002), MCP-1 (r=0.65, p=0.0002), and IL-8 (r=0.46, p=0.002). We demonstrate that non-invasively collected urine samples from wild orangutans can be used for the detection of inflammatory mediators and products of protein breakdown. Through comparative detection of selected urinary pro-inflammatory proteins, urinary 3MH, and observational focal data, levels of inflammatory and catabolic stress can be quantified in wild primates and used for evaluating overall health.

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Multidisciplinary analysis of an osteosarcoma from the 11th-12th AD centuries of Hungary

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In the paleopathological literature there are only a few reports about osteosarcomas.

This paper focuses on a case of osteosarcoma coming from the 11th-12th AD centuries of Hungary. During the paleopathological study macroscopic, radiological, light and scanning electron microscopic investigations were performed.

The skull of the mature female revealed serious pathological lesions. The characteristic macroscopic feature of the lesions is the radiant alignment of the massive new bone mass. The CT scans reveal an extensive left facial tumor with bone destruction and spiculated pathologic new bone formation presenting "sunburst" appearance. The lesion probably originated from the medial wall of the orbit and the ethmoidal cells, and propagated into the frontal and maxillary sinuses. In the left frontobasal region the tumor show intracranial propagation. The left nasal cavity is enlarged probably due to the once existing soft tissue component of the tumor. The nasal septum is dislocated to the right, the cranial part of the septum is also involved. Based on the microscopic investigations, the tumor consists of quickly grown woven bone. Slim bony spiculae and numerous Howship's lacunae demonstrate a change between proliferation and resorption on the external parts of this tumor which characterizes its nature. Besides tumorous alterations signs of healed multiple incomplete trephinations of the left parietal bones can also be observed.

Identification of all examples of cancer in antiquity represents an important contribution to paleopathology in light of the increasing clinical, epidemiological, and demographic importance of this disease today.

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Diaphyseal cross-sectional variation in extant hominoid humeri: Implications for incomplete hominid fossils

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Cross-sectional parameters of the humeral diaphysis in great apes and humans have featured in discussions of the behavioral adaptations of extinct hominoids and prehistoric humans.

Although cross-sectional geometric properties are most commonly measured at 'midshaft,' not all researchers calculate this point using the same landmarks. Moreover, inferring data for this level for incomplete fossils is problematic. In this study, we assess structural variation along the length of the humeral diaphysis in four extant hominoid taxa to evaluate how accurately midshaft must be defined to yield comparable cross-sectional data.

The humeri of mixed-sex adult samples of *Pan troglodytes*, *Pongo pygmaeus*, *Gorilla gorilla* and *Homo sapiens* were CT-scanned at full length using a 2.5 mm slice thickness. Cross-sectional structural parameters were determined

for each slice, and these data were used to compute error ranges and construct predictive models. Employing these models, ranges of probable midshaft parameters were constructed for several fragmentary hominin fossils (e.g., Border Cave).

Overall, cross-sectional properties at midshaft are not significantly impacted by differences in determining this position on the humerus. Moreover, except for the region influenced by the deltoid tuberosity, no significant differences in parameters (e.g., cortical bone area) were found between 40 - 70% of the total length in our sample. Such stability along the diaphysis indicates that midshaft properties can be inferred with a reasonably high degree of confidence for incomplete fossils, thus enabling researchers to expand analyses to incorporate specimens that may previously have been considered too incomplete for analysis.

Fossil monkeys from South Africa in the University of California's Museum of Paleontology collections

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In 1947, the University of California's Museum of Paleontology (UCMP) led an expedition to South Africa and collected fossils from more than 40 site localities. Just over 200 of these fossils have been taxonomically identified as Cercopithecidae. These specimens have spent much of the last 40 years undergoing preparation at the American Museum of Natural History. With the exception of 20 specimens still withdrawn, and 36 specimens donated to the University of Witwatersrand, all primate materials are now stored in the UCMP. Five genera and nine species of Cercopithecidae have been identified from these collections, and n=45 specimens have been included in publication.

We undertook a detailed curation of the collection, identifying 22 new specimens and bringing the total number of Cercopithecidae housed in the UCMP to N=144. After carefully reviewing field notes and records, we found that the Cercopithecidae fossils were recovered from over 15 site localities, including the cave associated with the famous *Australopithecus* "Taung Child," and span a period of approximately two million years. Of the total Cercopithecidae fossil material, n=126 are adult specimens. This count includes 107 craniodental materials, 16 postcranial materials and three specimens with both cranial and postcranial elements. Approximately 18 fossils have been identified as juveniles, including 16 craniodental and 2 postcranial specimens. The collection provides new information on the anatomy and ontogeny of fossil Cercopithecidae. Incorporating these data, we are able to update and revise taxonomy, contributing new data to a greater understanding of primate evolution and diversity in Pleistocene South Africa.

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Atresia of the external auditory meatus in an individual from pre-Columbian Venezuela

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Only a few cases of congenital aural atresia, a pathological condition involving malformation of the external and middle ear, have been reported in prehistoric individuals despite the relatively common nature of the disease in modern-day populations (> 1 in 20,000 individuals). Here we present a case of congenital aural atresia in an adult male individual from the Ceramic Age site Los Tamarindos in Venezuela, that dates to approximately 1000 BP. Macroscopic examination of the cranium revealed a complete lack of the right external auditory meatus; the left side is normal. Further analysis using a micro-CT scanner uncovered a fused incus and malleus in the right ear as well as other abnormalities. In most cases, these skeletal symptoms are associated with malformation of the external ear that would have been visible to the community living at Los Tamarindos. Given the severity of the symptoms, this individual would likely have suffered from significant, if not complete, unilateral hearing loss.

The burial context suggests that this individual was fully integrated within the community. The grave is located centrally within the burial area from which 22 other individuals have been studied. Unmodified deer antlers were placed next to the affected side of the head; this unique grave offering may represent social recognition of the individual's hearing disability and likely malformation of the external ear.

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Neutral and adaptive evolution of femoral morphology: A comparative study of developmental variation within and between *Pan* taxa

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While femoral morphology is typically interpreted in terms of taxon-specific locomotor adaptations, the influence of neutral evolutionary processes on between-taxon femoral variation remains largely unexplored. *Pan* species and subspecies provide a unique test case to tackle this problem, since their phyletic history and population structure are now well documented by detailed genetic data. Here, we analyze the ontogeny of femoral diaphyseal morphology in *Pan troglodytes troglodytes*, *P. t. schweinfurthii*, *P. t. verus*, and *P. paniscus* using CT-data based morphometric mapping methods. We use these

data to compare phenetic distances with non-coding genetic distances. Our results show that, during infancy, phenetic distances between taxa are largely congruent with non-coding genetic distances, indicating that the evolutionary diversification of early ontogenetic programs is largely due to neutral processes. Toward adulthood, however, phenetic distances deviate from the non-coding genetic pattern, indicating adaptive evolution of late ontogenetic programs. Overall, our data indicate that neutral processes play a primary role in the evolutionary diversification of femoral morphology.

Nocturnal predation and the isotopic niches of tarsiers and scops owls

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Stable isotope ratios are a practical tool for quantifying the diets of difficult-to-observe animals such as nocturnal or cryptic taxa. While the exploitation of insects by tarsiers has been well studied, the degree of niche overlap and interspecific competition among tarsiers and sympatric animals has received little attention. Tarsiers (*Tarsius*) and scops owls (*Otus*) share extremely large and forward-facing eyes, acute directional hearing for locating prey, specialized feeding morphology for immobilizing prey, and efficient sit-wait-and-ambush predatory tactics. Thus, *Tarsius* and *Otus* are predicted to have similar isotopic niches, or overlapping $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ values, because both taxa are reported to consume invertebrate and vertebrate prey, typically near the ground in the forest understory. Quantitative support for this prediction would be consistent with functional interpretations of the many anatomical homoplasies shared between these two taxa, including the retinal fovea. This hypothesis can be tested with an analysis of carbon and nitrogen stable isotopes in tissues, which provide time-averaged information about diet and trophic level. In this study, we found that the isotopic niches of *Tarsius* and *Otus* overlapped. In both Borneo and the Philippines, the $\delta^{13}\text{C}$ values were indistinguishable, whereas the $\delta^{15}\text{N}$ values of *Otus* were marginally but consistently higher than those of *Tarsius*. Our results indicate that both diets consisted mainly of ground-dwelling prey and raise the possibility of some invertebrate-vertebrate partitioning. Taken together, our isotopic analysis of diet fails to refute a functional interpretation of the many homoplasies shared by tarsiers and scops owls, including the retinal fovea.

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Is lower DNA methylation along the leptin core promoter associated with increased metabolic risk profiles in SE Asians: A comparison of immigrants offspring from different continents

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Increasing evidence suggests Asian populations experience a greater metabolic risk for obesity-related diseases than other ethnicities, despite lower percentages of body mass index (BMI). A disorder in adipokine levels is believed to be a determinant. Leptin protein synthesized in adipocytes serves to regulate energy homeostasis -- energy intake, expenditure and storage. Leptin also upregulates inflammatory cytokines. Asian populations have greater levels of serum leptin than expected in relation to their percentage of adipose tissue and experience greater levels of inflammatory markers in relation to that leptin than other populations. The explanation behind the unfavorable profile is unknown. We hypothesize that DNA methylation along the leptin gene (*LEP*) core promoter offers some explanation.

Using the processes of bisulfate conversion, PCR and pyrosequencing, we identified DNA methylation density in seven CpG sites of the *LEP* promoter, which includes the "hotspots" of a C/EBP α transcription binding site and two CpG sites proximal to the TATA box. Here, decreased gene expression correlates with increased methylation. Comparing thirty-one immigrant offspring (<18yrs old), we identified significantly lower methylation density along the promoter in Asian females than Ethiopian females, specifically in sites 2,3,5 and 6 (all sites at $P < 0.02$ and density percentage 16-20% lower). At Site 4, a transcription binding site, Asians demonstrated significantly lower density percentages ($P < 0.023$) than the Ethiopians, but differences were not sex-specific. We suggest that these lower levels of methylation seen along the Asian *LEP* promoter offer a plausible explanation to higher leptin levels and risk factors of insulin resistance.

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Stable isotope ratios ($\delta^{13}\text{C}$ and $\delta^{15}\text{N}$) of hair reflect differences in foraging ecology and seasonal variation at two chimpanzee field sites (Gombe and Ugalla)

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This project uses stable isotope analysis ($\delta^{13}\text{C}$ and $\delta^{15}\text{N}$) of hair keratin to provide valuable information on the foraging ecology and habitat use of chimpanzees (*Pan troglodytes*). We analyze hair samples from two distinct habitats, Ugalla (N=52) and Gombe National Park (N=29), to explore ecological variation between regions and seasonal dietary differences within each site. All samples were collected from night nests across a span of several years. Our results demonstrate that differences in $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$

values between these sites are highly significant ($p < .001$), reflecting clear environmental differences between Ugalla, a miombo woodland with grass groundcover and small patches of forest, and Gombe, a forested area that ranges from grassland to tropical rainforest. The open and dry environment of Ugalla resulted in higher $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ hair values relative to the wetter Gombe. Isotopic data also reveals differences between the sites in regards to the extent of seasonal variation in the apes' diet. Gombe hairs collected after the May-October dry season exhibit significantly higher $\delta^{13}\text{C}$ values compared to those collected after the November-April wet season. Interestingly, no seasonal differences were observed at Ugalla, perhaps indicating behavioral buffering.

The results of this study demonstrate the utility of stable isotope values as indicators of environmental variation. Moreover, they allow for time-averaged dietary comparisons between sites without the requirement for habituation or detailed foraging data. The significant seasonal variation in isotope ratios suggests that future studies investigating dietary variability through stable isotope analysis need to take into account seasonality during collection.

Assessing cortical and trabecular bone loss as stress indicators in an archaeological sample using pQCT

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Bone loss is an important skeletal indicator of past biological and environmental stress. Cortical and trabecular bone, however, are differentially affected by internal and external stressors. Thus, measurements of the cortical index, or total bone mineral density (BMD) by DXA, may not accurately reflect effects of stress on the skeleton. Peripheral quantitative computed tomography (pQCT) potentially resolves this issue by separately calculating cortical and trabecular BMD, but remains underutilized in bioarchaeology. This project had two major goals: 1) evaluate the effectiveness of pQCT in measuring cortical and trabecular BMD in archaeological specimens; 2) test the hypothesis that females suffered greater bone loss than males in a socially stressed population due to biological and social factors. Cortical and trabecular BMD was measured at the distal end and midshaft of the radius and femur of 30 adult skeletons from Point of Pines Pueblo, Arizona.

pQCT effectively measured BMD in the archaeological sample. Females lost cortical and trabecular density in the femur after young adulthood but showed no significant changes in the radius. Males lost trabecular BMD after young adulthood in both elements but experienced no significant changes in cortical density. The hypothesis that females suffered greater overall BMD loss than males was not supported. Sex-specific activities may explain preferential bone maintenance in the female radius, while hormonal differences likely maintained male cortical density. These results demonstrate the importance of evaluating cortical and trabecular bone separately, the usefulness of pQCT in bioarchaeological research, and reveal new information about the health of this population.

Standardization issues for the measurement of mammalian body composition

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Analyses of body composition quantify the relative percentage of skin, fat, bone, and muscle in the body. Traditionally, body composition data in non-human primates has been obtained through dissection. Several non-invasive methods are available for calculating body composition in humans, however in non-human primates and other mammals body composition calculations are often difficult. Researchers use calipers, bioelectrical impedance, creatinine, and dual energy x-ray absorptiometry to estimate body composition variables. However, none of these methods can calculate all body composition parameters alone and most are not readily available for non-human primates. Computed tomography (CT) can accurately assess all body composition variables non-invasively, but the accuracy of that approach has not been extensively tested. Here, we examine the use of CT in collecting body composition data from adult *Lagothrix lagothrica* cadavers (n=5). Cadavers were CT scanned and analyzed using Mimics 14.1. We established tissue specific pixel-density contrast thresholds for bone, muscle, fat, and skin and then used stacked images to obtain values for each tissue type. Relative tissue volumes were calculated for the upper and lower limbs, and for individual limb segments, with respect to total cadaveric tissue volume. We then dissected CT scanned cadavers and compared the dissection derived body composition values to CT derived values. CT values for muscle and bone were not significantly different from dissection values. Isolating skin from fat using CT images proved difficult and results differed significantly from dissection values. This study validates the use of CT data for the collection of body composition data.

Musculoskeletal stress markers in an ancient Puebloan population

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Musculoskeletal stress markers have been used as evidence for activity patterns in past populations. Due to the variety of factors that may influence muscle size, assuming direct relationships between muscle marking scores and specific activities is problematic. Previous studies have demonstrated that musculoskeletal stress markers may be affected by age and body size, so the relative contribution of these factors must be considered, particularly when comparing males and females.

Robusticity for eight entheses in the upper limb were studied in sample of 28 individuals from Basketmaker II (750 BC-AD 500) and Pueblo I (AD 700-900) contexts from Durango, Colorado following the methods of Mariotti and colleagues (2007). Aggregate data analysis and age and size controls were also used as suggested by Weiss (2003, 2007). The present study found that aggregate scores for robusticity of the upper limbs are significantly correlated with age

($p < 0.01$), but not humeral size. Thirty-four percent of the variation in aggregate robusticity is explained by age and 16.8% is explained by humeral size. Males and females in this sample are not dimorphic in upper limb muscle markers despite significant differences in humeral size. Smaller humeral size in females therefore does not inhibit robusticity of the upper limb and females are more robust than expected since they do not show significant differences from males. Brachioradialis, which stabilizes the elbow during rapid flexion and extension and brachialis, which is a strong elbow flexor, are particularly well-developed in this sample.

The most vulnerable inmates: Age distribution and cause of death among Erie County Poorhouse infants

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Bioarchaeological investigations of children have increased substantially in the last two decades. As it relates to the biological variation of past populations, research has focused on the vulnerability of children to cultural and environmental variables. As such, the morbidity and mortality of infants is often used as a gauge for understanding the influences on and impact of pathology in the larger population. Recent studies have addressed children themselves as essential actors in society, and therefore of significant anthropological value. This study specifically addresses how a multidisciplinary analysis of infants from a late 19th century population may reveal information regarding their social roles and the cultural and biological impacts on their development and growth during this crucial and physiologically demanding time of life history.

The skeletal remains of 54 infants were excavated from the Erie County Poorhouse Cemetery in Buffalo, NY. This research integrates data from the archaeological and historical records with skeletal data to determine age-at-death patterning among the poorhouse infants and to address both the proximate and ultimate causes of their morbidity and mortality. Age-at-death and pathology were determined using both metric and macroscopic data from the skull, postcranial skeletal and dentition. The minimal pathology present in the skeletal record is not surprising given the early deaths of the infants. However, according to Erie County Poorhouse records, among the most frequently mentioned causes of death are those related to severe malnutrition. Discussion includes the degree of skeletal evidence for growth disruption and plasticity and its relationship to physiological stress.

Male sexual coercion and female mating preferences in wild chimpanzees

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Clear evidence for female mate choice has been documented in many vertebrates, but among promiscuously breeding primate species, determining female preferences has proven elusive. For example, female chimpanzees (*Pan troglodytes*) often mate more restrictively around ovulation, and this has been interpreted as evidence for increased choosiness at that time. However, an alternative hypothesis is that females are always highly motivated to confuse paternity by mating as widely as possible, and that restricted mating around ovulation results not from free choice, but from fear of male aggression.

I review long-term data from the Kanyawara community in Kibale National Park to illustrate problems with inferring female preferences from behavioral observations, and to test predictions of the male coercion hypothesis. In support of the hypothesis, Kanyawara females initiated periovulatory copulations most frequently with the males who were most aggressive toward them throughout their cycles, and showed dramatic increases in proceptivity when those aggressive males were absent. Continuing aggression by high-ranking males in the periovulatory period was consistent with a conflict of interest, in which females attempted to mate broadly rather than concentrating paternity.

Detecting female preferences in promiscuous species will continue to be difficult in the wild, requiring rigorous controls for long-term conditioning aggression by males, and clear models of what females are choosing (e.g. good genes vs. complementary genes). It is possible that in some species females would not benefit from increased choosiness during the periovulatory period, given the risk of male infanticide, and the existence of intense male-male competition.

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The effect of maternal stress on newborn birth outcome and methylation profiles

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In the Democratic Republic of Congo, we are investigating the potential for an epigenetic mechanism to mediate the effects of maternal prenatal stress on maternal and newborn health. We collected blood and placental samples from 25 mother – newborn dyads and conducted ethnographic interviews to measure maternal stress exposures. Methylation status at both the genic level (glucocorticoid receptor *NR3C1*) and genomic level (Illumina Human Methylation 450 BeadChip) was assayed. We previously observed that maternal stress is correlated with increased fetal methylation at *NR3C1* and reduced birthweight, consistent with the tenets of the developmental origins of health and disease hypothesis in which maternal stress modifies offspring biology. Our genome-wide analysis shows only a small fraction of methylation sites

are correlated with stress; 212 CpG sites, 13 genes, 37 promoters at a FDR 5%. Yet, stress related methylation is observed to be highly heritable (we estimated heritability of CpG methylation between mothers and newborns), likely the result of a shared environment. When evaluated in a regulatory context, we find that methylation variation within promoters is stable across different tissues and conditions but variation in enhancers and insulators is highly dynamic, suggesting that variation in enhancers may play a larger role in expression variation than variation within promoter regions. Modification of gene expression through epigenetic mechanisms and the heritability of such changes looks to be, not surprisingly, highly complex. Our ongoing collaboration with HEAL Africa and continuing collection of samples, including follow-up newborn samples, will help clarify the important steps in this essential process.

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Premolar odontomes: A study of their frequency and familial occurrence in a Native American sample from Arizona

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Odontomes, also known as dens evaginatus, is a morphological dental trait characterized by protrusion of an occlusal tubercle consisting of enamel, dentin and variable amounts of pulp tissue. The trait is found most commonly on human premolars. Population variation is well documented, with Asian and Asian-derived samples exhibiting the highest odontome frequencies, which rarely exceed 20%. Analyses indicate varying levels of genetic control for morphological dental traits, but it appears that odontomes have yet to be analyzed. The intent of this study is to investigate the frequency and possible familial distribution of odontomes by studying 19 pedigrees of Pima Indians from the A.A. Dahlberg Collection of dental casts at Arizona State University.

Our analysis included 714 maxillary and mandibular premolars in which 78 (10.9%) exhibited an odontome. Employing the individual count method, our total sample reveals that odontomes occur more frequently on the first maxillary premolar (15.8%) relative to the second maxillary premolar (11.1%). Interestingly, there is contrasting directionality in odontome frequency in the mandible, where the trait occurs more often on second premolars (LP1=7.5%; LP2=20.9%). At least one first-degree relative of an affected individual also exhibited an odontome in 9 out of 19 (47.4%) pedigrees. Overall, premolar odontomes occurred in 16.5% (13/79) of first-degree relatives of affected individuals. The familial odontome frequencies found here are higher than in prior studies of the Pima, thus supporting a genetic causation for premolar odontomes.

Human variation and the biocultural response to colonialism: A view from the central coast of Peru

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Until recently bioarchaeological investigations of native responses to conquest and colonialism in South America have lagged behind similar studies in North and Mesoamerica, but burgeoning research in South America has demonstrated tremendous variability in biocultural responses and outcomes to colonialism. The goals of the Rimac Valley Bioarchaeological Project, Peru are 1) to uncover the biocultural outcomes and responses to Inca and Spanish colonialism through the comparative investigation of human remains (N=approximately 800 individuals) from several different sites (N=5) from the central coast of Peru; and 2) to interpret and understand these results within the context of the different forms of colonialism experienced by these central coast communities. Preliminary results indicate that Inca imperialism did not negatively impact diet or health at several of the sites. Diet may have improved under Inca rule on the central coast. The early colonial burials have demonstrated higher levels of violence and perimortem traumatic injuries, but the frequencies of skeletal indicators of stress among the early colonial burials, while slightly higher, were not statistically significant. When compared with other Late Horizon samples, these results indicate that not all communities experienced higher levels of violence or a deterioration of health after Spanish conquest and invasion. Furthermore this research hints that under Inca imperialism on the central coast of Peru, some communities may have experienced positive health outcomes and some communities may have experienced negative health outcomes. Future research will reconstruct diet and population migration and movement among these samples through additional stable isotope analysis.

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A comparison of cranial trait and craniometric sexual dimorphism in a medieval Nubian sample

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Previous research on the Kulubnarti ancient Nubian sample indicates that this population displayed a low level of sexual dimorphism in terms of isolated browridge and chin morphologies when compared to other samples. This study sought to determine whether craniometric analyses would reveal comparable low levels of sexual dimorphism. Three craniofacial measurements and three cranial vault measurements were collected from the same three-dimensional skull surface scans utilized in the previous browridge and chin study (n= 38 males and 44 females). Discriminant function analyses were performed on the vault and facial measurements combined, as well as

separately to evaluate whether sexual dimorphism varies across functional components of the skull. The same analyses were also performed on 15 groups from the Howell's data set in Fordisc 3.1 to compare relative levels of dimorphism and elucidate any regional patterns. The results reveal a moderate level of sexual dimorphism in the Kulubnarti sample (D^2 value of 4.9) compared to both modern and non-modern Howell's groups included in this study (D^2 values ranged from 3.7 to 9.0). The vault measurements, particularly glabella-occipital length, were found to account for greater sexual variation in the Kulubnarti crania than the facial measurements. The Howell's 20th century Black sample displayed similarly low levels of craniometric sexual dimorphism, indicating possible geographic patterns. These results suggest that in some populations facial features may be less reliable than vault or overall size measurements in sex discrimination and could account for the lower levels of dimorphism observed in discrete cranial traits.

Food intake, nutrition and ecology in Amazonian Ribeirinho populations: A multivariate analysis

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Ecological differences among major Amazonian riverine environments play an important role on local household diet composition. However, few studies compared directly the food intake observed between communities living in the different Amazon ecosystems. Here, we address this limitation by comparing household food intake and its association to specific Amazonian environments. Ribeirinho household food intake was measured in three Amazonian riverine ecosystems: seasonal white water floodplain (Ituqui Island), black water upperland (Caxiuana) and estuarine floodplain (Marajó Island). Data were collected using 24-hour recall in 45 households in the three ecosystems during seven consecutive days in rainy and dry seasons. Caloric and protein values were estimated using Brazilian food composition tables. All data was collected before the beginning of the national cash transfer program (*Bolsa Família*) in the Brazilian Amazon. Our results, based on Principal Component Analysis of the food sources of calorie and protein intake in each community, shows that seasonal floodplain households have very distinct caloric and protein intake patterns. High primary productivity, extreme water level fluctuations, and the need for specialized cultural adaptations might be proximate causes for such a pattern.

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Thermoregulatory and mobility consequences for reproductive age women carrying loads in an indigenous pack basket

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Determining the thermoregulatory and mobility consequences of load-carrying is important for understanding the locomotor constraints on extant and extinct human populations. Almost universally, women in indigenous cultures walk substantial distances carrying heavy loads, including food, water, and children; the distance they travel is likely influenced by walking speed. Based on previous work, we expect women carrying loads will regulate their speed to modulate heat load. We tested this expectation in a sample of free-walking, reproductive-age women who carried loads in an indigenous pack basket. The study involved 14 women in luteal menstrual phase or taking oral contraceptives. Subjects carried three different load amounts--0, 10, and 20 kg--in an indigenous style pack basket while walking around a gym perimeter at four walking speed directives ("slow walk", "walk all day", "brisk walk", "fast walk"). The 12 conditions (all combinations of 3 loads, 4 speed directives) were performed in a random order. Thermoregulatory changes were monitored after each trial with an infrared Temporal Artery Thermometer; walking speed was determined from videotape. For a given speed directive, selected speeds dropped significantly from 0 to 20kg loads at all but the "slow walk"; the amount of drop increased at faster speed directives. The load-related drop in speed was highly correlated ($r=0.98$) with the increase in temporal artery temperature as a function of speed directive. Thus, women appear to constrain their walking speed while carrying loads in a manner consistent with modulating thermoregulatory changes that could alter their fertility or reproductive health.

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Analysis and interpretation of health skeletal indicators from the ancient Mayas

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Maya population health in the past was expressed in a considerable amount of studies, with different results related with ecological and socioeconomic variables. In this paper we integrated our results from skeletal analysis based on health indicators, such as cribra orbitalia, spongy hyperostosis, enamel hypoplasia, periostitis, among others. We used skeletal collections from sites in the coast of Yucatan, and some other series from Palenque, Chiapas. We try to create a long-term perspective on biosocial and cultural adaptation. Comparing these stress indicators, Palenque is usually more affected than are the coastal populations of Jaina and Xcaret. The morbidity risks for juveniles appear similar for the various

parts of the Classic Maya World. These individuals also have dental pathology and at least slight infectious reactions. Individuals in Jaina and Xcaret generally have to survive fewer stresses as children, and while infections are a serious, dental disease is less.

Unique body proportions of *Microcolobus*

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Microcolobus (ca. 10 Ma) is one of the earliest cercopithecids and virtually the only cercopithecoid taxon that fills the gap in the fossil record between the middle Miocene (ca. 15 Ma) victoriapithecids and 8 my-old *Mesopithecus* (Colobinae). *Micocolobus* was first discovered at the Ngeringerowa bed, in the Tugen Hills, Kenya in the 1980s. For many years, it was known from only a single mandible. However, during the last decade, numerous *Micocolobus* specimens have been collected from the Nakali Formation (9.8-9.9 Ma) by the National Museums of Kenya-Kyoto University joint team. This collection includes several partial skeletons, which reveal *Micocolobus* body proportions. *Microcolobus* is a small-sized colobine (4.5-5 kg), almost at the lower end of extant colobines. Whereas *Microcolobus* exhibits a number of postcranial similarities to extant colobines in the morphology of joints (typically the elbow), it had not experienced degeneration of the thumb, a hallmark of modern colobines. When scaled on body mass, the fourth metacarpal is shorter than that of extant colobines but comparable to that of extant arboreal cercopithecines, whereas the manual proximal phalanx (of median ray) is elongated like extant colobines surpassing that of arboreal cercopithecines. The hallux proximal phalanx is bigger than that of extant colobines and arboreal cercopithecines. *Microcolobus*, although it was a fully arboreal monkey with enhanced pronation/supination ability at the elbow, might exhibit an early evolutionary stage of colobines toward fast arboreal locomotion in which hook-like grasp was more adaptive. The meaning of the large hallux, however, is not clear.

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Heavy is the crown: Investigating form-function relationships among the head, neck, and posture during locomotion in primates

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While many investigations of primate posture and locomotion have focused on the thoracic and lumbar regions of the spine, the cervical column has been largely ignored in functional analyses. Previous research suggests that categorical classification of postural and locomotor behaviors oversimplifies species-typical behavioral repertoires and this has limited the scope and application of investigations into

cervical functional morphology. By using kinematic data on primate head and neck postures (Strait and Ross, 1999), the relationship between posture and craniocervical morphology can be more directly explored. Cranial and vertebral features were quantified using linear and three-dimensional coordinate data in 186 specimens, representing 14 primate species. Relationships among vertebral morphology, neck posture, and cranial morphology were analyzed using phylogenetic generalized least squares. Results support a link between neck posture and some cervical features—specifically, spinous process length, pedicle cross-sectional area, and the craniocaudal length of the cervical column increase as the cervical column becomes more horizontally oriented. Similar results were obtained in analyses of cranial features known to vary with differences in neck posture (i.e., orbital axis orientation [AOA]). As with neck posture, spinous process length, pedicle cross-sectional area, and cervical column craniocaudal length were consistently correlated with AOA (positive association). Analyses including AOA also produced a greater incidence of significant correlations with additional vertebral features (orientation of the vertebral canal, laminar cross-sectional area). These results support a link between vertebral form and postural function, and emphasize the value of incorporating cervical vertebrae into reconstructions of postural behavior in fossil taxa.

Basket cases: Temporal comparison of the patterns and prevalence of the acromio-humeral facet in samples from the Pre-Columbian Tennessee River Valley

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Postural markers, such as squatting facets, have provided information on habitual behaviors, which in turn provide clues to past life-ways. The acromio-humeral (AH) facet is a little researched pressure induced, skeletal marker on the greater tubercle of the humerus. The facet has previously been linked to particular burden bearing activities requiring retro-flexion and elevation of the humerus. This facet manifests differentially by sex, age, and body size. The facet has not yet been quantified with respect to possible differential subsistence-based difference in burden-bearing behaviors.

A combined three Late Archaic (~6500-3000 BP) hunter-gatherer sample (N=62) and a sedentary agriculturalist Mississippian (900-700 BP) sample, Middle Cumberland Culture (N=40) from west-central Tennessee reveals upper arm changes related to burden bearing. A clear temporal difference between facet presence and intensity (incipient, full) was observed. The facet is ubiquitous in the Mississippian period (90.38%) compared to the lower presence (49.44%) in the Late Archaic. This result was unanticipated given a presumptive greater reliance on burden bearing among foragers.

A metrically determined robusticity index (area of the humerus at midshaft / humeral length x 100) was compared with facet presence indicating that, like previous research, larger individuals and vulnerable individuals are most likely to have fully formed AH facets.

The prevalence of the facet in the Mississippian sample relative to the Archaic sample further suggests that activity-related behaviors, however related to the strategies of foraging or harvesting, may be culturally variable within and between subsistence strategies.

Evidence for skeletal fluorosis in Illinois: A pathological analysis of individuals from the Ray Site and discussion of environmental factors affecting community health

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Skeletal fluorosis is an endemic problem in populations at risk of ingesting excess fluoride. Whether ingestion takes place as a result of toxic levels of natural mineral content in water or from consumption of plants growing in fluorite rich soils, the results can be detrimental to an individual's health. When toxic levels of fluoride are consumed the pathological condition of skeletal fluorosis ensues. Fluorosis has been identified in skeletons from Bahrain, Naples, and the UAE. While a very serious concern for some parts of the world today, the etiology and history of this metabolic bone disease is poorly understood because it is often misdiagnosed or not considered in archaeological remains. Although not yet described in archaeological collection from North America, we predict that this pathological condition may be present in the Illinois River Valley due to the natural geologic conditions conducive to fluorosis. Our results indicate that of the 117 individuals analyzed from the ray Site, 12 may have suffered from skeletal fluorosis. These individuals display characteristic hyperosteo-sclerotic activity of bone, high incidence of fractures, as well as dental pitting and mottling, all indicative of skeletal fluorosis. We present new information discussing and describing the evidence consistent with skeletal fluorosis occurring in individuals at the Ray Site.

Associations between digit ratio and musculoskeletal stress markers in the hand in three species of ape

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Musculoskeletal stress markers (MSM) are areas of bone reflecting ligamentous and tendinous attachments and are often more prominent in males than females. Here we investigate if MSM are associated with the length ratio of proximal phalanges 2 and 4 (2PP:4PP) used as a proxy for digit ratio (2D:4D); a sexually dimorphic trait linked to the developmental effects of prenatal sex hormones. In humans, low 2D:4D, reflecting exposure to high prenatal testosterone (PT), has been associated with increased grip strength in males. Prediction: low 2PP:4PP will be associated with larger MSM in the hand, with more pronounced effects for males.

2PP:4PP and average size of 11 MSM were calculated for humans (n=83) from two historical cemetery populations (Écija, Spain and Greenwich, England) and museum specimens of chimpanzees (n=20) and gorillas (n=32).

Relationships were in the same direction, but opposite to predictions; low 2PP:4PP (high PT) was associated with smaller MSM. Significant relationships were found for right 2PP:4PP and right MSM in men. Trends were found in chimps and gorillas when males and females were pooled (sex was controlled). No relationships were detected in women.

Relationships were stronger for males and for right 2PP:4PP. This is consistent with other studies of 2D:4D and sexually dimorphic traits. Associations were in the same direction in all three species. Unexpectedly, these were opposite to predictions; individuals exposed to high prenatal testosterone (inferred by low 2PP:4PP), who are potentially stronger, had smaller MSM in the hand. We discuss factors that might underpin this counterintuitive result.

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Patterns of dental wear in prehistoric Palau

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Patterns of dental wear can provide a window into the diet and lifeways of prehistoric peoples. The large (approximately 40 MNI), early (1700-3000 BP), cemetery of Chelechol-ra-Orrak, Republic of Palau, presents an opportunity to investigate dental wear in an early Pacific Island population adapting to a new environment. For this study general wear was quantified on all available mandibles and maxillae retaining at least the first and second molars (n=17) using Scott (1979) for molars and Smith (1984) for incisors through premolars and macrowear (chipping and pitting) was evaluated for frequency, severity, and location. Paired sample t-tests show significantly more wear on three of four first vs. second molar pairs, lower molars exhibit significantly higher wear than their upper counterparts, and there is no significant difference between left and right side molars. The differences between upper and lower molar wear are not mirrored in the anterior dentition where no significant differences in any analysis were found. Light to moderate chipping appears throughout most dentitions but is focused on the post canine teeth and a pattern of molar buccal cusp tip and ridge pitting occurs in 88 percent (15/17) of individuals with varying severity. Both may be of non-dietary origin. In addition, while molar cusps of those with mixed dentitions exhibit facets typical of attrition, by early adulthood cusps are rounded and facets are few. This can probably be attributed to the ubiquitous chewing of betel, with its fibrous bolus, which does not appear to begin until the late teens.

Variability in children's postnatal HPA activity is associated with maternal cortisol levels during very early gestation

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Maternal stress during pregnancy may affect *in utero* programming of the stress or hypothalamic-pituitary-adrenal axis (HPAA) with consequences for child development and disease susceptibility across the lifespan. The first six gestational weeks (peri-conceptual period), in particular, may represent a critical window of vulnerability as crucial epigenetic processes take place during this period. Here we evaluate the relationship between mothers' peri-conceptual stress and their children's pre-pubertal HPAA activity. To that aim we quantified cortisol levels, a biomarker of HPAA activity, in first morning urinary specimens collected every other day from mothers during the first six gestational weeks of 18 pregnancies conceived in 2001 and daily from the resulting 18 children, now 11 to 12 years of age, for three weeks in 2013 as they started a new school term. Children's average first morning urinary cortisol levels during the first two weeks of school were negatively associated with maternal average peri-conceptual cortisol levels ($R^2 = 0.23$, p -value = 0.025), while their average cortisol levels prior to the start of school were not. We also measured changes in the children's salivary cortisol levels in response to an experimental stressor. The change in salivary cortisol levels during children's recovery from experimental stress exposure correlated positively with maternal average peri-conceptual cortisol levels ($R^2 = 0.35$, p -value = 0.014). This is the first study to evaluate the relationship between peri-conceptual maternal cortisol levels and children's postnatal stress physiology. Our results suggest that periconceptual stress levels may affect HPAA ontogeny and postnatal stress responsiveness.

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Shape analysis of endocranial asymmetry in humans and apes

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Morphological brain asymmetry is related to hemispheric specializations of the brain. To some extent, endocranial morphology can provide evidence about the brain's asymmetry and has been used to discuss hominin brain evolution. Humans, for example, show a combination of right frontal and left occipital petalias (protrusions) and this combination is correlated with right-handedness. Apes also have asymmetric endocasts but seem to lack such a consistent and population-wide pattern.

Here we use geometric morphometrics to quantify endocranial asymmetry without

requiring the definition of a midline. Our sample consists of 70 humans, 26 chimpanzees, 37 gorillas, 42 orangutans, and 10 gibbons. For each individual, we measured 309 endocranial landmarks and semilandmarks. The semilandmarks were allowed to slide according to a symmetric landmark configuration so as to remove asymmetric shape information that is related to the arbitrary location of semilandmarks. Using the relabeled reflections of landmarks, we computed the symmetric and asymmetric variation for analyses.

We found that the levels of total asymmetry vary among species. Gorillas have the most asymmetric endocasts. The pattern of directional asymmetry also differs between species. For humans, our data document the known contralateral frontal-occipital asymmetry combined with differential projections of the temporal poles. Size explains asymmetric variation only to a low degree and only in some species. This approach can add to our knowledge about the variation of the amount and the pattern of brain asymmetries and in the broader sense about the evolution of hemispheric brain specializations.

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The genetics of hominin cranial base integration and evolution

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Transgenic mice provide a tractable model aimed at interrogating the potential consequence of altering the expression of a single gene on morphological traits as well the covariance patterns among these traits. Here the concept of morphological integration has been applied to a single bone (the basioccipital) in previously reported and commercially available transgenic mouse models. One model alters early pattern formation of the chondrocranium through the hedgehog signaling pathway (i.e. a *DISP1* knockdown). Diminishing *Disp1* expression results in a longer basioccipital bone at parturition and the unaffected portions of the basioccipital bone show a significant pattern of covariation compared to unaffected regions. A model altering cartilage maturation (i.e. an *FGFr3* knockdown) similarly results in a longer basioccipital bone at parturition; however this model results in a significant pattern of covariation within the affected region. These data suggest that selection acting on a variety of genes with roles in disparate biological pathways can result in elongation of the basioccipital bone. These data show two models simulating elongation of the basioccipital bone in which significant covariation was observed in a region that was not the target of selection, as well as significant covariation in a region that was directly the target of selection. Like morphological traits, genes act through integrated functional and transcriptional networks. This model of morphological integration was based on the effect of altering a single gene. Future work concerning the genetic components of morphological integration may

aim at integrating gene expression or functional networks with phenotypic covariance data.

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Cranial morphology of the human skeletal remains from Lapa do Santo, Lagoa Santa, Brazil: Implications for the peopling of the New World

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The karstic region of Lagoa Santa (eastern central Brazil) has been highly important for discussions about the tempo and mode of human dispersal in the Americas, owing to the high density of late-Pleistocene/early-Holocene sites and hundreds of human skeletons recovered from the local rockshelters. Lapa do Santo rockshelter, excavated during the past decade, represents to date one of the largest collections of early Holocene human remains recovered from controlled excavations in the region. Here we analyze the morphological affinities of Lapa do Santo individuals with other early series from Lagoa Santa and Colombia, contextualizing them within the modern human cranial variation across the planet. Our analyses are based on complementary multivariate approaches to describe cranial shape, aiming to characterize the within-group variance and the between-group morphological affinities of the series included in the analyses. Our results indicate that 1) Lapa do Santo and other Lagoa Santa individuals do not present higher levels of within-group variation than modern human groups, supporting the idea that they represent one single biological population despite the ~3,000 years of occupation span in the region; and 2) the early South American groups, Lapa do Santo included, share high morphological affinities among themselves and with Australo-Melanesian and Easter Island groups. Taken together, these results suggest an increase of biological diversity in the continent during the Holocene, possibly associated with the influx of new extra-continental diversity after its initial settlement by groups showing Paleoamerican cranial morphology.

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The biocultural context of dental modification in prehistoric Southeast Asia

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This research examines intentional dental modifications by means of ablation and filing from archaeological sites throughout Southeast Asia. Until recently, cases of intentional filing

were undocumented throughout prehistoric Southeast Asia and intentional ablation has been limited to Neolithic and Iron Age sites with only four tentative cases of intentional ablation in the Bronze Age. The increasing number of samples from newly documented sites in Cambodia, and previously documented evidence from other parts of Southeast Asia, such as Thailand and Vietnam, allows the opportunity to systematically examine ablation patterns from across the region and around the world. Worldwide ethnographic studies indicate the technique of filing differs around the world, while ablation methods are similar. Biological factors such as age and sex are examined, along with migratory and diet patterns, to evaluate the association of these factors with dental modification. Methods of extracting and filing the teeth, and the biological impact on subsequent dental health are also explored. Pathology related to alveolar bone or adjacent teeth is quite low, and it appears dental modification did not negatively impact dental health. Similar patterns of ablation were found between the Neolithic Thai site of Khok Phanom Di and late Iron Age Cambodian sites Phum Snay and Phum Sophy, suggesting possible links between Thailand and Cambodia. Though, unique patterns have been identified and are discussed, including exclusive filing patterns for Cambodia and Thailand. This research allows improved opportunities for understanding the biological impact and biocultural significance of intentional dental modification throughout prehistoric Southeast Asia.

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Artificial cranial modification of human remains from two archeological sites in Xinjiang, China

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The practice of intentional cranial deformation has a long time depth worldwide. Although it has been documented in some archaeological site reports in China, this practice has not been systematically studied. This paper explores artificial cranial deformation from two archaeological sites in Xinjiang, China.

Jilintai cemetery (2500 – 2000BP) is located in Yili region, northwestern Xinjiang, and Yingpan cemetery (2000 – 1500BP) is located in Yuli county, northeastern Xinjiang. A total of 253 crania (202 from Jilintai and 51 from Yingpan) were examined in this study. Crania were measured according to the Standards Book, and 11 angles and 6 indices were calculated. Statistical analyses include discriminant function analysis and the one-way ANOVA test.

The results show that 23 crania (female=10, male=13) were modified in Jilintai sample. In contrast at Yingpan 22 crania (female=15, male=7) were deformed. The inter-population comparison shows that all crania from both sites exhibited circumferential modification, indicating a similar cultural tradition. The significant differences between modified and unmodified crania were on measurements of

cranial length and breadth, and angles of the vault, while there are no significant differences in facial morphology. The intra-population comparison suggests that generally females display more pronounced deformation than males. In addition, individuals with deformed crania possess more prestigious burial goods, especially females, than those with normal cranial morphology. This may suggest that individuals with deformed crania enjoyed higher social status in their community.

Preliminary investigations of habitual stress on femora from two economically different archaeological populations in China

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This study aims to examine skeletal indication of potential habitual stress on femora in two economically different ancient populations from northwestern China: Liushui (LS) cemetery (2950±50BP) from southwestern Xinjiang and Neiyangyuan (NYY) cemetery (2500BP) from Shanxi province. Based on archaeological contexts and other lines of evidence, the former is a nomadic population with similar cultural appearance to the Scythian culture from Eurasiathe latter is suggested to be sedentary agriculturalists.

Femora of 188 individuals (LS=99; NYY= 89) were visually examined for presence/absence and severity of markers such as Poirier's facet, Allen's fossa, linea aspera expression, distal femoral osteoarthritis, and size of femoral diaphysis. The frequencies of Poirier's facet, Allen's fossa and enthesophytes along the linea aspera in LS were shown to be significantly higher than in NYY. In addition, LS males displayed significantly higher frequencies of Poirier's facet and Allen's fossa than LS females; however, there was no significant sex-related difference in NYY.

The distinct robusticity patterns of muscle attachments in LS suggests that horse-riding was the habitual activity causing the change, which is consistent with the nomadic lifestyle of this particular skeletal population. When comparing LS with NYY, this study demonstrates that different habitual activities took place in these nomadic and sedentary agricultural populations respectively, which can result in distinctive and observable skeletal changes.

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Testing stature equations on a medieval Upper Nubian skeletal sample

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Stature is a component of the biological profile along with age, sex, and ancestry. In bioarchaeological contexts, changes in stature or body proportions over time can indicate trends in

the health of a population. However, stature regression equations are likely to be inaccurate when applied to populations temporally and geographically distant from their reference sample. This study tested the accuracy of previously published regression equations on a well-preserved medieval Nubian collection and hypothesized that stature would be significantly overestimated.

The study sample was drawn from a skeletal collection representing three Upper Nubian medieval cemeteries (300-1500AD) excavated by the British Museum along the Fourth Cataract in Sudan - sites 3-J-10, 3-J-11, and 4-M-142. Based on preservation of required skeletal elements, living stature was calculated for 36 males and 33 females using the revised Fully method (Raxter et al. 2006). These data were compared to point estimates from regression equations for modern American blacks (Trotter and Gleser 1952) and ancient Egyptians (Raxter et al. 2008). Although distant in both time and space, these groups represented the closest proxies for Nubians among previously published studies.

Results indicated significant differences between both sets of estimates and the Fully revised method living statures ($p < 0.001$). Both Trotter and Gleser (1952) and Raxter (2008) equations overestimated living stature in this sample of medieval Nubians. These results confirmed the need for new stature regression equations for males and females in this region and time period. Equations were then developed using single and multiple long bone measurements.

Ancient DNA analysis of human skeletal remains from pre-Columbian Puerto Rico

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Ancient DNA (aDNA) analysis is a useful means for reconstructing the population history of pre-Columbian Caribbean human groups, as well as for ascertaining their genetic relationships to contemporary, highly admixed island populations. Here we present the results of pilot research geared towards retrieving aDNA from human skeletal remains from three pre-Columbian sites, dated between 590 to 1280 cal AD, from the island of Puerto Rico. We extracted DNA from 43 individuals from three sites: Tibes (n=11), Punta Candelero (n=9) and Paso del Indio (n=23). PCR amplification of an 80 bp fragment of mitochondrial DNA (mtDNA) indicated that 42% (n=18) of our samples have amplifiable mtDNA. Samples from Punta Candelero have a higher proportion of amplifiable mtDNA than those from Paso del Indio and Tibes. However, these differences are not statistically significant ($p = 0.709$). Nevertheless, factors such as the presence of inhibitory substances or extensive DNA fragmentation may affect amplification efficiency in these ancient samples. In order to address these issues, we transformed 18 of our extracts into sequencing libraries, and performed target enrichment for complete mitochondrial genomes. Preliminary assessment using

quantitative PCR and fragment analysis suggest that we have successfully captured ancient mtDNA in at least nine of our sequencing libraries. Complete mtDNA data from these individuals will allow us to characterize the origins, population history and genetic diversity of pre-Columbian Caribbean Amerindians. In addition, our data may be instrumental in describing the role these ancient groups played in shaping the genetic ancestry of modern Puerto Ricans.

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Application of generalized linear models and generalized estimating equations in multifactorial conditions: The case of enthesal changes

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The current presentation explores whether generalized linear models (GLM) and generalized estimating equations (GEE) can be employed in place of conventional statistical analyses in the study of ordinal variables. Enthesal changes recorded in an ordinal scale among two Late Holocene North African populations, the Garamantes and Kerma, were used as a case study.

The p-values obtained from GLM/GEE were compared to those from traditional parametric and non-parametric tests, such as Mann-Whitney, Kruskal-Wallis, Spearman partial correlations and their parametric equivalents. In addition, the model coefficients of GLM/GEE were compared to the Spearman and Pearson correlation coefficients.

Parametric and non-parametric methods gave convergent results. When studying single or aggregated enthesal changes, the p-values of traditional tests converged satisfactorily with the results calculated from the GLM, whereas GEE only gave satisfactory results when used for paired comparisons, e.g. bilateral asymmetry data. Both models gave identical model coefficients, which can be used instead of the partial correlation coefficients. These results are the same whether we study fibrous and fibrocartilaginous entheses together or separately.

Therefore, GLM can be used in place of traditional tests as they provide the same amount of information as the latter but they additionally allow the study of the simultaneous impact of multiple predictors and their interactions, and the modeling of the experimental data. However, GEE should be adopted when exploring bilateral asymmetry. Thus, the proper use of GLM/GEE allows the examination of a sample with different degrees of detail and can offer a fuller understanding of the observed patterns.

Computed fluid dynamics of the air-conditioning through the nasal passage in humans, chimpanzees, and macaques

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We are odd-nosed hominins who have an external nose protruding on the face. This feature was derived for genus *Homo*, along with the facial flattening and reorientation, to form a vertical tube of the nasal vestibule connected antero-inferior to a tall nasal cavity. The nasal passage performs the conditioning of the inspired air toward the alveolar condition. Here we use computational fluid dynamics to show the horizontally straight flow of the inspired air in chimpanzees and macaque, by contrast to humans who have an upward curved flow. Nevertheless, the inspired air flows largely through the mid-medial region of the nasal cavity, to be efficiently conditioned commonly in the three species. The anatomical advantages of this region have probably maintained this principle of the efficient conditioning since the modifications to nasal anatomy in *Homo*. The vertical vestibule contributes to the production of such a distinct airflow to secure a fine air-conditioning in *Homo*, since the primitive horizontal vestibule would facilitate the airflow straight toward the inferior region to impair a fine air-conditioning. The odd external nose thus arose to avoid such a potential risk derived in flat-faced *Homo* who has successfully survived highly fluctuated climate in the Pleistocene.

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Covariation in the human masticatory apparatus

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The patterns and intensity of shape covariation, and how this is related to diet, is essential for understanding the evolution of functional masticatory adaptations of the human cranium. Although many studies have described shape variation of the modern human cranium in relation to subsistence, the patterns of covariation within the human masticatory apparatus remain largely unexplored. We here present a first analysis of the relationships between three components of the masticatory apparatus: upper dental arch, masseter muscle and temporalis muscle attachments, studied within a worldwide sample (n=255) of 15 populations with different modes of subsistence. Using Partial Least Squares analysis, we show that shape of the masseter and temporalis muscle attachments covary, but that shape of the dental arch seems to be rather independent of the

masticatory muscles. On the contrary, when relative positioning, orientation and size is included in the analysis, the dental arch shows the highest covariation with the other cranial parts, suggesting that these additional factors are more important than actual shape in regards to covariation within the masticatory apparatus. Covariation patterns differ mainly between hunting-fishing and gathering-agriculture groups, possibly relating to greater masticatory strains resulting from a large meat component in the diet. High strain groups show stronger covariation between upper dental arch and masticatory muscle shape, compared to low strain groups. These results provide a clearer understanding of constraints and interlinkage of shape variation within the human masticatory apparatus and allow for more realistic modelling and predictions in future biomechanical studies. *This project was generously supported by SYNTHESYS (AT-TAF, DK-TAF, GB-TAF), The Leakey Foundation, The Wenner-Gren Foundation, Athene Excellence Initiative fellowship (Tübingen University) and the German Research Foundation (DFG INST 37/706-1).*

Promise, challenges, and considerations of epigenetic analyses of early life adversity: A case study of institutionalized Romanian children

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An emerging literature suggests that epigenetic mechanisms hold great promise for addressing how early life adversity can become biologically embedded to potentially alter lifetime health trajectories. Given growing interest in utilizing epigenetic data in anthropology, it is important to consider methodological issues that may arise. DNA methylation patterns tend to be tissue- and cell-specific, may change during development, and are responsive to environmental changes. Thus, choice of tissue and timing of sample collection must be balanced with accessibility, mix of cell populations, and appropriateness of tissue to research questions. Selection of methylation sites requires consideration of their putative relevance to gene regulation. We discuss these issues in our ongoing analysis of DNA methylation patterns in the Bucharest Early Intervention Project (BEIP). The BEIP is a randomized controlled trial in which institutionalized children <30 months of age were randomized into foster care placement, and compared with those who remained in institutional care, and a never-institutionalized control group. We are examining associations between exposure to institutional care and

methylation status in *FKBP5* and *SLC6A4*. Methylation status was determined in DNA extracted from buccal epithelial cells of children ~age 12. Preliminary results indicate that with low DNA concentrations, (range: ~3-200ng/ul), shorter amplicons and sequence regions more amenable to primer binding produced more consistent results, as demonstrated by more successful amplification of *SLC6A4* over *FKBP5* (93% vs 78%, respectively), and smaller differences between duplicates (1-2% vs 3-4%, respectively). This unique study demonstrates many of these challenging methodological considerations and provides suggestions for future investigations.

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Patterns of sequence variation at the pigmentation loci *ASIP* and *OCA2* in Melanesian and African populations

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Skin pigmentation is a complex trait determined by multiple genes. Global variation in skin pigmentation reflects an adaptive response to levels of ultra-violet radiation. Extensive studies of pigmentation sequence variation in European and East Asian populations suggest that light skin color has evolved independently in these two populations. However, it is unclear if darker skin color exhibited by populations living in high UVR regions is also the result of convergent evolution or if instead it reflects shared ancestral variants in pigmentation candidate genes. Here we present resequencing data from 2 pigmentation genes (*ASIP* and *OCA2*) in a population of 58 Melanesian individuals from the island of New Hanover and 88 YRI individuals sequenced as part of the 1000 Genomes Project. Summaries of the site frequency spectrum, including Tajima's D, indicate that patterns of variation at both loci are consistent with expectations under a neutral model in both the Melanesian (*ASIP* TD = 0.76; *OCA2* TD = -1.15) and YRI (*ASIP* TD = -1.02; *OCA2* TD = -1.14) populations. However, Melanesians exhibit notably different allele frequencies of derived alleles at two loci in *ASIP* (rs819136 and rs6058017) compared to the YRI sample, consistent with previous observations in a broader Melanesian sample supporting convergence. In addition, we report the presence of a novel allele in *OCA2* occurring at a frequency of 11% in the Melanesian sample. We discuss patterns of sequence variation and the distribution of these mutations in each population in the context of the convergent and ancestral variant models.

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Assessing the effects of a hurricane and forest fire on diet, activity and grouping patterns in spider monkeys (*Ateles geoffroyi*) at Runaway Creek Nature Reserve, Belize

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Large-scale, stochastic events leading to significant habitat alteration occur infrequently at long-term primate study sites, but when they do occur they afford an opportunity to assess the animals' responses and resiliency to such events. On October 25, 2010 Hurricane Richard hit a spider monkey research site (Runaway Creek Nature Reserve) in Belize, and it was followed six months later by a forest fire. We took advantage of this opportunity to analyze 44 months of data spanning time periods pre- and post-hurricane, as well as post-fire in order to assess changes in activity, diet, and grouping patterns in resident spider monkeys (*Ateles geoffroyi*). We also compared rainy and dry seasons before and after the events. Repeated measures tests (t-tests and repeated measures ANOVA) reveal that the monkeys exhibited differences in all three variables in each time period sampled. In almost all comparisons, the monkeys travelled less, foraged more, and relied more heavily on leaves than on fruit. Sub-groups were more stable, cohesive and exhibited fewer instances of within-group aggression in post hurricane and fire comparisons. However, a comparison of dry seasons before and after the events (2010 and 2012) showed little differences in the monkeys' behavior, diet or grouping patterns, suggesting that responses to the events were short-term. This flexibility in diet and behavior points to a possible resiliency in spider monkeys when faced with severe, but ephemeral, habitat disturbances. It remains, however, to determine whether such resiliency could withstand sustained or permanent habitat alteration.

United in death: The osteobiography of a Roman double burial at Çatalhöyük, Turkey

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Çatalhöyük contains among the most comprehensive Neolithic skeletal series in Anatolia, but also contains a well-documented series of Roman-era remains. Unlike other Roman-era interments at the site (single, minimal treatment), one early Roman burial (c. 2nd century B.C.) is especially elaborate, and contains the remains of two adults sharing a single coffin. The coffin contained a young adult male (20-30 years) and an older adult female (~50 years), both in supine position, with the female lying atop the male. The female shows evidence of advanced-stage tuberculosis. The individuals were accompanied by a number of early Roman burial objects, including glass and ceramic *unguentaria*, an *intaglio* ring on the female's hand, and many copper-alloy fragments. This poster presents a detailed documentation of the bioarchaeological identities of these two individuals (focusing on age, sex, and pathological conditions) and how these identities relate to their unique burial style and context. The osteological analysis,

archaeological context of burial, mortuary ritual, and the historical record of Roman Anatolia provide the basis for linking life history, including elements of disease, age, and sex, with concurrent death and burial events. The identities of these individuals, their relationship to one another, and their relationship to their community also reflect lesser-known aspects of Roman life and death at Çatalhöyük as well as Anatolia in general.

Dissection and surgery at the Erie County Poorhouse

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The proliferation of medical schools during the 19th century and the popularity of anatomy courses created a demand for anatomical specimens that far exceeded supply. This created a market for illegally acquired bodies; a market that explicitly exploited socially marginalized groups that had neither the political or economic means to protect their dead. Escalating public outrage ultimately prompted the passing of legislation that made it legal for medical schools to acquire the corpses of some socially marginalized groups, specifically the unclaimed bodies of poorhouse inmates; New York State passed such legislation in 1854.

Excavations at the Erie County Poorhouse cemetery (1850 – 1920) yielded evidence that the Erie County Medical School (est. 1847) acquired corpses of the unclaimed and utilized them in medical education. Out of an estimated 333 individuals recovered, 12 (3.6%) exhibit evidence of postmortem examination or surgical intervention. The vast majority of cases are in adult males (n = 9, 2.7%), with one subadult (0.3%), one female (0.3%), and one indeterminate (0.3%) represented. The majority of postmortem examinations consisted of craniotomies (n = 7, 2.1%) while four individuals (1.2%) exhibit cut marks on postcranial material. Only one individual exhibits evidence of a craniotomy and postcranial cut marks (0.3%). All of the individuals showing postmortem examination are located in the 'old' part of the cemetery. The excavation at the Erie County Poorhouse cemetery exemplifies the steps taken, especially against marginalized groups, to provide a higher standard of medical knowledge.

Parasite ecology of black-shanked douc in Cat Tien National Park, Vietnam

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This research provides an initial review of the gastrointestinal parasites harbored by a population of black-shanked doucs (*Pygathrix nigripes*) in Cat Tien National Park, Vietnam. Forty-eight fecal samples were collected in 2012 and analyzed for parasite presence using direct smear and floatation protocols. Parasite species recorded include *Strongyloides* sp., *Trichuris* sp., and *Physaloptera* sp., as well as unidentified tapeworm and pinworm. Eighty-three percent of

the samples were infected by at least one species of parasite and 58% of the samples were infected by at least two species. Black-shanked doucs were more likely to be infected by gastrointestinal parasites, than to be free of infection ($p < .001$, $\chi^2 = 21.333$, $df = 1$). Fisher's exact test showed that doucs analyzed by Kenyon (2007) are statistically no different and have the similar parasite presence and absence likelihood as this current sample, but with different parasites present. One surprising result was the lack of protistan parasites in this sample compared to Kenyon (2007) and the abundance of *Strongyloides* sp. when they were absent in the previous study. This study focused on only one season, but we plan to return to examine the effects of seasonality on parasite abundance.

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Rare incisor variants are observed at relatively high frequencies in Mexico and the American Southwest

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While human maxillary central incisors tend to be stable, maxillary lateral incisors are highly variable teeth. We examined 942 dentitions from pre-contact samples from Mexico and the American Southwest for the prevalence of anomalous incisor variants including: peg, barrel, talon, mesial marginal curvature, supernumerary, reduced, and congenital absence. We compared the frequencies of these variants among regions to determine which tooth forms were most common, whether anomalous variants tend to co-occur, and whether anomalous variants reflect population histories.

Combining all samples, the most common variant is peg tooth (0.029). Many traits are correlated. Surprisingly, the highest correlation is between talon form and peg tooth (0.818). The trait that is most common in a single sample is the talon tooth, seen in 5.1% of Highland Maya. This is the highest frequency of talon form yet documented. The samples from the Lowland Maya and Huasteca regions have the overall highest frequency of incisor variants (0.094 and 0.092, respectively) with talon teeth accounting for 53.8% of all anomalous teeth in these regions. Higher frequencies of unusual traits are consistently found in samples from smaller populations. We argue that serial founder effects coupled with population isolation may have led to the high frequencies of incisor variants seen in some of these regions.

The removal of fossils from unstable decalcified breccia: An experimental model

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South Africa's caves contain some of the world's most prolific fossil assemblages and are invaluable to the study of human evolution. These deposits formed as loose surface material, bones, and stone tools entered caves and solidified as calcium carbonate dripped from the cave roof to form breccia, a conglomerate rock. The cave roof often collapses, exposing the breccia to the elements, thus decalcifying the breccia and turning it back into a loose soil that can be excavated. Unfortunately, fossils in this decalcified breccia are often surrounded by damp, silt loam that weakens their integrity. When these fragile fossils are removed from the ground, they are often broken and fragmented beyond repair. Valuable data are being lost because there is no method for safely removing very fragile fossils from decalcified deposits. This project attempted to re-calcify the decalcified breccia surrounding fragile fossils. A concentrated solution of calcium carbonate was applied to an experimental matrix. The experimental matrix contained silt loam, distressed bones, small rocks, and sand particles. Results indicate that a 2cm² unit of experimental matrix can be calcified using a 1% solution of calcium carbonate and water. Small rocks and bone fragments suspended in the matrix adhered to the newly formed solid breccia successfully. Once solidified and removed, the protected fossil can be safely released from the solid matrix by acid erosion or mechanical reduction. These results indicate that it is possible to save very fragile fossils that have hitherto been unsalvageable, potentially increasing the available samples of rare taxa.

Do patterns of termite-fishing by Kasekela chimpanzees reflect patch depletion?

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Termites (usually *Macrotermes*) and other insects are a small but (probably) nutritionally important component of the diet for many wild chimpanzee communities. Termite mounds are predictably encountered in time and space, and termite soldiers can be acquired efficiently with tools. At Gombe National Park, Kasekela chimpanzees engage in relatively longer and more frequent bouts of termite-fishing in the early wet season when *Macrotermes subhyalinus* are most active and productive (i.e., fishing attempts are likely to yield termites). I used video-recorded and scored termite-fishing bouts by adult chimpanzees observed from Sep-Dec 2008 to test for relationships between per-bout and per-minute (within bout) intake rates, bout duration, and cessation.

Termite-fishing bouts ranged from <1 – 162 min (n = 46, mean = 16, median = 9, S.D. = 25). Using a percentage bend correlation, I found bout duration to be positively correlated with intake rate ($r_{pb} = .58$, $p < 0.001$), which ranged from 0 – 21.1 soldiers/min (mean = 4.3, median = 2.6, S.D. = 4.4). There was no significant relationship between bout intake rate and the frequency of 'breaks' to switch holes or to investigate the mound ($r_{pb} = -.15$, $p = 0.33$). 70% of bouts ended with a per-minute intake rate >0, indicating that chimpanzees will cease fishing at a productive mound if yields are low. Though

bouts at multiple mounds in a day were common, chimpanzees never re-visited the same mound in a single day. Kasekela chimpanzees appear sensitive to foraging yields from termite-fishing, and treat mounds as depletable resources.

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Ring-tailed lemurs and the evolution of the primate juvenile period

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Multiple hypotheses have linked the extended primate juvenile period to interactions between feeding ecology and sociality. Accumulating behavioral and ecological data on juvenile monkeys, however, have not shown these predicted relationships (e.g., low foraging efficiency and intake rates, decreased proximity while foraging, and increased feeding competition). These studies indicate that the ecological immaturity of juveniles does not limit their foraging success, with the exception of food that requires high degrees of strength or dexterity. If these limitations in feeding ecology are not present in monkeys, it is possible that these ecological effects on life history are present in the gregarious strepsirrhines, but this remains untested. To explore this, I present feeding and foraging behavior collected from a mixed-longitudinal sample of infant, juvenile, and adult ring-tailed lemurs at the Beza Mahafaly Special Reserve, Madagascar. I found that juvenile ring-tailed lemurs have more diverse diets than adults, and like many platyrrhines do not show the predicted ecological tradeoffs during juvenility in foraging competency, despite receiving higher rates of aggression. The similarity of juvenile feeding patterns between ring-tailed lemurs and multiple platyrrhine species may indicate that the ecological immaturity of juveniles may not be the primary selective force structuring the elongation of the primate juvenile period. Developing within a complex social network may have a stronger overall effect on overall primate life history, whereas ecological limitations may have larger effects on differences in growth and development among closely related species.

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Individual muscle function in chimpanzee bipedalism II: Musculoskeletal model predictions based on static optimization

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An important goal in paleoanthropology is to better understand how limb design and gait mechanics affect the loading of the skeleton in bipedal locomotion. This requires knowledge of the distribution of individual muscle forces, which cannot be measured directly. Here, we provide the first empirical, model-based estimates of individual hind limb muscle forces during chimpanzee bipedal walking. These data are then used to calculate the instantaneous hip joint reaction force to address the question of how a facultative biped loads its femoral head, and permit comparisons to model-based estimates from human walking.

Marker and force platform data were collected from common chimpanzees (*Pan troglodytes*, N=3) walking overground. These data were integrated with a three-dimensional musculoskeletal model of the chimpanzee pelvis and hind limb, which included Hill-type models of 35 muscle-tendon units per hind limb. Individual muscle activations and forces were calculated over a full stride via static optimization. Predicted activations were compared to electromyography (EMG) measurements for 26 of the 35 modeled muscles to assess the robustness of model predictions.

In general, we found a good correspondence between the predicted muscle activations and the measured EMG. The greatest similarities were at the hip and knee, while the ankle predictions were less consistent. The peak hip joint contact forces were 3-4x body weight, and occurred near the transition from double to single-limb support. Due to their relatively small femoral head, chimpanzees may experience higher hip joint stresses than humans during bipedal walking. *NSF BCS-0935321 and BCS-0935327.*

Remote sensing and habitat heterogeneity: Quantifying modern analogues for African palaeoenvironments

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Hominin habitats are often described as 'mosaic' (i.e. with water, grassland and trees), but are these mixed habitats really widespread in Africa, or does this reflect our present inability to refine palaeoenvironmental proxies in the fossil record?

To answer these questions, we have taken a 'top-down' approach, and are using remote sensing methodologies to examine modern sub-Saharan landscapes to determine where, and at what scale, mosaic habitats are found. Here we define mosaic habitats as those with more than one landcover type represented. Our pilot phase used eight landsat ETM+ images in eastern and southern African locations. Each image covers 185x185 km and is classified into 19 broad habitat categories, such as closed woodland (>75% trees), continuous grassland (>50% grassland), and freshwater. These classified images were subsampled with a 2.5km radius

circle on a regular grid of 10km, excluding all subsamples with >10% anthropogenically modified landcover. We then derived a suite of landscape metrics describing the spatial organisation of land cover patches. Comparisons of eastern Africa (n= 932) and southern Africa (n = 949) indicate that the median number of patches in each region is not significantly different (U = 437300, p= 0.672), and that the vast majority (97.6%) of all subsamples represent heterogeneous habitats.

Remote sensing indicates that heterogeneous habitats are common throughout our study images, but that certain areas are not 'mosaic'. Results from the project will have implications for understanding how hominins were distributed across the landscape and what factors control heterogeneous habitats.

This work forms part of the Quantifying the Mosaic project, funded by a grant from the Leverhulme Trust (RPG-2012-472).

The importance of activity in cold climates: Using the allocation model to examine energy expenditure differences of highly active humans in natural environments

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Laboratory studies have demonstrated that the increased loss of body heat associated with cold temperatures diminishes when subjects exercise. Though a number of studies demonstrate the increased metabolic rate associate with cold conditions, few have analyzed the importance of activity in reducing the cost of thermoregulation in natural cold conditions among a highly active population. Here the allocation model is used to analyze the importance of activity levels in reducing the cost incurred from thermoregulation in cold environments. The allocation model includes metabolic cost terms for basal metabolic rate, activity, thermoregulation and the thermic effect of food. The allocation model was tested using doubly labeled water and flex-heart rate measured TEEs of healthy, highly active adults (N=55) participating in National Outdoor Leadership School semester long courses. Two of the semester-long courses took place in both hot and temperate climates (N=25) and the other two in both temperate and cold climates (N=30). This enabled TEE measurements in a variety of climatic conditions, allowing a greater examination of the impact thermoregulatory cost has on TEE in natural environments. The allocation model produces TEE predictions that are not significantly different from measured TEE values. Cold TEE values were significantly higher than temperate and hot climate TEE values (p<0.01). However, once activity costs were removed from TEE, cold and hot climate energy expenditures were not significantly different from temperate energy expenditures (p=0.43 and p=0.54 respectively). The results presented here suggest that high activity levels can help mitigate thermoregulatory costs.

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The morphological differences in the size, shape and enthesal attachments of the clavicle from the Erie County Poorhouse Cemetery

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Within the anthropological literature, enthesal changes and morphological variability are often addressed as the result of the interplay between biomechanical loading and bone's functional plasticity. Much of this research has focused its attention on directional asymmetry as assessed using metric data or the degree of rugosity of attachment sites. Through the analysis of adult skeletal remains from the Erie County Poorhouse, Buffalo, New York, this study specifically addresses the relationship between the morphological shape of clavicles and enthesal changes. The unique s-shaped clavicle is the sole osseous structure that connects the upper limb to the axial skeleton. Acting as a strut between the sternum and the upper limb, as well as the site for numerous ligament and muscle attachments, the clavicle allows for an array of movements of the pectoral girdle without obstructing the soft tissue structures that pass beneath it. Data on enthesal changes of fibrous attachments, i.e. *pectoralis major*, *deltoideus*, and *trapezius* and fibro-cartilaginous attachments, i.e. *costoclavicular*, *conoid*, and *trapezoid* ligaments were assessed using both Villotte (2006) and Henderson et al. (2012). Morphological shape variability was assessed using both metric and nonmetric data, including the mid-shaft diameter and the shape of the anteriomedial surface. In addition to presenting the relationships between shape and enthesal changes, correlations with sex and age variables are presented. Discussion of the results includes the complexities associated with establishing relationships among morphological and enthesal changes, as well as the difficulties in distinguishing how these changes may reflect activities found in the historical record.

Seasonality and niche partitioning among sympatric gorillas and chimpanzees in Loango National Park (Gabon) revealed by stable isotope analysis

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The feeding ecology of sympatric great ape species yields valuable information for palaeodietary reconstructions in fossil hominin species. Here we present the first isotopic study on sympatric great apes, namely lowland gorillas (*Gorilla gorilla gorilla*) and central chimpanzees (*Pan troglodytes troglodytes*) from Gabon. We analyzed the stable carbon and nitrogen isotope ratios in a selection of great apes' food plants (n = 31) and ape hair samples (n=30) retrieved from sleeping nests to test whether niche partitioning among sympatric chimpanzees and gorillas is detectable using isotope analysis of hair. Ape

hair strands with roots were sectioned into sequential segments (total n = 100) to investigate temporal isotopic variation related to seasonal variations in food resources. We found significant $\delta^{13}\text{C}$ -differences between herbaceous plants and fruits due to canopy effects. While the $\delta^{13}\text{C}$ values of chimpanzees indicate the consumption of fruit, the low $\delta^{13}\text{C}$ values in gorilla hair indicate folivory, most likely the consumption of ^{13}C -depleted terrestrial herbaceous vegetation. Our isotopic data also confirmed dietary overlap between chimpanzees and gorillas, which varied by season. Gorillas showed significant variation in $\delta^{13}\text{C}$ values in response to season due to shifting proportions of herbaceous plants versus fruits. In chimpanzees, seasonal variation in $\delta^{15}\text{N}$ was likely related to the seasonal availability of fruit species with particularly high $\delta^{15}\text{N}$ values. Our findings provide a valuable reference for palaeodietary research on fossil hominins using $\delta^{13}\text{C}$ analyses, particularly for studies focusing on sympatric taxa and on temporal isotopic variation within incremental tissues such as tooth enamel.

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Social inequality and differential prestige in the prehistoric Atacama oases: The impact of foreign cultures on local lifestyle during the Middle Horizon

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The Tiwanaku polity played a significant role in the social and cultural developments of northern Chile's Atacama oases. However, most studies assume that Tiwanaku influence was homogeneously distributed across the oases, disregarding the role of foreign cultures in the establishment of social inequality among the oases communities. Here, we address this limitation by testing the hypothesis that Tiwanaku goods, along with other imported cultural material, may have served as prestige wealth within the oases. Grave goods associated with 453 burials from four Middle Horizon (AD 500-1000) cemeteries (Quitor 5, Solcor Plaza, Solcor 3, and Tchecar Túmulo Sur) were analyzed and categorized as either Tiwanaku, foreign or local based on stylistic differences. Individuals associated with each of these categories were evaluated based on indicators of skeletal stress (i.e., porotic hyperostosis and cribra orbitalia), trauma, and cranial modification. Fisher's exact tests and correspondence analyses were performed to assess the relationship between these indicators and associated grave goods. The presence of cranial vault modification is clearly associated with Tiwanaku mortuary goods, however this trend appears to be true only for males. This association suggests that males who were born into elite families were more likely to acquire Tiwanaku goods as symbols of status. In conclusion, our data favors previous archaeological information that Tiwanaku style grave goods were used as prestige items in San Pedro de Atacama during the Middle Horizon.

Dental decay on the Atacama oases during the period of the influence of the Tiwanaku Empire

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The oases of San Pedro de Atacama were occupied during the entire Holocene period, but from 1500BC this occupation was intensified and consequently transformed the Atacama landscape. Hunter-gathering was replaced by agriculture. Between 400 AD and 1500 AD, two Andean empires influenced the atacameñan society before the Spanish conquest: the Tiwanaku Empire and the Inca Empire. The influence of the Tiwanaku Empire on the local quality of life was assessed in this study based on oral pathologies of 402 individuals from 12 sites of the Atacama desert. Dental decay, one of the main pathologies that infer the diet of ancient societies, was analyzed to evaluate if and how this empire influenced the health of the Atacama people. Differences between males and females and between people with or without cranial deformation were analyzed. To improve the analysis, the presence of fluoride ion in the water of the local rivers was measured, however the results presented a low natural quantity of this element in them. The results show that there was a positive influence of the Tiwanaku Empire on local life conditions. Both men and women and also people with or without cranial deformation were affected indistinctly. These results suggest that the contact between a local small-scale society and an expansionist state is not always detrimental to the former.

Landscape genetics of western Black Crested Gibbons (*Nomascus concolor*) in China

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Of the living apes, Western black crested gibbons (*Nomascus concolor*) number among the fewest. A formerly broad distribution across much of China and Southeast Asia has been reduced to a handful of fragmented populations numbering fewer than 1,500 individuals, rendering them critically endangered by the IUCN. The majority of the species (~1,000) remains in isolated mountaintop forests in Yunnan, China. While several behavioral studies of this species have recently been published, almost nothing is known of their molecular ecology.

In the course of one year of fieldwork, 92 genetic samples were obtained from free-ranging individuals in the three predominant population fragments, Wuliangshan, Ailaoshan, and Yongde Daxueshan. Fecal samples were located and identified with a scat-detecting dog trained in China and collected with the 2-step EtOH/silica method. Samples were barcoded by sequencing a ~600 bp fragment of the mitochondrial d-loop for each sample. 454 genomic sequencing of one *N. concolor* tissue sample from the Kunming Institute of Zoology, was used to generate 621 putative microsatellite markers. Eight

polymorphic loci were selected from the 454 run and combined with 14 polymorphic loci identified by cross-specific amplification, totaling 22 analyzed loci (18 autosomal, 4 X-linked). Replicated multilocus genotyping identified 43 of these fecal samples as being from distinct individuals. Fst, computer assignment tests, and parentage analysis indicate minimal population structure associated with geography within Wuliangshan, and a likely ability of *N. concolor* to disperse through degraded forest.

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Locomotor hand postures, carpal kinematics, and wrist morphology in anthropoid primates

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Integrating data on locomotor hand postures, carpal kinematics, and morphology is important for interpreting wrist function in extant and fossil primates. Here, kinematics of the intercarpal joints composing the radiocarpal and midcarpal complexes are examined using three-dimensional data derived from computed-tomography scans of cadaveric forelimbs. Knuckle-walking chimpanzees have low ulnar deviation ranges of motion (ROMs), while both chimps and orangutans both exhibit low overall wrist flexion. Dorsiflexion (extension) demonstrates the clearest association with locomotor hand positioning. Chimpanzees and digitigrade baboons (which both hold their hands in a near-neutral posture during forelimb stance) are characterized by limited extension at most joints of the radiocarpus and midcarpus. Taxa that use palmigrade postures are capable of greater overall extension, but achieve mobility differently. Palmigrade monkeys have high extension ROMs at both radiocarpus and midcarpus, while *Pongo*'s high overall ROM (allowing palmigrady) occurs primarily via the midcarpus. Although *Pongo* has slightly more proximal-row extension than *Pan*, radiocarpal mobility in both apes is limited vis-à-vis palmigrade monkeys. The radial dorsal ridge is a correlate of that restriction in apes, although it may only limit extension incidentally—its primary function being to provide flexion stability. The included angle of the lunate's articular arc on the dorsal capitate is correlated with midcarpal extension ROM across taxa. Finally, apes and monkeys differ in scapholunate and lunocapitate kinematics with the proximal row rotating as a more rigid unit in monkeys. This difference may facilitate a diversity of climbing postures in apes while providing flexion-extension stability during quadrupedalism in monkeys.

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Dental health and nutritional status among mayas of Quintana Roo: Comparative study between coastal maya and inland maya, across Classic and Postclassic times

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Analyze past Maya populations has always been a challenge for physical anthropologists. Therefore, their study from dental indicators of stress is an efficient pathway. The present study deals with the corroboration of hypotheses which has been working extensively: coastal populations generally have better living conditions than inland populations. We present results from two site-population prehispanics groups from Quintana Roo, México divided in time and space: inland populations Late Classic / Terminal (Kohunlich and Margarita Maza de Juárez) and the Late Postclassic coastal populations (El Meco, El Rey and Chac Mool). We analyzed indicators such as enamel hypoplasia lines, caries, calculus, dental wear, abscesses, antemortem tooth loss, chipping of enamel and dental fluctuating asymmetry. We used crosstabs and chi square to evaluate the differences between groups. There are differences, but not significant among indicators. This means heterarchy in the access to food resources by site-populations and hence health status among populations of coastal and inland Maya territory. This differential access is given by the common access resources that the environment provides, as it is expected in inland populations are based largely on agricultural consumption (i.e. corn) while coastal populations in spite of the limitation of resources imposed by its environment (failure to create large areas of crop) generally show better dental health than their counterparts in the interior in Classical times, where perhaps the marine resources and maritime trade, played an important role in feeding late Postclassic populations from the east coast of the Yucatan Peninsula.

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Female-female social relationships and feeding competition in Verreaux's sifaka (*Propithecus verreauxi*)

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Socioecological models predict that the importance of dominance relationships among females increases with increasing contest competition for food. Folivores are often assumed to experience low within-group contest competition and thus female relationships are predicted to be egalitarian and unrelated to kinship. Verreaux's sifaka (*Propithecus verreauxi*) is a medium-sized, gregarious folivore that has been suggested to exhibit a "dispersal-egalitarian" competitive regime. However, it also exhibits male-biased dispersal and formalized dominance relationships. We examined six years of behavioral, demographic, and morphological data from four social groups

to assess feeding competition in Verreaux's sifaka in the Kirindy Mitea National Park. One female in 233 lemur years was observed to disperse versus at least 20 males. Females exhibited unidirectional formalized submissive signals, suggesting contest competition, but agonistic rates were low and not predicted by the proportion of fruit and seeds in the diet. Consistent with a diet based on resources with low contestability, dominant females did not have significantly higher body mass indices than subordinate females, and mother's rank did not predict infant survival. Group size predicted infant survival and a normalized measure of group spread; however larger groups had lower spread and infant survival was higher than for smaller groups. Our results suggest that within-group competition in Verreaux's sifaka is low and their resources have low contestability. Large groups may be beneficial in between-group competition and for reduced predation risk. Nevertheless, sifaka exhibit small social groups, suggesting that a factor other than feeding competition is driving small group size.

Possible prenatal and perinatal scurvy at Telekfalva, Romania

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The Telekfalva assemblage consists of the remains of over 60 juveniles buried within the confines of a 17th century Calvinist church from the village of Telekfalva, Romania. Only one adult was present, an older woman. Of the burials, over half are preterm (less than 36 weeks, n=14) or perinatal (36-40 weeks, n=35), with 16 of the perinatal group dying at approximately 38 to 40 gestational weeks. Every one of these perinatal individuals exhibits the same pattern of pathological processes throughout the cranium and the postcranial bone. In the cranium, most have severe CO, all have either increased porosity or periosteal bone deposition on the lateral surface of the greater wings of the sphenoid, and most have periosteal bone development or vascular channeling on the internal surface of the cranial vault. This pattern is consistent with scurvy, according to previous research. This presentation details the pathological bone visible and presents a differential diagnosis.

Given the young age distribution, the presence of possible scurvy in preterm and perinatal individuals is an indication of maternal health. The burial population cannot be considered "normal" in any sense, and so frequencies of disease within this burial population are likely not reflective of the society at large. The assemblage, however, sheds light on 17th century maternal health and dietary practices based on prenatal and perinatal health profiles as well as Calvinist burial practices involving possibly stillborn or very young individuals.

Australopith lumbar vertebral morphology: Insights from *Australopithecus sediba*

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Previous studies have suggested differing limb proportions between species of *Australopithecus* that have functional implications related to locomotor behavior. Fossils of *Australopithecus sediba* include two partial vertebral columns, allowing for comparisons in vertebral morphology. As the lumbar spine serves as an important weight-bearing region in bipedal hominins, variation in australopith lumbar vertebral morphology has potential biomechanical implications for understanding locomotion in early hominins. The goal of the present study is to explore variation in lumbar vertebral morphology among australopiths, chimpanzees, and modern humans, and to examine potential differences between australopith taxa.

Osteometric data from the lumbar vertebrae were collected on a modern human sample from the Dart Collection (47 males, 51 females), a small sample of chimpanzees (*Pan troglodytes*), and from *Au. sediba* (MH2) and *Au. africanus* (Sts 14). For this analysis, 11 measurements were used to analyze shape variation in size-corrected variables for the last lumbar vertebra. Principal components analysis indicates that both australopiths differ from modern humans in sharing primitive features with chimpanzees including relatively small vertebral bodies in cross section, but not in relative vertebral body height. MH2 appears distinct with a relatively long spinous process and tall ventral body height. A large ventral body height contributes to a more lordotically wedged vertebral body, and a long spinous process increases biomechanical leverage for the back (extensor) muscles. These features are consistent with the hypothesis that *Au. sediba* differs from *Au. africanus* in its postcranial anatomy and had a relatively lordotic and flexible lumbar spine.

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Evaluating the potential of geometric morphometric analysis of mandibular shape to shed light on fossil hominin diet

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Diet is a key issue in palaeoanthropology, one that has implications for many aspects of human evolution including cranial form, habitat choice,

lifestyle, social structure, and technology. However, there is still much debate over the diets of a number of fossil hominin species. With this in mind we have initiated a project to examine the relationship between mandibular shape and diet in non-human primates and humans, with a view to developing a predictive model for the fossil hominins.

Recently researchers have exploited the link between mandibular shape and diet to reconstruct the diets of two extinct bear species, the cave bear and short-faced bear. We are employing a similar protocol to reconstruct fossil hominin diets. We are using 3D geometric morphometrics to record 41 landmarks on mandibles of several non-human primate species with differing diets, and several human groups with differing subsistence strategies. Multivariate statistical techniques are then used to identify dietary signal within the landmark data. The framework provided by the extant specimens will be used to assign fossil hominin mandibles to dietary categories.

Catarrhines and Platyrrhines are clearly distinguished from each other in a Canonical Variates Analysis, which indicates an influence of phylogeny on mandibular shape. However, within Catarrhines there are significant differences in mandible shape among dietary types (10,000 permutations $p \leq 0.05$). The latter result indicates that a dietary signal is reflected in the shape of the primate mandible and implies that it should be possible to use mandibular shape to reconstruct the diets of the fossil hominins.

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Y-chromosome analysis of ancient Native Americans from British Columbia

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Much of the autochthonous Y-chromosome diversity among Native Americans was lost due to the detrimental effects of European colonization approximately 500 years ago. This loss of diversity has introduced a significant bias when studying questions of migration, population structure, and the effects of European colonization without understanding the diversity of Y-chromosomes of men in the Americas before European contact. Because of the difficulty in obtaining Y-chromosome DNA from human remains, it has been challenging to reconstruct the genetic diversity. Prince Rupert Harbour, off the coast of British Columbia, Canada is the location of numerous archeological sites that suggest continual occupation by the Tsimshian for at least 6000 years. Human remains from more than 200 individuals from these sites are currently being scientifically studied.

To help increase the accuracy of inference of population history when using Y-chromosome data, we analyze pre-European contact Y-chromosomes from Native Americans at the Prince Rupert Harbour archaeological sites. Specifically, we generated SNP and high resolution STR data on the Y-chromosome. We show that all individuals studied have Native American Y-chromosome haplogroups, unlike many of the individuals from the descendant communities (~40%). The preliminary analysis of haplotypes suggest a loss of autochthonous Y-chromosome diversity as a result of colonization.

Mitochondrial haplotype C4c confirmed as a founding lineage through the whole mitochondrial genome sequencing of an ancient North American sample (Norris Farms #36, Illinois)

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Since the publication of mitochondrial hypervariable region I data from individuals from the Norris Farms #36 site in central Illinois (ca. AD 1300), it has been suggested that at least one individual belonging to mitochondrial Haplogroup C may also belong to the rare mitochondrial haplotype C4c lineage. This would be significant, as currently, less than 20 individuals in the Americas have been identified as C4c despite the haplotype's status as a founding lineage in the New World. To date, all published data on C4c individuals have been obtained from modern samples that post-date European Contact.

We have analyzed 98 samples from Norris Farms #36 for the mitochondrial hypervariable regions I and II, and identified two individuals as candidates for exhibiting the C4c haplotype on the basis of the characteristic absence of the np 16325 substitution. Confirmation of this rare haplotype required the presence of multiple mutations throughout the mitochondrial genome, so the complete mitochondrial genome was subsequently sequenced for both individuals. Results confirm that one of these individuals belongs to haplotype C4c. This study provides confirmation of the founder status of the C4c haplotype from a pre-Contact individual, thereby contributing new information relevant to the early population history of the Americas.

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Estimation of sex from the talus of prehistoric Southeast Native Americans

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Determination of sex through macroscopic examination of human skeletal morphology is fundamentally important for archaeological and forensic investigations. Results of this study are evidence of sexual dimorphism in the human talus, and metric ranges for male and female tali

are presented for estimation of sex in the skeletons of prehistoric Southeast Native Americans. While the most reliable indicators of sex are in the skull and pelvis, these structures are fragile, and bones may be damaged or missing. In such cases, the investigator must use alternative means of sex determination. Many studies have investigated metric properties of sexual dimorphism in the postcranial skeleton. Among tarsals, the talus exhibits a high degree of sexual dimorphism and resists taphonomic erosion due to a robust morphology. Studies of tali from geographically and temporally diverse populations demonstrate variation among populations and between male and female tali. The present study relies primarily on five measurements as a basis to determine sex in prehistoric Native American samples from Alabama. Differences between male and female samples were significant. Sex determined from the talus method strongly correlated with conventional sexing methods, with 85 – 93% agreement. Metric ranges of this study are presented alongside those of similar studies on tali from other populations. This and other studies indicate that the talus method of determining the sex of a skeleton is a viable alternative in situations where conventional methods are untenable or in need of secondary supporting evidence.

Growing up in Medieval Alytus, Lithuania: Dietary reconstruction and biocultural analysis

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Stable isotopic profiles allow researchers the unique opportunity to investigate relationships between diet and mortality among juvenile age cohorts. Establishing a chronology of variation in isotopic signatures can unravel frailty associated with biological and social age. This study employs isotopic analysis of bone collagen nitrogen and carbon of the femoral diaphyses for 70 juveniles (32 weeks gestation-16 years) from the site of Alytus, a late 14th to early 18th century Medieval Lithuanian cemetery. Previous skeletal studies conclude that Alytus' juveniles experienced high rates of physiological, metabolic, and non-specific stress as well as specific diseases such as tuberculosis.

Preliminary dietary reconstruction reveals that exclusive breastfeeding ceased in mid-infancy (1-3 years, n=24) when average $\delta^{13}\text{C}$ (-19.5‰) and $\delta^{15}\text{N}$ values (12.6‰) were their most enriched suggesting introduction of carbohydrate-heavy foods and weaning-associated infirmity. $\delta^{15}\text{N}$ signatures remained slightly elevated in children (3-5 years, 11.3‰, n=7) compared to young adult means (16 years, 9.9‰, n=2) until the beginning of juvenility (5-12 years, 10.2‰, n=27) when values more closely mirrored adult signatures.

However, adolescents (12-16 years, n=9) demonstrated a slight enrichment in both mean $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ (-20.0‰; 10.4‰) over juveniles, possibly signifying a period of increased nitrogen cycling caused by nutritional stress during a growth spurt. One 7 year-old exhibits depleted $\delta^{15}\text{N}$ (8.6‰) possibly due to inadequate ingestion of protein resulting in lower nitrogen balance during bone-tissue formation after exposure to chronic pathogens or malnourishment. Correlations between disease and dietary experience contribute to our holistic bioarchaeological evidence of childhood morbidity experience in Medieval Lithuania.

The influence of seasonal fruit variation on Sanje mangabey (*Cercocebus sanjei*) feeding ecology in a montane rain forest in Tanzania

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This research evaluates the importance of ripe fruits in the diet of the Sanje mangabey (*Cercocebus sanjei*) by investigating data on monthly variation in food availability and consumption. A study group of 30 adult Sanje mangabeys was followed for 12 months from December 2010 to November 2011, in the Mwanihana Forest, Udzungwa Mountains National Park in Tanzania.

Using bite counts per items as separate feeding data points, Sanje mangabeys had a diverse diet, exploiting 56 species of plants. When ripe fruit availability was low, Sanje mangabeys increased their dietary diversity with the Shannon-Wiener index of diversity (H') increasing from 1.62 to 2.47 (mean: 2.02; SD: 0.23) and the Pielou evenness index (J') increasing from 0.72 to 0.98 (mean: 0.82; SD: 0.05). Consistent with the *Cercocebus* mangabey clade, ripe fruits made up 65% of the annual diet, with mechanically protected seeds representing 10% of the annual diet and insects and fungi representing both 8% of the diet. During the low ripe fruit period, mangabeys consumed a higher proportion of non-fruit food items such as insects ($r^2 = -0.361$, $p < 0.05$) and seeds ($r^2 = -0.860$, $p < 0.01$). Fungi and woody plant pith also represented up to 29.2% and 26.6% of the monthly diet during low ripe fruit period.

Results reveal the ability of Sanje mangabeys to seasonally intensify on a diversity of highly abundant food items available year-round such as pith of woody plants and dry seeds found on the forest floor, as a buffer during periods of ripe fruit scarcity.

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Exploring C₄ plant foods and their potential as hominin dietary resources: The mechanical properties of savanna vegetation from the Cradle of Humankind, South Africa

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Recent carbon isotope analyses of hominin fossil material have demonstrated that after ~4 Ma, hominins began to incorporate significant amounts of C₄/CAM plants (tropical grasses, some sedges, and succulents) into their diets. Evidence also suggests that the proportion of C₄ foods consumed by australopithecines is positively correlated with molar size, implying that increasing reliance on these resources may have selected for the robust craniodental features often viewed as adaptations for hard object feeding. Previously, grasses and sedges were believed to offer little nutritional benefit to most primates, thus there have been few systematic efforts to determine which C₄ plants (grasses and/or sedges) and plant parts (e.g., leaves, seeds, underground storage organs) were potentially consumed by early hominins.

In this project, we are exploring links between C₄ food availability/abundance, mechanical/nutritional properties, and consumption by savanna primates. Here we report our analyses of the mechanical properties of C₄ and C₃ plants from within the Cradle Nature Reserve, Cradle of Humankind, Gauteng, South Africa. Our transects included wetland, woodland, and open grassland microhabitats, with collections made during wet and dry field seasons in order to capture temporal and spatial variation. Within each transect, dominant grass, sedge, tree, and forb species were collected, and their relevant parts were isolated for analysis. Our results indicate that within these environments, most potential foods register toughness values beyond those generally attributed to primate dietary resources. Our data also illuminate differences in plant mechanical properties within and across sites, species, plant organs, and seasons.

Epidemic frequency and reproductive value in the Holocene

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Explores possible impacts of increasingly frequent epidemics on human life history, using a database (the HPHD) of 14,000 European skeletons from the Mesolithic to Medieval period. First, we tested a hypothesis that increases in epidemic frequency over time could have caused trends in child death patterns identified in the HPHD. We used Leslie matrix projections to perturb model populations then tracked the effects of the perturbation, over time, on age-at-death distributions. Increased epidemic frequency in model projections recreated the two

seemingly contradictory trends in subadult mortality observed in the HPHD.

We then examined impacts of increasingly frequent epidemics on life history, by tracing changes in reproductive value (Fisher's Reproductive Value Equation) of children (3yr-olds) and young adults (18yr-olds) in the model populations. Young adult reproductive value in model populations declines steadily with increased epidemic frequency until the interval between crises falls below 18 years (holding population growth and age-specific fertility rates constant) then increases with shorter intervals. Similarly, child reproductive value declines until the epidemic interval falls below ten years, then recovers.

Life history theory predicts decreases in the reproductive value of young adults (here 18yr-olds) should favor lower age at sexual maturity and first reproduction, and higher age-specific fertility rates. Lowered reproductive value of existing children (3yr-olds) should favor investment in additional children, versus greater investment in existing children, resulting elevated fertility when 3yr-old reproductive value is low. Our reconstruction predicts these changes would be temporary, reversing as the interval between epidemic events became very short and reproductive value recovered.

Historical contingency and the coevolution of terrestriality and genital skin coloration among Old World monkeys

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Old World Monkeys (Cercopithecoidea) are unusual among primates for the high percentage of species exhibiting genital coloration, as well as the large percentage of highly terrestrial species. Kingdon (1974, 1980) suggested that genital skin coloration is correlated with terrestriality but this hypothesis has not been tested. From the literature we collected data on habitat use (terrestrial/arboreal) and genital coloration (present/absent) for 78 species in Cercopithecoidea. Indeed, among the 78 species surveyed here, 75% of them fall into either the category of colored genitals with terrestrial lifestyle, or of uncolored genitals with arboreal lifestyle [$\chi^2(1)=19.550$, $P<0.001$]. However, conventional statistical procedures assume all taxa are equally related—which is not usually the case in multispecies analyses—leading to higher rates of both Type I and II statistical errors. We performed Bayesian trait co-evolution analyses which show that models of dependent trait evolution are not significantly better than models assuming independent evolution of the two traits (log-likelihood ratio test $P=0.396$, Bayes Factor=1). Bayesian nodal reconstructions of the Cercopithecoidea phylogeny indicate that relatively few trait transitions are needed to account for the distributions of the two traits. Further, chi-squared distributional tests show that sub-family affiliation (i.e. Cercopithecinae, Colobinae) is an accurate predictor of trait status. Ultimately the evolution of genital coloration in Cercopithecoidea is likely the result of multiple

selective pressures including sensory bias and habitat ecology, but based on the analyses presented here, it appears that the association between genital coloration and terrestriality is the product of historical contingency.

Paternity among ring-tailed lemurs from southwestern Madagascar

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Ring-tailed lemurs (*Lemur catta*) are seasonally-breeding strepsirhines in which females often mate with many males during estrus, including resident and extra-group males. However, no study of this species in the wild has compared parentage by resident versus extra-group males. In this study, we analyzed paternity in a population of ring-tailed lemurs from Beza Mahafaly Special Reserve in southwestern Madagascar. Biological samples were collected from 11 groups in 6 distinct capture years between 1987-2006. Paternity was determined for 45 offspring who were either infants (1 yr), subadults (2 yrs) or young adults (3 yrs) at the time of capture. Individuals were genotyped at 8-10 polymorphic microsatellite loci, which were sufficient to determine paternity with 95% confidence. For years in which group membership was known, the majority of infants (two-thirds) were sired by males resident in the group at the time of infant conception, and approximately one-third of offspring were sired by extra-group males. Although some males sired 2 or more offspring per year, each male only produced offspring in a single group per year. Furthermore, in groups that produced >1 infant, it was common for >1 male to sire offspring (in the same season as well as across years). In conclusion, these results have major implications for understanding male mating strategies in this species. Our study provides evidence for limited male reproductive skew in most groups, with resident males siring a greater number of offspring relative to extra-group males.

Stable carbon and nitrogen isotope data offer novel opportunities for hypothesis testing in non-human primate weaning ecology

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Weaning is an important life history phase because it directly affects a mother's fitness and infant development. Observational data

traditionally used to assess weaning age can be imprecise due to the problems of comfort nursing and nursing at night. We employ an isotopic approach to more objectively assess age-at-weaning of captive rhesus macaques (*Macaca mulatta*). We also examine factors thought to influence weaning strategies, including mother's rank, infant sex, and infant growth rate. We test two alternate hypotheses: (1) Infants are weaned at age 5 months (based on previous observations of captive *M. mulatta*) and (2) infants are weaned upon reaching two-thirds adult body size: approximately ages 6-12 months (the threshold weight hypothesis).

Stable carbon and nitrogen isotope data were assayed from plasma of 13 mother-infant pairs of known age, rank, parity and weight housed at the Yerkes Primate Research Center. Mothers were sampled at ages 2 and 5 months. Infants were sampled at ages 2, 5-8, and 10 months.

Mean values of mothers over 10 months were $\delta^{13}C=-19.3\pm 0.37\%$ and $\delta^{15}N=6.9\pm 0.3\%$. Between 2 and 10 months, infant $\delta^{15}N$ values dropped from $7.7\pm 0.3\%$ to $6.8\pm 0.3\%$, and $\delta^{13}C$ values dropped from $-18.0\pm 0.28\%$ to $-19.9\pm 0.44\%$. Males were weaned earlier than females (approximately age 6 months versus age 8 months). No relationship was found between isotopic values and infant growth rate or maternal rank, although the lowest-ranking mother weaned her offspring earliest and most abruptly. The refined "snapshots" of weaning status obtained isotopically permit previously impossible hypothesis testing in primate weaning ecology.

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Plant biomarkers as climate proxies during early rice domestication

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Human-climate interaction has had a central place in anthropological debates pertaining to human adaptation, nutrition, and demography in the cradle of rice domestication: the Yangtze Delta region. Which palaeo-environmental context drove hunter-gatherer food choice in the changing climates of the early to mid-Holocene? What does population history say about subsistence strategies, settlement patterns, and procurement technologies adopted to survive climatic extremes?

We hypothesize that there is untapped methodological potential in utilizing isotopic information contained in micro-botanical remains to reconstruct ecology and pinpoint the environmental conditions that allowed local populations to increase landscape productivity at the locus of Tianluoshan.

Methodologically, we provide the most complete molecular carbon and hydrogen isotope

record during early rice domestication. Lipids were extracted from micro-botanical remains preserved in palaeo-sediments in order to isolate *n*-alkanes. Gas chromatography and isotope ratio mass spectrometry were used to quantify *n*-alkanes and obtain molecular carbon and hydrogen isotope values. These values were paralleled with plant seed and phytolith, and also diatom data to correlate archaeological and ecological responses to changing climates.

The isotopic values for *n*-alkanes compounds C₂₇, C₂₉, and C₃₁ are highly synchronized for both carbon and hydrogen isotopes. Because their coupling is tight, we can state with confidence that our methods are successful, and that palaeo-climatic proxies are indeed contained in botanical remains. This climate signature runs parallel with techno-demographic data and suggests that palaeoclimatic instability switched on and off rice consumption locally and made human groups resort to alternative resources at times of climatic stress.

Emancipation of the forelimb: New experimental evidence on the different functional roles of grasping hands and grasping feet during arboreal quadrupedal locomotion

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Primate quadrupeds typically use a diagonal sequence gait, place their forelimbs in a highly protracted position at touchdown, and experience greater substrate reaction forces on their hindlimbs than on their forelimbs during arboreal locomotion. It is believed that this combination of gait characteristics can help primates successfully occupy an arboreal environment in part by functionally differentiating the forelimbs from the hindlimbs. Specifically, it has been hypothesized that the hindlimb and its grasping feet are likely involved in facilitating balance and propulsion, whereas the forelimb and its grasping hands are specialized for arboreal foraging and testing unstable branches. If this hypothesis is correct, then there should be noticeable differences in how manual and pedal digital flexors muscles are recruited during arboreal locomotion. In this study, we analyzed electromyography (EMG) data from the flexor digitorum fibularis (FDF), flexor digitorum tibialis (FDT), flexor digitorum superficialis (FDS), and flexor digitorum profundus (FDP) muscles in ruffed lemurs (*Varecia rubra*) walking on a 3.1cm diameter pole. EMG data reveal that all digital flexors are active during support phase. However, both FDF and FDT show significantly higher levels of activity and longer durations of activation when compared to FDS and FDP. These results support the hypothesis that the grasping distal extremities of primates have different roles during arboreal locomotion, with the foot emphasizing a greater role in maintaining a secure hold. This functional differentiation in primitive primates like lemurs likely facilitated the evolution of full

emancipation of the forelimb from locomotor duties as seen in bipedal humans.

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Regional diversity patterns in African bovids, hyaenids, and felids during the past 3 million years: The role of taphonomic bias and implications for the evolution of *Paranthropus*

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Reconstructing patterns of Plio-Pleistocene mammalian exchange between eastern and southern Africa may help us to better understand geographic patterns of hominin evolution. Unfortunately, a host of taphonomic factors complicate attempts to compare the faunas of the two regions, but access to new comprehensive datasets encourages a re-examination of this critical period in the African record. In this study we examine the biogeographic histories of three mammalian families whose fossil records span the past 3 million years to test hypotheses relevant to the evolutionary history of the genus *Paranthropus*. We used presence/absence data for 117 species from 38 genera within the family Bovidae and 34 species from 15 genera within the families Hyaenidae and Felidae from 52 eastern African and 40 southern African fossil localities. Our findings indicate that sampling biases have a stronger effect on the patterns of interchange between eastern and southern African Bovidae than they do on the patterns of interchange seen in the Hyaenidae and Felidae. However, there are consistent differences within and between these families. These findings suggest that mammalian groups (including hominins) can have very different histories of exchange between eastern and southern Africa over the past 3 million years. Of the three families considered here, we suggest that the Bovidae is the most appropriate comparator for *Paranthropus*. If our inference is correct, then it implies that megadont hominin taxa in the two regions had effectively independent evolutionary histories.

Cooperative hunting for wasps, opportunistic gathering of grasshoppers: The behavioural ecology of insect consumption in rural Japan

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The collection and consumption of invertebrates plays an important role in the diet and lifestyle of traditional rural Japanese communities. We focus on the two most commonly consumed species, grasshoppers (*Oxya spp*) and wasp larvae (*Vespula spp*) in order to investigate the behavioural ecological significance of Japanese entomophagy. Both are seasonally abundant, nutrient-rich prey species. However, while hunting for wasp nests is a risky

activity with a variable return rate that requires cooperation between foragers, grasshopper collection affords little risk and a predictable harvest. Based on behavioural ecological theory, we propose two hypotheses: Firstly, that wasp collection is a primarily male activity, while grasshoppers are likely to be collected mainly by women. Secondly, that since cooperative hunting is required to obtain wasp larvae, these will be shared amongst fellow hunters and kin groups. To test these hypotheses, we conducted a survey of men and women in rural Japan (N=135), and supplemented our quantitative data with follow-up interviews. We found that men were significantly more likely to have experience searching for wasp larvae than women ($\chi^2=5.58$, $p=0.018$), but that gender did not affect experience of foraging for grasshoppers ($\chi^2=0.098$, $p=0.75$). Wasp larvae are shared to a greater extent than grasshoppers ($\chi^2=12.18$, $p=0.00048$). Follow up interviews confirmed that social factors play an important role in the collection, distribution and consumption of wasp larvae. This study contributes to the growing body of data on the behavioural ecology of entomophagy, a little studied yet widespread human dietary practice.

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Orangutans: A study of activity and play

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Very little research has been done on the activity budget of orangutans in captivity although this research is necessary in order to properly care for captive orangutans and understand the flexibility of primate activity budgets. Currently, Sumatran orangutans (*Pongo abelii*) are critically endangered, with a decreasing wild population of 7,300 individuals. The species is reliant on Species Survival Plans for protection as their habitats are being systematically destroyed, yet our understanding of their social behavior in captivity is limited.

This research looks into orangutan activity in captivity in order to lead to a better understanding of captive orangutans' needs. We conducted our research at the Oklahoma City Zoo and tested two hypotheses: 1. the older female orangutan will spend less time in "active" behaviors than the younger male orangutan and 2. the younger male will engage in more play behavior than the older female. Nine volunteers watched the orangutans for scanning periods of fifteen minutes and documented their actions in accordance with an ethogram. Using chi-square to analyze our data, we found the younger male to be more active, and no significant difference in their play habits. This research shows that orangutans' activity may diminish with age. It also shows that orangutans either don't play often regardless of their age, or it could mean that orangutans' activity relies heavily on their companions. Knowledge of orangutan behavior in captivity is important to be able to better provide for orangutans. Their good health and welfare depends on this research.

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Advances in the study of intramembranous bone formation and growth

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An understanding of prenatal developmental processes driving osteogenesis is necessary to identify the major bases of differences in skull morphology that exist between closely related primate and hominid species shortly after birth. Connecting cellular activities underlying intramembranous bone formation and development with critical aspects of variation is a priority for understanding processes that lead to evolutionary change. Using computed tomography images of the heads of craniosynostosis model mice and unaffected littermates, measurements of bone volume, relative density, and form were used to quantify "typical" and modified patterns of individual skull bone development during prenatal and early postnatal ossification. Endochondral bones typically increase in density across prenatal ossification, while intramembranous bones retain low or moderate densities until birth, even as volumes increase; suggesting fundamental differences in initial ossification beyond the existence of a cartilage model. Although significantly different prenatally, the intramembranous bone volumes of craniosynostosis model mice are similar to unaffected littermates at birth, a time when facial bone shape is significantly different between these groups. Our quantitative observations illustrate how differing measures of cranial bone reveal different facets of phenotypic variation caused by a single mutation. Importantly, these varying aspects of variation could conceivably be acted upon separately by evolutionarily processes. A combination of phenotypic measures may be necessary to illuminate the total effects of new mutations, as well as the rich basis of phenotypic variation that serves as the raw material for evolution.

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Erie County Poorhouse Cemetery Site (UB 2756) excavation methods and results

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Major infrastructure improvements necessitated the salvage excavation of human skeletal remains associated with the Erie County Poorhouse Cemetery Site (A02940.02949, UB 2756) in the City of Buffalo, New York, on what is now the Main Street or South Campus of the University at Buffalo (UB). Work was performed between March and September 2012 through the combined efforts of Archaeological Survey staff and physical anthropologists from the UB Department of Anthropology. The portion of the

burial site examined represents a small part of a larger poorhouse cemetery used between about 1850-1909, and perhaps later. It is estimated that hundreds to thousands of people are buried here but little information is available regarding the numbers and nature of interments. About 450 burial locations were examined in 2012. Analysis of the condition and contents of the burials resulted in a range of findings from intact burials in sealed coffins to disturbed and fragmentary remains in partial coffins, with some empty coffins and spaces representing the prior removal of remains. Excavation goals included the respectful removal of all human remains in the project impact area, maintaining a separation of individuals by location, assuring the complete removal of all remains in difficult excavation conditions, maintaining the construction schedule and performing on-site public outreach and education. Site conditions varied from wet to dry, resulting in intra-site variation in the preservation and condition of coffins and contents. A synopsis of site location, site conditions, excavation methods and results are provided from an archaeological perspective.

Signatures of selection and convergent evolution at genomic loci associated with the pygmy phenotype in Batwa rainforest hunter-gatherers

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The convergent evolution of the 'pygmy phenotype' among Central African and Southeast Asian rainforest hunter-gatherers has prompted hypotheses that small body size may confer fitness benefits related to one or more ecological challenges of the tropical rainforest. However, an adaptive basis for the pygmy phenotype has not yet been fully demonstrated, to justify further consideration of specific ecological hypotheses. For this study, we collected anthropometric and 1M SNP genotype data from 169 Batwa East Central Africa rainforest hunter-gatherers and from 62 Bakiga, the Batwa's Bantu-speaking agriculturalist neighbors. We identified variable levels of Bakiga admixture among the Batwa (mean=14.2%, median=7.7%, range=0%-93%). Batwa stature is significantly positively correlated with the proportion of Bakiga admixture (after regressing out sex; $r^2=0.25$; $p=2.83 \times 10^{-12}$), confirming a genetic basis for the pygmy phenotype. We next used an admixture mapping study design to identify 18 loci associated with the pygmy phenotype at genome-wide levels of significance (FDR=0.25). These loci are enriched for SNPs previously associated with stature in Europeans ($p=0.037$) and for genes with growth-related functions ($p=0.0029$). The mean level of Batwa-Bakiga population differentiation (Fst) for SNPs within these regions is significantly greater than that of the rest of the genome ($p=0.032$), consistent with a model of polygenic adaptation for this phenotype. In contrast, Fst between the Batwa and the Baka, rainforest hunter-gatherers from West Central Africa, in the 18 regions is not

significantly different than the genomic background ($p=0.62$), suggesting a model of at least partial convergence for the evolution of the pygmy phenotype even within Africa.

The importance of long-term fieldwork for answering evolutionary questions: The Lomas Barbudal Monkey Project in Costa Rica as a case study

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Long-term field studies provide crucial data sets for testing evolutionary hypotheses regarding life histories, sexual selection, the impact of environmental disturbance on social and feeding strategies, the evolution of personality traits, the impact of kinship on social strategies, the development of traits, and cultural transmission, to name a few. Here I will discuss how the Lomas Barbudal Monkey Project (LBMP) has contributed to these scientific debates, highlighting areas in which the scientific conclusions would have been different had data collection been terminated earlier. The comparative method is foundational to behavioral ecology research, and long-term studies are the best sources of data for these efforts as well. I present here the types of data that are routinely collected by the LBMP, by way of emphasizing the collaborative potential of this project. Long-term field sites are also critical as (a) training grounds for beginning researchers, and (b) sources of data and personnel for conservation efforts. The constant, long-term presence of PI's in the communities in which they conduct their research helps them develop relationships that enable solid grassroots conservation and environmental education programs. These relationships also enable PI's to make their field sites a home base for more short-term investigators and conservationists who can benefit from their logistical support for scientific and conservation purposes. Despite the tremendous value of long-term field sites for all of these goals, the current funding environment for basic research renders it virtually impossible to keep such projects running, and several sites have folded in recent years.

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A metric assessment of iliac crest curvature as a method for subadult sex determination

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This study examined the curvature of the iliac crest as a method for sex determination in subadults. Determining biological sex in subadults is difficult because sexual dimorphic features have not yet developed on the os coxae, yielding traditional sexing methods inaccurate. Schutkowksi (1993), Sutter (2003), and Wilson and colleagues (2008) studied the curvature of the iliac crest as a sexing method for subadults; their results yielded accuracies of less than 80%

for females, but more than 80% for males. This study nonmetrically and metrically tested the curvature of the iliac crest as a method for sex determination using the ilia of 15 known sex subadults from the Scheuer collection. The ilia were visually assessed and categorized into three groups: slight s-shaped/shallow (females), s-shaped/deep (males), and indeterminate. The visual method was subjective and results indicate that it inaccurately sexed the ilia. The metric assessment yielded an 89% confidence that by measuring the length of the iliac crest and dividing it by the greatest depth of the curve, unknown ilia could be classified into the correct range of numbers that correlated to sex. Due to the small sample size, further testing is needed to determine if this is a viable method. This study contributes to ongoing research on developing methods to sex subadults and contributes to the studies on the viability of the curvature of the iliac crest as a method for subadult sex determination.

Variability in variability - variation in sexual size dimorphism in *Homo sapiens*

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Variability, be it genetic or morphological, is the raw material of evolution. There are many aspects of variability in and among populations, temporal, geographical, and sexual, to mention some. Understanding of the evolution of sexual dimorphism is essential to understanding of human biocultural evolution. Therefore proper methods for analysing sexual dimorphism are essential. Often, focus is on sex differences in mean values. However, differences in variability also deserve attention. Two levels of such variability in variability can be defined: are the two sexes in one population in a given biogeocultural setting different when it comes to the level of variability, and are different populations different with regard to the level of sexual dimorphism? Recently, the implication of this variability in sexual dimorphism has been investigated with respect to sex estimation from skeletal remains from medieval Denmark. It has been found that standard procedures for sex estimation have different efficiency in different samples. This can then be compared to the level of sexual dimorphism in other morphological characters, and the pattern found interpreted in the actual cultural and historical setting. The present study will summarize the general problem of variability in sexual dimorphism, including methods for quantifying this aspect of variability. Danish medieval skeletal material is used as an example and it is shown that sexual dimorphism can vary significantly for a set of characters within a relatively small geochronological range, in what is assumed to be subdivisions in a genetically homogeneous population.

Suspension, brachiation, and the evolution of short torsos in atelines and hominoids

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Hominoid primates possess reduced numbers of lumbar vertebrae relative to non-hominoid primates and most other mammals. However, reduction in lumbar number appears to have evolved a number of times across mammals in different locomotor contexts. In many cases, lumbar reduction is achieved via homeotic change with the thoracic region, maintaining a consistent number of thoracolumbar vertebrae. Hominoids depart from this pattern, as do a select few mammals, including ateline primates. The extant Atelidae contains four genera: *Alouatta* and *Lagothrix*, which occasionally employ hindlimb/tail and forelimb suspension, respectively, but are otherwise arboreal quadrupeds, and *Ateles* and *Brachyteles*, which are primarily tail-assisted brachiators. Given their degree of locomotor variation and phylogenetic proximity to hominoids, the Atelidae provide an analogy for reconstructing the evolutionary history of extant hominoids, all of which are fully suspensory and capable of brachiation.

We collect vertebral number data on a large sample of primates (N=4000), identify the modal vertebral formula for each genus, and quantify intra-and-inter-generic variation. Results demonstrate that *Ateles*, *Brachyteles*, and *Lagothrix* converge with hylobatids in thoracolumbar numbers, whereas *Alouatta* retains an unreduced thoracolumbar column. In contrast to hominoids, ateline thoracolumbar reduction is generally accomplished via meristic rather than homeotic change at the lumbo-sacral border. Within atelids, intraspecific variation is structured such that *Alouatta*, *Lagothrix*, and *Brachyteles* are characterized by high degrees of variation, whereas *Ateles* demonstrates little variation. We suggest that forelimb suspension and locomotion, not suspensory behavior generally or brachiation specifically, best explains the convergent evolution of reduced thoracolumbar numbers in Atelinae and Hominoidea.

Cranial modification and identity at Cusirisna Cave, Nicaragua

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Cultural traditions of cranial modification are important chronologically and geographically to investigate ethnic relationships. Eight crania were present in the commingled remains (n=82, MNI=9) recovered from Cusirisna Cave, Boaco, Nicaragua in the 1870s. Five crania display fronto-vertico-occipital modification most likely achieved through compression by cradleboards or freeboards. The five crania each display a vertical occipital, superior elevation of the lambdoidal suture, and laterally expanding parietals, though they exhibit variability in degree of slope. Ethnohistoric reference from the 1870s describes the placement of the crania in *guacales* (bowls made from *jicaras*), a different treatment than the postcranial remains in the cave burial. A radiocarbon assay using the

accelerator mass spectrometry technique on a sample from one of the *guacales* yielded a date of cal A.D. 1450 with a 2-sigma calibrated interval (95% probability) of Cal AD 1430 to 1483 (Cal BP 520 to 470) (Beta-315973). We explore cranial modification in this temporal and spatial context to examine identity and use this framework to interpret the function of the mortuary cave. There is little information in regard to this particular locale in Nicaragua, and even less so in terms of osteological analysis and cranial modification. These bioarchaeological analyses of identity and mortuary function allows for inference into ethnic affinity, social status, comparison of cultural traditions, and addresses Cusirisna Cave as a place of ritual importance.

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Tooth ablation in early Neolithic skeletons from Taiwan

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Although varied in its expression, the intentional removal of teeth during life has been documented in the living and in archaeological skeletal record worldwide. Several earlier studies indicate that tooth ablation was relatively common in Taiwan as well as in the Chinese mainland beginning with the Neolithic Age continuing into the Iron Age in these regions. More recent examples of tooth ablation among several of Taiwan's indigenous groups, some occurring as late as the early twentieth century, have also been reported. In this study, we report a usually high frequency of tooth ablation in some of the earliest Neolithic (ca. 5000 BP) skeletons from the Nankuanli East (NKLE) site in southwestern Taiwan. The patterns of ablation and teeth missing in 15 adult male and 8 adult females from the NKLE site are compared. With one exception, the most common pattern of tooth ablation in the NKLE skeletons, male and female, was the symmetrical removal of the maxillary lateral incisors and canines. In contrast to these findings, we further report no tooth ablation among the Iron Age skeletons from the Shisanhang (SSH) site in northwest Taiwan. The significance of the almost ubiquitous occurrence of tooth ablation among the earliest Neolithic skeletons from Taiwan, including the manner of tooth removal, and the absence of this cultural modification in the SSH teeth are explored. This study contributes to studies in anthropology that attempt to reconstruct past behaviors from archaeological human skeletons.

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Discrete dental traits differentiating *Gorilla* sexes, subspecies and species

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As the largest living sexually dimorphic hominoid, *Gorilla* patterns of dental variation have special relevance for addressing questions about intraspecific and interspecific dental variation in fossil hominoids. Previous research has shown that gorillas can be separated into taxonomic units of species and subspecies by dental metrics. The purpose of this study is to document variation in discretely occurring dental traits in gorillas. Dental traits on incisors, canines, premolars and molars were documented in 324 individuals. Frequency counts with chi square statistics ($p < 0.05$) and mean measures of distance were used to study differences between taxa.

Gorilla male canines are 50-80% larger in surface area than female canines and there is a significantly greater likelihood that they will exhibit developmental grooves. Male postcanine teeth are 5-10% larger than female postcanine teeth and they are more likely to possess fourth molars and accessory tubercles. The eastern species, *G. beringei* is larger than the western, *G. gorilla* and has significantly higher frequencies of premolar accessory tubercles, and molar accessory features such as pericone, carabelli's cusp, mesostyle, distoconule, tuberculum sextum, tuberculum intermedium and protostylid. The same is true for subspecies: the western subspecies, *G. g. diehli* is the smallest of the subspecies and exhibits lower counts of accessory dental tubercles than both, *G. g. gorilla* and eastern subspecies of *G. beringei*.

When taken in conjunction with patterns of discrete dental trait variation in other modern hominoids these size-related findings are of significance in determining species configurations in fossil taxa such as *Paranthropus*, *Dryopithecus* and *Proconsul*.

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Reevaluating Dr. Lund's ideas at the Lapa do Sumidouro, a classic paleoanthropological site of the American Quaternary

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In September 1843 Danish naturalist Peter Wilhelm Lund first explored Sumidouro Cave in the Lagoa Santa Karst area, southeastern Brazil. Following detailed stratigraphical work he put forward the hypothesis that men had co-existed with the extinct megafauna, besides proposing a great antiquity for paleoindians in South America.

New research has been carried out at Sumidouro Cave, involving hydrological, sedimentological, stratigraphical and taphonomical analyses. Chronology was determined by U-series dating of calcite flowstone intercalated with fossil-rich sediment and radiocarbon dating of freshwater shells and both megafaunal and human bones.

Results indicate that human bones were deposited in the cave at approximately 8,400 cal yr. B.P. These human remains were later intermixed with both living and extinct faunal remains, during various flooding episodes,

creating asynchronous and highly heterogeneous fossiliferous deposits.

Elsewhere in the Lagoa Santa Karst area, the oldest dated human remains (11,200 ~ 12,300 cal yr BP) indicate a chronological overlapping with the youngest dated extinct fauna - ground sloth *Catonyx cuvieri* (11,570 to 11,250 cal yr BP) and sabre toothed cat *Smilodon populator* (11,050 to 10,960 and 10,770 to 10,170 cal yr BP). Little is known about the relationship between humans and megafauna, but archaeological evidence does not indicate that the extinct fauna was part of paleoindians diet.

The great ape-like patella of *Pierolapithecus catalaunicus* and the mosaic nature of the postcranium of Miocene hominoids

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Several authors have emphasized the role of the patella in knee biomechanics and its relationship with locomotion among primates. In particular, platyrrhine and especially cercopithecoïd monkeys show proximodistally high, mediolaterally narrow and anteroposteriorly thick patellae, whereas great apes display proximodistally short, mediolaterally wide and anteroposteriorly thin patellae. The monkey configuration has been related to habitual running and leaping, by increasing the moment arm of the quadriceps muscle favoring knee extension from flexed postures. In contrast, the great-ape patella has been functionally related to a wider—less stereotyped—range of knee movements. In order to better understand knee biomechanics and the evolution of patellar morphology in hominoids, we performed morphometric (multivariate and allometric) analyses of the fossil great ape *Pierolapithecus catalaunicus* patella (IPS 21350.37; 11.9 Ma) in comparison to earlier fossil hominoids and selected extant anthropoids. Our results show that the *Pierolapithecus* patella is more similar to those of extant great apes, differing from those of some earlier hominoids (e.g., *Proconsul* and *Nacholapithecus*) and hylobatids, which display more anteroposteriorly compressed patellae. *Pierolapithecus* exhibited an orthograde body plan coupled with short hands and lack of ulnocarpal articulation. Thus, its locomotor repertoire has been reconstructed as retaining above-branch palmigrady in combination to new adaptations enhancing orthograde locomotor behaviors such as vertical climbing, but without specific adaptations for below-branch suspension. Our results further suggest that knee function in *Pierolapithecus* was more similar to that of modern great apes than to those of earlier hominoids, thereby

reinforcing the mosaic nature of postcranial evolution in hominoids.

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Morphological mismatch between the mandible and the lower dentition following the transition to agriculture in the Near East, Anatolia and Europe

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The dentition of hunter-gatherers differs from agriculturalists in crown size, tooth wear, and in the prevalence of malocclusion, dental crowding and oral pathologies.

A recent study of global craniofacial and mandibular shape variation among modern-day hunter-gatherers and agriculturalists suggests that mandibular shape variation significantly reflects subsistence strategy with hunter-gatherers having consistently longer and narrower mandibles than agriculturalists.

We postulate that if variation in subsistence plays a major role in generating a mismatch between the mandible and the dentition then it should be evident in early transitional populations of the Near East/Anatolia that combined farming with hunting/gathering, and only adopted a subsistence spectrum relying solely on domesticates several millennia after the emergence of agriculture. This was investigated by analysing mandibular mesiodistal and buccolingual crown dimensions and seven mandibular measurements for 20 Upper Palaeolithic, Epipalaeolithic, Mesolithic, Pre-Pottery and Pottery Neolithic populations from across Europe and the Near East. Each dataset was subjected to (1) multidimensional scaling analysis of squared Mahalanobis distances between all populations, and (2) principal components analysis of the same 284 individuals.

Results indicate that teeth and mandibular dimensions are smaller in early farmers. However, while there is no significant change in multidimensional tooth shape, agriculturalist mandibles are allometrically smaller than those of hunter-gatherers, indicating a substantial change in mandibular shape. These observations accord with previous studies suggesting phenotypic plasticity in the mandible, but no concordant plasticity in tooth size/shape, which may explain/predict the onset of malocclusion and crowding problems with the transition to agriculture.

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Nutrition in transition: Dietary strategies and health status of Ribeirinhos in the 21st century

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Anthropological debates surrounding human dietary patterns in the Amazon Basin have been dominated by ecological approaches that have emphasized environmental limitations in determining human occupation of the region. This literature, including Walter Neves' contribution to it, has influenced my research. In this poster, I present the results of longitudinal research I conducted among rural peasants (Ribeirinhos) in the eastern Amazon, work that would not have been possible without Dr. Neves' support. Incorporating a broader, biocultural view of the environment, I tracked the effects rapid economic and socio-political changes in Brazil in the 21st century have had on subsistence farmers and captured the early stages of the nutrition transition in this context. With new economic opportunities, households have shifted away from subsistence farming which has influenced both dietary intakes, as well as anthropometric measures. Sources of energy and protein have shifted from locally produced/procured items to those purchased on the market. Among all age groups there was a significant decline in muscle mass and increase in body fat. Changes in weight have been modest and limited to adult females. A new finding with significant physical and mental health implications is the high rate of food insecurity measured as a decline in dietary energy adequacy over time, as well as through women's perceptions assessed via the Brazilian food insecurity questionnaire (EBIA). These findings will be compared to data from other rural populations in the region and their implications for understanding human dietary ecology in the Amazon will be discussed.

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A test of three hypotheses of pica and amylophagy among pregnant women in Tamil Nadu, India

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Pica has been studied for more than one hundred years, yet no well-supported explanation for it has emerged. Amylophagy, sometimes considered a type of pica and sometimes studied separately, is less frequently investigated and also lacks a convincing explanation. This study used a biocultural approach to test three hypotheses of pica and amylophagy: protection, hunger/nutrition, and psychological distress.

The research took place in Tamil Nadu, India. A cultural investigation was carried out among non-pregnant, adult women (n=54) to determine non-food substances that are consumed in this region and perceptions of health consequences. Next, using the substances identified in study 1, three hypotheses of pica and amylophagy were tested in a cross-sectional study of pregnant women (n=95). Logistic regression analysis was used to analyze the presence/absence of engaging in pica and amylophagy. A series of bivariate analyses were used to examine the

variation in amount and frequency of consumption.

Study 1 revealed that cultural attitudes strongly shape the selection of non-food substances. In Study 2, the presence/absence of pica was not predicted by any of the variables included in the study, whereas the frequency and amount of consumption of pica substances was primarily explained by the psychological distress and hunger/nutrition hypotheses. Both the presence/absence of amylophagy, as well as the frequency and amount of consumption were best explained by the protection hypothesis.

This research provided partial support for the protection and hunger/nutrition hypotheses for amylophagy, and provided some evidence for the role of psychological distress and hunger or nutrition in pica.

Comparing the pattern of cranial, postcranial, and size dimorphism in non-human primates, early hominins and modern *Homo*

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While many conclude that sexual size dimorphism was strong in *Australopithecus afarensis*, Reno et al. (2003, 2005, 2010) present analyses suggesting "human-like" dimorphism using postcranial data. Interestingly, modern humans show an unusual pattern of modest total body mass dimorphism, but strong lean mass dimorphism. Cranial dimorphism in *Homo* parallels total mass dimorphism, while postcranial dimorphism matches lean mass dimorphism. This raises the questions of why humans show this pattern, and whether it is apparent in early hominins. Cranial and postcranial data for *A. afarensis* and *A. africanus* were gathered from the literature and laser scans of original specimens. Data for 20 extant primates were gathered from Gordon (2004) and Plavcan (2002). Estimates of fossil dimorphism were generated using a variety of methods, including that of Reno et al. (2010). Comparisons of body mass, postcranial, and cranial dimorphism confirm the unusual pattern of human dimorphism, but also demonstrate that postcranial dimorphism in primates is generally stronger than cranial dimorphism. Dimorphism in *A. afarensis* appears stronger than extant humans, and the pattern is similar to that of non-human primates. *A. africanus*, in contrast, shows modest dimorphism. Estimates of strong cranial dimorphism in this taxon contrast with modest postcranial dimorphism suggesting that lower estimates of cranial dimorphism may be more likely, which in turn would suggest diversity in dimorphism among early hominins. The unusual pattern of modern human dimorphism appears derived, and probably reflects shifts in human life-history favoring a shift in body composition in females.

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Vertebral morphology, locomotion, and human spinal health

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Back pain is a major health issue but its causes remain poorly understood. We are afflicted by back problems more frequently than other primates and consequently researchers have suggested that our lineage's shift to bipedalism may be the cause. This hypothesis has been widely discussed, but inadequately tested. Accordingly, we have initiated a project to examine the relationship between vertebral shape, locomotor behavior, and a key human spinal lesion, the Schmorl's node, which is a depression on the vertebral body resulting from intervertebral disc herniation.

Seventeen 2D landmarks were placed on photographs of the superior aspects of T12/T13 to L3 vertebrae of humans (n=80), chimpanzees (n=40), and orangutans (n=19). Fifty-three of the human individuals exhibited Schmorl's nodes on at least one vertebra and 27 were unaffected. The landmark coordinates were analyzed using geometric morphometrics. The data were regressed on centroid size to minimize the influence of allometry and analyses were performed on the regression residuals.

Preliminary results of a Canonical Variates Analyses indicate that the morphology of pathological human vertebrae shows greater similarity to chimpanzee vertebrae than to healthy human vertebrae. Procrustes distances were significantly different among groups (p<0.0001) with the exception of the distance between pathological humans and chimpanzees (p>=0.12). These results indicate that human vertebrae with Schmorl's nodes share similarities in shape with chimpanzee vertebrae, and offers tentative support for the hypothesis that back pain may, in part, be due to individuals having a plesiomorphic vertebral shape, one which is relatively poorly suited to bipedal posture and gait.

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Phenotypic integration and the evolution of suspensory behavior in primates

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Suspensory behavior has evolved multiple times in primate evolution. The primates that engage in suspensory behaviors are characterized by relatively long forelimbs and a suite of distinctive bone shapes and joint morphologies compared to quadrupedal primates, which likely

better represent the primitive primate condition. Previous research has demonstrated reduced levels of integration between the fore- and hindlimb bone lengths of apes and humans compared to quadrupedal species, which is likely due to selection for different functional requirements of these two regions. In this project we evaluate whether this reduced pattern of integration is observed in other serially homologous limb and joint morphologies, and whether the patterns of reduced forelimb-hindlimb integration are similar in suspensory platyrrhine and hominoid species. Limb lengths, joint dimensions, and bone shape coordinates were obtained for large samples of the scapulae, innominates, humeri, ulnae, femora and tibiae of *Homo sapiens*, *Pan troglodytes*, *Gorilla gorilla*, *Pongo pygmaeus*, *Hylobates lar*, *Ateles sp.*, *Alouatta sp.*, *Cercopithecus ascanius*, and *Macaca fascicularis*.

Pairwise phenotypic correlations, measures of evolvability, and patterns and magnitudes of integration among serially homologous dimensions across limbs and adjacent elements within limbs were derived from observed correlation and mean-standardized variance-covariance matrices. In general, homologous fore- and hindlimb lengths showed reduced levels of integration in suspensory species compared to quadrupeds, as did other joint and bone shapes typically associated with suspensory behaviors. Differences in the patterns of integration allow inferences to be made about the independent origins of suspensory behavior in different primate lineages.

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The individual-level 'dual burden' of short stature and excess adiposity: Discounting a methodological explanation using tibia length

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The individual 'dual burden' of short stature and excess adiposity is a growing concern in developing countries given the accompanying increases in chronic disease risk, but its aetiology remains unclear. Context-specific environmental factors are proposed to account for varied rates of the dual burden between studies, but the influence of measurement error in height where certain proxies for adiposity are used (e.g. body mass index (BMI), waist circumference-height ratio (WCHtR)) might influence the results. We investigated whether Peruvian children from contrasting environments (urban lowlands, rural highlands) are differentially affected by the

individual dual burden, and explored the use of tibia length to discount problems arising from measurement error in height. Adiposity proxies (BMI z score or WCHtR) were regressed on height or tibia length z score for children aged 3-8.5 years (n=201). Z scores were derived from international reference data (World Health Organization) and sample-specific centile curves. Height is positively associated with BMI and weakly with WCHtR among lowland children, while among highland children, height is negatively associated with WCHtR but unrelated to BMI. We suggest that the results relate to environmental differences between the two groups, primarily greater poverty in the highlands. We discount measurement error on height as an explanation, since results are very similar using tibia length instead of stature. Our results concur with previous arguments that the individual dual burden has a complex and context-specific aetiology, and demonstrate the utility of tibia length to exclude one potential methodological barrier to confidently interpreting the results.

Daily water turn over in humans, apes, and fossil hominins

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Maintaining water balance is essential for life, but little is known about daily water flux in humans and other apes. Adaptations for maintaining water balance may have been particularly important in the evolution of our lineage as hominins increased their ranging activity and adopted hairless, sweaty skin for thermoregulation in hot, dry environments. In this project, we used the doubly labeled water method to measure daily water turnover (liters/day) in humans (Hadza hunter-gatherers and U.S. adults), chimpanzees, bonobos, gorillas, and orangutans, and compared these to water turnover rates in other primates and other mammals. As expected, daily water turnover was positively correlated with body mass and activity level. Among humans, activity level was shown to have a strong effect on water use, consistent with previous studies. Hadza hunter-gatherers

had water turnover rates similar to those published for endurance athletes and significantly greater than our U.S. sample. However, humans had lower water turnover rates than other apes, controlling for effects of mass and activity level. Indeed, rates of water turnover among traditional Hadza foragers were similar to those of relatively sedentary apes housed in zoos and sanctuaries. These results indicate that humans maintain physiological or anatomical mechanisms to conserve water. One hypothesis is that humans' external nose reduces water lost through respiration. We discuss the implications of these findings for reconstructing the ranging and foraging ecology of fossil hominins.

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Morphologic integration in the hominoid shoulder and forelimb

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The upper limb has undergone dramatic morphological changes during human evolution. These anatomical changes are thought to underlie major behavioral shifts, affecting our ancestors' ability to climb, throw, and use stone tools. Such changes have been traditionally viewed as the result of selection on the upper limb, but due to genetic relationships between traits - integration - selection on one trait may have an indirect but correlated response in another. Thus, differences between species may not directly correspond to evolutionary processes such as selection, obscuring functional interpretations.

Here, we use quantitative genetic methods to estimate integration patterns and reconstruct selection pressures acting on the shoulder and forelimb during human evolution. We collected metric data on 18 traits in the hominoid pectoral girdle (scapula and clavicle) and forelimb (humerus and radius) from a large sample of *Pan troglodytes* and *Homo sapiens*. Direct selection pressures to evolve a modern *Homo sapiens* (MHS) morphology from a *Pan*-like last common ancestor (LCA) were estimated for each trait. For the LCA-MHS evolutionary transition, results indicate that about half of traits have undergone positive selection, resulting in the morphology of the MHS shoulder and forelimb. These findings highlight how natural selection has acted on some, but not all, regions of upper limb anatomy over the course of human evolution, which has implications for adaptive scenarios about the evolution of the human upper limb.

A three-dimensional quantitative analysis of subtalar and talonavicular joint morphology in Plio-Pleistocene hominins

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The unique presence in *Australopithecus sediba* of a curved subtalar joint and a large talar head, among other lower limb characters, was

used to support the hypothesis that this species walked with a hyperpronating gait. Here, I use a three-dimensional methodology involving segmentation of articular surfaces to quantify relative size, curvature, and conarticular congruence of the subtalar and talonavicular joints in extant hominids ($n = 92$) and fossil hominins ($n = 22$) to further evaluate these morphological hypotheses. Preliminary results show no significant difference in the relative surface area of the talar head among humans, chimpanzees, and gorillas (ANOVA $p = > .1$) despite differences in body size and foot function. Among African apes, joint curvature decreases with increasing body size while humans maintain relatively flatter joints at smaller body sizes. *Australopithecus afarensis* (i.e., A.L. 288-1, A.L. 333-8, A.L. 333-55, A.L. 333-47, A.L. 333-36, A.L. 333-75) is human-like in the flatness of the subtalar joint despite being small-bodied, but is characterized by a markedly curved talonavicular joint. *Australopithecus sediba* and other South African specimens attributed to *A. africanus* such as Stw 88, Stw 102, and Stw 352 are more African ape-like in subtalar curvature. Conversely, the *A. sediba* talonavicular joint is more moderately curved than *A. afarensis* and most similar to specimens thought to represent early *Homo* (i.e., OH 8 and Omo 323-76-898). These results support the notion that the early hominin locomotor repertoire was diverse in frequencies of arboreality and terrestriality.

Nest type, structural variations, and tree species choice in wild Bornean orangutans (*Pongo pygmaeus wurmbii*)

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Nest building is an important and complex activity in wild orangutans and is likely influenced by learning and innovation. Indeed, most juvenile orangutans share a night nest with their mothers until weaning around 6-7 years of age. Orangutans build a nest every evening, either by constructing a new nest or rebuilding an older nest structure. The process of nest building involves selecting the tree(s), constructing the initial foundation, and locking and adding additional features that have been linked to comfort and protection from environmental elements. Here, we examine individual variation in nest characteristics and nest-building techniques in a peat habitat, the Tuanan Orangutan Research Project (TORP) study area, in Central Kalimantan.

Data were collected on 22 wild orangutans, *Pongo pygmaeus wurmbii*, at TORP using full-day, focal-animal sampling and are based on 360 orangutan nests. A total of nineteen different nest structures were identified, with 58.3% of the nests constructed in two or more trees. The basic support foundation of nests at Tuanan is

described as butterfly shaped with branches concentrated at both the head and foot positions of the orangutan. Over 90% of nests at Tuanan were new nest constructions at 5-9 meters height and the most commonly used tree species was *Elaeocarpus mastersii*. Nest tree species choice was not correlated with the abundance of that species in the habitat ($p > 0.05$), or whether it contained edible fruit, and thus it appears orangutans at this site are selective with nest species choice. Variation was also observed among individual techniques used.

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Non-bony lesions and functional losses in leprosy

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Sixty skeletons were recovered from a historically documented 14th century leprosarium in Maribo, Denmark (approx. half of the churchyard was excavated). Only four skeletons showed phalangeal lesions, and none of the 30 skeletons with intact facial bones showed signs of facies leprosa. It has been proposed that perhaps some people were consigned and later buried in the leprosarium due to misdiagnosis. By combining the osteological evidence with historical records (consisting of some of the first clinical paintings and photographs of leprosy patients) from 17th and 18th century leprosarium in Bergen, Norway, we here argue that medieval leprosy was probably correctly diagnosed because of the overt, severe effects of the disease, even though osseous lesions had not developed.

The primary sites of leprosy infection are the skin, peripheral nerves, anterior parts of the eyes, the upper airways, the testes, and the distal upper and lower extremities. But the skin lesions and ocular involvement are among the first symptoms of early and indeterminate leprosy: they are conspicuous and stigmatising. While there are differential diagnoses, the skin lesions of leprosy are rather pathognomonic, e.g., hyperaesthesia is always present, and peripheral nerve involvement is common. Early involvement of the eye and the eyelids may result in blindness, likewise a conspicuous handicap. Unless other documentation exists regarding the use of the churchyard, we argue that all skeletons found in a dedicated leprosary cemetery should be considered as having suffered of leprosy, even though osseous involvement is not present.

Diet and trade in an Eighteenth Century British Colonial sample from Saint George's Caye, Belize

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This study analyzes $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ values of bone collagen and $\delta^{13}\text{C}$ values of bone apatite in

19 human burials from St. George's Caye, an island off the coast of Belize. In the late 1600s, St. George's Caye was occupied by British colonists, who engaged in extensive logging on the mainland. The colonial economy revolved around extensive trade with Jamaica, New England, and Great Britain. At this time, mass production of cane sugar and maize in the Caribbean likely provided an easy source of calories apart from the small personal gardens managed by the baymen.

Analysis of historic food webs is complex in its nature, as international trade networks made a multitude of non-local resources available to consume. To evaluate the range of variation in food consumption among individuals in the sample, bone collagen stable carbon and nitrogen isotope values were compiled from several published sources to model historic foodwebs from colonial Belize and Jamaica. Traditional European diet and native Belizean resource stable isotope values primarily reflect the contribution of C3-based terrestrial sources ($\delta^{13}\text{C} = -26.1$ to -22.9 ; $\delta^{15}\text{N} = 2.4$ to 7.6). In contrast, C4-plants, such as cane sugar and maize, were considered in both colonial diets ($\delta^{13}\text{C} = -10.2$ to -8 ; $\delta^{15}\text{N} = 1.9$ to 6.0) as were marine resources ($\delta^{13}\text{C} = -3.7$ to -18.3 ; $\delta^{15}\text{N} = 5.6$ to 18.3), especially sea turtle and local reef fish. This food web will be used to estimate the dietary contributions of local and non-local food at an individual level at Saint George's Caye.

Discriminating behaviors to measure personality traits in free-ranging Tibetan macaques (*Macaca thibetana*)

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The present study is an exploratory technique for personality assessment that discriminates behavioral measures selected without *a priori* assumptions, permitting long-term analysis of personality using behavioral proxies. During August – September, 2012, we studied a group of free-ranging, provisioned Tibetan macaques (*Macaca thibetana*) at a tourist site in Anhui Province, China. Familiar humans rated 12 adult macaques using a 27-item personality survey for each monkey. Behavioral measures were recorded from observations of the same 12 monkeys. A principal component analysis of 22 reliable items of the personality survey revealed five personality components that represented the underlying structure: Insecurity, Reactivity, Boldness, Sociability and Leadership. Discriminant analyses were used to determine, from > 100 hours of behavioral data, which behavior variables best predicted personality group membership for each of the components. Results indicated that in certain situations the behavioral measures of *avoidance*, *lunging*, *fear-*

grinning, self-directed behaviors, touching, proximity and chasing can significantly ($ps \leq 0.05$) predict the personality traits in this macaque population. Spearman's correlations between component and discriminant scores showed that behaviors are effective exploratory proxies for four personality components ($rs > \pm 0.6$). General linear models of repeated measures also examined situational effects of provisioning and tourists on the relevant behaviors, with significances found in three of the seven behaviors ($ps \leq \alpha$). Personality components are comparable with similar publications on personality in *Macaca*. We suggest this methodology is effective at discriminating behaviors as proxies for personality components.

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Sweet (or meat) surrender?: An examination of the frequency of dental abscesses in the highland Andes

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The study of dental abscesses within populations can inform on subsistence and consumptive patterns. Abscesses are caused by plaque bacteria that penetrate the gums, tooth roots, or alveolar bones and cause fatal infections. Cross-culturally, abscesses on the front teeth are often associated with a larger portion of meat in the diet. This research evaluates these associations through analysis of abscess frequencies on 198 individuals from several archaeological sites in Apurimac, Peru that span ca. AD 700-1400. The teeth were divided into groups based on side and type. Abscess rates were collated with data on era, cultural affiliation, sex, and age when possible. The canines were more prone to abscesses than any other dentition likely because this food-tearing tooth is less protected by the gums. Moreover, there was no difference in abscess rates between different cultural groups or sites over time. Nor were there significant differences in abscess rates between males and females. Results indicate that overall consumptive practices in Apurimac did not change significantly. Over time, Apurimac witnessed increasing dietary gender parity.

This research was supported by Fulbright Hays, NSF, and Vanderbilt University.

Mortuary genetics of the ancient Swahili sites of Manda and Mtwapa, Kenya

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Over five field seasons, 2008-2012, two ancient Kenyan Swahili sites were excavated.

Mtwapa (ca. 1000-1750 CE) and Manda (ca. 800-1600 CE) were once wealthy, cosmopolitan polities involved in the Indian Ocean trade network. Both towns had populations of 5,000-10,000 at their height of occupation, and had large central mosques with adjacent cemeteries. Genetic data collected from individuals sampled at these sites is currently being used to discern the burial trends of the Swahili, as well as whether the Swahili practiced matrilineal residence patterns. As Swahili burials typically contain no grave goods, genetic information is able to provide valuable data regarding burial patterning and social structure at these sites.

Mtwapa excavations occurred between 2008 and 2011 and produced a minimum of 87 individuals buried across 13 crypts in the cemetery located next to the central mosque, with an average of 7 individuals per crypt. Crypts contained both men and women, as well as children, and all individuals uncovered were laid on their right side, extended, facing mecca. Mitochondrial DNA (mtDNA) extractions from teeth have been performed on 73 of these individuals, and Y-chromosome studies are set to begin this fall. The presence of mtDNA haplotypes of both West-Central and East African origin have been noted in preliminary sequence analysis of the first Hypervariable Region (HVRI) of the control region.

Excavations at Manda began in December 2012, with a total of 19 individuals being exhumed. Extractions began in September of 2013, and preliminary sequence data is expected in Winter 2013/14.

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Correlating form and function in the tali of catarrhine primates

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The talus occupies a pivotal position between the foot and hindlimb, contributing to three joint complexes. As such, tali, which are relatively well represented in the hominin fossil record, have the propensity to contribute to a better understanding of the locomotor patterns of early hominins and may be of use in elucidating the suite of locomotor behaviors used by the last common ancestor of *Pan* and *Homo*. It has been suggested, however, that the talus is too variable to allow reliable reconstruction of locomotor behaviors. This study aims to determine if tali are useful in differentiating catarrhine primates into broad locomotor categories based on linear measurements and to use this information to make inferences about the locomotor behaviors of fossil taxa using a multivariate statistical approach.

On the basis of talar morphology, catarrhines can be differentiated into four broad locomotor categories: quadrupedalism, brachiating, suspensory knuckle-walking, and bipedalism; arboreal and terrestrial quadrupeds were not found to differ significantly. The fossil hominin tali that were sampled preserve features associated with both bipeds and suspensory knuckle-walkers and were found to be distinct from one another, perhaps indicating a

transitional stage where arboreal behaviors shared with extant apes (including vertical climbing, which may be important in shaping the talus) were retained and bipedalism was used when moving terrestrially. This result suggests that the foot of the *Pan-Homo* LCA was most morphologically and functionally similar to that of an extant African ape, contrary to the predictions stemming from analyses of the postcrania of *Ardipithecus ramidus*.

Sexual dimorphism of the femur: Biomechanical influence of pelvic morphology

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Knowing the relationship between pelvic and femur morphology is essential for understanding femoral developmental plasticity, sexual dimorphism, and morphological changes associated with habitual load levels. The purpose of this research project is to examine how pelvic dimensions influence the shape of the femur within a biomechanical framework in a modern American White population. Specifically the research examines the relationship between sex differences in biacetabular breadth and femoral functional angles. Sexual dimorphism in pelvic dimensions and femoral angles of 30 males and 30 females were analyzed using 3D landmarks and geometric morphometric techniques to provide a visual representation of overall shape change in the femur and pelvis between males and females. The Procrustes analysis revealed significant shape differences in epicondylar breadth, acetabular version, and iliac flare between males and females. Analysis of the data also showed significant sexual dimorphism in the biacetabular breadth, biomechanical neck length, femoral neck-shaft angle, femoral angle of version, and the bicondylar angle. Regression analysis showed significant relationships to exist between several variables, including biacetabular breadth, the neck-shaft angle, and the bicondylar angle. The findings also show that the neck-shaft angle and biomechanical neck length are correlated with the bicondylar dimensions. The research indicates that the femoral and pelvic morphological traits are multi-factorial and reflect biomechanical adaptations to varying dimensions among humans, which has applications for reconstructing modern and fossil human femoral plasticity and variation.

Culture change and the relationships between infection and stress in the middle Holocene Cis-Baikal

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Previous research has noted that Early Neolithic (EN; 8000-7000/6800 cal. BP) populations in Siberia's Cis-Baikal experienced more physiological stress than did the subsequent Late Neolithic-Early Bronze Age

(LN-EBA; 6000/5800-4000 cal. BP) groups. Of particular interest is an apparent 800-1000 year biocultural 'hiatus' during the seventh millennium BP, reflected archaeologically by the absence of formal cemeteries and the fact that EN and LN-EBA populations lying on either side of it are biologically and culturally distinct. Here we aim to provide insight into the nature of this culture change by examining infection-induced bone changes as markers of physiological stress in three cemetery populations: two EN ('pre-hiatus') and one LN-EBA ('post-hiatus'). In particular, non-specific bone changes such as periostitis, otitis media, and sinusitis were systematically recorded. Logistic regressions and model reductions of the generalized linear model family were performed so as to evaluate the relationships between the frequencies of infection- and stress-induced bone changes in each culture. The results are consistent with those previously noted in that there appears to have been more infection-induced bone changes during the 'pre-hiatus' EN period than the later LN-EBA. Otitis media and periostitis are the most common and ubiquitous forms of infection, with more individuals exhibiting symptoms of hypertrophic osteoarthropathy, in particular, in the EN period. Overall, males exhibit more infection-induced bone changes than do females. We suggest that an individual's biology, both their sex and their genetics, play a large role in how they manage stress and, consequently, how they cope with infection.

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Osteoarchaeological and paleomicrobiological evidence of leprosy in Hungary

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Study of specific infectious diseases, including leprosy, has been a research focus of Hungarian paleopathologists since the 1970s. This activity became more intensive at the beginning of the 21st century when a number of new cases were detected. The aim of this study is to review the evidence of skeletal leprosy from ancient times in the territory of present-day Hungary based on previously published and newly detected cases. The skeletal material (nearly 10,000 skeletons), derives from different archaeological periods. The skeletal features of leprosy were observed macroscopically, but the diagnoses were complemented with biomolecular analyses in some cases. Based on the characteristic osteological signs of leprosy, the disease was

present in our ancient populations in the late Copper Age (3800-3500 BC). There is no evidence of leprosy in skeletons from earlier periods (Bronze and Iron Age, or the Roman Period). According to paleopathological data, the disease was present again after the Roman Period. It was most frequent in the 7th-9th and 10th-12th AD centuries. Some of these cases have been confirmed by biomolecular analysis. After the 13th-14th centuries leprosy is not present in skeletal remains in community cemeteries. This fact could be explained by the establishment of leprosaria and/or the decline of this infection. From this time leprosy individuals were isolated from the non-infected population. Contrary to this, according to the analysis of cemetery plans, no sign of segregation of infected people have been found prior to the 13th century AD.

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Hominoid cranial remains from the Vallès-Penedès Basin (NE Iberian Peninsula): Taxonomic and phylogenetic implications

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The hominoid cranial remains recovered from the Vallès-Penedès Basin during the last decade have revealed a higher diversity of Middle Miocene Dryopithecinae than previously recognized. Available material includes the maxillae of *Dryopithecus fontani* (IPS35026), the splanchnocranium of *Pierolapithecus catalunicus* (IPS21350) and the partial face and other maxillary remains of *Anoiapithecus brevirostris* (IPS43000, IPS35027 and IPS41712). Some authors have cast doubt on the taxonomic validity of *Pierolapithecus* and *Anoiapithecus*, suggesting that they might be synonymous with *Dryopithecus*. Here we review the external and internal morphology of the available cranial remains, to evaluate the taxonomic distinctiveness of each genus. Our results show that *Pierolapithecus* differs from the other two genera in the stronger midfacial projection, the more posteriorly located nasal apex, and the possession of a zygomatic recess of the maxillary sinus, and from *Anoiapithecus* also in the complete lack of frontal sinus (this condition cannot be assessed in *Dryopithecus*). In turn, *Anoiapithecus* differs from both *Pierolapithecus* and *Dryopithecus* in the more orthognathous face and the clearly visible lacrimal fossa in frontal view, and from *Dryopithecus* in the less laterally-oriented zygomatic and the shorter premaxilla (the latter two features not preserved in *Pierolapithecus*). Moreover, *Dryopithecus* is larger in cranial size than the other two genera, even when only males are compared. Overall, our results show that cranial

anatomy provides significant features enabling the differential diagnosis of the three Middle Miocene dryopithecine genera recorded at the Vallès-Penedès Basin.

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Inference of Neandertal quantitative gene expression profiles

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Inference about Neandertal phenotypes necessarily comes from fossil remains, endocasts, chemical dating, and archaeological evidence including settlement patterns, complex tool manufacture, and the creation of symbolic communications. The sequencing of multiple Neandertals has opened up the possibility of estimating Neandertal phenotypes based on the effect of "Neandertal alleles" present at low frequency in modern human populations. However, the relationship between these genetic and phenotypic differences is unknown. In an attempt to capture a portion of the functional effects of Neandertal variants, we consider whole genome sequence and mRNA expression profiles obtained using an Illumina Sentrix Human Whole Genome BeadChip microarray from lymphocytes drawn from 600 participants in the San Antonio Family Study (SAFS). A variance components-based association analysis was performed in SOLAR for each transcript against a panel of 56,294 SNVs monomorphic in the three Vindija Neandertal genomes, but polymorphic in the SAFS.

To contextualize these results, all associations significant at $p \leq 1 \times 10^{-5}$ were considered in a gene-set enrichment analysis of biological domains defined from the KEGG database. Enrichment was determined by an empirical p-value derived from comparing the test set of significantly associated mRNA transcripts to 1000 randomly selected sets of equal numbers of transcripts represented on the array. Using all Neandertal variants, we also estimate an expected Neandertal gene expression profile using best linear unbiased prediction. With these results and additional data which will become available as more Neandertal sequencing occurs, we can create an expected quantitative profile of the hypothetical transcriptome of our hominid relatives.

"I breastfed, therefore I am": Infant feeding characteristics and early supplementation practices among Tibetan mothers living in the Nubri Valley, Nepal

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Although the World Health organization recommends exclusive breastfeeding for six months, few mothers will achieve this goal. Research attention has focused on the factors that may lead to early supplementation or overall cessation of breastfeeding among mothers in the United States and Western Europe, much less research has focused on the use of early complimentary feeding in populations without access to infant formula. Here, we investigated breastfeeding practices, especially the use of supplemental foods, among a sample of 70 Tibetan mothers living in the Nubri Valley, Nepal.

The study was conducted in six villages in the Nubri Valley, with altitudes ranging from 7500-12,300ft. There is no access to infant formula or commercial baby foods in the villages, and no question that an infant will be breastfed. However, despite universal breastfeeding initiation, 35% of infants were given supplemental food by the third day of life, 65% by week 2, and 86% by the end of the first month. The first food given to infants was almost uniformly *aam*, a derivative of the Tibetan dietary staple *tsampa*.

Less than half of infants received breast milk on the first day of life. The most common reason women gave for not feeding was a lack of milk, although some reported it was toxic. Hospital deliveries had no impact on early feeding decisions, either the decision to breastfeed or to use *aam*. Social beliefs related to the use of *aam*, as well as ecological factors identified by mothers, appeared to drive early feeding practices.

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The environmental context of *Australopithecus anamensis*: Pedogenic carbonate stable isotopic evidence for vegetation structure and climatic conditions at Kanapoi, Kenya

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The origin of *Australopithecus anamensis* at ~4 Ma in the Turkana Basin represents the start of the *Australopithecus* clade and may signal adaptation within hominins to increasingly open habitats via habitual bipedalism and masticatory traits for a tough diet. Previous studies from Kanapoi suggested wooded and open

environments. Here we enlarge the stable isotopic database of pedogenic carbonates by sampling temporally and spatially and compare the environments of the fossil locality to those elsewhere in the Turkana Basin and at other Pliocene hominin localities in East Africa. Paleosols were sampled from 12 stratigraphic levels at 20 locations above, at, and below the main fossil localities at Kanapoi. Six of these sample locations were clustered near the main hominin-bearing sediments that produced the majority of the *A. anamensis* hypodigm. Forty-one analyses yielded mean $\delta^{13}\text{C}_{\text{VPDB}}$ values of -8.1‰, ranging from -11.2 to -5.3‰. Kanapoi $\delta^{13}\text{C}_{\text{VPDB}}$ values do not significantly differ from those of comparably aged paleosols (3.4-4.5 Ma) from Dikika, Gona, Laetoli, Koobi Fora, and Nachukui. $\delta^{13}\text{C}_{\text{VPDB}}$ values are significantly lower than those of Tugen Hills and Aramis indicating relatively more woody cover and less C_4 biomass than these sites. Kanapoi $\delta^{18}\text{O}_{\text{VPDB}}$ values are significantly higher than those of all other hominin sites except Tugen Hills and Koobi Fora. This may reflect regional variability in water source $\delta^{18}\text{O}_{\text{VPDB}}$ values and/or different climatic conditions. We also contextualize the recently published dietary isotopic values of *A. anamensis* from enamel and discuss the species' habitat preference and dietary selectivity within the reconstructed environment.

The Horn of Africa has a long and complex history of admixture

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The Horn of Africa (HOA) occupies a central place in our understanding of modern human origins. This region is the location of the earliest known modern human fossils, a possible source for the out-of-Africa migration, and one of the most genetically and linguistically diverse regions of the world. Numerous genetic studies over the last decades have identified substantial non-African ancestry in populations in this region, and the most recent population genomic work dates this admixture to approximately 3,000 years ago. However, there is mitochondrial, and Y chromosome evidence for contact with non-African populations well before 3,000 years ago and the archaeological, historical, and linguistic evidence are not supportive of a large influx of non-Africans into the HOA 3,000 years ago. In this work, we collect new genome-wide SNP data from a Yemeni population sample and re-analyze the HOA population genomic data to find that the genetic composition of non-African ancestry in the HOA is distinct from the genetic composition of current populations in North Africa and the Middle East. We demonstrate that most non-African ancestry in the HOA cannot be the result of admixture within the last few thousand years, and suggest that the majority of admixture probably occurred prior to the advent of agriculture. These results contribute to a growing body of work showing that prehistoric hunter-

gatherer populations were much more dynamic than usually assumed.

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Effects of aging and nutrition on bone microstructure and gait

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Behavioral patterns in extinct animals are often inferred from the morphology of bones, but little is known about the influence of age and nutrition, and specifically the contribution of these life history variables on both gait and anatomy. A murine model was used to test the effects of calorie restriction and age-related changes on gait patterns and bone strength. Ten male mice were allowed to feed *ad libitum* (AL) and seven were calorie-restricted to 60% of a normal diet (CR). Mice were video recorded while walking freely across a force platform. Temporal gait parameters, peak vertical ground reaction forces (GRFs), and loading rates were measured. Following the experiment, hind limbs of the 24 month-old mice were scanned using micro-CT. It was found that the AL mice had significantly heavier weight than the CR mice ($p = 0.01$). Independent of speed, peak forces in CR mice were 30% greater than the AL mice. In addition, CR mice had significantly higher bone volume at the knee joint, and higher bone mineral density in the tibia, while the AL mice had higher degrees of anisotropy ($p < 0.05$). Aging may reduce the overall health of bones but a diet reduced caloric volume may positively affect bone structural properties. This study has important clinical and paleontological implications and emphasizes the need for a wide range of information for references about bone material properties and function in current and past populations.

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Beyond Neandertal morphology: Alan Mann's impact on the studies of the Krapina Neandertals

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From the moment the first specimen of its kind was unearthed, Neandertals were described and perceived as creatures *different from us*. Innumerable studies, starting from the mid 19th century and extending to the present day studies, have been dedicated to numerating and naming Neandertal characteristics that prove their distinctiveness in relation to the morphology and behavior of recent human populations. However, taking into account and exploring the patterns of variation and patterns of growth and development in Neandertals and recent modern humans has been a crucial step in questioning the

degree and implications of Neandertal distinctiveness.

In his research, Alan Mann has made thoroughly broad, integrative inquiries in examining what lies beyond Neandertal morphology and mechanisms of their evolutionary trajectories. This paper presents a short review of Alan Mann's innovative approach in studying the Krapina fossil sample and explores the research trends Mann's work has set. Mann's research on the Krapina Neandertal collection was a significant contribution to the field, delving into the Neandertal pattern of growth and development, particularities of Neandertal trauma and pathology and exploring new methods in curatorial treatment and conservation of the specimens. Working with his many students and collaborators on the Krapina large fossil sample, Mann has made and initiated innovative approaches in studying the various details of Neandertal biology and behavior. Mann's impact on our knowledge of Neandertals and his innovative research methodology has inspired many future journeys into exploration of modern human ancestry.

Understanding the colonization of the North American Arctic: Phylogenetic analysis of Y chromosome lineages from Inupiat populations of the Alaskan North Slope

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Modern Inupiat-speaking populations of the North Slope are descended from the Neo-Eskimo Thule, who colonized North Alaska, Canada, and Greenland in a migration event approximately 800 YBP. The Genetics of the Alaskan North Slope (GeANS) project has sought to characterize genetic diversity in Inupiat populations of the North Slope in order to better understand the colonization of the Arctic.

Previous genetic studies of mitochondrial genomes from Inupiat populations suggests that there was considerable genetic exchange between villages on the North Slope, and that this region served as a staging ground for the Thule expansion further eastward. However, these results are derived from only maternal lineages; a more complete understanding of Inupiat population history also requires characterization of male-specific Y chromosome lineages.

Our previous investigations of STR diversity of Y chromosome lineages present in the North Slope populations showed considerable sex-biased admixture. This admixture likely resulted from historically documented contact with European whalers in the 19th century. Expanding upon this research, we excluded the admixed lineages and focused on the subset of North Slope Y lineages that show Native Alaskan ancestry. By typing a suite of informative SNP markers, we have been able to add to the current phylogeny of the pan-Arctic Y haplogroup Q. The combined SNP and STR data for the

Inupiat-specific Y lineages indicates that there was considerable pre-contact genetic diversity in this region. We present the results of this phylogenetic analysis and offer a new synthesis of Inupiat population prehistory based on mitochondrial and Y chromosome data.

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A molar microwear texture analysis of pitheciid primates

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Dental microwear texture analysis has been examined for a broad range of primates to assess its efficacy for reconstructing diets of fossil species. To date though, no dental microwear texture analysis has been published for pitheciids, despite variation in degree of sclerocarp and, by implication, the fracture properties of foods these platyrrhines eat. While all pitheciids eat hard seeds, *Chiropotes* has been documented to consume more than *Pithecia*, and *Pithecia* has been documented to consume more than *Callicebus*. Here we report results for a study of microwear textures on M² "Phase II" facets of *Ch. satanas* ($n = 11$), *P. irrorata* ($n = 8$), and *Ca. moloch* ($n = 13$) from the Brazilian Amazon (Oriximina, UHE Samuel, and Taperinha, respectively). These were examined using a Pli Neox scanning confocal profiler (Sensofar Corp.) with a 150x objective, lateral point spacing of 0.14 μm , and work envelope of 162 x 121 μm . Results indicate that despite small samples, different sites, and varying seasons of collection, there are differences in microwear texture complexity and anisotropy between species; and these differences are as expected given reported variation in diet. For example, *Chiropotes* has the highest average of and greatest variance in complexity of the three species examined. In contrast, *Callicebus* has the highest variance in anisotropy, and higher average anisotropy than *Chiropotes*. These results confirm that dental microwear texture analysis reflects differences in the feeding behaviors of pitheciids in the Amazon Basin, and that it holds potential for diet reconstruction in fossil primates.

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Histomorphology of endosteal lamellar pocket: Comparison of the second metacarpal in two genetically distinct populations

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Bone modeling, by constantly removing and adding bone, is an essential process for the control of bone architecture during growth. However, at the microscopic level, bone modeling and more particularly modeling drift, is poorly understood. This study focuses on the presence of the endosteal lamellar pocket (ELP),

a possible indicator of modeling drift, in the second metacarpal to document whether its presence varies with age, sex, or populations. Our sample consists of histological slides of adult 19th century Eurocanadian settlers (EC) ($n=48$, 15 females, 33 males) and adult proto-historic Sadlermiut Inuit from Southampton Island, Central Canadian Arctic ($n=26$, 12 females, 14 males). For each sample, the relative area (RA) of ELP was measured and its orientation in the bone was calculated as a weighted mean angle of the ELP distribution (OR). No correlation was found between age and RA, which suggest that the ELP is not removed by endosteal expansion. When present, the ELP represents about 12.5% of the cross-sectional area and it is located in the posteromedial quadrant. However, Inuit have significantly smaller RA when compared to EC, a morphology particularly marked in the Inuit males. This suggests that their metacarpals are less prone to modeling drift. Further more, OR is significantly different in Inuit females, where it is oriented more anteromedially compared to Inuit males or in the EC sample, which suggest that their manipulatory activities cause drift to occur in a more posterior direction than in the other groups.

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An ontogenetic framework linking locomotion and trabecular bone architecture with applications for reconstructing hominin life history

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The ontogeny of bipedal walking is considered uniquely challenging, due in part to the balance requirements of single limb support. Thus, locomotor development in humans and our bipedal ancestors may track developmental milestones including the maturation of the neuromuscular control system. Here, we examined the ontogeny of locomotor mechanics in children aged 1-8, and bone growth and development in an age-matched skeletal sample to identify bony markers of neuromuscular control. We show that step-to-step variation in medio-lateral tibia angle relative to the vertical decreases significantly with age, an indication that older children increase stability as their neuromuscular control system matures. Analyses of trabecular bone architecture in the distal tibia of an age-matched skeletal sample (the Norris Farms #36 archaeological skeletal collection) show a bony signal of this shift in locomotor stability. Using a grid of eleven cubic VOIs in the distal metaphysis of each tibia, we show that the degree of anisotropy (DA) of trabecular struts changes with age. Intra-individual variation in DA across these VOIs is generally high at young

ages, likely reflecting variation in loading due to kinematic instability. With increasing age, mean DA converges on higher values and becomes less variable across the distal tibia. We believe the ontogeny of distal tibia trabecular architecture reflects the development of locomotor stability in bipeds. We discuss the possibility that this novel bony marker of development may be used to assess the relationship between locomotor development and other life history milestones in fossil hominins.

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The importance of documentary evidence in understanding demographic patterns at the Erie County Poorhouse (1851-1926)

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The second Erie County Poorhouse complex operated on Main Street in Buffalo, New York from 1851-1926. When skeletal remains were recovered on the south campus of the University at Buffalo (the former site of the Poorhouse) in 2012, a research effort was undertaken to document the history of the institution and the demographic profiles of the poor who were received there.

A wealth of documentary evidence was identified and analyzed. Sources included State, County and City records, institutional reports, newspaper clippings, maps, photographs, and diaries. Out of this research emerged the story of a complex and evolving institution. Over the course of its history, the facility served the poor of Erie County and New York State in several capacities – as an almshouse, as an insane asylum, and as a hospital with maternity and consumptive wards. Poorhouse administrative policies and conditions reflected several important factors: changing social policy and medical knowledge; the passage of anatomy laws; the influence of individual Keepers and Physicians of the Poorhouse; and the increasing demands of a growing county population.

During the property's seventy-five year history, County administrators reported that more than 171,000 individuals received care on the grounds with more than 11,000 deaths occurring at the institution. The project's documentary evidence provides specific historical context and essential demographic data about the population at the Erie County Poorhouse. This information has an important supporting role to play in the understanding and interpretation of the skeletal collection.

Hominin craniodental evolution and autonomy of mandible and tooth morphogenesis

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Studying the evolutionary trend among fossil hominins towards gracile jaws and smaller postcanine teeth is important to understand the ecological, physiological and socio-cultural factors that have helped sculpt human craniodental morphology. Explaining at the

genetic level how change in tooth size and jaw robusticity can occur will help to structure plausible explanations of why this change happened. The core question is what impact do the jawbone and teeth have on each other's development and, consequently, evolution? Here we test the hypothesis of developmental independence between the mandible and lower dentition by experimentally removing the dentition as a variable using a toothless mouse model that lacks both alleles of the p63 gene. We executed comparative analyses of mandible morphology and developmental genetics between toothed (p63^{+/+}; p63^{+/-}) and toothless (p63^{-/-}) mice aged embryonic days 10-13 and 18. A 3D geometric morphometric analysis found that mandible shape was abnormal in toothless mice only in that there was less alveolar bone and a developmental delay of one to two days compared to dentate littermates. Microarray and Q-PCR analyses showed that expression levels and protein products of a subset of genes were significantly perturbed in toothless mice compared to littermates with normal tooth morphogenesis. These results support substantial developmental independence and putative evolutionary autonomy between tooth and jaw tissues, implying that as-yet-unknown developmental mechanisms coordinate their morphogenesis such that they are functionally integrated across a range of phenotypes. Ultimately, rigorous selection for optimal function likely ensured the coordinated evolution of hominin teeth and jaws.

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The gape of *Homo neanderthalensis*

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We argue that much of the uniqueness of the Neandertal mandible is linked to its ability to produce a relatively large gape. That is, some of the Neandertal's morphological modifications contribute to the large gape, and some are necessitated by it. Changes producing a large gape include the mandibular condyle's descent to a position closer to the occlusal plane than in the generalized mandible; the dental arcades' forward migration in relation to the ramus and mental foramen; the arcades' shortening at the expense of their posterior end; and the increased use of the anterior teeth (as deduced from both their absolute and relative size)--the site of the largest distance between the upper and lower dental arcades. Except for the latter, all these morphologies are quantified, and the modifications in Neandertals are shown to be statistically significant in comparison with other hominids.

The descent of the condyle also carries it forward (because of the generalized condylar neck's oblique orientation). As a result, the condyle's junction with the mandibular notch's crest lies approximately at the midpoint of the condylar width in Neandertals, whereas in the generalized mandible, the crest merges with the

condyle's lateral pole. The dental arcade's forward migration and shortening in Neandertals produce the typical retromolar space. In our view, the changes in the shape of the coronoid process and the presence of the medial pterygoid tubercle and lateral subcondylar spine are all necessitated by the large gape. Why Neandertals need such a large gape is still an enigma.

The effects of resource availability on the diet and activity budget of female Spider Monkeys (*Ateles geoffroyi*) on Barro Colorado Island (BCI), Panama

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Spider monkeys are often described as "ripe fruit specialists," and at all sites where longitudinal data have been collected, ripe fruit has been shown to constitute the bulk of their diet. Accordingly, we would expect that spider monkeys would adjust their activity to accommodate seasonal fruiting patterns.

We investigated the relationship between activity budget and fruit availability in 8 female spider monkeys living in a single stable social group on BCI, Panama. Behavioral data were collected by conducting full-day (6AM – 6PM) focal follows using instantaneous sampling at 3-minute intervals from September 2010 – August 2011. During all feeding bouts we recorded plant part and species. Data on fruit availability, using fruit-fall traps, were obtained from the STRI's 200 Trap Plant Phenology Project.

On average females spent 21% of time feeding (range: 9-24%), 58% resting (range: 52-76%), 18% traveling (range: 13-28%) and 2% in other activity (range: 0-7%). We found a significant correlation between fruit availability and time-spent feeding ($r(8) = -0.76$, $p < 0.01$) and resting ($r(8) = 0.68$, $p < 0.02$). There were no significant relationships between food type in the diet and fruit abundance. Spider monkeys consistently fed on high amounts of fruit (82%) independent of season and fruit availability.

Our findings suggest that the availability of fruit plays a significant role in shaping spider monkey activity budgets and are consistent with prior research showing that spider monkeys are able to maintain high amounts of fruit in the diet even in the face of fluctuating fruit supply.

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Decorative dental drilling techniques among the Prehispanic Classic Mayas

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This poster explores the effects of ancient Maya dental drilling to the health status of teeth, and concretely the extent to which enamel and dentine penetration, cementation, and inlaying led to infectious decay and pulpal reaction. For the purposes of this study, we analyzed forty anterior teeth presenting inlays from individuals recovered at the Classic period (AD 250-700) site of Xcambó, in the northern coast of the Yucatan peninsula. More than 50% of the inlays were still firmly inserted in the enamel. Macroscopic and radiographic analyses scored the anatomical depth of the drilling, whether limited to the dentin, or reaching the pulpal chamber. Dentine reaction was correlated to the depth of perforation. Infectious cavitation was recorded as present when it appeared around the edges of the perforation. Deposition of secondary dentin increases in relation to the depth of the perforation, indicating lack of pulp necrosis also in cases of anatomical approximation. Only in one case did perforation reach the pulpal chamber. Only few cases of marginal carious lesions were encountered, and no caries were detected beneath the inlay. No noticeable increase in caries frequencies is apparent when the drilled series is confronted with a control sample of undrilled anterior teeth. We conclude that experienced practitioners performed drillings and were able to limit the damage to the teeth, sealing the cavity quite successfully to prevent the attack of external pathogens and thereby preserving the dental piece from post-traumatic necrosis

Demonstration of an image-based interpolation method for elastic constants in the human dentate mandible

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Elastic constants that relate stresses to strains are required for structural finite element (FE) analyses of skeletal tissue. These constants must be determined experimentally. The number required for a given analysis (from 2 to 21) depends on the degree of bone tissue symmetry. Irrespective of the spatial resolution of experimental methods, some bone is lost to specimen preparation: constants in some regions must be estimated or interpolated for input into FE models. We present a method for interpolating values between locations with known constants that preserves assumptions of bone least symmetry. This approach avoids the risk that naive interpolation methods incur: an improper set of elastic constants that result from independent interpolation of single elastic constants. We augmented our method by incorporating imaging information. The spatial resolution achieved when experimentally determining constants is often less than that offered by imaging techniques such as computed tomographic scanning, the output of which, radiographic density, is related to bone composition and, ultimately, bone elasticity. We take advantage of the full-field scope of radiographic imaging as follows: if skeletal elements are imaged prior to their destruction

during the course of elastic property determination, radiographic densities can be used as "distances" (versus simple Euclidean distances) to interpolate constants between locations with known constants and density. This permits a finer resolution mapping of elastic properties of bone that is based on its intrinsic composition. We demonstrate our method using data from human dentate mandibles (*AJPA* 120:252-277) and illustrate cases for which naive interpolation methods fail.

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Population dynamics and evidence of polyestry in gray brown mouse lemurs, *Microcebus griseorufus*, in stressful habitats at Beza Mahafaly, SW Madagascar

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The goal of this study was to document the population dynamics and reproductive activity of gray brown mouse lemurs, *Microcebus griseorufus*, at Beza Mahafaly. We captured 435 individuals within a seven-year extended study period. The capture rate was low and population turnover high; very few individuals captured in the previous year were recaptured in the following year. Capture success rates also declined from 2003 to 2007. By analyzing the intervals between first and last captures, we estimated the life span of mouse lemurs at Beza Mahafaly. The longest interval was 1428 days. Fewer than one percent of individuals were observed to be alive over periods of four consecutive years.

Female reproductive status was determined by examining vaginal swelling and opening, nipple development, weight gain, and direct evidence of pregnancy (by palpating captured individuals). Reproduction begins at one year. Within a reproductive season, some *M. griseorufus* exhibit two reproductive cycles, the first from September to November and the second from February to April. This comprises direct evidence of polyestry, but indirect evidence of polyestry also occurs at Beza. Morphometric data of captured immature individuals and mouse lemur skeletons collected from owl pellets at Beza show the existence of young infants in December/January and in May/June.

These data suggest that *M. griseorufus* in stressful habitats are able to reproduce rapidly and repeatedly during a reproductive season in order to meet the challenge of apparently high mortality affecting both infants and adults.

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Morphoscopic trait frequencies of Southeast Asians and Pacific Islanders

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When assessing ancestry in a forensic context, individuals are generally classified into one of four categories: belonging to European, African, Asian, or Native American ancestry. With only these four ancestry assessments, individuals from Southeast Asia and the Pacific Islands are usually phenotypically classified as Asian. While the oceanic regions of Southeast Asia and the Pacific Islands will most likely have trait frequencies similar to those of mainland Asia because of their shared ancestral lineages, there is still a great deal of variability in this region with genetic drift being an important factor. To address the variability within these regions, data were taken using Osteoware on seventeen morphoscopic traits. Skeletal specimens include those (n=136) from the Smithsonian National Museum of Natural History and from the University of Pennsylvania Museum of Archaeology and Anthropology (n=30), for a total of n=166. Populations collected include individuals from Island Southeast Asia, Micronesia, Melanesia, and Polynesia. More variability was observed between the data collected and the mainland Asian data than expected. When compared to known African, American Indian, European, and Asian trait frequencies, the individuals collected fall most closely with the Asian grouping for most traits while also falling closely with the African grouping on a few traits. When comparing those collected to the mainland Asian groupings, chi-square values at the 0.05 level show significance between groups for 7 of the traits. Three of the traits show evidence for a clinal pattern of frequency reaching from mainland Asia to Southeast Asia and further to the Pacific Islands.

The use of pressure-sensing technology in the study of primate arboreality

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In the study of primate locomotion, there are many hypotheses regarding arboreal grasping and autopodal biomechanics that have yet to be addressed experimentally. In the present experimental study, pressure-sensing technology previously applied to questions of terrestrial locomotion is used to address an outstanding question about arboreal locomotion. For instance, in above-branch locomotion, the force of gravity combined with the animal's mass directed normal to the substrate should result in larger animals exerting proportionally greater autopodal pressures on substrates of equal size, such that autopodal pressures are predicted to be positively correlated with body mass. Here, pressure-sensing technology is used in an arboreal setting to test this hypothesis in three species of different-sized lemurs (*Lemur catta*, *Varecia variegata rubra*, *Propithecus coquereli*). Using a pressure-sensing seat pad (Sensor Products Inc.), pressure data were recorded from the right hand and foot from 12 adults (4 per species) as they crossed an artificial substrate during above-branch locomotion. Absolute and average maximum pressures were recorded (kPa). Pressures, autopodal size (cm²) and

masses(kg) were logged and interspecific RMA regressions were performed ($p < 0.05$). Absolute maximum pressures were positively correlated with body mass in both autopods (isometrically). Average maximum pressures were not significantly correlated with body mass in either autopod. Positive allometry of autopodal size versus body mass was found for only the hand. These findings demonstrate that, while grasping pressure during a similar arboreal behavior does not vary with size, larger-bodied lemurs may exert greater frictional forces during arboreal grasping via the presence of disproportionately larger hands.

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Population demography of native ring-tailed and introduced brown lemurs at Berenty reserve

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Population demography of ring-tailed and brown lemurs from Berenty reserve, from 2005 to 2013, are reported in this paper. Population data were recorded using a complete and direct census of all troops of ring-tailed and brown lemurs within the reserve. Group size, birth rate, sex ratio and juvenile recruitments were analyzed per species and per habitat. Brown lemur population in Malaza forest increased till 2006. The population started decreasing in 2007 when water provisioning in the forest was stopped. This decrease was considerable in scrub. Fluctuations have been seen in ring-tailed population though it was described as stable. The density of ring-tailed lemurs increased then remained stable. The presence or absence of water provisioning did not affect the growth or the decrease of this population in different habitats. In gallery habitat, brown lemurs had larger groups compared to ring-tailed. Nevertheless, this high density of brown lemurs did not affect the groups of ring-tailed lemurs which remained stable. There was a significant higher recruitment in brown lemurs compared to ring-tailed lemurs. Ring-tailed lemur distribution had moved into the periphery of the reserve and the scrubby places where their density became higher with a stable group size. Since 2007, the distribution of both species changed. Ring-tailed lemurs were then displaced into the marginal habitat and the very scrubby places however, brown lemurs occupied the closed canopy forest in Berenty reserve. This separation may affect the long-term viability of the closed canopy forest and the ring-tailed population.

Vocal recognition in ring-tailed lemurs

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Primates live in complex social groups, whose members form strong social bonds and compete with individuals in neighboring groups. These patterns may have fostered the evolution of cognitive abilities like individual recognition. Ring-tailed lemurs form large groups similar to those of Old World Monkeys. When alone, individuals produce contact calls. Spectrographic analyses indicate that these calls are individually distinct acoustically, but it remains unclear whether lemurs recognize calls produced by groupmates and neighboring conspecifics. In this study we examined whether ring-tailed lemurs living in two social groups at the Duke Lemur Center produced differential responses to playbacks of contact calls given by juvenile and adult females belonging to the same and different group. Lemurs distinguished between ingroup and outgroup callers, emitting more calls in response to ingroup juveniles than to outgroup juveniles. In one social group, this pattern was also displayed when lemurs heard ingroup and outgroup adults. In the other social group, most subjects failed to respond to playbacks of an ingroup adult conspecific. In general, lemurs were quicker to call and gave more calls when they heard playbacks of juveniles than when they heard playbacks of adults. The observed variation in responsiveness between groups may reflect differing social relationships between individuals. That lemurs responded at all to outgroup calls is intriguing, implying that contact calls may serve functions other than within-group cohesion and that ring-tailed lemurs are not xenophobic.

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Utilizing high impact educational practices to establish a new course in Biological Anthropology at the two-year college level

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An important element to establishing a new course at a two-year institution is to understand what works best in the classroom for student engagement and persistence. To examine the effectiveness of the creation and integration of specific high impact practices (HIPs) in the classroom we compared a standard lecture-based class in anthropology to one where students were part of a tailored educational plan that included common intellectual experiences, project-based learning module techniques, and reflection essays. The principle question addressed was: What are the effects of these HIPs on measures of student success and persistence. We used a mixed methods strategy that included both quantitative analyses of course grades, overall GPA, and persistence, and qualitative measures collected from focus group reports. Persistence rates into the following semester showed positive results compared to the lecture format class. Overall, students reacted positively to the tailored program with increased classroom engagement, increased content knowledge, and

perceived increase in critical and creative thinking skills, as well as, overall academic confidence levels. Based on the positive results of these techniques our next phase took these HIPS into a newly established biological anthropology course to garner institutional support and positive student feedback. Course designed included project-based group work, field trips to archaeological sites, reflective essays, and a touch-a-brain project. Preliminary results support the inclusion of high-impact practices into the course design to help generate excitement and help establish the course both institutionally, and as viewed from the student perspective.

African vegetation structure: Modern analogs and hominin habitat reconstructions

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Hominin habitats are often uninformative and said to be either savanna-like or mosaic, consisting of several vegetation structures. Whether using fauna, pollen, isotopes, or woody-cover methods to reconstruct habitats, these descriptions are actually somewhat accurate since savanna habitats encompass many vegetation structures from closed woodlands through open grasslands. Paleoenvironmental evidence often suffers from spatial averaging, and fossil collection areas are combined across kilometers to arrive at a single mosaic habitat reconstruction for a specific time period, e.g., Hadar Denen Dora 2 or Makapansgat Member 3.

We hypothesized that as spatial area decreases, vegetation structure become less mosaic and landscape depictions can be predicted more accurately. We analyzed modern savanna game reserves and national parks from eastern and southern Africa to understand the relationship between large mammalian fauna, overall area, and number and km² of each vegetation type within them. We then reconstructed habitats using large mammals from small collection regions across larger spatial areas from tephra-based time units at two fossil localities, Hadar, Kada Hadar 2 and Ledi-Geraru, Lee Adoyta. We used Mantel tests and canonical correspondence analyses to examine relationships between our variables. Results for extant habitats suggest that single habitat types are more frequent at small spatial scales and habitat heterogeneity increases with larger spatial scales. Smaller spatial scales for the fossil localities sometimes gives a better representation of the habitat from which the mammals derived, but, likely due to other taphonomic processes such as time averaging and distinctive depositional modes, vegetation structure reconstructions tend to be mosaic.

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Pelvic sexual dimorphism in the hominin fossil record

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Hominin fossil pelvic material is traditionally assigned sex based on modern human dimorphic traits. The human pelvis has been shown to be qualitatively and quantitatively dimorphic in a number of features, including ischial spines, sciatic notch, obturator foramen, acetabulum, sacrum, pelvic inlet shape, and iliac dimensions. Many of these traits are thought to be sexually diagnostic due to modern obstetric demands. Non-human primates do not have the same obstetric demands as modern humans, and do not follow the same patterns of pelvic dimorphism. This study examines whether sexually diagnostic non-human primate traits are also diagnostic in human ancestors prior to the hypothesized advent of modern obstetric demands.

We compiled a list of published sexually diagnostic features on both human and non-human primate pelvic morphology. We examined these features on available pelvises from the hominin fossil record. Data were collected from fossil casts representing multiple species of *Australopithecus* and early and late Pleistocene *Homo*. The sex standard used to test the accuracy of potentially diagnostic features is in concordance with previously published sex assignments for fossil specimens.

Using discriminant function analyses, modern human diagnostic features successfully differentiated fossil pelvises; non-human primate diagnostic features did not successfully differentiate fossil specimens. These results show that modern human dimorphic traits are strong indicators of sex in hominin fossils, but non-human primate traits are not. This suggests that human pelvic sexual dimorphism patterns began to evolve even before the advent of modern obstetric demands, perhaps related to birthing relatively large-bodied infants in the hominin lineage.

Cross-sectional geometric properties of adult upper and lower limb bones: Adding strength to the argument of being big-boned

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Long bone diaphyses are known to respond to mechanical loading in life by adding and/or redistributing bone to withstand the strains encountered. Differences in size, shape, and strength properties of bones from skeletal samples with associated vital statistics can provide perspectives on body size, behavior, nutrition, environmental factors, and their impact on the skeleton. This study examines systemic effects of obesity on cortical bone strength in the upper and lower limb bones using cross-sectional geometric properties obtained through CT scans.

High-resolution CT scans were taken of 110 individuals (70 males, 40 females) of known age, height, and weight-at-death from the William M. Bass Donated Skeletal Collection at The University of Tennessee. Cross-sectional geometric properties were measured at five locations (80, 65, 50, 35, and 20 percent, respectively, of maximum bone lengths) along the diaphyses of the humerus, radius, femur, tibia, and fibula. Males and females were examined separately, and individuals were grouped by BMI category, normal (BMI 18.5-

24.9) and obese (30+ BMI). Cross-sectional properties analyzed include cortical area, total area, second moments of area, and section moduli. Results indicate obese individuals demonstrate larger measures of cortical bone strength properties in cases in which there are significant differences between groups. Additionally, males and females differ greatly in the patterning of significant upper-versus-lower limb strength properties. The observed differences in cross-sectional geometry between obese and normal individuals may be a step towards revealing the relative influence of obesity-related mechanical changes and other factors, such as metabolism, on the skeleton.

Long-term research without long-term funding: Studying white-handed gibbons at Khao Yai National Park, Thailand

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After 20 years of painstaking data collection, we published the first comprehensive paper on the life history of Khao Yai's wild white-handed gibbon population. Research over the last two decades was underfunded with significant support being limited to a few "prosperous" years of external funding. Nonetheless, it was these prosperous years at the beginning of the new millennium which became the foundation for the ongoing *Khao Yai White-Handed Gibbon Long-term Research Project*. The formula for success was simple: more resources meant more manpower in the field to physically expand the study site, create an up-to-date trail grid system, and habituate more individuals. The project grew from the typical 1-3 study groups to the current 15 social unit sample. Life-history research of mammals characterized by complex social organizations and slow or delayed maturation is tedious. However, it is critically important to gather fundamental life-history data in order to reliably address questions regarding species' evolutionary trajectories. Based on our ongoing research at Khao Yai, we learned that white-handed gibbon females usually do not reproduce before the age of 10, that both sexes often disperse onto a neighboring home range, and that white-handed gibbons have an unusually long juvenile period of nearly 9.5 years. However, we still do not know their life expectancy or the average life-time reproductive success of either sex. Our long-term study has proved critical to understanding long-lived animals in their natural environment, and would only benefit from private and public grant money.

Exploring the relationship between cross-sectional properties and external shape of the femur

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External traits and cross-sectional properties of the femur have both been studied as potential indicators of limb use and positional behavior. Investigating the relationship between external femoral shape and cross-sectional properties can enhance our understanding of how these variables should be interpreted when examining them in the primate fossil record. The objectives of this study were to explore variation in femoral external shape and cross-sectional geometry and examine how these features correlate. We collected 25 three-dimensional landmark coordinates on the proximal and distal portions of the femur in *Cercopithecus* and *Papio*. Using geometric morphometric techniques and principal component analysis, we explored external shape variation across our sample. The principal component scores were employed as external shape variables in subsequent analyses with cross-sectional properties. Using computed tomography scans, we measured cross-sectional properties of the femoral midshaft, including diaphyseal shape, and examined the correspondence between cross-sectional and external shape variables. Mean diaphyseal shape did not differ between *Papio* and *Cercopithecus*, but this variable did correlate with the orientation of the femoral head across our sample. We also found weaker correlations between femoral head orientation and several other cross-sectional properties. It is unclear how these correlated traits are potentially influenced by limb use since we did not find differences between the highly arboreal *Cercopithecus* and highly terrestrial *Papio*. The relationship between femoral head orientation and cross-sectional properties needs to be examined further, and we plan to explore these variables in a broader taxonomic sample characterized by greater locomotor diversity.

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Discrimination between unwilling and unable helpers by capuchin monkeys (*Cebus apella*)

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Social animals can choose partners in cooperative interactions. In humans, this partner choice often relies on understanding others' intentions. Recognizing which partners have helpful intentions allows us to choose useful partners because, in addition to experiencing the outcome of another's actions, we understand the purpose behind their actions and discriminate between individuals on the basis of their likelihood of being helpful in future interactions. Experimental evidence suggests that chimpanzees and capuchins have some understanding of others' intentions, and distinguish between partners who are willing, but unable to help, and partners who are unable, but willing, to help. This study examined whether capuchins (*Cebus apella*) could differentiate between unwilling and unable experimenters in a cooperative task that required them to choose a partner. Capuchins were first trained to retrieve a reward with the help of an experimenter using a

transportable tray. Next subjects were introduced to two potential cooperators: one experimenter who tried to help them, but was unable to deliver a reward because of a faulty device (willing/unable), and another who had access to a functioning device but was unwilling to help the subject obtain a reward (unwilling/able). In the test phase, subjects could choose between these two experimenters for help on a different cooperative task. Subjects ($n = 9$) did not discriminate between the willing/unable and able/unwilling experimenters in this task. This suggests that capuchins may have difficulty with recognizing or remembering intentions in these contexts or with transferring their knowledge of others' intentions to new contexts.

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Political ecology of the "Golden Liberty": Elite diet in the Polish-Lithuanian commonwealth (16-18th c. AD)

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Diet reconstructions through stable isotope analysis play a key role in political ecology, highlighting dietary differentiation and diet change through time. During the 16-18th c. AD, Poland and Lithuania were united into one of the largest political entities to have existed in Europe: the Polish-Lithuanian Commonwealth, or Rzeczpospolita Obojga Narodów (Republic of Two Nations). The Commonwealth possessed sociopolitical characteristics unique for that time, including legally enforced religious tolerance, a multiethnic population, and extreme checks on the monarch's power by the nobility (the *szlachta*), who enjoyed unparalleled freedoms and rights, and comprised c.a. 10% of the population. This "Golden Liberty" blended oligarchy and democracy at a time when the rest of Europe saw increased centralization and development of absolute monarchies.

Given these unusual characteristics, the Polish-Lithuanian Commonwealth offers unique comparative opportunities to explore relationships between sociopolitical organization and human diet. We apply stable carbon and nitrogen isotope analysis to reconstruct diets of 51 nobles, including bishops and individuals of known identity, from 8 churches within the Commonwealth.

Collagen data indicate a diet including plant, animal and fish protein ($\delta^{13}\text{C}$: $-19.81 \pm 0.48\%$; $\delta^{15}\text{N}$: $12.1 \pm 1.35\%$). This stands in contrast to data for the Polish peasantry during the earlier medieval period (12-14th c.), whose diets did not include fish in appreciable amounts ($\delta^{13}\text{C}$: $-19.80 \pm 0.50\%$; $\delta^{15}\text{N}$: $6.6 \pm 1.1\%$; $n=96$). Stable isotope values differ significantly between the elite subsample from Poland and that from Lithuania (Kruskal-Wallis, $P < 0.001$), with the Polish elites evidently consuming more fish. We discuss these results in light of the local environment and social climate.

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Measuring mitochondrial DNA diversity and demographic patterns of tribal and caste populations from the Northeast Indian State of Assam

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The Northeast Indian state of Assam has been under-represented in studies of Indian mitochondrial (mtDNA) diversity. To address this gap, sequence data from the HVR-1 and HVR-2 regions and select diagnostic mutations were used to characterize patterns of intra- and inter-population diversity in 205 individuals from tribal (Ahom, Sonowal Kachari, and Rabha) and caste (Assamese) populations of the region. Similar to reports by other studies conducted in India and Southeast Asia, an AMOVA result of 97% variation observed within Assam's populations demonstrated the heterogeneity of the region. Results indicate that the people of Assam predominantly express autochthonous Indian haplogroups: M, M2, M3, M4, M5, M6, R, R5 (52.5%), but also express a higher degree of East Asian markers: A, F, D, M7, M8, M9, and B (24.0%), due to their close proximity to South China and Southeast Asia. A general lack of Northern Chinese, Tai, and Indo-European ancestral markers, however, indicates that many of the population migrations to Assam were male specific; the ethnically Tai Ahom in particular reflect next to no Southeast Asian specific haplotypes (7.7%), indicative of their 13th century male specific migration. Haplogroup affiliation was more closely associated with geographical location rather than ethnolinguistic heritage. Principal component analysis showed distinct clustering with other Indian caste and tribal populations. This study also identified two novel haplogroups: one subhaplogroup was found within macrohaplogroup M, the other in haplogroup R. Both novel haplogroups were discovered in the Rabha, an ethnically Tibeto-Burmese tribe hailing from Lower Assam.

Dental microwear texture analysis of the people of Herculaneum

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The seaside town of Herculaneum was buried by the AD 79 eruption of Mt. Vesuvius in a manner that preserved hundreds of humans and copious subsistence remains that represent Roman life at a single moment in time. From loaves of bread to seeds from varied wild and domestic plants, Herculaneum's subsistence points to dozens of plant foods being consumed.

As such, we determined that Herculaneum would be a good test site for the DENTALWEAR project, a global survey of human dental microwear texture analysis (DMTA). Fifty-eight people from Herculaneum had lower M1s or M2s suitable for this study, which followed standard methods regarding molding, casting, and data collection (using a white light confocal profiler and scale sensitive fractal analysis software). Despite Herculaneum's anticipated evidence for fishing, the array of hard foods (e.g., nuts seeds, etc.) led us to posit that the DMTA complexity and anisotropy values would approximate that of Bronze Age farmers (roughly 1.2 to 1.5 for complexity and .0030 and .0035 for anisotropy) rather than coastal fishers. The Herculaneum values were 1.46 and .0033; the texture data matched our prediction and contribute to the efficacy of human DMTA.

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Evo-devo sheds light on mechanisms of human evolution and parallelism in hominoids

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African apes have served as primary models for the *Pan-Homo* last common ancestor due to their close phylogenetic relationships. However, recent comparative and fossil evidence suggests the existence of substantial homoplasy during the hominoid radiation. One of evo-devo's strengths is identifying genetic and developmental mechanisms underlying evolutionary change. Thus, consideration of the role these mechanisms have played in other adaptive radiations can be crucial to understanding hominoid evolution. Homoplasy is common in the radiations of stickleback fish, anole lizards, and fruit flies. In addition, the independent evolution of similar phenotypes commonly involves the reuse of a narrow set of genes and developmental pathways. A survey of these studies indicates that parallelism results from genetic and developmental biases such as the topology of gene regulatory networks, co-option of regulatory modules, and shared standing genetic variation. In addition, results from our lab and others demonstrate that similar mechanisms observed in other species are also crucial for the evolution of the human phenotype. Preexisting mammalian regulatory architecture in the form of Hox's role in determining skeletal growth and vertebral segment identity and the identification of individual genetic enhancers modulating rib curvature, shows that key hominoid features such as elongated forelimbs, shortened lumbar spine, and broadened thorax can be highly evolvable. These results indicate that despite involving appreciable homoplasy, such models proposing parallel evolution in hominoids can be substantially more likely when considered within larger developmental, ecological, and paleontological contexts.

The crania of African origin in the Samuel G. Morton Collection: Investigating aspects of health in two historical samples

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During the mid-19th century, Philadelphia physician Samuel G. Morton collected crania from populations all over the world, amassing the largest collection of its kind at the time. Morton's contributions and legacy in physical anthropology have recently received renewed research attention. However, few studies have focused upon the context of each specific geographic sample. In this study, 66 crania representing individuals from two different historical contexts in Africa are analyzed for markers of physiological stress, dental health, and trauma in order to help illuminate the health, lifeways and identities of the individuals represented.

In a group of crania shipped to Morton from Havana, Cuba, described as enslaved Africans who died shortly after their arrival to the New World (n=51), a relatively low frequency of enamel defects (6%), porotic hyperostosis of the vault (9.8%), and caries (6.2% of teeth) was found. This group shows a higher frequency of orbital porosity (60.8%) but with mild severity. Four individuals show evidence for cranial trauma (7.8%). In another group of crania sent to Morton from several settlements in Liberia (n=15) a number of pathologies associated with violent trauma are observed, as well as high frequencies of alveolar erosion and antemortem tooth loss.

These results suggest that the presumably African born individuals from Cuba experienced minimal childhood physiological stress and demonstrate good dental health. This study contributes to what little is known about the skeletal health of historical African populations and deepens our understanding of a significant anthropological collection.

Reorganization of cerebral cortical layers in primates compared to other mammals

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Cortical layers of the cerebral cortex are characterized by distinct cell types and connections with other brain regions. Reorganization of neurons among cortical layers across phylogeny can indicate evolutionary changes in the function and connectivity of cortical circuits. This study investigated frontal and occipital cortices across nine mammalian orders (124 species) using the percentage of total cortical thickness occupied by layer 1, layers 2/3 (supragranular), layer 4 (granular), and layers 5/6 (infragranular). Phylogenetic order has a significant effect on relative layer thickness

($p < 0.001$). Relative layer thickness significantly differs among several orders, showing a clear differentiation between orders that have a granular layer (primates, tree shrews, carnivores) and those that do not (bats, insectivores, cetaceans, even-toed ungulates), and also between rodents and the other orders (adjusted $p < 0.05$). In both regions, orders without a granular layer have increased relative layer 1 thickness. In the frontal cortex, primates have relatively thick frontal supragranular layers, whereas rodents have a different cortical layering pattern of smaller supragranular and enlarged infragranular layers. In the occipital cortex, primates and tree shrews share reduced infragranular layers; however, primates have an expanded granular layer, while tree shrews have larger supragranular layers. The granular layer receives sensory input from the thalamus, which suggests it may be enlarged in primates in response to increased reliance on vision. Rodents, tree shrews, and primates appear derived relative to other mammalian orders based on relative cortical thickness patterns.

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Ancient DNA from the Schild site in Illinois: Implications for the Mississippian transition in the Lower Illinois River Valley

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Archaeologists have long debated whether the sudden cultural change that took place between the Late Woodland and Mississippian periods in central North America was due to *in situ* development or the migration of a new group into the region. This change was characterized by the rise of intensive maize agriculture, shifts in technology and pottery style, and increased population aggregation. In this study, we tested these competing explanations for culture change in the Lower Illinois River Valley using ancient DNA data from the Schild site in western Illinois. Schild is a Late Woodland and Mississippian mortuary site (ca. 700-1200 AD) containing 13 Late Woodland mounds and two Mississippian cemeteries, which together contain more than 500 burials.

We recovered DNA from 40 individuals from the Mississippian cemeteries and 27 individuals from Late Woodland mounds 1, 2, 3, 6, and 9 using standard ancient DNA methods. The first hypervariable region of the mitochondrial DNA (mtDNA) was sequenced to determine mtDNA haplogroups and haplotypes, and results were verified through multiple independent extractions and amplifications. Pairwise *F*_{st} comparisons and exact tests of population differentiation show that haplogroup frequencies were similar in the Late Woodland and Mississippian periods, but haplotype frequencies changed across these two periods. Network analyses show 8 derived haplotypes shared between Late Woodland and Mississippian

individuals, suggesting some degree of population continuity between the two periods. We used computer simulations to help evaluate the effects of gene flow and genetic drift on the observed genetic changes over time.

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Hominin size, behavior, and ecology based on 1.5-million-year-old footprint assemblages from Ileret, Kenya

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Footprint assemblages record evidence about the anatomy, behavior, and ecology of our extinct hominin relatives within a very short time frame. Here we report on a series of footprint excavations (2010-13) in 1.51-1.53 million-year-old sediments in the Koobi Fora Formation, Ileret region, Kenya. We have uncovered dozens of hominin footprints and many other animal prints at six sites in the 8.5m-thick Okote Tuff Complex. Most animal tracks were made by bovids of various sizes, but water bird and hippopotamus prints are also preserved, indicating close proximity to water. This study examines the implications of the Ileret footprint assemblages for early Pleistocene hominin body size, behavior, and ecology. Body size estimates are based on our experimental analyses of footprints made at various speeds in the same sediment by habitually barefoot and minimally-shod adult Daasanach (n=48).

Most of the hominin footprints are large, comparable in size to footprints made by adult Daasanach males. These footprints yield body mass and stature estimates comparable to or above the predicted sizes of male *Homo ergaster* or *Paranthropus boisei*. At FwJl14E, at least five hominin trails are oriented together in a direction that differs significantly ($p < 0.05$) from other animal print orientations. These trackways may represent a group of males traveling together. Furthermore, the preservation of hominin prints at multiple sites demonstrates that they are more abundant than expected based on skeletal fossil frequencies from the same stratigraphic interval. These footprint assemblages raise provocative questions about early Pleistocene hominin social behavior and habitat preferences.

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Understanding variation in facial projection in anthropoid primates: Implications for modern human origins

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Facial projection—i.e., the position of the upper face relative to the anterior cranial fossa—is an important component of craniofacial architecture in primates. Study of its variation is therefore important to understanding the bases of primate craniofacial form. Such research is particularly relevant to studies of human evolution because the condition in *Homo sapiens*—in which facial projection is highly reduced, with the facial skeleton located primarily inferior (rather than anterior) to the braincase—is derived vis-à-vis other primates species, including others in the genus *Homo*. Previous research suggests that variation in facial projection is explained by: (1) cranial base angulation; (2) changes in the size and/or shape of the middle cranial fossa (particularly an anterior migration of its anterior margin); and/or (3) the anteroposterior length of the facial skeleton relative to the length of the anterior cranial base.

To test these hypotheses, linear measurements characterizing aspects of the facial skeleton and cranial base were collected from radiographs ($N = 46$ species; 901 specimens) from a sample of anthropoid primates. These data were subjected to phylogenetically-controlled multiple regression analyses that tested for correlations between facial projection and each of three independent variables, corresponding to the hypotheses above. The results suggest that cranial base angulation is the single, best predictor of facial projection in the sample. However, all three variables account for significant proportions of this variation. The results are discussed in the contexts of brain evolution in Mid-Late Pleistocene *Homo* and the emergence of modern human cranial form.

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Throwing and the reconstruction of the *Homo erectus* shoulder

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Powerful, accurate throwing may have been an important mode of early hunting and defense. Our previous work has shown throwing performance is functionally linked to several anatomical shifts in the upper body that occur during human evolution. The final shift to occur is the inferior reorientation of the shoulder. However, precisely when this change in shoulder morphology occurred is the topic of continued debate. Scapular fossils show a more inferior glenoid orientation present in *Homo erectus*.

However, where the scapula rests on the thorax is uncertain. The relative length of the clavicle, the only bony attachment of the scapula to the torso, is seemingly quite variable. Depending on which fossils or skeletal measures are used to reconstruct the *H. erectus* shoulder either a novel, anteriorly facing shoulder configuration or a modern human-like lateral orientation is possible. These varying reconstructions complicate our understanding of the functional anatomy and emergence timing of high-speed throwing behavior and bear further scrutiny.

This study evaluates competing models of the *H. erectus* shoulder using skeletal measures from fossil and extant taxa, as well as anthropometric and kinematic data from 21 Daasanach throwers from northwestern Kenya. These data show that claviculohumeral ratio alone is a poor predictor of both shoulder position and throwing performance. Given available data, reconstructing the *H. erectus* shoulder with a human-like, laterally facing glenoid is best supported. This suggests the capacity for high speed throwing dates back nearly 2 million years. Implications of this reconstruction for climbing and stone-tool manufacture will be discussed.

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Begotten of corruption: Leprosy and high rates of infection at the end of the Indus Age, South Asia

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The Indus Civilization flourished in northwest India and Pakistan in the Third Millennium B.C. as part of a vast interaction sphere that stretched across the Persian Gulf region. The urban period (2600-1900 B.C.) was characterized by large, well-planned urban centers that exercised economic and cultural influence over hundreds of villages and cities in 1,000,000 square kilometers of territory. Climate, social, and economic changes across South and West Asia after 2200 B.C. led to the disintegration of the Indus Civilization and significantly, to the abandonment of the urban lifestyle in South Asia for millennia. Bioarchaeological evidence demonstrates that socio-economic changes in the post-urban phase at the city of Harappa (1900-1700 B.C.) were associated with increasing prevalence of violence, infection, and infectious disease (leprosy and possibly TB). The presence of violence and infection is highest in the most marginalized subset of the population, an inference based on mortuary treatment. *M. leprae* may have migrated to South Asian cities as part of the interaction sphere but the disease rapidly spread far from the urban centers, as indicated by its presence at the rural outpost of Balathal by 2000 B.C. This poster summarizes the paleopathological evidence for infection and infectious disease in the Indus Age and uses this evidence to address the question of vulnerability in the context of climate uncertainty in a strongly differentiated society. The skeletal and mortuary evidence suggests a growing pathology of power characterized by the 'collapse' of this weakened and increasingly incoherent state.

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Osteoarthritis in three prehistoric Alabama populations

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Osteoarthritis is the most common paleopathological condition other than dental diseases and can be quite useful in reconstructing past activity patterns. Three sites in Alabama, two from the Mississippian Period (Moundville and the Perry site of Seven Mile Island) and one from the Archaic Period (the Perry site) were examined in this study. Eighty-four individuals were examined, (Moundville Mississippian = 17, Perry Mississippian = 34, Perry Archaic = 33) with all major joints analyzed, including each vertebral section, and proximal and distal components of the shoulder, elbow, wrist, hip, knee, and ankle. OA was considered present if eburnation and/or marginal lipping were apparent. The goal of this study was to examine the differences between males and females in regard to patterns of osteoarthritis. Statistically significant differences were found between males and females of the Mississippian-era Perry in the lumbar spine ($p = .037$, Pearson Chi Square), the right knee ($p = .010$, Pearson Chi Square), and the left ankle ($p = .011$, Pearson Chi Square). The Archaic site males possessed significantly more osteoarthritis in the right foot than the females ($p = 0.38$, Pearson Chi Square). The Mississippian-era Perry site also contained significantly more examples of osteoarthritis of the left knee ($p = .009$, Pearson Chi Square) and the left ankle ($p = 0.13$, Pearson Chi Square). Activities performed by males, such as hunting, playing a lacrosse-like ball game, and warfare may have contributed to the patterns of osteoarthritis that were found in the data set.

An overview of the global palaeopathological evidence of leprosy

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Bioarchaeological evidence for leprosy was studied for much of the 20th century, and remains of interest. Vilhelm Møller-Christensen's initial research defined the diagnostic criteria used in bioarchaeology, which have been used, with some refinements, since his groundbreaking work on the leprosarium skeletons from late medieval Naestved, Denmark. This study tests the hypothesis that past people with leprosy were not necessarily marginalized in death. Data on skeletons with leprosy in published journal papers, monographs, and book chapters, and unpublished outlets, were collated, along with burial context data. Skeletal evidence was recorded in three of the seven continents of the world (Africa, Asia, and Europe), being particularly common in Europe where most countries had evidence, particularly Denmark, Hungary, Sweden and the UK. The earliest evidence is dated to the 3rd millennium BC (India, Scotland, Turkey), but most data falls into the late medieval period of Europe (12th - 16th C AD). The majority of burials derive from non-leprosarium contexts, and often in 'normal'

parish cemeteries. Some burials were different (grave goods or elaborate grave ‘furniture’). Few burials were marginalized. Leprosy has been a part of people’s lives for several thousand years, and remains so. The data suggest that people with leprosy in the past were not necessarily ostracized and marginalized from their communities, in death, and likely in life. This is contrary to a continuing popular belief, stemming from apparent biblical references, in many academic and public circles, and supports recent research by historians such as Rawcliffe (2006) and Demaitre (2007).

A correlation between non-metric sex traits and hip bone shape

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Non-metric traits of the hip bone (the greater sciatic notch, ventral arc, ischiopubic ramus ridge, subpubic contour) are highly accurate indicators of sex, however, they represent a small portion of human morphological variability. The intent of this study is to uncover the relationships between the non-metric hip bone sex traits and overall hip bone shape variability. Fifty-nine undocumented left hip bones were assessed for skeletal sex using the standard non-metric traits, and categorized on a 5 scale sex classification scheme (male, possible male, indeterminate sex, possible female, and female). The specimens were translated into three-dimensional computer images. Thirty landmarks captured the shape of the hip bone for geometric morphometric analysis. A Spearman’s correlation assessed the relationships between the pattern of hip bone shape, obtained by principal component analysis, and the non-metric traits. Hip bone shape is correlated with all of the non-metric traits, however, the strength of the linear relationship differ between traits and certain components of hip bone shape. This study reveals that the subpubic concavity and the greater sciatic notch have the strongest linear correlation with the components of shape that identifies females and males. While the ventral arc, ischiopubic ramus ridge, and greater sciatic notch have the strongest linear correlation with the components of shape that suggest a separation of females from possible females. No patterns of male/possible male shape variation were identified. This suggests that non-metric traits can discern patterns of female shape variation better than patterns of male shape variation.

Holey mandibles! The frequency of accessory mental foramina among the Hominoidea and its relationship to dental arcade length

CHRIS A. ROBINSON and ALAN HOLGUIN. Department of Biology and MLT, Bronx Community College.

The mental foramen marks the location where the inferior alveolar nerve and blood vessels exit the mandibular canal to become the mental nerve and blood vessels. In some specimens the nerve and/or blood vessels ramify inside the canal leading to multiple mental foramina. Accessory mental foramina have been documented in all extant great apes and humans, but are

particularly common in *Gorilla* and *Pongo*. To further understand this character we documented the number of accessory mental foramina in a large sample (n=448) of seven extant hominoid species and explored whether differences among species in the frequency of accessory mental foramina might be related to size (e.g., dental arcade length).

Results showed significant differences (Student’s t test; $p < 0.05$) between most hominoid species for the mean number of mental foramina; with only the two *Pan* species, and humans and siamangs not significantly different. No significant differences were found between males and females of these taxa, between four *Homo sapiens* populations, or between *Pongo* or *Pan* subspecies for mean mental foramen number. The two gorilla species were found to have the largest average number of accessory foramina and the highest frequency of accessory foramina. Humans and siamangs had the lowest figures for these variables. Interspecific regression analyses showed a strong correlation ($r^2 > 0.95$) between mean number of mental foramina and percentage of individuals with accessory foramina, and dental arcade length. We suggest that the length of the inferior alveolar nerve/blood vessels influences the likelihood of individuals possessing multiple mental foramina.

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Developing a paleoenvironmental context for Middle Stone Age behavioral transitions: A multi-site approach

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Characterizing the tempo and mode of Middle Stone Age (MSA) behavioral change is integral to understanding the evolution of modern human behavior. An understanding of the links between behavior and ecology requires well developed environmental contexts. Carbon and oxygen isotopic characterization of fossil tooth enamel of faunal communities from seven equatorial African MSA sites is reported here to (1) demonstrate the extent to which regional climatic proxies (East African megadroughts, Kalahari expansion, and Congo rainforest cycles) calibrate with site-level ecological signals, and (2) to develop robust, high-resolution environmental databases for these key sites. This research provides a comprehensive "ground-up" approach with long-term diachronic data. The seven sites selected for analysis are: Lukenya Hill, Kenya, Porc Epic and Kibish Formation, Ethiopia, Makwe Caves and Kalemba, Zambia, and Katanda and Ishango, Democratic Republic of the Congo.

Specifically, the isotopic analysis provides evidence on whether regional environmental events can be documented at specific archaeological sites, if there are temporal offsets of these events, or if they are manifested in locally variable ways. Isotopic results suggest that global climatic regimes such as the last glacial maximum are captured in the tooth enamel of fauna throughout Africa. Regional events, however, are not unequivocally identified at all archaeological sites across the study area,

such as East African megadroughts which appear to be recorded at Kenyan sites yet are faintly identified at Ethiopia sites. Results of this study provide a more complete picture of regional environmental diversity for contextualizing local habitats in which humans evolved across Africa.

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Re-evaluating the sisterhood: Are captive bonobos female-bonded?

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Bonobos are frequently characterized as female-bonded, despite their patrilocal residence patterns in the wild. However, some argue that these differences are over-emphasized, and are the result of studying newly-formed captive groups. The “traditional” model of bonobo sociality bonds emphasizes strong female bonds, low rates of aggression, and the reduced role of kinship in determining social bonds. Conversely, the “revised” model of bonobo sociality emphasizes male-female bonds, moderate rate of aggression, and kinship as a predictor of relationships strength. Here, I examine these models using data collected on dyadic relationships in a familiar group of captive bonobos at the Columbus Zoo, Ohio. I found that female-female, female-male, and male-male dyads do not significantly differ in rates of grooming bouts (Kruskal-Wallis $K=0.118$, $N=55$, $P=0.943$) or sexual behavior (K=3.794, $N=55$, $P=0.150$). Male-male dyads engaged in significantly higher rates of aggression than male-female and female-female dyads ($K=7.375$, $N=555$, $P=0.025$). Grooming rates were positively associated with coefficient of relatedness (Spearman $r_s=0.333$, $N=55$, $P=0.013$). Taken together, these results support the revised model, and suggest that female-male and male-male bonds are as important in structuring bonobo society as female-female bonds.

Biodistance analysis of Hispanic skeletons

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The morphoscopic traits used to assign the term Hispanic to a skeleton constitute mainly a mixture of characteristics assigned by anthropologists to Asian and Caucasian ancestry groups. Therefore, the morphological characteristics for the populations termed Hispanic are not well defined. This study involved conducting a biodistance analysis of skeletons from Puerto Rico. The purpose of this study was to assess how similar their morphoscopic characteristics are to other populations termed Hispanic as well as populations termed Asian. The analysis was conducted by taking craniometric measurements following *Standards for Data Collection from Human Skeletal Remains* (Buikstra and Ubelaker 1994). Data was collected from pre-Columbian and modern Puerto Rican crania as well as

individuals who could not be classified into either timeframe. Because of the time difference between crania, an Analysis of Variance (ANOVA) was conducted to determine whether the measurements differed between samples using time as the independent variable, so the samples could be pooled. The biodistance analysis was performed using *RMET 5.0*, created by John Relethford, Ph.D. Skeletons from Puerto Rico were compared to individuals from Guatemala, Mexico, China, Japan, and Vietnam from the Forensic Data Bank (FDB). The results from the biodistance analysis indicated a greater variability than expected within the Puerto Rican sample. It is possible that the variability within the Puerto Rican sample masked the variability between this sample and the other sample populations studied. Results from this study will help characterize Hispanic skeletal variation and understand the complexities of Hispanic classification in forensic anthropological contexts.

St Mary Magdalen, Winchester: A medieval leprosy hospital in context

SIMON ROFFEY. Department of Archaeology, University of Winchester.

In medieval England, over a quarter of all hospital foundations were dedicated to the care of people with leprosy. It is therefore surprising that, in contrast to a number of important historical works on leprosy, comparatively little archaeological work has been conducted on medieval leprosy hospitals. Since 2008, excavations at St Mary Magdalen, Winchester, have achieved the most extensive excavation of a British leprosy hospital to date. Analysis of the medieval cemetery indicates skeletal evidence for leprosy in over 85% of excavated examples, a much larger percentage than has previously been recorded in any British material. Current archaeological excavations at Winchester, has also provided a valuable insight into both the form of early institutional care and the nature and status of its community from a relatively early date. The evidence confirms that the hospital is one of, if not the, earliest, excavated examples from Britain (c AD 1070-90). Moreover skeletal material from the cemetery has formed the basis for recent collaborative projects concerned with identifying the origins of medieval leprosy. Overall, it is argued that the hospital represented a pioneering establishment of both charitable and institutional care. Consequently, it may have further embodied a model for succeeding charitable institutions of social care, not properly formalised until more recent centuries, and one that emerged as a direct response to the spread of the disease of leprosy. This poster, presented by the project co-director, will present these important findings in the context of wider research on medieval leprosy and its institutional context.

How population growth affects linkage disequilibrium

ALAN R. ROGERS. Anthropology, University of Utah.

Linkage disequilibrium (LD) is often summarized using the "LD curve", which relates

the LD between pairs of sites to the distance that separates them along the chromosome. This paper shows how the LD curve responds to changes in population size. An expansion of population size generates an LD curve that declines steeply, especially if that expansion has followed a bottleneck. A reduction in size generates an LD curve that is high but relatively flat. As LD converges toward a new equilibrium, its time path may not be monotonic. Following an episode of growth, for example, it declines to a low value before rising toward the new equilibrium. In European data, the curve is steep, suggesting a history of population expansion. These conclusions emerge from the study of σ_d^2 , a measure of LD that has never played a central role. It has been seen merely as an approximation to another measure, r^2 . Yet σ_d^2 has different dynamical behavior and provides deeper time depth. Furthermore, it is easily estimated from data and can be predicted from population history using a fast, deterministic algorithm.

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Differing long bone lengths among hominoids can be achieved through changes in growth plate chondrocyte behavior

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Despite being sister taxa, chimpanzees and humans exhibit significantly different limb bone lengths, both absolutely and relative to body size. Growth data show that although limb bone length differences between *Pan* and *Homo* are present by birth, these differences are amplified during postnatal ontogeny. From mechanistic point of view, this suggests that species differences in limb bone lengths are achieved through changes to the cell dynamics of growth plate chondrocytes. The aim of the present study was to develop a simple mathematical model of longitudinal growth in the long bones of hominoids, and to relate variation in the model's parameters (i.e., cell proliferation and differentiation; hypertrophy in the growth plate) to predict differential growth rates and bone lengths between *Pan* and *Homo*. Using evolutionary simulations, I show that developmental determinants of chondrocyte hypertrophy – especially the transition rate from proliferative to hypertrophic cell type, and the rate of hypertrophy itself – are highly effective ways of changing postnatal growth of the long bones, regardless of the direction of evolutionary change among humans, chimpanzees and their last common ancestor. These results agree with published data on the cell dynamics of growth plates in different rodent species, and suggest that the onset, rate and duration of matrix production in hypertrophying chondrocytes are the principal target of selection in the context of limb bone length evolution.

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Variation in human body form is not distributed along a latitudinal cline

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Patterns of human population structure and putative drivers of natural selection are often geographically structured. This can lead to situations where variation among groups generated by genetic drift and gene flow can mimic the expectations of models of natural selection. Here we consider the problem of the worldwide distribution of group means for traits reflecting human body form (bi-iliac breadth, femoral head diameter, and limb element lengths) by comparing the fit of three models of evolution in a sample of 121 human groups. One model includes a term reflecting a climatically distributed cline (given by absolute latitude), the second includes population structure, and the third combines both. The population structure term is a relationship matrix estimated using recent human molecular variation. In no case was the model reflecting natural selection the best fit. Only in the case of bi-iliac breadth was the model containing both natural selection and population structure the clear best fit. In all cases, population structure accounted for a substantial proportion of the among-group variation. Our results show that human body form is not distributed in a latitudinal cline. While natural selection might have acted to structure among-group differences, our results suggest would have acted episodically and was too weak to obscure the effects of genetic drift. Estimates of the proportion of among-group variance attributable to population structure are imprecise, making robust estimates of population structure using morphology unlikely.

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Infant helplessness in the human fossil record from ape to Mann

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Two aspects of Alan Mann's research are directly relevant to the evolution of human infant helplessness: his work on human life history and on the importance of culture to the human adaptation. As early as 1972, he pointed out that prolonged childhood dependency allows time for learning language and other aspects of culture. But extended childhood is not the only reason that we spend so much energy parenting, nor is it the only aspect of our biology that enhances learning. Our babies are born in an unusually helpless condition that Ashley Montagu characterized as "exterogestate fetuses." Humans resemble the great apes in gestation length. But human newborns combine relatively large bodies (6.1% of maternal weight compared to about 3% in African apes) with relatively small brains (29% of adult brain size compared to 40-45% in African apes), making them large, but immature infants and hence, costly creatures to parent. An improved explanation of the human pattern combines recent analyses of the evolution of pelvic morphology and birth mechanism associated with *constraints* imposed by encephalization, with the recognition of a

headstart in infant learning afforded by immature birth. Certainly the learning process in humans is extended over a longer period of childhood dependency compared to apes, as Mann argued. In addition, the immature state in which humans are born exposes them to cultural stimuli earlier in development (at times that recent research suggests are critical periods). Thus, duration of cultural exposure is extended at both ends of the developmental process.

Nutritional quality and biological significance of foods consumed by Coquerel's sifaka (*Propithecus coquereli*) mothers during lactation

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Lactation is energetically expensive. Food quality may be important for lactating mothers to invest in infant care-giving while sustaining their own energetic needs. We determined the nutritional quality of foods consumed by Coquerel's sifaka (*Propithecus coquereli*) mothers (n=10) over two birth seasons (2010 and 2011) in Ankarafantsika National Park, Northwestern Madagascar. *P. coquereli* mothers give birth during the austral winter, where almost no precipitation occurs from May-September. Biotic data were collected during 93 focal hours on 31 calendar days over 26 consecutive weeks. Food parts consumed, frequency at which food was consumed, and Latin name were recorded for each food item. Samples were collected and dried under field conditions, shipped to the Smithsonian National Zoological Park, and assayed for nitrogen, neutral detergent fiber (NDF), acid detergent fiber (ADF), ash, and gross energy. From these data we calculated crude protein, available protein, and non-protein energy. Cluster analysis revealed three food categories: high fiber foods (NDF = 59.0±2.3%SEM), high available protein foods (15.9±0.6%), and foods high in non-protein energy (4.3±0.6 kcal/g). The most commonly consumed foods were predominantly high non-protein energy (51.6%) and high fiber foods (34.4%) with, on average, low available protein (7.6±0.5%) and high non-protein energy (4.1±0.1 kcal/g). Moderately consumed foods were mostly from the high available protein foods (73.7%; mean available protein = 15.4±1.1%, non-protein energy = 3.6±0.2 kcal/g); least consumed foods were intermediate (10.9±0.9% and 3.8±0.1 kcal/g). Lactating *P. coquereli* appear to prefer foods high in non-protein energy, though they also regularly consume foods with high available protein.

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Mosaics, mandible morphology, behavior and diet. Where's the variance?

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Mosaic habitats might elicit a diversity of diets and feeding behaviors in a single species, or interspecific divergence in diet and feeding behavior. Differences in diet or feeding behavior might be associated with different patterns of strain in the mandible, leading to selection for differences in mandibular form. But where is the variance? Mandibular strain is caused by jaw muscle, bite, and joint reaction forces. Analysis of variance of the sources of these forces suggests that most of the variance in jaw muscle relative timing (Vinyard et al. 2008, Integr. Comp. Biol. 48:294-311) and jaw kinematics (Iriarte-Diaz et al., 2011, Integr. Comp. Biol. 51:307-319) is nested within feeding sequences. These results predict that mandibular strain also varies more between behaviors than between foods. Variance in principal strain magnitudes recorded from the lateral aspect of the mandibular corpora (12 individuals; *Eulemur*, *Varecia*, *Chlorocebus*, *Macaca*, *Cebus*; 4000+ cycles) was analyzed using a random, nested ANOVA model with 5 hierarchical factors: species, individuals, sequence, food type, cycle type. The largest proportion of the variance (50%) was nested at the level of cycle type (i.e., behavior) with food type accounting for only 3% of the variance. If mandibular form is adapted to the strains it experiences, then the primary determinant of variation in mandibular form is variation in feeding behavior, not variation in food type. Variation in feeding behavior in extant primates across different habitat types will be important for understanding the influence of habitat mosaics on hominid mandible evolution. NSF bcs 0962682, 0725147, 0531067, 0240865, 0101930.

Integrating research into primate conservation: Insights from Uganda

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Positive relationships with government institutions responsible for wildlife protection are critical for primate conservation progress and maintaining long-term primate field projects. Together governments and researchers can work together in synergistic ways to promote effective primate conservation and build local capacity. We highlight the ways in which we have integrated research to promote primate conservation in Uganda, thereby maintaining long-term field research that has an impact on management. First, we have provided feeding and nutritional ecology data to park management, which led to policy implemented on management practices including selective exotic tree removal in protected areas. Second, we have facilitated the training of local researchers and management staff who have gone on to play active roles in conservation and education. This has involved establishing a memorandum of understanding between the wildlife authority to use our compulsory research

fees to provide scholarships to wardens of protected areas to obtain graduate degrees in wildlife management with thesis research that focuses on pressing issues in primate conservation. Third, we worked with the government to establish a physical clinic and now a mobile health clinic outside our study area to promote wildlife conservation. Lastly, our research findings have helped to establish more effective primate ecotourism programs. Our results demonstrate that constructive long-term linkages between government institutions responsible for wildlife protection and long-term researchers have productive outcomes for primate conservation.

Leprosy in Italy: Pathological aspects and paleopathological perspectives

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Leprosy has been documented in Italian skeletal remains from the Roman Age (4th century CE). To date, however, there has been little evidence recorded (only ten skeletons), and the data are mainly located in Central Italy. The aim of our research was to investigate skeletal remains using standardized methods to understand the dynamics of leprosy's spread and of its demographic impact in Italy. Furthermore, a comparison between paleopathological methods (macroscopic recording of bone changes and radiographic analysis) and biomolecular analysis was effected for some cases. The materials of our study came from Italian cemeteries of Prehistoric, Roman and Medieval Ages.

The chronological and geographic distribution of the Italian skeletal data suggests (with caution) an overland route of transmission of leprosy from eastern and central Europe into Italy. This pattern of spread seems different to historical documentation suggesting much contact with Italy by sea from Asia and Africa. Furthermore the demographic data from the leprosy skeletons in Italy are the same as for those without leprosy, suggesting that leprosy does not lead to earlier death. In conclusion, the skeletal evidence for leprosy is under-represented in Italy. However, this under-representation is also linked to the random nature of discovery and excavation of human remains, their preservation, and their chronological and geographical location.

How much more would KNM-WT 15000 have grown? A case study in applying growth trajectories to fossil hominins

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KNM-WT 15000, an East African *Homo erectus* juvenile, possesses the most complete skeleton of any early hominin. Thus, it has played a key role in many analyses of the evolution of human body size. Because of its

juvenile status, however, such analyses often depend on extrapolation to adult size, which necessarily involves various assumptions about growth curves in early hominins. This is made more complicated by evidence that at least dental maturation in KNM-WT 15000 followed a more accelerated schedule relative to chronological age than in modern humans. Partly based on such evidence, a recent analysis concluded that KNM-WT 15000's adult stature was much shorter than previously estimated – about 166 cm rather than the original estimate of 185 cm (not factoring in his lower cranial height). The new estimate is only 9 cm larger than his estimated stature at death (157 cm), implying that an increase of only 6% would have occurred had he lived to adulthood. However, even chimpanzees grow much more than 6% in body length between 8 years of age (the dental age estimate for KNM-WT 15000) and maturity – in the authors' favored longitudinal study, they grew by 11-12%. Applying this to KNM-WT 15000's stature at death yields an adult stature of 175 cm. Applying growth models intermediate between those of modern humans and chimpanzees, which are more consistent with his overall pattern of development, yields higher adult stature estimates. Thus, KNM-WT 15000 would almost certainly have grown to more than 175 cm in height.

The price of disobedience: Death by firing squad in the French and Indian War, Fort William Henry, NY, 1754-1756

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War has long been a part of human history, however historical accounts of war tend to portray only some aspects of conflict, and often focused on a few key elements such as glory, bravery, strategy, and causes or outcomes of war. Earlier historians also have romanticized war by praising the patriotism and heroic sacrifices of the soldiers who fought in battle. But there is another side to war, a darker aspect not often spoken of in historical texts. Enforcing discipline and obedience in the ranks has long been an issue for military officers but little evidence of punishment survives in the archaeological record. Eighteenth century British soldiers were subject to harsh discipline for a variety of transgressions, and some crimes resulted in a death sentence. We report here on the skeletal remains of a soldier from Fort William Henry, NY whose body was struck by multiple projectiles in a concentrated area. There is a cluster of depressed rib fractures, and damage to the arms, right shoulder and vertebrae. The trauma is consistent with multiple musket ball impacts, fired at relatively close range. Given the inaccuracy and low propulsive power of the 18th century muskets, it is unlikely that these injuries occurred in battle. The extensive damage to the bones and the patterning of the injuries suggest that this individual was executed by firing squad.

Hierarchical analyses of bone and muscle structural, material, and physiological properties improve our understanding of their integrated functions

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The integration of bone and muscle structure and function is critical to movement and adaptation. Both tissues are composite materials comprised of constituent parts that have different mechanical and physiological properties. Bone strength is related to bone mass, architecture and material properties such as the degree and quality of mineralization, collagen spacing, and hydration. Similarly, force of muscle contraction is related to muscle mass, architecture, and composition of fast and slow myosin heavy chain (MHC) isoform fiber types. Our recent work takes a hierarchical approach to analyses of mechanical and physiological properties of bone and muscle in the tails of three animal models: captive platyrrhines, wild-caught didelphids, and laboratory-raised mice. Our data demonstrate that mechanical analysis of bone or muscle alone does not give us a complete picture of mechanical and physiological adaptation in locomotion. In platyrrhines, caudal vertebral architecture and mass differ between prehensile and nonprehensile tails, whereas lateral tail muscle mass differs but not fiber architecture, per se. MHC isoform distributions of the flexor caudae longus muscle differ between arboreal and terrestrial didelphids, along with caudal vertebral gross morphology. Finally, laboratory mice raised in a simulated fine-branch arboreal milieu show a marked increase in lateral caudal muscle cross-sectional area compared to controls, whereas caudal vertebrae display little differences between groups. Collectively, these data suggest that a hierarchical approach to the study of tissue and organ structure and function can more fully illuminate mechanical and physiological adaptation to locomotion.

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Model-based clustering analyses reveal similar geographic structure in dental morphology and neutral genetic diversity

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Human dental morphology is often assumed to mirror neutral genetic diversity. If true, dental morphological data from large historic and prehistoric samples provides a low cost, non-destructive source of information about human evolution. We used a model-based clustering approach to compare the structure of global dental morphology and neutral genetic diversity. Our dental sample consists of 47 dichotomized dental morphological traits, scored using the Arizona State University Dental Anthropology System, from 2,658 individuals in 88 skeletal collections. Our genetic sample consists of 678 microsatellites genotyped in 1,484 individuals from 53 widespread populations. We used *Structure* to compare the patterns of variation in the two datasets.

We found that the geographic structure of dental morphology is similar to the geographic structure of neutral genetic diversity. More specifically, dental morphological variation forms distinct African, Asian, and European clusters. Admixed North Americans have membership in each of these three continental clusters. Additionally, African Americans and Hispanic Americans from different regions of the US possess levels of European, Native American, and African ancestry predicted by historical patterns of admixture. These results suggest that statistical methods commonly applied to neutral genetic diversity can also be informative when applied to dental morphology.

Tail length reconstructions of extinct primates using sacrocaudal functional links among living primates and other mammals

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Tail length variation is functionally and phylogenetically significant among extant primates. Thus, an understanding of the anatomy associated with tail length differences can inform interpretations concerning postcranial adaptations and phylogenetic affiliations among extinct primates. However, tail length is difficult to determine from fossil material because complete caudal vertebral sequences are rarely found. As such, researchers must look to other skeletal elements for establishing its correlates. This study examines the morphology of the sacrum – the sole bony link between the tail and the rest of the body – in a broad, comparative sample of extant primates and other mammals (carnivores, diprotodonts, pilosans, rodents, and tree shrews; N=472) known to vary in relative tail length ($RTL = \text{tail length} / [\text{head} + \text{body length}] \times 100$). Phylogenetically informed regression methods were used to evaluate the relationship between RTL and vertebral variables. Multivariate models constructed from the extant primate data were used to predict the RTLs of extinct primates. Results demonstrate that shorter-tailed mammals exhibit features associated with reduced sacrocaudal joint mobility (e.g., more elliptically-shaped caudal articular surfaces exhibiting smaller surface areas) and reduced mechanical advantage for basal tail musculature (e.g., shorter last sacral vertebral transverse and spinous processes), compared to longer-tailed mammals. Reconstructions of tail length in extinct primates support previous interpretations that *Proconsul* was tailless, that *Archaeolemur* possessed a long tail, and that *Palaeothropithecus* possessed a short tail. Results also demonstrate that *Megaladapis* and *Epiphiopithecus* had short tails. The findings presented here support the utility of these methods for reconstructing tail length in other extinct primates.

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Primate tourism as a conservation tool: Towards a balanced view

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This paper assesses the contribution of primate tourism to primate conservation. Primate tourism, like nature tourism, has often been promoted as a conservation tool on the view that it offers high gains and low impact. It merits separate consideration because nonhuman primates' close, biologically-based similarities to humans are largely responsible for its popularity and profitability but also for the risks it creates for the primates visited (e.g., conflict, disease transmission). With growing evidence that its risks generate adverse effects that can be substantial, assessments that weigh its conservation benefits against its costs are increasingly needed. We review findings from empirically-based assessments of the positive and adverse effects of primate tourism on primate conservation, especially for the primates visited, based on a broad sample of the world's living primates. We discuss the cost-benefit patterns that emerge from this review, suggest how net conservation benefit might be assessed, and suggest broad recommendations on how to design and manage primate tourism to achieve and sustain net primate conservation benefits.

Maternal birth weight predicts placental nutrient transport characteristics thirty years later in Metro Cebu, Philippines

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The placental interhemal membrane separates fetal and maternal circulations at the microscopic level; its thickness is an important driver of nutrient transport from mother to fetus. We report novel evidence of an early life maternal influence on the interhemal distance (IHD) in the placentas of offspring of women from Metro Cebu, Philippines who have been studied since they were infants in 1983. Twenty placentas from term infants were included in the microscopic analyses of IHD using StereoInvestigator software; membrane thickness in this sample averaged 8.08 μm . A linear regression model including infant and maternal birth weight, infant and maternal gestational age, placental weight, and maternal adult height explains a very large proportion of the variance in IHD (adjusted $R^2=0.495$, $p=0.02$), with infant birth weight and maternal birth weight being the only two significant predictors ($p=0.03$ and $p=0.002$, respectively). Infant birth weight did not retain this power standing alone in simple models. In surprising contrast, maternal birth weight alone predicted 31.5% of the variance in IHD ($p=0.006$). Mothers who were born at lower (but still normal) birth weights produced normal

birth weight infants 30 years later whose placentas had a significantly thinner IHD, a pattern that is similar to that in high altitude hypoxia wherein the placenta compensates for reduced oxygen by minimizing the transport barrier. These lower birth weight mothers may be initiated in lifecourse developmental trajectories that have an impact on the way they transport nutrients to their own fetus, with the placenta making structural adjustments to compensate.

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Patterns of cortisol excretion and social behavior among juvenile chimpanzees (*Pan troglodytes schweinfurthii*) of the Kanyawara community at Kibale National Park

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In many group-living species, an individual's ability to establish and maintain affiliative bonds and attain high dominance rank has an impact on their reproductive success. Stress is an unavoidable and recurrent cost of negotiating social relationships in groups. Juveniles may be expected to experience many stressors related to gaining independence from their mothers and negotiating new aspects of the physical and social environment. In turn, variation in the stress response of individuals can affect temperament and how social relationships are formed. Yet, little research has evaluated correlates of juvenile cortisol excretion in naturalistic populations. We analyzed urinary cortisol in 5769 morning samples collected from 59 individuals of the Kanyawara community of chimpanzees between 1998 and 2012. Infant and juvenile chimpanzees excreted significantly lower amounts of cortisol than did adults. As a group, immatures displayed high variance in cortisol compared with adults. This difference was not easily explained by age, but was instead attributed to interindividual and sex differences. Females in each age group had significantly higher average cortisol than males. We discuss the evolutionary implications of this sex difference and how it may be linked to observed sex differences in social behavior and development.

Neanderthal diet and the patchy environments of Mediterranean Iberia

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Mediterranean Iberia is one of a few known refugia for temperate fauna and flora during glacial cycles in the Northern hemisphere. Though generally several degrees warmer than other areas in north central Europe, the mountainous landscape in this region was less uniform than the so-called "mammoth steppe" and contained a variety of microhabitats. This patchy environment provided Neanderthals with a larger number of food options. Previous studies of Neanderthal diets in the central part of their range suggest a narrow diet, focused on large animal game with limited use of plant foods, small and hard-to-catch fauna, or aquatic resources. It is unclear, however, if this diet was due in part to the more uniform habitat of Central Europe. In this case, we expect that Neanderthals of Mediterranean Iberia made use of the greater variety of habitats and foods. We have used a combination of methods, including zooarchaeology, stable isotope analysis, and studies of plant microremains, to recover information about the diets of Neanderthals in Mediterranean Iberia. Our results suggest that their diet focused heavily on meat, including a variety of large and small game. Plant foods were likely a significant dietary component, but aquatic foods were rarely consumed. These results indicate that though a variety of habitats were used, Neanderthals had generally the same diet as those from central Europe.

In the footsteps of giants: Deciphering the details of the demise of Madagascar's subfossil lemurs

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Madagascar's lemurs suffered a significant extinction episode beginning approximately 2000 years ago. Seventeen species were lost, with three families disappearing entirely, and two others losing members. Twelve additional vertebrate clades lost species during the Quaternary; these included other mammals, birds, and reptiles.

Whereas some investigators have argued that island-wide drought was the primary trigger for this extinction event, this explanation is contravened by stable nitrogen isotope data, which demonstrate that not all habitats that suffered species loss also suffered drought. The loss of arboreal primates is unusual (particularly as it occurred in some regions that remain forested). Primates comprise 37% of vertebrate species lost. Factors other than body size contributed to species' vulnerability; the body size threshold for lemur extinctions (10 kg) was much lower than has been observed globally in other vertebrate clades that experienced quaternary extinctions. Extremely low reproductive rates likely increased lemur vulnerability to extinction; analyses of subfossil lemur reproductive rates support this hypothesis.

The Malagasy extinctions occurred after humans arrived, which strongly implies that humans played a primary role in the demise. Now-extinct lemurs were decimated by around 1000 years ago, although at least five species survived past ~500 years BP. Malagasy extinction rates far exceed what is expected through background extinction. These extinctions, which have been described as “slow” or “prolonged,” are extremely rapid in geological terms. As Madagascar is currently recognized as one of the world’s highest-priority “hotspots” for biodiversity, the unsustainable pace of these extinctions is of concern.

Genomic identification and characterization of adaptive introgression from Neandertals

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High coverage archaic human genomes have been recovered from Neandertals and a previously unknown archaic population identified from remains in Denisova Cave in the Altai Mountains. These genomes are providing unparalleled insight into the relatedness between archaic and living humans. It is now apparent that admixture between the Pleistocene African ancestors of modern humans and archaic humans outside of Africa has left present-day people with a genetic legacy from Neandertal and Denisovan ancestors. Some isolated examples of adaptive introgression from archaic humans into modern humans have been identified, such as haplotypes in the HLA region of the genome. Yet, it remains unclear to what extent introgression from archaic humans provided an adaptive advantage to early modern humans outside of Africa. To begin to address this issue we combined whole-genome sequencing from archaic human genomes and sub-Saharan African foragers to enrich for genomic loci that if found in modern humans outside of Africa, are likely due to introgression. We then examined these loci in whole-genome sequencing from from the 1000 Genomes Project to identify and characterize the extent of adaptive introgression across multiple human populations. *This research was funded in part by The Ellison Medical Foundation.*

Species differences in sleep quality between captive orangutans (*Pongo pygmaeus*) and baboons (*Papio papio*)

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The great apes, humans included, are unique in that they share the universal trait of sleeping platform building. Even primates characterized by large body and brain mass (e.g., *Papio* and *Mandrillus*) and/or high levels of intelligence (e.g., *Cebus*) do not build nightly platforms on which to sleep. Therefore, a direct comparison between a large-bodied hominoid such as *Pongo* and a relatively large-bodied *Cercopithecidae* may yield insight into the important differences and derived traits that may categorize great ape sleep and sleep architecture as unique among

primates. We test two hypotheses: 1) orangutans (*Pongo spp.*) will possess longer, less fragmented sleep and higher quality sleep than baboons (*Papio papio*) and 2) baboon sleep will be characterized by more social disruption and less relaxed sleeping posture when compared to orangutans. Using all-occurrence sampling on primate subjects, infra-red video recordings yielded sleep quota time allocation data for: total time spent awake, total sleep time, and total time in bed. In addition, frequency data of gross body movement and motor activity were used to generate variables such as: sleep fragmentation, arousability, sleep quality, percentage of time spent in a posture, and presence or absence of sleeping partner. Orangutans experienced longer, higher quality sleep that was characterized by less fragmentation and arousability. Baboons slept in the guarded position more than expected, whereas orangutans slept in the vulnerable positions more than expected. Overall, baboons remain more vigilant, more prone to waking and sleep in guarded positions with resulting poorer quality sleep than their hominoid counterparts.

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Stable isotope ecology of modern micromammals from the Sterkfontein Valley: Implications for habitat reconstruction in mosaic environments

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The stable isotope ecology of fossil micromammal communities may aid in paleoenvironmental reconstructions of fossil hominin localities, particularly where landscapes comprise a mosaic of habitat types. Micromammals are potentially good indicators of environments at small spatial and temporal scales because they have relatively limited home ranges, high generational turnover, and are often associated with specific microhabitats. A lack of understanding of modern micromammal stable isotope systems, however, hinders our ability to interpret patterns in the fossil record. Here we present stable carbon and oxygen isotope data from modern micromammal enamel recovered from owl roosts in different microhabitats in the Sterkfontein Valley, Gauteng, South Africa. Molar and incisor pairs were measured in a subset of individuals to explore how these tooth types differ in the dietary and environmental signals they record. Results show that isotopic compositions do not reflect environmental characteristics consistently across all taxa, and extreme variability in some taxa may obfuscate

simple habitat associations. This implies that, in contrast to many current approaches which advocate a taxon-free point-of-view, careful attention needs to be given to species composition in community-level analyses. Tooth type differences suggest strong seasonality in diet and habitat use for some taxa. We also present preliminary stable isotope data for fossil micromammals from Sterkfontein M4, Swartkrans M2, and a mid-Pleistocene deposit from Gladysvale to explore how the modern data might influence interpretations of fossil assemblages. A better understanding of rodent dietary ecology and habitat use, life-history, and roost taphonomy should enrich this approach in the future.

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Litter size as a selective pressure on group size in mammals?

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Primates are unusual among mammals in being highly social. Despite considerable research, the selective pressures leading to sociality remain inconclusive. Predation is hypothesized to be an important selective force across all taxa, including primates, but many mammals maintain a solitary life. Why is group-living an adaptation for some species and not others? In addition to sociality, most primates invest significant energy in slowly maturing, single offspring. Since infants are especially vulnerable to predation, could group-living be an adaptation to protect single offspring? Other taxa that produce single offspring, such as ungulates, typically live in large groups. Across mammals, species with smaller litters may experience greater predator pressure compared to species with larger litters. Here we investigate the role of litter size on group size in mammals. Using data from the literature (Jones et al. 2009, PanTHERIA: a species-level database of life history, ecology, and geography of extant and recently extinct mammals, Ecology, 90: 2648), we test whether group size and litter size are correlated in a sample of 144 mammals, representing 10 orders. Using Ordinary Least Squares regression, there is a negative correlation between group size and litter size. However, when controlling for phylogenetic non-independence, the correlation is not significant. Although many social species have small litters, the role of litter size on group size in mammals remains ambiguous. Further analyses on group size and litter size across a wider sample of taxa, while controlling for confounding factors, may help elucidate the evolutionary history of sociality.

Craniometric analysis of the Howells Egyptian sample: The Greek connection

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The Egyptian "E" series, a collection of skulls dating to the 26th-30th Dynasties (c.660-340 BC) of the Late Period of Ancient Egypt has been assumed to be representative of Ancient Egyptians. The series was used in many early craniometric studies in the biometric school and by Howells in his worldwide craniometric database. The Late Period was marked by population movement and increased trade with Greece, and historical evidence suggests the series represents people who had strong ties to Ancient Greece. To our knowledge, no previous craniometric studies have compared Howells' Egyptians to Greek samples. In this study, Howells' Egyptian sample and other Ancient Egyptian and Greek samples were compared to understand the biological affinities of Pre-dynastic and Dynastic Egyptians and their connections to Ancient Greece.

Craniometric data from Ancient Egyptian and Greek sites were collected at museums and from a variety of archival sources including *Biometrika*. Samples spanned from Pre-dynastic to Late Period Egypt and included the Bronze and Classical Ages of Greece. Six measurements were common to most datasets and were standardized based on sex-specific means. Canonical Variates Analysis and Cluster Analysis were performed using Fordisc and R. Results indicate that the Howells sample is similar to other late Dynastic Egyptian groups, but also shows strong similarities with Classical Greek samples that no other Egyptian groups display. Results also reflect dynamic relationships between Upper and Lower Egypt, and support a separation between Pre-Dynastic and Dynastic Egyptian populations followed by population continuity throughout the Dynastic Period.

First South American prehistoric mitogenome: Context, continuity, and the place of C1d haplogroup

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At least 15 founder mitochondrial lineages, carried by the first inhabitants that entered America, have been defined. Most of the supporting information comes from living populations' mtDNA hypervariable regions, but seems inept to solve some issues, as for example population movements inside the continent and inferences of continuity. To help resolve these issues we analyzed the complete mitochondrial genome of a prehistoric woman buried in a mound in eastern Uruguay and dated to 1610+90 years BP. Moreover, mitogenomes of possible descendants were also analyzed.

The prehistoric mitogenome showed all the typical mutations that characterize haplogroup C1, but also six other mutations in the D-loop (16051G, 16140C, 16209C, 16422C, 16519C, 194T), two of which are present in subhaplogroup C1d, as well as three mutations in the coding region (12378T, 14992C, 15662G),

not shared. Two facts are surprising: 1. despite the high quantity of mutations related to C1 or C1d, the lineage seems to be restricted to Uruguay; and 2. at least four individuals living at present—one of them, previously published—as well as an historical Charrua Indian, share several characteristics of this lineage, being derived from it.

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Patterns of nursing and allonursing in white-faced Capuchins (*Cebus capucinus*)

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Lactation is the most energetically expensive reproductive state for primates. Therefore, it is expected that females should restrict nursing access to infants that are not their own. Yet, capuchins are known to allonurse regularly and the reason for this high frequency remains unclear. Using focal follows and *ad libitum* data I observed patterns of allonursing in white-faced capuchins (21 infants, 6 groups) at Sector Santa Rosa, Costa Rica. We then examined the effects of kinship, rank, female lactation status and parity status of allonurse-infant dyads using GLMM models.

Nursing bouts (n=1042) were significantly longer and overall rates higher than allonursing bouts (n=215) (Duration: $F_{1,1253} = 109.32$, $p = 0.001$; Rate: $F_{1,178} = 94.13$, $p = 0.001$). Rates of allonursing were higher for lactating females compared to non-lactating females ($F_{1,161} = 26.088$, $p = 0.001$). Allonursing bouts were significantly longer for lactating and parous females (Lactation: $F_{1,211} = 10.570$, $p = 0.001$; Parity: $F_{1,213} = 8.158$, $p = 0.005$). Rank and kinship did not affect the rate or duration of allonursing bouts.

Higher rates and longer bouts exhibited by lactating allonurse-infant dyads suggest that obtaining milk is the infant's goal. In turn, females may be more receptive of an allonursing attempt if their infants are then able to allonurse freely from other females. This study provides a more in depth analysis of patterns of allonursing in this species than we have had in the past and contributes additional knowledge for this genus, and for primates in general.

We would like to thank Dr. Linda Fedigan's NSERC grant and the Canada Research Chairs Program for funding this study.

Should I stay or should I go now? How social, developmental and ecological factors influence patterns of male and female dispersal in a wild ring-tailed lemur population

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Documenting patterns of dispersal in natural primate populations is essential for providing insight into interindividual variation in reproductive strategies and life history. Using ten years of demographic data from wild ring-tailed lemurs at the Beza Mahafaly Special Reserve in

Madagascar, it is now possible to explore how ecology, growth and development as well as social factors may influence migration in this strepsirrhine primate. A total of 190 dispersal or disappearances were recorded. Patterns of dispersal differed by sex, season, age and year. Of dispersals into known groups 53% were male and 7% were female transfers. Although dispersal occurred throughout the year, the majority of transfers occurred during either the birth or weaning season for both males and females. Natal males also followed this pattern, but here the majority of migrations (60%) were with at least one male partner. Conversely, only 14% of non-natal males migrated with another partner. Natal males also differed from non-natal males in average tenure, remaining in their new troop 4.25 years compared to only 2.56 years for non-natal males. Average age of first natal male transfers was 3.82 years and may be linked to growth and developmental factors such as canine eruption. Ecological factors may affect male transfer patterns with an especially high number of transfers occurring after a major cyclone that reduced food availability and was linked to a high mortality pattern among females. Results indicate that although rare, female dispersal does occur in this species and may also be linked to ecological factors.

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A new classification system for assessing morphological variation in lumbosacral transitional vertebrae

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Developmental shifts in Hox gene expression at the L5-S1 boundary can result in lumbosacral transitional vertebrae (LSTV) which exhibit both lumbar and sacral characteristics. Variation in LSTV morphology has been linked to changes in spinal biomechanics, and is commonly considered a risk factor for low back pain (Bertolotti's syndrome). Current classification systems for assessing LSTV have proven problematic, both morphologically and clinically, as they fail to account for the functional implications of variation in LSTV anatomy. Here we present a new classification system which assesses LSTV morphology based on 1) presence of pseudoapophysis or fusion of the vertebral element, 2) pattern of unilateral or bilateral fusion/pseudoapophysis, and 3) the number of lumbar motion segments. This system thus assesses variation in LSTV morphology with consideration for lumbosacral biomechanics. This methodology was applied to 2803 adult skeletons in the Hamann-Todd Osteological Collection, revealing the presence of LSTV in 196 individuals (approximately 7% of the total collection). Among the affected skeletons, 10 out of the system's 12 possible categories were identified, confirming a high degree of variability in LSTV morphology. Moreover, these 10 LSTV categories were found to be relatively evenly distributed across the

affected sample, with no category constituting more than 21% of the sample and only two categories exhibiting frequencies less than 7%. Intriguingly, metric dimensions of specific vertebral elements (L5, S1, etc.) were found to significantly differ among LSTV categories, suggesting that certain LSTV categories may more severely impact spinal biomechanics, with potentially important clinical ramifications.

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Resource utilization and home range overlap in territorial owl monkeys of Argentina

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Territorial behavior generally occurs when resources are economically defensible and in such limited supply that their defense is beneficial. Owl monkeys are territorial and live in socially monogamous groups of two to six individuals, all of whom participate in aggressive intergroup encounters. Despite apparent territoriality, there can be significant home range overlap between groups. We investigated how resource availability and distribution may influence home range use and defensibility for four groups of Azara's owl monkeys (*Aotus azarai*) inhabiting the gallery forest of Formosa, Argentina. We determined the percentage of each home range shared among groups and assessed feeding and sleeping tree abundance and distribution in the exclusive and overlap portions of each home range. Using kernel density estimates, we determined home range size (95% volume contours) and the extent of overlap for two winters. During 2008, on average, exclusive areas comprised 79% (72 – 87%) of each group's total home range, containing 70% of the feeding and 83% of the sleeping trees used by groups. In 2009, following a severe drought, exclusive areas comprised 93% (91 – 94%) of home ranges, containing 95% of feeding and 98% of sleeping trees. The greater proportion of feeding and sleeping trees found in exclusive areas in 2009 is likely due to the reduced home range overlap during that year. Given that 2009 was a drier year with lower preferred food availability, our results suggest that a reduction in resource availability is associated with reduced territory sharing, possibly due to more intense resource defense.

Mid-Holocene population dynamics in eastern Africa: New dental evidence from megalithic "pillar sites" west of Lake Turkana, NW Kenya

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Excavations at pillar sites west of Lake Turkana (2012 and 2013) yielded skeletal remains that provide new information on regional population relationships during the mid-Holocene. Pillar sites are known on both sides of Lake Turkana; they have linear arrangements of columnar megaliths of basalt and sandstone associated with platforms, stone circles, and/or cairns. Dating suggests construction and use 5270 – 4825 cal BP, with activity at several key sites occurring in the short span of 4868-4825 cal BP.

This study compares mesodistal and buccolingual diameters of M¹, M², M₁, and M₂ from pillar site burials (n=15 dentitions, 107 teeth) to tooth measurements from Later Stone Age (LSA) human remains in southern Africa (n=72, 310), North Africa (n=60, 322), and early Holocene West Turkana (n=11, 63). Because tooth dimensions are highly inheritable and preserve well in archaeological contexts, they are an important tool for investigating population relationships. Measurements are from left molars (antimeres substituted where possible for missing data), sexes pooled. Dental wear is typically slight on this sample. Principal components and canonical variates analyses show a separation between the early and mid-Holocene Turkana samples, suggesting different populations lived in the region. Cluster analysis groups the pillar site sample most closely with the southern African LSA sample. This is not correlated with greater temporal proximity ($r = 0.27$ $p > 0.05$), but rather reflects biological similarity. These results have bearing on human migrations in and out of eastern Africa, as well as how pastoralism may have been introduced to the region.

Socially facilitated *E. coli* transmission in ringtailed lemurs (*Lemur catta*): Social relationships that promote and prevent the spread of disease

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Mechanisms of transmission are environmental and social in nature. However, few studies focus on how social behavior influences pathogen transmission and none, to our knowledge, test this relationship directly by incorporating both documentation of social interactions and genetic differentiation of pathogen strains. Although existing research provides evidence that social interactions do cause disease transmission, there are no published data that elucidate *how* these interactions contribute to fine-scale transmission dynamics within and between groups. Specifically, what are the characteristics of relationships that predictably promote transmission and those that fail to promote transmission? The distribution of these relationships within a social unit can potentially allow the identification of species that are

particularly vulnerable to disease. We present an approach that incorporates the documentation of host social behavior and differentiation of a pathogen to elucidate the role of social interaction in the transmission dynamics of ringtailed lemurs. Differentiating many bacterial strains using standard multi-locus sequencing methods is unrealistic because it requires the isolation of each individual strain. We therefore propose the use of fecal *E. coli* as a model bacterial organism in the study of socially facilitated transmission because we can employ a novel 1-locus sequencing approach that solves this methodological problem. Furthermore, all ringtailed lemurs tested from Duke Lemur Center harbor *E. coli*, which makes it possible to infer patterns of transmission among *all* group members, and not just those with an occasional pathogen. This approach can be a powerful tool to elucidate expected patterns of transmission within and among social groups.

Dental chipping in subfossil Lemurs

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Dietary reconstruction has focused on dental structure, dental microwear and isotope analysis; these methods can be complemented with dental chipping frequencies. Dental chipping occurs near the occlusal edge during feeding on large hard objects. Rarely eaten foods (e.g. fallback foods) may be missed by dental microwear and isotopic analysis as wear patterns and isotopic signals can be overwritten by more commonly consumed foods. Thus, analysis of dental chipping patterns can record rarer feeding habits. Chipping has been reported in several haplorhine species, but no information on dental chipping is presently available for strepsirrhines. The current study fills this gap. Previous studies have suggested some seed-predation for several subfossil lemur species. Large hard object feeding has been proposed for *Archaeolemur* and *Hadropithecus* though recent stable carbon isotope data for *Hadropithecus* has contradicted this. We predict that dental chipping will be present in *Archaeolemur* even if hard object feeding was a rare event. The occlusal surface of 459 post-canine teeth of subfossil lemurs (*Pachylemur*, *Archaeolemur*, *Hadropithecus*, *Palaeopropithecus*, and *Megaladapis*) was visually examined with and without magnification. No dental chips were observed on the occlusal surface of any of the post-canine teeth. Dental chipping requires high vertical bite force on large hard objects. The larger subfossil lemur species could generate the high bite force necessary for teeth to chip, but some, (e.g. *Megaladapis*) directed force more laterally instead of vertically. It is also possible that chipping from large hard objects was rare in subfossil lemur species and thus not captured in our sample.

Evolution of the *HERC2* eye color gene in Europeans using linkage disequilibrium analysis in four human populations

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During the course of developing SNP assays for the determination of eye color, it was decided to evaluate if a haplotype at the *HERC2* locus would provide more discriminatory power than individual SNPs. The SNP rs1291382 provided significant information in Europeans on the prediction of blue eye color (G,G), and was the primary discriminator of eye color. It was decided to add the SNP rs916977 (C,T), which is 147,746 bp downstream from rs1291382.

Substitutions were coded as ancestral if they were the same as the predominant African allele (1 = A for rs1291382 and T for rs916977) or derived if found in other populations (3 = G for rs1291382 and C for rs916977), yielding four possible haplotypes: 1 1, 1 3, 3 1 and 3 3. A total of 1,844 haplotypes were identified among Europeans (part of the eye color cohort N=380), African Americans (N=500), Southwest US Hispanics (N=462) and East Asians (502). All populations showed significant LD between the two SNPs, with the exception of East Asians where LD could not be calculated due to too few haplotypes. Significant heterogeneity was found among the four populations for the haplotypes detected ($X^2=1,274.59$, 6 df, $p<0.0001$).

The most significant observation, from an evolutionary standpoint, is that the *HERC2* haplotype associated with blue eyes occurred when the minor haplotype 1 3 (African American frequency of 0.033) became 3 3 (European frequency 0.718). Also, the haplotype 3 1 does not appear to exist.

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Casts and endocasts: The enduring legacy of Zhoukoudian

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The providential production of casts of the Zhoukoudian (ZKD) material ensured that we have an enduring record of those lost materials. The use of casts, combined with newer technologies for digital scanning and modeling, makes continued analysis of the Zhoukoudian material both possible and informative. The site provides one of the largest assemblages of *Homo erectus* spanning a fairly constrained time span (>0.80 to >0.40 Ma, Shen *et al.* 2001, 2009). Zhoukoudian is therefore a critical component of studies assessing variability in the species in comparison with other contemporaneous taxa. This has been particularly true of brain evolution studies. Several ZKD endocasts were made by Weidenreich (ZKD II, III, X, XI, XII), and subsequent work by YY Zhang (ZKD V) increased the available sample to six. Recent reconstructions of other Chinese specimens (Hexian, Hulu Cave or Nanjing 1) bring the total of Asian *erectus sensu lato* endocasts to 15.

Bivariate plots of basic dimensions of the ZKD endocasts reveal, as expected, some linear increases in brain size over time. However, PCA analyses of nine log measures and eight ratio measures for a larger Asian and African fossil dataset (n=17) with a modern Chinese comparative sample illustrate the diversity in the ZKD endocasts, suggesting selective expansion of certain brain areas, rather than generalized size increase, as well as the lack of a geographical pattern distinguishing the Asian from the African specimens.

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Semi-automatic soft-tissue reconstruction of the human nose

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Most contemporary computer-driven approaches of craniofacial reconstruction try to model the facial surface based on information from the complete head (usually data from CT or MRT). While the osseous substructure of the nasal area is a relatively small part of the skull, the soft-tissue nose is a very prominent feature of the human face. This discrepancy might lead to larger prediction errors within this area by methods estimating the facial surface as a whole. The development of a nose-specific procedure can solve this problem and the concentration on a specific sub-structure might reveal correlations that are underrated in reconstructions based on global similarity measures. Another issue can be addressed by estimating the facial surface from substructures: As most data derive from hospitals, the region of interest is usually restricted to pathologically affected areas and complete head-scans are very rare. Exploiting data of specific areas of the head separately may increase prediction accuracy due to larger databases. Solutions are presented to tackle the problem of predicting nasal soft-tissue shape based on the shape of the underlying bone. The data consist of 560 CT-scans of the human mid-facial area, acquired from European and Chinese patients. The surface is parametrized by dense sets of semi-landmarks and a procedure is presented to estimate the nasal soft-tissue surface from the underlying bone by applying Partial-Least-Squares Regression. The model's validity is tested by section-wise cross-validation and the overall prediction error assessed by calculating the distances between the estimated and the true surfaces.

Intraskelletal covariation of morphological and compositional traits

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Previous investigations found robustness (transverse size relative to bone length) of select long bones to significantly covary with cortical tissue mineral density (Ct.TMD) and cortical area (Ct.Ar); maximizing stiffness while minimizing mass. How these traits covary across bones, and whether Ct.TMD and Ct.Ar

adequately compensate for robustness consistently across bones is unknown.

Using pQCT, covariance among robustness, Ct.Ar, and Ct.TMD was assessed throughout the appendicular skeleton of 115 male and female young adult cadavers. Significant covariance between traits within all bones was observed. Slender bones were predictably 5-8% higher in Ct.TMD and 25-50% lower in Ct.Ar compared to robust bones. The attainment of similar trait sets was consistent throughout the skeleton irrespective of body size and the weight-bearing status of the bone, with individuals with more/less Ct.Ar or higher/lower Ct.TMD in one long bone demonstrating the same variation throughout their skeleton. Additionally, Ct.TMD ($r = 0.79-0.66$, $p < 0.0001$) and Ct.Ar ($r = 0.71-0.29$, $p < 0.05$) significantly and predictably varied across skeletal elements, regardless of body size and robustness, with bones that were slender being as much as 3x less stiff for body size compared to those that were more robust ($r^2 = 0.52-0.79$, $p < 0.0001$).

Finding that robustness trait sets naturally vary among individuals in a systemic fashion warrants consideration of trait covariance when assessing skeletal function among and across populations, as there may be intrinsic limitations to the functional adaptation process responsible for diminished bone accrual and the natural variance of bone strength.

Heritability of obesogenic growth trajectories during development in captive vervet monkeys (*Chlorocebus aethiops sabaues*)

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Increasing evidence points to the importance of early development in adult obesity, yet few studies have been undertaken of developmental measures that might be associated with this process. This research investigates the genetic underpinnings of obesogenic growth from birth through adulthood in a genetically well-characterized model under a controlled diet and environment: the vervet monkey (*Chlorocebus aethiops sabaues*) in the Vervet Research Colony at Wake Forest School of Medicine. Measures of body composition – body weight (BW), crown-to-rump length (CRL), waist circumference (WC) – were collected thrice yearly in a population of 560 vervets from 2000 through 2013. 59 adults (8 M and 51 F), showed chronic abdominal obesity – an adult WC above 40.5 cm for > 3 successive measurements. Growth was modeled with three-parameter logistic growth curves using nonlinear mixed effects, with parameters modeled as fixed effects and subject and sex/obesity modeled as random effects. We assessed heritability of growth parameters using maximum likelihood variance components analysis in SOLAR. Although sex alone

influenced CRL, we found marked effects of both sex and obesity status on all parameters of growth in BW. For both traits, growth parameters were highly and significantly heritable, with sex as a significant covariate (e.g., BW: θ_1 , $h^2 = 0.78$, $p < 0.0001$; θ_2 , $h^2 = 0.39$, $p < 0.0001$; θ_3 , $h^2 = 0.10$, $p < 0.01$). These results suggest that adult obesity is, in part, the outcome of developmental processes driven by heritable obesogenic trajectories, with faster and longer growth leading to larger adult size.

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Limb anatomy influences swing duration and angular velocity: Implications for understanding primate locomotor adaptations

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To understand the functional correlates of diversity in limb length, mass, and weight distribution among mammals, most biomechanical studies have focused on stance phase mechanics, while swing phase has remained relatively understudied. Previous studies have shown that as animals move faster the stance period shortens while the swing period stays relatively constant. This suggests that mechanical qualities, such as limb length and mass distribution, constrain swing timing and can influence animal velocity and energetic costs. Primates—with relatively more distal weight distribution associated with prehensile hands and feet—may experience longer swing periods compared to other mammals. We tested this hypothesis by calculating swing period from videorecords for a wide range of mammals, including humans, dogs, cats, kinkajous, coatis, lemurs, squirrel monkeys and callitrichids. In every species in our sample stance duration decreases with increasing speed and swing duration remains nearly constant. When absolute swing durations are compared, most species were identical, although dogs and marmosets showed significantly shorter absolute swing durations than other mammals. This similarity in swing period (in spite of differences in limb length) leads to differences in angular velocity, and thus, muscular effort needed to accelerate and decelerate the limb. Although relatively longer limbs and grasping cheiridia may provide benefits for increasing stride length and stability, such anatomy may also constrain speed, influence speeds at which gait transitions occur, and increase costs of locomotion. Understanding the relative costs and benefits of different limb anatomies allows a better understanding of selective pressures driving morphological evolution in primates.

Using a white light confocal profiler for cut mark analysis

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The current study employs a white light confocal profiler (WLCP) to analyze cut marks on a prehistoric bone to determine if they were made with stone (i.e., ancient) or steel (i.e., modern) tools. The unknown in this case is a 5,300-year-old, 5 cm cranial fragment with cuts consistent with scalping but which came from a site damaged by a modern auger. The cranial fragment cuts were compared to experimental cuts made on cow bone with a bifacial chert knife, unworked chert flake, unworked slate, sharpened slate, a bifacial steel knife, a serrate steak knife, and a trowel. Experimental cuts were made perpendicular to the long axis of the bone holding the implement vertically; for this study force was deliberately not standardized. Data collection commenced at 20X magnification; we generated three profiles for each cut using SolarMap® software. Steel tools created deep, narrow cuts ranging from ~10 to 100 microns in width and had starkly flat kerf floors. The exception was the trowel, which made wide scratches around 200 microns across, but their floors were flat. The stone tools created shallow, wide cuts that measured between 110-250 microns wide with rounded kerf floors. The cranial fragment cuts were wide and shallow, were ~230 microns wide, and had distinctly rounded floors. Thus, they appear to be ancient. Although preliminary because quantification and standardization need to be developed, it is clear that a WLCP can ably assist with cut mark study.

Assessing diet specialization of Hadza microbiota through activity and composition

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In this study we used the TNO in-vitro intestinal model (TIM-2) to replicate fermentation of wild African tubers consumed by the Hadza hunter-gatherers of Tanzania to learn about microbial activity and metabolite production that may play a role in host health and nutrition. The TIM-2 replicates the large intestine through a tightly regulated computer-controlled environment in which fermentation takes place. This enables non-invasive techniques for studying human physiology as a dynamic and living environment. The TIM-2 was inoculated with microbiota derived directly from two human fecal sample sources: Hadza and European adults. Test compounds (food) included three Hadza tubers, sweet potato, resistant starch and an in-house carbohydrate solution. Tubers were tested both raw and briefly roasted. Lumen and dialysate were sampled every 24-hours for microbiota and metabolite production respectively. Metabolites measured included short chain fatty acids (SCFAs), branched chain fatty acids (BCFAs), lactate, and ammonia. The activity of the microbial communities displayed unique qualities both between test compounds and between communities. The test compounds containing

starch and carbohydrates were characterized by high production of acids, an indication of fermentation, lowering of pH, and low production of other metabolites. In contrast, where acid production did not occur, ammonia production denoted a shift in microbial metabolism. We present the findings for each trial and discuss how they relate to microbial adaptations to different diets. This work is important for understanding how microbiota can confer advantages for the host absent macroscopic adaptations.

Inferences about prefrontal cortex size in humans from motor and premotor area scaling relationships

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Disproportionate increased size of particular areas of the human brain, as assessed relative to trends found among primates, suggests that behaviors mediated in those areas have been particularly important during human evolution. One area that has been the focus of several studies is the prefrontal cortex. Early data by Brodmann suggested that it was approximately twice as large as would be predicted for a primate neocortex as large as ours. These data have been called into question recently partly because they do not fit expectations reported from more recent studies. The entire frontal lobe, which includes primary motor (Brodmann area 4) and premotor (Brodmann area 6) areas in addition to the prefrontal cortex, is apparently as large as would be predicted for a brain as large as ours. However, if the prefrontal lobe is in fact disproportionately large, then areas 4 and 6 would therefore necessarily have to be disproportionately small. Data from the literature on the sizes of areas 4 and 6 in a small sample of primates (Glezer 1958) was used to assess this question. The results show that these areas are indeed disproportionately small: area 4 is only ~32% as large as predicted, and area 6 is only ~72% as large as predicted. However, the prediction intervals do not exclude the human data, possibly because sample size is so small (N=7 including humans). It is argued that a consideration of all published studies relevant to prefrontal size suggests that it is indeed particularly large in humans.

Infanticides during a socially stable period in wild white-faced capuchin monkeys (*Cebus capucinus*)

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Infanticide occurs in a range of primate species, usually in the context of intergroup encounters, group takeovers, or following changes to the male dominance hierarchy. Here

we report on two infanticides – one observed and one inferred – during a socially stable period in one group from the Santa Rosa, Costa Rica population of white-faced capuchins (*Cebus capucinus*). We evaluate the sexually selected infanticide (SSI) hypothesis using a combination of behavioral, genetic, and hormonal data. We also consider the epiphenomenal aggression hypothesis, social pathology hypothesis, nutritive benefits of cannibalism hypothesis, and limited resources hypothesis. The group contained 8 adult and subadult males, 10 adult females, 12 juveniles, and 4 infants. In support of the SSI hypothesis, the infanticidal male did not sire the infant, both infants were unweaned (<3 months), both mothers resumed ovarian cycling within four months of the infanticide (based on progesterone and estradiol patterns), and one mother had a reduced interbirth interval (<9 months vs. mean IBI=27 months; the other female disappeared after the infanticide). Inconsistent with the SSI hypothesis, both infanticides occurred during a period of stability in the male dominance hierarchy, the infanticidal male was closely related to the infants ($R=0.5$), he did not engage in sociosexual behavior with either mother, and he did not sire the subsequent infant; instead, the alpha male sired the deceased infants and also the subsequent one. Overall, we found mixed evidence in support of the SSI hypothesis and little evidence in support of the alternate hypotheses.

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Enacting Egyptian colonialism: A comparison of enthesal changes between the C-Group and Pharaonic samples

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The C-Group, an indigenous Lower Nubian population, maintained unique cultural traditions in the Nile Valley for centuries (c. 2,400-1,450 BC). At the onset of the New Kingdom Period (1,550-1,069 BC) the Egyptian Empire conquered Nubia and enforced colonization practices, which impacted C-Group lifeways considerably. Bioarchaeological evidence suggests that some C-Group individuals became increasingly transcultural and were buried according to Egyptian funerary tradition (a.k.a. Pharaonic). Other C-Group individuals maintained traditional identities until the 15th century BC, when the C-Group culture ceases. This research examines broad changes in physical activity between the C-Group ($n=152$) and Pharaonic ($n=31$) samples as a product of colonization. By comparing the C-Group sample, the majority of which predates the Egyptian Empire, and the Pharaonic sample, which includes both transcultured individuals of the C-Group as well as Egyptians, we can begin to discern the impact of imperialism in the region.

Of the 34 entheses examined, 8 were found to be significantly higher in the C-Group sample. Similar results were also found in contemporary comparative samples. These data suggest that the C-Group population were engaged in activities that were more physically strenuous than the Pharaonic population. This may be due to

increased economic networks that were instituted with imperial expansion and/or significant changes to the traditional agropastoral lifestyle. Furthermore, this research supports the notion that imperialism may not have adversely impacted Nubia as was once assumed; rather, interaction between Egyptians and Nubians during the New Kingdom Period may have been positive, encouraging interaction, exchange, and coexistence.

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Development of feeding and social behavior in wild mantled howler monkeys (*Alouatta palliata*)

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The juvenile period is a risky developmental stage in which individuals must both ensure survival and gain the skills necessary to survive and reproduce during adulthood. In this study we examined the contrast between the development of feeding and social behavior in a population of mantled howler monkeys (*Alouatta palliata*) on Ometepe Island, Nicaragua. We hypothesized that juveniles would feed more frequently than adults because they lack extensive knowledge of preferred foods and their masticatory apparatus has not yet developed adequate strength to process their highly folivorous diet. We also hypothesized that juveniles would associate most frequently with age mates in order to practice social behaviors and avoid adversarial relationships with adults. In July and August 2013, we conducted instantaneous scan sampling of focal individuals, including adults, juveniles, and infants, and collected a total of 60 hours of data. We recorded activity (feeding, rest, travel) and nearest neighbor. Our results show that juveniles fed less frequently than adult males and adult females, but more frequently than infants. Juveniles associated most frequently with adult females, and rarely associated with other juveniles, infants, or adult males. This pattern of association contrasts considerably with that of adult males, who associated most frequently with adult females and rarely with any other age/sex class, and adult females, who associated most frequently with infants and juveniles. These findings suggest that juveniles are sufficiently competent at feeding and foraging, but have not yet transitioned away from strong associations with their mothers.

Modeling macroevolutionary trends in hominin postcanines through the inhibitory cascade

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The inhibitory cascade is a macroevolutionary model that describes changes in relative postcanine sizes and how these changes may relate to dietary adaptation. It has been robustly tested in rodents, ungulates, and carnivores and may be useful for interpreting morphological

trends observed in fossil hominins. However, the inhibitory cascade has not yet been robustly tested in primates. This study examines relative postcanine sizes in the mandibular dentitions of 17 extant primate genera ($N>400$) and three fossil hominin genera ($N=53$). Occlusal diameters were measured and used to approximate postcanine sizes. Relative sizes were then analyzed in the context of a general inhibitory cascade for mammals. The results show that non-human extant primates consistently fit the general inhibitory cascade. However, a few fossil hominins – notably *Paranthropus boisei* – do not follow the general cascade and have unusually large M_{2S} compared to their M_{1S} . Results also indicate that relative postcanine sizes in cercopithecoids and hominoids differ in their specific cascade patterns. While cercopithecoids are best described by relative sizes of $M_1<M_2<M_3$, hominoids are best described by relative sizes of $M_1<M_2\approx M_3$. Hominoids as a whole may exhibit a derived cascade in which there is more inhibition (or less activation) acting on their posterior molars, making it increasingly likely for small M_{3S} to evolve within this clade. This study demonstrates that the inhibitory cascade adequately describes relative postcanine sizes in extant primates and may therefore be a powerful tool for interpreting the derivation of dental traits in fossil hominins.

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Insights into the evolutionary history of leprosy

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Leprosy, one of the oldest recorded and most feared diseases in human history, is caused by the bacillus *Mycobacterium leprae*. The successful de novo reconstruction of *M. leprae* genomes from medieval skeletons and modern biopsy samples revealed an exceptional DNA preservation of the pathogen DNA as well as a relatively low mutation rate compared to other pathogens. This opens the possibility to obtain additional insights into the evolutionary history of *M. leprae* and the opportunity to trace back its pre-historic origins. This study provides an overview over the evolutionary history of *M. leprae* during the last 1500 years including novel genome-wide data of an early medieval strain. A phylogenetic comparison of ancient and modern strains reveals a pre-medieval origin of most contemporary human and armadillo leprosy lineages. The most basal lineages are present in Asia today pointing to an Asian origin of the disease. Using radiocarbon dates of the skeletons as tip calibrations in a Bayesian framework analysis changes in mutation rates over the last 1500 years are estimated in order to calculate the most recent common ancestor of all so far studied *M. leprae* strains.

How sociality affects independent exploration: Evidence gathered in two populations of wild orangutans

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Previous studies have shown that wild immature orangutans learn many of their subsistence skills (e.g. in the feeding context) through social learning, in which observational learning in the form of peering (i.e. attentive close-range watching for over 5 seconds) seems to be means to skill acquisition. However, independent exploration also seems to play an important role in the learning process. Here we investigate how social learning and independent exploration are interconnected by looking at indicators for social learning and independent exploration in two populations of wild orangutans.

First of all, we find that sociality directly (proximately) affects independent exploration since rates of explorative behaviors increase with party size. Furthermore, social learning is integrated with independent exploration into a "peering-practicing cycle" during which the immatures try to replicate the observed behavior: For complex behaviors, (i.e. extractive foraging) peering is followed by significantly increased rates of explorative behavior.

These results suggest that differences in sociality between populations may also indirectly (ultimately) affect levels of independent exploration since rates of explorative behaviors are considerably higher in the more gregarious Suaq (Sumatra) population compared to the less gregarious Tuanan (Borneo) population. Direct comparison further shows that immatures at Suaq not only have more opportunities for social learning but also peer more frequently than immatures at Tuanan. Consistently, the repertoire of socially learned feeding skills is higher at Suaq than at Tuanan.

Our study shows that sociality and opportunities for social learning affect rates of innovations and also how easily innovations spread through a population.

Isotopic variation in Gibraltar Macaques: Further explorations of differences between and within sites, and over time

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Stable carbon- and nitrogen-isotope ratios of hair from 135 Barbary macaques (*Macaca sylvanus*) living in five groups in Upper Rock Nature Reserve, Gibraltar showed that the macaques ate predominately C3 diets and that there were statistically significant differences in the stable isotope ratios (and hence of the diets) between groups that was correlated with the intensity of group interaction with tourists. Four groups with the greatest contact with tourists had diets slightly but significantly enriched in ¹³C

and ¹⁵N compared to one group that was largely isolated from tourists. The isotopic differences suggest the macaques interacting with tourists consumed more commercially-produced agricultural products (including perhaps peanuts) and C4 foods, probably from human snack foods. Isotope ratios not only provide information about diet, they can also serve as a proxy measure for intensity of human interaction when humans provide foods that are isotopically different from those that can be foraged from the local environment.

In this poster, we expand the sample of 135 individuals with isotope ratios from an additional 38 macaques to create a larger sample size that supplements the inter-site comparisons to explore intra-group variation based on age and sex. We also explore longitudinal variation over time in a subset of individuals. The isotopic patterns are contextualized using an extensive record of field observations of macaque behavior and GPS tracking of individuals.

Analysis of Y-chromosome diversity in indigenous Mexican populations reveals complex paternal haplogroup structure in the New World

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Studies of Y-chromosome diversity in Native American populations have shown that several paternal haplogroups are present in the New World. These include Q-L54, Q-M3, and C3c. While C3c is confined to North America, the other two lineages are widespread across both continents, with Q-M3 being the dominant haplogroup in South America. Recent work has also revealed additional, younger branches of haplogroup Q (Q-MEH2, Q-NWT01 [Q1a6], Q-P89 [Q1a5]) in North America, suggesting they arose and expanded into the circumarctic region after the initial colonization of the Americas. However, much less is known about Y-chromosome diversity in indigenous Mexican populations, which represent a key region of human settlement in the Americas. An initial analysis revealed the prevalence of Q-L54 and Q-M3 haplotypes in Native Mexicans, with none of them exhibiting SNPs seen in derived Q-M3 haplotypes in South American Indian groups, such as M19, M194, M199, and SA01. Subsequent work indicated that Y-SNPs identified in Native North Americans from the

US and Canada, were also not present in indigenous Mexican populations. By contrast, SNP analyses detected through re-sequencing of Mexican-American Y-chromosomes revealed that new and geographically unique branches of Q-L54 and Q-M3 exist among these groups. These results suggest that additional founding paternal lineages are present in the Americas, thus adding complexity to models of the peopling of the Americas. They further imply that Native Mexican Y-chromosomes have diverged from those appearing in indigenous populations from North and South America since the settlement of Mesoamerica.

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The dental morphology of Yupik-speaking Eskimos in a broader Arctic and New World context

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Arctic populations have been studied extensively for nonmetric crown and root trait variation by pioneers in the field of dental anthropology, including P.O. Pedersen, A.A. Dahlberg, C.F. A. Moorrees and C.G. Turner II. The majority of these studies have focused on Aleuts and Inupiaq-speaking Inuit populations in Greenland, Canada, Northern Alaska, and the Aleutians. To put Yupik-speaking Eskimos into a broader Arctic perspective, morphological observations were made on Nunivak Islanders, St. Lawrence Islanders, and Kodiak Islanders. Contrary to most biodistance studies that align Aleuts with Eskimos, the inclusion of Yupik groups generates a different tree. Yupik samples, and an Inupiaq group on the Inupiaq-Yupik boundary, cluster together while Aleuts aggregate with Northeast Siberians, Athapaskans, and Northwest Coast groups. This result parallels the findings of Nancy Ossenberg on nonmetric cranial traits. Two key traits that set the Eskimo cluster apart from other world groups are high frequencies of three-rooted lower first molars and three-cusped upper second molars. Two traits that separate American Indians from Eskimos and Aleuts are central incisor winging and shovelings, which are more common and pronounced in American Indians.

Is timing everything? Late versus early developmental effects of changes in dietary properties on jaw growth in an animal model

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It is widely held that the ability of an individual's skeletal phenotype to change in response to environmental stimuli decreases as development proceeds. Here we report the results of a long-term plasticity experiment that tested this hypothesis with respect to jaw growth and

variation in dietary properties in an animal model. We obtained 30 five-week-old weanling rabbits and separated them into three cohorts: *control* rabbits, fed a relatively easy-to-process diet of rabbit pellets, and two experimental tough-diet groups fed pellets supplemented with three hay cubes daily, one given hay during weeks 1–6 (*early* rabbits) and one given hay during weeks 19–24, when skeletal maturity was achieved (*late* rabbits). Rabbits were micro-CT imaged longitudinally at two-week intervals. From these scans, we obtained bone cross-sectional areas at four sites on the mandible (symphysis, condyle, corpus) and cranium (palate) involved in force resistance during chewing. Measurements were size-adjusted using shape ratios computed with cranial length as the denominator. Prior to onset of hay supplementation, neither experimental group differed statistically from the *controls*. At week 6, *early* rabbits had greater relative bone areas than controls at all sites. Similarly, at week 24, *late* rabbits differed from *controls* at all sites except the condyle. Notably, the magnitudes of these differences were statistically indistinguishable at homologous sites (except the condyle), indicating similar plastic responses in the two experimental groups. These results suggest that patterns of skeletal plasticity are site-specific, with some traits maintaining relatively constant levels of plasticity throughout development and into early adulthood.

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Spatial determinants of mentum osseum morphology in recent and fossil *Homo sapiens*

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Adaptive dynamics related to masticatory biomechanics have long been used to explain the presence of the mentum osseum in *Homo sapiens*, but recent preliminary studies on extant *H. sapiens* have demonstrated an inverse relationship between chin size and facial prognathism, indicating that the size of the chin likely results from differential growth of the maxilla and mandible. Multiple craniofacial traits that once were thought to have arisen via adaptive selection have since been shown to be related to an overall decrease in facial size and prognathism (e.g., supraorbital torus size, canine fossa presence). The emergence of the projecting chin may also constitute a part of this larger complex of craniofacial spatial changes.

This study tests whether alveolar prognathism can account for variation in chin prominence in adults across a mixed-sex sample of recent and fossil (*i.e.*, Late Pleistocene and Early Holocene) *H. sapiens*. The prediction that chin prominence should be associated with the relative anterior-posterior placement of the maxilla and dentoalveolar complex was tested with 3-D coordinate landmark data subjected to principal components analysis of Procrustes shape variables and thin plate spline analyses. As predicted, chin prominence was positively associated with the anterior-posterior position of the dentoalveolar complex and maxilla. This suggests that chin prominence in both extant and fossil *H. sapiens* is related, at least in part, to lower anterior maxillary growth reduction,

indicating that the presence of the chin, like the supraorbital torus, is related to adaptive morphological selection that occurred elsewhere in the craniofacial skeleton.

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An assessment of phenotypic adaptation of the prehistoric Jomon hunter-gatherers and the Yayoi agriculturalists of Japan: A study of postcranial indices, ratios, and body mass versus eco-geographical variables

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Human body size and shape exhibit considerable global variation and these follow Bergmann's and Allen's rule. Body and limb proportions may shed light on human evolution and ancestral climatic adaptation.

In this study, we explore variation in body and limb proportions between Jomon hunter-gatherers (14,000-2,500 BP) and Yayoi agriculturalists (2,500-1,700BP) of Japan with 12 geographically diverse samples from Africa, Europe, Asia, Australia, and North and South America. Brachial-crunal indices; femur head breadth-femur length ratio; femur head breadth-lower limb length ratio; and body mass are used as indicators of phenotypic climatic adaptation.

Data were subjected to principal components analysis and Manly's permutation regression tests. The principal components analysis of body proportions and limb proportions were used to interpret how those indices, ratios, and body mass contribute to phenotypic adaptation.

The results of Manly tests indicate that body proportions and body mass are significantly correlated with latitude, minimum and maximum temperatures, while limb proportion were not significantly correlate with these climatic variables. Principal components plots separated "climatic zones": tropical populations, temperate populations, and arctic populations. Yayoi people who were recent migrants from Northeast Asia belong to the temperate populations. They show cold-adapted body and limb proportions. On the other hand, the indigenous Jomon show cold-adapted body proportions and warm-adapted limb proportions. As one considers the past climate of Late Pleistocene and Holocene East/Northeast Asia, it could be interpreted that the Jomon may have achieved cold-adapted physiques, and then adapted to a warmer climate before or after migrations to Japan.

Tarsal morphology of *Caenopithecus*, a large adapiform primate from the middle Eocene of Switzerland

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The middle Eocene (MP 13-14) "γ" fissure-fill of Egerkingen, Switzerland, has yielded several gnathic fragments of the enigmatic adapiform *Caenopithecus lemuroides*. These remains have inspired radically different phylogenetic interpretations, with the most prominent hypotheses being that *Caenopithecus* is either a stem strepsirrhine or a stem anthropoid. We have recently identified a primate astragalus and calcaneus in the Egerkingen collections that have compatible articular surfaces, and that are most parsimoniously attributed to *C. lemuroides* on the basis of size and morphology. An astragalus from Egerkingen (Eh. 741) that Stehlin (1916) previously attributed to *C. lemuroides* belongs to a non-primate placental. The astragal body of *Caenopithecus* is intermediate in morphology between those of European *Adapis* and African *Afradapis*, and shows no anthropoid-like features. Automated geometric phenotyping across a sample of 50 living and extinct primate species indicates that the *Caenopithecus* calcaneus is most similar to those of adapines; this result is likely driven by its short distal segment and a strongly inverted long axis of the cuboid facet. The calcaneal body is also mediolaterally bowed as in extant lorises, but differs in having a distally positioned peroneal process (as in notharctids and basal haplorhines). We propose that *Caenopithecus* was a slow and cautious climber, perhaps to a greater extent than any other known European adapiform. A similar locomotor pattern has been inferred for *Afradapis*, a genus that has been placed as a close relative of *Caenopithecus* in multiple phylogenetic analyses. Our findings are entirely consistent with this phylogenetic hypothesis.

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Morphometrics of the elbow relating to fine branch arboreality: Trochlear keel morphology and the proximal ulna

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To study potential cartilage modeling effects on the elbow, we placed ICR/CD-1 mice (Charles River, Wilmington, MA) in one of two groups (n=10 each) from postnatal day 21 to >4 months old. With veterinary and institutional approval, the climbing group was exposed to a habitat where obtaining food, water, and nest space required grasping and fine branch arboreality on 2 mm wide substrates. Control mice did not grasp or climb. Forelimb elements were harvested and elbow size and shape metrics were measured from photographs using ImageJ

(NIH; Bethesda, MD). All metrics were size corrected using a geometric mean of all linear variables and compared using t-tests. A discriminant functions analysis was performed to assess which variables carry the highest factor loadings in discriminating mouse elbows between climbing and control phenotypes. The medial keel of the trochlea at the distal humerus was over 3% larger in the climbing mice ($p < 0.05$) and was the only significantly different linear metric between groups. A single discriminant function successfully classified nine of ten individuals in each group (Eigenvalue=3.54, $R^2=0.77$) and its structure matrix is dominated by medial keel size, with a factor loading (0.353) more than twice as large as all other linear variables. This change in climbers' medial keel size is most likely due to cartilage modeling differences influenced by biomechanical forces unique to this locomotor behavior throughout ontogeny. This demonstrates that certain aspects of elbow joint morphology may not reflect phylogeny, but can be informative as to grasp-climbing behaviors above slender branches.

Maternal mortality and longevity in the past: A paleodemographic approach to understanding risk and survivorship

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The advent of bipedalism combined with selection for larger brains, has made childbirth difficult, painful, and risky for women. As it remains a significant source of mortality in living populations, so must it have been in the past. By examining patterns of mortality in two roughly contemporaneous sub-samples from the Iron Age skeletal collection of Hasanlu, Iran, one attritional/cemetery group ($n=59$) and the other a catastrophic/destruction assemblage ($n=72$), we can discern patterns of risk and survivorship associated with childbirth. Females had a lower life expectancy than males in most age ranges with the exception of females who lived into the 50-64.9 age interval. These individuals increased in life expectancy upon reaching old adulthood. The sex-based difference in mortality can most simply be attributed to risks associated with childbirth, including experiencing multiple pregnancies and older maternal ages. This pattern of lowest female life expectancy in middle age followed by improvement in older age can be found in other attritional archaeological samples as well. This suggests that the women who survived into older adulthood had fundamentally strong constitutions. The genetic underpinnings of longevity are just beginning to be explored; however, it is evident that certain individuals in past populations were able, through luck of circumstance or biological attributes, to live well beyond average life expectancy. The presence of larger numbers of older adults in the attritional Hasanlu sample than in the destruction sample reinforces the Osteological Paradox that individuals, even those with generalized stress indicators, may represent survivors in cemetery populations.

More fiber means more dirt? The role of geophagy in Diademed Sifakas

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Geophagy has been observed in an increasing number of primate species, with six main hypotheses existing regarding its function: 1) toxin adsorption, 2) antacid action, 3) diarrheal alleviation, 4) parasite removal, 5) nutrient supplementation, and 6) altitude-related iron enhancement. We quantified geophagy and diet characteristics of diademed sifakas (*Propithecus diadema*) living in disturbed and undisturbed rainforest habitats at Tsinjoarivo, Madagascar. Geophagy was common (0.44 bouts/day or 33.3 sec/day; 0.30% of daily feeding time), and average bout duration was 76.51 sec. Seasonal variation in geophagy (lean season, 22.5 sec/day; fruiting season, 44.9 sec/day) mirrored variation in total food mass consumed. Foliage, slightly richer in minerals, and fruits, slightly lower in minerals, made up the bulk of the diet during the lean and fruiting seasons, respectively. The toxin adsorption hypothesis is not cleanly supported as geophagy is least common in the season richest in both seeds and leaves and subsequent correlations were weak. Mineral supplementation is not supported; while geophagy is highest during higher fruit consumption, higher overall food intake more than compensates for fruit's lower mineral concentrations. There was a moderate correlation between monthly soil consumption and mass of dry matter consumed ($R^2=0.00-0.56$ for each of 4 groups), but a higher correlation was found with amount of fiber (NDF) consumed ($R^2=0.31-0.73$). It is unclear whether alkaline soils could act as a viable buffer for hindgut fermenters. Further study is necessary to evaluate possible functions in alleviating diarrhea or mitigating parasitism.

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Assessing testability of brain-based hypotheses about Neandertal behavior

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The study of behavior in ancient humans, such as the Neandertals, has sometimes relied upon inferences based on the relative sizes of brain areas. These studies have a large estimation error as applied to fossil samples, particularly when they are based on comparison across species of extant primates. The size of the neocortex relative to overall brain size may be relatively securely estimated with an endocast, but the size of the visual cortex, for example, involves

substantial error, particularly when predicted by means of regression from the orbital volumes of other primates. We consider several major pathways of error that have led to unsupported behavioral inferences about Neandertals from estimates of the relative sizes of brain regions. We show that for realistic values of brain-behavior relationships, both within recent human populations and across primate species, no statistically supportable interpretation of Neandertal behavior can be made from what we know about the sizes and shapes of Neandertal brains. Although information about Neandertal brains may help generate interesting hypotheses, we suggest that testable aspects of Neandertal behavior will be gleaned from archaeological evidence, not indirectly from primate allometric relationships.

New standards of dental formation for permanent mandibular teeth based on radiographic data from the Fels Longitudinal Study

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Dental formation is preferentially used in bioarchaeological and forensic contexts to estimate age-at-death of immature individuals, as it is less susceptible to environmental influences than skeletal growth and development. In clinical contexts it is a valuable indicator of the rate of maturation relative to chronological age. To date, the standards of dental formation by Moorrees, Fanning and Hunt (1963) are the only longitudinal reference sample that extends from birth until adulthood, and are therefore suitable for estimating chronological age (using the age-for-stage approach) or evaluating maturation (stage-for-age approach) in subadults of all ages. However, their utility is limited due to the lack of summary statistics in the original publication.

Here we present a detailed description of dental formation from birth until adulthood in the participants of the Fels Longitudinal Study. We analyzed a sample of 5,855 radiographs from 284 girls and 301 boys, recorded between 1940 and 1982. The subjects' chronological age ranges from 2 weeks postnatal to 18 years. Dental formation of permanent mandibular canines, premolars and molars was scored by a single observer using the Moorrees et al. (1963) 14-stage method. Analyses of the first molar suggest that developmental variability increases through late childhood. Girls exhibit greater variability in attained molar stages than boys during early childhood (1-5 years), but after age 9 years the opposite is true. At most ages, the median stage is the same for boys and girls. When they differ, the median stage in girls is more advanced than in boys.

Female mate choice in mandrills (*Mandrillus sphinx*)

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Mandrills (*Mandrillus sphinx*) are one of the most sexually dimorphic primates and are a poster species for sexual selection. Males are far larger than females, possess exaggerated ornaments including bright colour and a sternal olfactory gland, and show little or no investment in offspring post-mating. We will review what we have learned about sexual selection in mandrills based on long-term studies of a semi-free-ranging colony in Gabon, concentrating on evidence for female mate choice, and highlighting open questions. Behavioural observations show that female mandrills solicit, and accept, matings from multiple males, but show preference for both dominant and colourful males, supporting models of female mate choice for multiple partners, as well for possible direct (infant protection) and indirect (genetic) benefits. Moreover, our recent analyses suggest that male colour is heritable, a key aspect of models of mate choice for indirect benefits. Genetic analysis of the Major Histocompatibility Complex shows that reproduction is biased towards both males that are genetically diverse and those that are genetically dissimilar to the female, providing support for models of female mate choice for indirect benefits in the form of both individual 'good genes' and compatible genes. These patterns may arise from pre-copulatory mate choice, possibly via olfactory communication, as MHC genotype is reflected in volatile odour signals, or from post-copulatory sperm selection. Finally, we will comment briefly on male mate choice, as a comprehensive understanding of the mechanisms of sexual selection requires the study of mate choice in both sexes.

Preliminary study of the sustainability of primate hunting among indigenous Waiwai in the Kanashen Community Owned Conservation Area, Guyana

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Primates are important components of the diet of many Amazonian peoples. However, many researchers have questioned the sustainability of indigenous subsistence hunting. I studied primate hunting by indigenous Waiwai horticulturists in southern Guyana to assess the long-term sustainability of current hunting practices. The Waiwai own and manage the 625,000 ha Kanashen Community Owned Conservation Area (COCA) and are the only indigenous group in Guyana that intensively hunt primates. Approximately 200 Waiwai live in the area, concentrated in the village of Masakenari.

In summer 2013, I conducted line-transect and boat surveys to assess primate densities and accompanied hunters on primate hunts to document primate harvesting practices. Overall encounter rate (2.21 groups/10km) was similar to surveys in non-hunted areas of Guyana. In areas > 5km from Masakenari, regularly hunted primates were common. *Saimiri sciureus*, *Alouatta macconnelli* and *Chiropotes sagulatus* had the highest densities. Within 5km of Masakenari, the density of all primates was low and large bodied species were very rare. Waiwai

hunters regularly hunt six species of primate but the two most preferred species are *Ateles paniscus* and *Chiropotes sagulatus*. Most primate hunting is conducted with shotguns although arrows are used occasionally. Primates are rarely hunted outside of the months of May, June and July.

I used these data to model primate depletion in COCA over a 20 year period. The model suggests current practices are sustainable, due primarily to the extremely low population density in the area. However, more research and long-term monitoring are necessary to validate these results.

Kinematic adjustments to substrate size and orientation during asymmetrical gaits in mouse lemurs (*Microcebus murinus*)

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Ancestral primates most likely relied frequently on asymmetrical gaits, as do other small mammals. As the smallest living primate, the mouse lemur is a suitable model for reconstructing the locomotor mechanisms by which primate ancestors might have responded to the challenges of an arboreal environment. However, previous lab-based studies of mouse lemurs have focused exclusively on symmetrical gaits and/or have been limited with respect to substrate variation, and none included substrates small enough to represent the often cited "small branch niche". We tested whether mouse lemurs (*Microcebus murinus*, n=48 strides) and an arboreal nonprimate mammal of similar body size, *Petaurus breviceps* (sugar glider, n=50 strides) adjust asymmetrical gait limb kinematics in response to changes in substrate size and orientation. Subjects were filmed on horizontal, inclining and declining poles of 2.5, 1.0 and 0.5cm diameter, and on a 10cm wide flat board. When using asymmetrical gaits, mouse lemurs highly preferred transverse gallops on all substrate types, and used bounds or half-bounds only on substrates larger than 1.0 cm. Mouse lemurs enhanced stability on the smaller poles and on declines by significantly lengthening time intervals between leading and trailing limbs, and increasing relative limb pair contact durations. Sugar gliders showed less flexibility in response to substrate variation, and on a given substrate, used higher values of both variables compared to mouse lemurs. These results reveal that small arboreal mammals employ asymmetrical gaits even on very small substrates, and that primates may be more secure using these gaits than other small arboreal mammals.

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Life styles, health and frailty among elderly Slovenians

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Physiological dysregulation occurs in all individuals as they respond to life's stressors. Frailty is a multi-system physiological dysregulation that follows multiple stressors, compounds with age and increases vulnerability to negative health outcomes. Associations of frailty with life styles, biocultural factors, and aspects of health are not fully understood. Elsewhere frailty, as assessed using Walston et al's 5-factor index, is positively related to education, age, sex, and disease prevalence in United States samples. The generalizability of this association to all populations has not been verified. Here we examine whether frailty, as assessed by a modification of Walston et al's index, significantly associates with life style, demographic, and health differences in a sample from a geographically isolated Slovenian locale.

During 2008 and 2009, 40 residents, aged 55 to 85 years (26 women/14 men), of Slovenia's Selska Valley completed a questionnaire to self-report their health, life style, and demographics and participated in assessments of their blood pressure, weight, height, skinfolds and physical abilities. Using linear regression and t-tests, we observed significant associations of frailty with age, being female, height, length of residence in the valley, lower self-reported health, daily pain, feeling tired, low physical activity, negative future health expectations and disagreement with the statement "My health is excellent". After controlling for age and sex, significant associations remained with poor self-reported health, daily pain and low physical activity. Frailty likely is partly determined by life style factors, influences daily activities, and predicts pain among members of this remote population. Funding was provided by The Ohio State University and The Institute of Public Health of The Republic of Slovenia.

Evaluating causes of error in landmark-based data collection using scanners

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Over the last decade, landmark-based 3-dimensional geometric morphometrics (3DGM) utilizing digital scans has become an increasingly integral tool in physical

anthropology and (primate) paleontology. However, there is no consistent protocol for scanning, and the extent to which landmark-based 3DGM studies can potentially suffer from problems of inter- and intraobserver error has not been thoroughly investigated. To assess the precision, accuracy, and repeatability of craniodental landmarks (Types I, II, and III, plus curves of semilandmarks), a single macaque cranium was scanned with three different surface scanners and a microCT scanner. Ten iterations of each scan were landmarked by nine individuals with varying osteological knowledge and 3DGM experience to investigate whether landmarks can be placed at truly homologous points given inherent differences in researcher experience as well as quality of the digital model resulting from different scanners and scanning protocols. Initial results indicate that interobserver error is of far greater concern than inter-scan type error among all individuals and for all scan types. Regarding landmark types, semilandmark curves are much more prone to inter- (and intra-) observer error than most other single point landmarks, though Type III landmarks exhibit predictably high variance. Experience with osteology and morphometrics both positively contribute to accuracy and precision in multiple landmarking sessions, and later iterations in our trials exhibit less variance. We therefore suggest that researchers wishing to utilize digital landmark-based methods should combine data collected by different researchers only with caution and should perform multiple training sessions before collecting data for publication.

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A case of primate rafting and island hopping: Long distance dispersal and successful colonization over open ocean in a volcanic archipelago

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Primates are distributed in Africa, Asia, Madagascar, and the Neotropics. This distribution, combined with chronometric estimates of a crown age of ~71-63 Ma and the timing of the breakup of Gondwanaland, leads many to assume that primates must have reached this distribution in part by rafting. Others find the notion of primates rafting great distances over open ocean and successfully colonizing distant shores to be so utterly incompatible with primate ecology that there must be another explanation, such as ephemeral land bridges and/or primate origins being sufficiently ancient to explain primate biogeography with vicariance alone.

I identify a case of long distance dispersal and successful colonization by rafting and island hopping in the primate species *Tarsius sangirensis* and *T. tumpara*, endemic to Sangihe and Siau Islands, respectively, islands within the Sangihe volcanic arc. The 180m bathymetric contour of Siau and Sulawesi are separated by ~90km, while Siau and Sangihe are similarly separated by ~60km. Both are separated from Sulawesi, and from each other, by oceans that

exceed 1000m in depth. Evidence indicates these species are sister-taxa, relative to the source population. Chronometric analysis indicates a divergence date of 3.4-11.1 Ma: far too old to be the result of human-mitigated dispersal, and far too young to be explained by ephemeral land bridges crossing such deep ocean.

This evidence many not settle the debate whether primates rafted from Africa to South America and Madagascar, but it does settle, conclusively, that rafting and island hopping happened at least once.

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Cranial morphometric variation and human sacrifice at the Epiclassic site of Xaltocan, Mexico

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The Epiclassic period in central Mexico (ca. AD 600-900) is characterized by economic, political, and religious problems due to the emergence of new communities and centers, following the collapse of the Teotihuacan state. Although the adoption or introduction of new forms of material culture has been widely documented, it is unclear whether these changes represent local development by a continuous population or the immigration of different groups into the Basin of Mexico. In the region of Lake Xaltocan, human skeletal remains provide a unique opportunity to address questions concerning population movement and interaction during the Epiclassic period, as well changes in the practice of human sacrifice. In a sample of 40 decapitated skulls, craniofacial variation was assessed with inter-landmark distances via direct measurement, sliding semi-landmarks via photographs, and three-dimensional landmark coordinates via digital surface models, together with ordinal scores on non-metric traits. Morphometric analyses showed a wide range of vault forms, including a large number of crania with antero-posterior modification and a small group of unmodified crania with highly dolichocephalic indices. Across different vault forms, facial patterns were diverse and showed no correlations with patterns of non-metric trait frequencies, dental modifications, or cut marks. Cut marks were observed mainly on the posterior part of the mandibular ramus (either left, right or both), and on the first cervical vertebra, which not only suggests that the decapitations were performed when the soft tissues were present, but distinguishes them from patterns reported at other sites in Mesoamerica.

The effects of sleeping platforms on next day cognition in captive orangutans (*Pongo* spp.)

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It has been hypothesized that with the advent of the Miocene, apes began to manufacture complex sleeping platforms to create more comfortable and stable sleeping environments which resulted in a lengthening of sleep architecture and augmented cognition. The cognitive effects of quality sleep in large bodied hominoids have yet to be tested. We hypothesize that orangutans (*Pongo* spp.) with nightly access to preferential sleeping materials (i.e., bedding hay, cardboard, sheets, blankets, memory foam mattresses, camping pads, comforters, and pillows) will show improved next day cognition. The focal subject was an adult male Azy (35) with previous computer touch-screen and cognitive testing experience. A training block exposed the subjects to different sequences that are all consistent with an artificial grammar (set of rules) and digitally recorded the duration of time following each sequence. The test block, exposed them to randomly introduced sequences that were either consistent with artificial grammar (i.e., grammatical sequences), or were not consistent (i.e., ungrammatical sequences) and recorded duration to completion. Several variables were measured; one variable (correct-touch % measuring the subject's overall accuracy), significantly improved after night access with high quality sleeping materials. Sleep deprivation and/or poor sleeping conditions leads to deleterious effects in humans and this research points suggestively to a similar effect in orangutans. Until further great ape data is generated on the relationship between cognition and sleep quality, we cannot conclude with certainty that the benefits of high quality sleep do not exist in other great apes.

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Female dispersal post-takeover is related to male quality in *Colobus vellerosus*

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Male takeovers affect male tenure and female mate choice and are important events influencing individual reproductive success in group-living primates. In systems with predominant female philopatry and high male reproductive skew, male takeovers affect female mate choice to a large degree whereas in species with facultative female dispersal (FFD), females have the option of deserting a new male. We use a species with FFD to investigate the factors that promote the desertion of females after male takeovers, using nine cases with complete data on the process of the takeover and the female dispersal outcome. These cases took place in six groups of *Colobus vellerosus* over 10 years (2003 - 2013) at the Boabeng Fiema Monkey Sanctuary. Immediate takeovers (where males were able to defeat the resident male rapidly; N=4) were never followed

by female dispersal, whereas 4 of 5 slow takeovers (where the process of eviction took several months) were accompanied by female emigration. Immediate takeovers were achieved by single adult males (3/4) or by a single adult male accompanied by a subadult male (1/4). In contrast, slow takeovers involved mostly males who immigrated as an all-male band. These males jointly evicted the resident male and later tried to evict one another. The males involved in immediate takeovers were presumably stronger and were able to retain the females in their group. This greatly expanded data set supports earlier observations in that population. Nevertheless, whether female desertion is caused by low male quality or by social upheaval remains to be investigated.

Do women experience menopausal-type hot flashes during the post-partum period?

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From an evolutionary perspective, it has been suggested that menopausal hot flashes may be the vestige of a post-partum response to declining estrogen levels. Post-partum hot flashes may be an adaptive mechanism for warming a nursing infant; however, it is not known whether new mothers demonstrate menopausal-type hot flashes. New mothers (NM) were recruited through a doula network and by word of mouth. Women who are not new mothers are being recruited as a comparison group (CG). To date, 20 NM and 11 CG have completed brief surveys and measures of height and weight. All women were asked "Have you noticed any body temperature changes?" Biolog ambulatory hot flash monitors recorded changes in sweating on the upper chest. NM recorded each breastfeeding episode.

To date, NM are older than the CG (34.2 vs. 30.0 years, $p < 0.05$). Infants have a mean age of 3 months (0.27 years, s.d. 0.2). NM were more likely to report feeling warm compared to the CG ($p < 0.001$). With the Biolog monitor, 2 NM demonstrated 4 hot flashes that met the criteria for a menopausal hot flash (an increase of 2 micromho's in 30 seconds). Four NM demonstrated 1 hot flash, but the majority of NM did not demonstrate any hot flashes that met the criteria for menopausal hot flashes. Three of the NM who did not demonstrate objective hot flashes reported subjective hot flashes. The results offer only limited support for the hypothesis that menopausal-type hot flashes occur during the post-partum period to warm an infant.

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Strontium isotopes in the Sterkfontein valley: What do they say about early hominin habitat usage?

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Nearly thirty years have passed since Jonathan Ericson first suggested that strontium isotopes could be used to trace the movement of prehistoric individuals across landscapes. Since then, considerable knowledge of the limitations

and potential of the technique has accumulated across a wide variety of contexts, continents, and time periods. The technique seems especially promising at Swartkrans, where understanding early hominin habitat and diet has bedeviled conventional archaeological methods because multiple hominin species have been recovered from the same context.

My research in the 1990s established that (i) great care needed to be exercised in establishing local variability and baseline values for biologically available $^{87}\text{Sr}/^{86}\text{Sr}$ in the region; (ii) in the Sterkfontein valley, such variability was related to habitat (wet vs. dry), as opposed to substrate; and (iii) one large presumably male robust Australopithecine, SK876, was unlikely to have grown up in the immediate region, based on the depleted $^{87}\text{Sr}/^{86}\text{Sr}$ in its enamel when compared to its bone.

Subsequently, considerable new $^{87}\text{Sr}/^{86}\text{Sr}$ data from both Swartkrans and Sterkfontein has been published by Copeland, et al., who in contrast conclude that the female members of this species were more likely to disperse from their natal groups.

This paper examines the entire data set of these studies taken as a whole, and concludes that resolution of the problem will be made possible in the future by microsampling of defined growth areas of enamel; precisely the kind of detailed attention to dental growth anatomy pioneered by Alan Mann.

Ecological anthropology of riverine populations from the estuary of the Amazonas: Revisiting Marajó Island two decades later

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Between 1989 and 1992, the Human Biology Program of the Museu Paraense Emílio Goeldi, Pará, coordinated by Dr. Walter Neves, conducted successive research projects with riverine populations of Marajó Island. These were among the first anthropological investigations to analyze a wide range of socioecologic and biologic changes taking place in the Brazilian Amazon through an interdisciplinary approach. Riverine, Caboclo, groups are considered part of an "invisible" peasantry, even though they compose a large segment of the Amazonian population. Those projects started a long line of research endeavors by his students focusing on the health and ecology of vulnerable peoples in the region, which resulted in over one hundred journal articles, thesis and dissertations. These works have demonstrated the impact of Westernization on the traditional lifeways of the Caboclo, and the fast epidemiological transition affecting their health. There are still high rates of infant undernutrition in the Island ($> 20\%$), now living side by side, often in the same house, with obesity and hypertension, especially among the women. In the last decades food consumption, subsistence, and activity patterns have been altered due to government financial aid, environmental degradation has increased, basic sanitary and health infrastructure remains precarious, and Marajó still has the lowest HDI

of the country. The research started by Walter Neves has helped to understand the human diversity of the country, create new perspectives about the relationship between communities and their environment in the Amazon, and train professionals for the planning of more adequate regional public health policies.

Cranial shape evolution in the *Theropithecus oswaldi* lineage compared to ontogenetic, allometric, and geographic variation

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This investigation analyzes cranial shape evolution over more than 3 million years of *Theropithecus oswaldi* evolutionary history. A single, anagenetically evolving lineage that shows marked increase in size and adaptation to grazing through time, *T. oswaldi* is recognized as three successive chrono-subspecies: *T. o. darti*, *T. o. oswaldi*, and *T. o. leakeyi*. Shape change in this lineage could reflect, among other possibilities: 1) static allometry related to size increase through time, 2) extension of a conserved ontogenetic trajectory to accomplish size increase through time, or 3) selective pressures related to grazing.

Thirty five 3D landmarks were collected on nine fossil crania of *T. oswaldi*, representing both sexes and all subspecies. Comparative data were collected from 719 crania of extant *Theropithecus*, *Papio*, and *Macaca*. Multivariate regressions of Procrustes aligned coordinates against independent variables produced vectors of coefficients with which geographic variation, and evolutionary, static and ontogenetic allometry could be compared.

Even though the temporally successive subspecies of *T. oswaldi* increase in size, shape change in this lineage is inconsistent with static allometry alone, and does not seem to be merely an extension of a conserved growth trajectory. Specifically, reduction of the anterior rostrum, posterior migration of the maxilla, and increasing facial depth are contrary to static and ontogenetic allometry. These shape differences are also distinct from the geographic variation among extant *Papio* varieties. This suggests that the cranial morphology of the later members of *T. oswaldi* may have been the product of selection for traits beyond increased body size.

Gene tree incongruence, molecular phylogenetic accuracy, and the case of the colobus monkeys

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Over the past several decades, molecular data have emerged as the most relied upon source for reconstructing species relationships in extant taxa. The resulting phylogenetic trees have been critical in helping elucidate primate evolutionary history, including the classification of cryptic fossil species and the inference of divergence times across the primate tree of life. However, an increasing availability of multi-locus genetic data

has led to important theoretical developments in molecular phylogenetics and criticisms of previous standard approaches. In particular, the use of a gene tree as a hypothesis for a species tree has fallen out of favor, as has the use of consensus methods (e.g., supermatrices or supertrees) for the analysis of multiple loci. Instead, newly developed approaches are applying coalescent theory to multi-locus datasets for direct species tree inference. These new methods differ from previous ones by viewing gene tree incongruence as an underlying part of species history that can be used to infer phylogeny instead of a nuisance that needs to be purged from results. We review the theory behind these recently developed methods and use a newly generated multi-locus dataset from the colobus monkeys to demonstrate and highlight some of the challenges they present when applied to empirical data. We also discuss the implications these methods have for our current understanding of primate phylogeny and future directions for the field of primate molecular phylogenetics.

The role of FGF/FGFR signaling in cranial integration: Implications for primate evolution

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Relatively few major cell-cell signaling pathways, such as the fibroblast growth factors and their four receptors (FGF/FGFR), are conserved across many animal forms. FGF/FGFR signaling is necessary to produce several “vertebrate-specific” phenotypes, including the vertebrate head. Here, we focus on the role of FGF/FGFR signaling in craniofacial development and evolution by asking: how does a mutation in FGFR2 affect the craniofacial skeleton, particularly patterns of cranial integration? Studies of the skull have shown that patterns of cranial integration are highly conserved across primates, and possibly across mammals. Our data comprise micro-computed tomography images of newborn mice skulls, bred to express the *Fgfr2*^{S252W} mutation exclusively in one of two cell lineages, neural crest and mesoderm, and mice that express the *Fgfr2*^{S252W} mutation ubiquitously. Three-dimensional landmarks were used to measure cranial form in two blocks: bones that are neural-crest derived (face) and mesoderm-derived (caudal neurocranium). Procrustes-based methods and partial least squares analysis were used to analyze craniofacial integration patterns. Our results show a similar pattern of integration for the mice that express the mutation either only in the face or the neurocranium, and a different pattern of integration for the mice that express the mutation ubiquitously. Thus, our results suggest that the *Fgfr2* mutation influences cranial integration, particularly when affecting all tissues of the head, and that the FGF/FGFR pathways play important roles in maintaining cranial integration. We propose that FGF/FGFR

signaling networks might contribute to the similar integration patterns previously observed in the primate cranium.

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Age and habitat effects on hematology, plasma biochemistry, and urinalysis values in endangered, wild ring-tailed lemurs (*Lemur catta*) at the Beza Mahafaly Special Reserve, Madagascar

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The effects of age and habitat degradation on the health of wild ring-tailed lemurs in Madagascar are largely unknown. Seventy-two wild ring-tailed lemurs (n=40 in 2011, n=32 in 2012) were captured in intact and degraded habitats using Telazol® (tiletamine/zolazepam) administered via blowdart. Lemurs from the intact habitat were divided into three age classes: <5 years old, 5-9 years old, ≥10 years old. Blood was collected from a femoral vein, and urine was collected via manual expression of the bladder. Hematology profiles were performed manually, and plasma biochemistry profiles were obtained using an i-STAT® portable analyzer. For urine samples, biochemical values and specific gravity were determined, and the sediments were evaluated microscopically. All tests were performed at the Beza Mahafaly Special Reserve field laboratory. All results are reported as means.

Within the intact habitat, younger lemurs (<5 years old) had higher packed cell volume, total protein, potassium, and glucose values; and lower ionized calcium values. Older lemurs (≥10 years old) had higher blood urea nitrogen and creatinine values and lower leukocyte counts than middle-aged and younger lemurs. These findings may reflect impaired kidney function, immunosuppression, and a lower nutritional plane in older lemurs.

Compared with lemurs from intact habitat, lemurs from degraded habitat had higher packed cell volume and total protein values; lower creatinine and higher blood urea nitrogen and urine specific gravity values; and higher leukocyte counts and glucose values. These findings may reflect lower hydration levels and higher stress and/or inflammation in lemurs living in degraded habitat.

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Comparative morphometric analysis of a juvenile papionin fossil from Kromdraai A

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This study investigates the morphometric affinities of a juvenile fossil papionin from Kromdraai A (KAX). The KAX specimen preserves the face and cranial base anterior to the spheno-occipital synchondrosis. Emergent I1s, dp3-M1, and roots of di2-dc are present bilaterally; M1s are in full occlusion. The superior orbital margins, interorbital region, and distal nasals are damaged. The specimen is notable for small size and well-developed maxillary fossae, which excavate the infraorbital plate and zygomatic, forming a deep suborbital fossa (SOF) with projecting margins.

3D landmarks and semilandmarks were collected from a virtual model of KAX. The comparative sample comprised 270 juvenile and adult crania representing nine extant papionin taxa. To broaden comparisons, developmental simulation was used to estimate the subadult and adult morphologies of KAX. Sliding surface semilandmarks were used to compare zygomaxillary morphology of KAX with 16 juveniles of *Lophocebus* and *Papio*. KAX's affinities were assessed using Procrustes distances and PCA. Additionally, KAX dental measurements were compared to those of extant and fossil papionins.

In Procrustes distance comparisons, KAX is phenetically closest to *Papio kindae*. In PCA analyses, KAX falls at the periphery of the *Papio* distribution or intermediate between *Papio* and small-bodied papionins. KAX zygomaxillary shape is closer overall to *Papio* than *Lophocebus* but resembles the latter in SOF configuration. In PCA analyses, the KAX I1 falls within the *Lophocebus* distribution. Its M1 falls outside both *Lophocebus* and extant *Papio* shape distributions. Alternative taxonomic hypotheses will be discussed in light of the KAX specimen's mosaic morphology.

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Ancient DNA analysis of an infant from Sudanese Nubia (ca 500-1400 C.E.)

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An infant skeleton was recovered from the 6G8 cemetery (Christian Period, 500-1400 C.E.) during excavation in what is present-day Wadi

Halfa, located near the Second Cataract of the Nile in the Republic of the Sudan. Skeletal material from Wadi Halfa represents one of the most analyzed archaeological populations in the world. Building upon the research of Dr. George Armelagos and others, this study presents preliminary results of the first ancient DNA (aDNA) analysis of an individual from this population.

Analysis was carried out at the Molecular Population Genetics laboratory in the Smurfit Institute of Genetics at Trinity College Dublin, Dublin, Ireland. Using next-generation sequencing (NGS) techniques, DNA was extracted from a portion of cranial bone, indexed libraries were prepared, and the genome was sequenced on the Illumina platform using a MiSeq Personal Sequencer. Analysis of sequencing results indicated 0.59% endogenous DNA. Principle component analysis (PCA) was performed; despite a low number of SNPs, the individual was placed between African and European clusters. Using a method developed in Trinity's Molecular Population Genetics laboratory, the individual was sexed as a male. Haplogroup was assessed by analyzing SNPs from the mitochondrial chromosome with HaploGrep. The individual was assigned to L5a1, a branch of the ancient L5 haplogroup with origins in East Africa.

This study demonstrates the potential to gain unique insight into Nubian populations through aDNA analysis. Additional aDNA analysis of the Nubians will provide invaluable information regarding genetic influence and gene flow in individuals occupying ancient Nubia.

Paleopathology and the poor: Comparing historical records of morbidity and mortality to skeletal paleopathology in the Erie County Poorhouse Cemetery

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The Erie County Poorhouse Cemetery, in Buffalo, New York, (1851-1911) provides a unique opportunity to shed light on the impact of poverty on health during the nineteenth century. This study uses both the skeletal collection and the historic records to understand patterns of morbidity and mortality among Buffalo's urban poor.

Skeletal data were compared with cause of death for 6,399 adult individuals listed in the Poorhouse Mortality Registers for 1880 to 1911. During this time, tuberculosis and other respiratory diseases accounted for 31% of the deaths listed in the mortality registers. Bone trauma was listed as a cause of death for less than 2% of individuals and syphilis accounted for 1% of the causes of death.

Among the 327 skeletons in the collection, reactive bone on visceral rib surfaces was identified in 11.8% of the individuals. Two individuals (1.3%) had lesions indicative of tuberculosis. While 25% of the individuals had ante-mortem traumatic injuries, only one individual had a peri-mortem traumatic injury which probably was the cause of death. One individual had lesions typical of syphilis.

Given the frequency of deaths due to tuberculosis in the records, the low frequency

lesions typical of TB is surprising. However, evidence of reactive bone on the visceral rib surfaces may reflect chronic respiratory infections. It may be that those dying in the poorhouse hospital were already weakened and at risk by the stresses of poverty and succumbed to acute infectious diseases before the TB left any mark on their bones.

Current exclusion criteria for selecting osteons for circularity analysis are potentially problematic

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Variations in secondary osteon (SO) cross-sectional shapes are useful for determining species affiliations and interpreting load history. SO cross-sectional shape is expressed as "circularity index" [CI = $4\pi(\text{area}/\text{perimeter}^2)$; 1.0=perfect circle]. Recent studies recommend that SOs used in CI analysis should be selected based on central canal shape: (1) Crescimanno and Stout ("C&S"2012, J. Forensic Anthro.) selected osteons with central canals >0.9 CI; (2) Dominguez and Crowder ("D&C"2012, AJPA) selected osteons with central canals not exceeding 2:1 ratio of the max:min diameter. We hypothesized that the selection biases of these exclusion criteria eliminate important biological information. Using ImageJ we examined backscattered electron images (BSEi; 2 micron/depth) and circularly polarized light images (CPLi; 100 micron/depth) from modern human femoral shafts (n=12, avg. 53years; 25-71; male:female=3:9) and adult deer calcanei (representing a broad range of osteon sizes/shapes): (1) humans: 400 osteons/BSE, 1784 osteons/CPLi; (2) deer: 1328 osteons/BSE; 177 osteons/CPLi. C&S criteria excluded: (1) deer 307(23%) osteons from BSEi, and 125(70%) osteons from CPLi; (2) human 80(20%) osteons from BSEi, and 680(38%) osteons from CPLi. D&C criteria excluded: (1) deer 116(9%) osteons from BSEi, and 79(45%) osteons from CPLi; and (2) human 45(11%) osteons from BSEi, and 232(13%) osteons from CPLi. Although both the C&S and D&C exclusion criteria reduced sample sizes, statistical analyses were still possible. However, the significant CI difference between dorsal "compression" and plantar "tension" aspects of the calcaneus shown when using all OS became non-significant using the samples remaining after the exclusions. Therefore, these exclusion criteria forced an errant interpretation of load history.

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Dating early modern human occupation in southern Tanzania

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In 2010 several *Homo sapiens* teeth were found in the Magubike rockshelter, Iringa region,

Tanzania, with hundreds of flaked stone tools. Also in the site were other mammalian teeth and numerous samples of the land snail *Achatina* sp. Both materials are suitable for electron spin resonance (ESR) dating, although *Achatina* has not been fully tested for this purpose. ESR dating is a 'trapped charge' method similar to thermoluminescence (TL) and optically stimulated luminescence (OSL). It relies on measuring the accumulation of radiation-induced damage and can date materials as young as 30 ka and as old as several million years with a precision of 10-15%. Preliminary dating of some Iringa shells suggested an age in excess of 200 ka. In the summer of 2012 additional shells and teeth were collected from the MSA levels. The uppermost level dates to 165 ± 13 ka; dates from the level comparable to the depth of the teeth are 215 ± 16 ka (teeth) and 232 ± 33 ka (shell). These ages suggest strongly that the Iringa specimens are the oldest known examples of *Homo sapiens*.

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Cusp 6 variation in the hominin clade: Insights and implications revealed at the enamel-dentine junction

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Due to their preservation in the fossil record and their heritability, dental trait analysis continues to play an important role in studies of the phylogenetic relationships within the hominin clade. Recently, increased understanding in the developmental genetics of tooth crown morphology has influenced interpretations of trait variation within and among species and highlighted potential integration between components of the tooth crown such as tooth cusps. Additionally, the application of microtomography to image the enamel-dentine junction of tooth crowns (which is a proxy for the early stage of tooth crown formation) has revealed substantial variation in trait morphology that can improve our understanding of trait development. Both of these factors have highlighted the need to demonstrate the homology of traits being studied at the enamel surface to insure that variation among hominins is being properly interpreted. In this study we apply microtomography to examine the enamel-dentine junction expression of cusp 6 in a taxonomically broad sample of extant and fossil apes and fossil hominins (n = 256). Our results demonstrate previously undetected variation in cusp patterning on the distal margin of lower molars and suggest that a sixth cusp (and additional associated cusps) can form in a variety of developmentally distinct ways. Specifically, accessory dentine horns can form in association with the entoconid, hypoconulid or independently. We discuss our

results within the context of a patterning cascade model of cusp development and implications for the interpretation of cusp 6 variation within the hominin clade.

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Stature estimation from long bones in the Early Medieval population at Pohansko (Czech Republic): Applicability of regression equations

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The applicability of regression equations for stature estimation from long bones is sensitive to population affinity and to ecogeographic differences. Here, we test regression equations frequently used for stature estimation in the Central European skeletal record (Sjøvold, 1990 [Eq-Sjv]; Formicola and Franceschi, 1996 [Eq-FF]) and newly developed equations on broad pan-European samples (Ruff et al., 2012 [Eq-Ruff]). The test sample consists of 20 males and 19 females from the Early Medieval site at Pohansko (Czech Republic). Reference values for stature are derived from Fully anatomical reconstruction of living stature. We also compare selected equations with population-specific regressions derived directly from the Pohansko sample using RMA regression software (Bohonak, 2004). For the upper limb, Eq-Ruff produced relatively small directional bias (%PE = -0.25-1.47) compared to other equations, with both Eq-Sjv and Eq-FF overestimating living stature. For the lower limb, Eq-Ruff also produced relatively small error, as did Eq-FF for the tibia. For both upper and lower limbs, Eq-Sjv produced the highest %PE (1.05-3.77) with systematic overestimates of living stature that indicate limited applicability for the Central European record. The population-specific equation produced minimal %PE (-0.02-0.36) with the highest %PE found for femoral equations, although the range of %PE for the population-specific equation is comparable with that of other techniques. We also found sexually dimorphic differences in %PE between proximal and distal segments of upper and lower limbs, indicating sensitivity of regression equations to sexual dimorphism/ body proportion and support for using proximal limb segments in stature estimation.

From bone to muscle. Muscle cross-sectional area estimations for skeletal human remains

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We investigated the relationship between the cortical bone of the radius and the muscle area of the forearm in a living human sample. Muscle area and cortical area were measured directly in vivo by peripheral Quantitative Computed

Tomography (pQCT). The aim of this study was to develop a method for muscle area estimation from cortical bone area at 65% of radius length where the muscle area is largest. We found significant correlations between muscle area and cortical area ($r = 0.881$) in the forearm that are in line with previous studies. We have set up a regression model by testing relevant parameters such as age, sex, forearm length and stature that were all highly correlated to muscle area. Muscle area estimation from cortical bone is possible with a Percent Standard Error of Estimate (%SEE) ranging from 12.03% to 14.83%, depending on the parameters available and the age and sex of the individual. We also applied this new method to a sample of Neolithic human remains and will present these results.

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Comparative analysis of craniofacial morphogenesis: Implications for developmental constraints and the origin of variation in craniofacial shape

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Variation in complex morphological structures arises at various points in development. In the vertebrate craniofacial complex, one such point is the outgrowth and fusion of the facial prominences during face formation. Previous work by Young et al. has pointed towards this as a phylotypic stage at which variation is constrained by the fact that clefting occurs outside of a fairly narrow range of morphological variation. Here we present the comparative analysis of multiple mutations that influence this process and relate this to the generation of phenotypic variation in the skull. While we confirm that significant perturbations to facial prominence outgrowth produce either midline or bilateral clefts, we also show a surprising lack of concordance between facial morphology and eventual adult facial shape in our sample of mouse mutants. We conclude from this that later processes acting to formation of the skeletal elements of the face exert greater influence on variation in facial shape. These results are consistent with the hypothesis that facial prominence fusion is constrained developmental stage and that most evolutionarily significant variation arises at later developmental stages.

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Genetic variation among Native North Americans with complex ancestries: Implications for contemporary tribal diversity and recent population history

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Scientists studying Native American genetic variation have sometimes used sampling criteria that exclude individuals reporting complex ancestral histories (i.e., ancestry from multiple tribes and/or non-indigenous sources), but who nevertheless identify with indigenous cultures and maintain tribal affiliations. While these sampling practices can be helpful for understanding the peopling of the Americas and early population histories in this continent, they obscure patterns of gene flow between tribes and post-colonial patterns of population admixture. These practices have likely resulted in an incomplete representation of genetic diversity in contemporary Native American tribal groups and an underestimate of population admixture following European contact.

In this study, we extracted DNA from 75 Native American serum samples that were previously collected but excluded from earlier studies of Native North American genetic variation. We sequenced the first hypervariable region of the mitochondrial DNA to determine mitochondrial haplogroups and haplotypes. We also determined the sex of each individual by assaying a length dimorphism in the amelogenin gene, and for those identified as males, we analyzed Y-chromosome SNPs and STRs to identify Y-chromosome haplogroups and haplotypes. We found higher rates of admixture than previously reported, and show that the rates of admixture were geographically structured. This pattern may reflect differences in regional histories of settler colonialism as well as changing indigenous responses to westward European expansionism. These results also demonstrate that the genetic composition of Native American communities is more complex than some previous studies have suggested.

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Human skeletal remains from the Malliotaki Roman cemetery site in East Crete

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The Malliotaki site, a Roman cemetery located on the southern coast of East Crete, dating from the middle 1st to early 3rd century AD, was excavated by the 24th Ephorate of Prehistoric and Classical Antiquities of the Greek Ministry of Culture in 1997. This cemetery is one of several Roman cemeteries associated with one of the largest Roman cities on the island, Hierapytna (modern Ierapetra). The analysis of the skeletal remains from this collection of cemeteries will result in the first large-scale investigation of Roman human skeletal remains on the island. Nineteen tombs were recovered from the Malliotaki cemetery; eleven were tile-covered while the other eight were simple pits or badly disturbed. Among the grave offerings were ceramic vases and lamps, glass unguentaria,

bronze and ivory pins, jewelry, bronze coins, and parts of terra cotta figurines.

A minimum of 15 individuals was recovered from the tombs. Pathologies were minimal and primarily confined to carious lesions and other dental pathologies. Only one bone exhibited an enthesopathy (clavicle) and only one had evidence of arthritis (acetabulum). The frequency of pathologies and traumas differs markedly from a nearby earlier Late Hellenistic/Early Roman cemetery from the town of Agios Nikolaos, on the northern coast of East Crete. Analysis of the changing patterns of pathology represented in skeletal remains will provide some of the currently missing data about how the inhabitants' lives on Crete changed after the coming of the Roman Empire.

Resolving Pliocene and Pleistocene hominin dental ontogeny with synchrotron virtual histology

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Tooth microstructure is critically important for the study of cranial and postcranial maturation in hominins, as there are no alternative aging methods available without employing living reference populations, and primate dental development is broadly correlated with aspects of life history. Here we employ cutting-edge synchrotron imaging to characterize incremental development and age at death in several *Australopithecus anamensis*, *Australopithecus africanus*, *Paranthropus robustus* and South African *Homo* juveniles, and make comparisons to developmental information on living apes and humans. Long-period line periodicities range from 6-13 days, and do not support previous reports that australopithecines show lower mean values than living or fossil *Homo*. Molar crown formation times fall below or at the low end of modern human values for most comparisons. *Paranthropus robustus* generally shows the shortest times, which are often less than those of chimpanzees. Modern human developmental standards consistently overestimate age at death in Pliocene and Pleistocene hominins, as is also often the case for chimpanzee developmental standards. These fossil hominins show remarkable variation in tooth formation rhythms and times, and previous estimates of age at death that assume a narrow range of periodicities are likely to be in error. New histologically-determined ages for SK 62 and Stw 151 are six months younger than previous estimates. Although Pliocene and Pleistocene hominin ontogenetic patterns appear to be distinct from both living humans and chimpanzees, caution should be exercised when inferring aspects of

life history from long-period line periodicities, crown formation times, or molar eruption ages.

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The ontogenetic influence of olfactory bulbs on orbital growth and facial form

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Midfacial reduction in primates has been explained as a byproduct of other growth patterns, positing a structural tradeoff between convergent orbits and neighboring regions. This has been hypothesized as both an evolutionary and developmental explanation for relatively short snouts in most modern primates. Here, we use histological sections and microCT scans of perinatal nonhuman primates (tamarin, tarsier, lorises) to investigate how orbital morphology emerges during ontogeny in selected primates compared to another euarchontan (*Tupaia glis*). We annotated serial histological sections and corresponding CT slices for location of osteoclasts or osteoblasts, and used these to create three-dimensional "growth maps" showing perinatal remodeling patterns. Our findings indicate a disparity in growth between the competing orbital and neurocranial functional matrices. Distinctions among species are observed in the frontal bone, at a shared interface between the endocranial fossae and the orbit. A more extensive and resorptive medial orbit occurs in primates, whereas the opposite is observed in *Tupaia*. Either position or size of the eye offer possible explanations for early resorption of the medial orbit in primates; as hypothesized, the orbital soft tissues encroach on available interorbital space. However, eye size cannot, by itself, explain the extent of reduction of the olfactory recess. We suggest the olfactory bulbs are also significant in strepsirrhines, influencing an expanded interorbital breadth at early stages of development. Moreover, their large size in nonprimates (e.g., *Tupaia*), may influence greater divergence of orbital cones, via an outwardly drifting orbital plate of the frontal bone at early stages.

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Secular trends in body size and proportions among indigenous Siberians: The role of developmental and adaptive environments

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Anthropometric dimensions such as body size and proportions can provide valuable information on health and adaptation. Mean population stature has been used extensively as a proxy measure of health since growth is impaired under certain environmental conditions (e.g., undernutrition). In addition to developmental environment, genetic differences related to adaptation (e.g., to climatic factors) also contribute to variation in adult body size and proportions. Few studies, however, have examined contributors to body size and proportions among indigenous Siberians despite these populations occupying an extreme circumpolar ecosystem and having recently experienced massive social changes. The present study, part of the Indigenous Siberian Health and Adaptation Project, was conducted among the Yakut (Sakha) of northeastern Siberia in order to investigate: 1) the extent of secular trends in adult height by examining stature variation between age groups; and 2) the conformity of body size and proportions to ecogeographical predictions. Anthropometric data were collected in 2009 from 285 healthy adults (≥ 18 years; 141 females, 144 males) in the rural community of Berdygestiakh, Russia (62°N, 127°E). Regression analyses demonstrate that Yakut men (2.9 cm/decade [$r^2=0.39$]) and women (2.5 cm/decade [$r^2=0.30$]) experienced a substantial secular increase in height over the past several decades; this trend remained when analyses were confined to young adults and when stature was adjusted for age-related height loss. Relative sitting height in males (53.1 \pm 1.2%) and females (53.4 \pm 1.2%) is consistent with previous research among circumpolar groups in showing cold-derived body proportions. Thus, anthropometric dimensions in this population reflect individual developmental environment and adaptive history. Support: NSF ARC-0802390; Northwestern University; University of Oregon; FSRI Institute of Health.

Changes in human brain morphometry following the transition to plant and animal domestication

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The transition from hunting and gathering to plant and animal domestication that roughly coincides with the Pleistocene to Holocene transition resulted in a wide range of changes in the human skull. In general, Upper/Late Paleolithic human crania were larger, more robust, and more morphologically variable than those of Neolithic and historic period modern

humans. Many of these proposed changes are thought to be the result of the dietary transition to softer and fewer food choices. We suggest that changes in the human brain may also be evident with this major dietary transition. In particular, we propose that there may be a reduction in areas known to be related to complex motor coordination such as the cerebellum and dorsal regions and an increase in asymmetry and expansion in areas thought to mediate complex social interactions such as ventral regions. Some of these changes in the human brain are likely results of both a change in diet and greater reliance on more complex social interactions that occurred following the move to sedentary life. In order to test this hypothesis, we conduct a comparative geometric morphometric analysis of endocasts from a series of Pleistocene and Holocene hominins. The Pleistocene hominin fossil endocasts are part of the collections from Professor Holloway at Columbia University and the American Museum of Natural History. The Holocene human collections include a sample of 50 modern Korean crania that is part of the comparative anatomy collection of the medical school at Konkuk University in the Republic of Korea.

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Mate choice in monogamous Owl Monkeys (*Aotus azarae azarae*)

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Owl monkeys are small primates that live in serially monogamous pairs. Although male and female replacements by intruding conspecifics from the floater population occur frequently, it is not known which variables animals assess when choosing a pairmate. Given that owl monkeys display various olfactory behaviors (e.g., scent-marking, partner-marking, and inspecting), we hypothesized that chemical signals are involved in inter-sexual communication and mate choice. We also hypothesized that body mass and age may be assessed during mate choice as potential indicators of quality. To evaluate these ideas, we examined the sexual behavior of five pairs of wild Azara's owl monkeys in Argentina and the relative body mass and ages of eleven pairs. Paired animals did not differ markedly in either age (mean difference: 0.7 years), or body mass (mean difference: 95g, range: -175g to 230g). During 25 copulations in new and established pairs, males frequently inspected the female's anogenital region (n=10 events), whereas females frequently urinated before copulation (n=7 events). Males occasionally "partner-marked" females with the sub-caudal gland (n=1) or face (n=2) prior to copulation. Our data suggest owl monkeys may rely on chemical signals during the process of pairbond formation (i.e. new pairs) and maintenance (i.e. established pairs). Although there are no apparent preferences for a smaller or larger partner, animals may choose mates of a similar age. Our data emphasize the need to better understand

chemical signaling, rates of breeder turnover, and characteristics of the floater population, in order to more fully understand mate choice in monogamous owl monkeys.

Regrowth of timbered trees in Ranomafana National Park: Hope for rainforest recovery

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Regeneration of timbered forest is rarely studied. In Madagascar, timber exploitation is a main cause of the decline of lemur populations. In 1986, aggressive logging of large trees occurred in the rainforest of the classified forest of Ranomafana. This forest became a national park in 1991. In 1992, we measured 154 stumps of timbered trees representing 41 species of rainforest trees, distributed randomly within the study site of Talataky, in Ranomafana National Park. 88 out of 154 trees (57 %) resprouted, some with 2-8 sprouts and other species with just one trunk. The average growth of the sprouts between 1986 and 1992 was from 1-2 meters.

Although some of the trees could not be found, most of the sprouts had attained 12m-16m by 2013 and were fruiting. This study gives evidence that many Madagascar rainforest tree species in the families of Lauraceae, Clusiaceae, Fabiaceae, Monimiaceae, Moraceae, Apocynaceae, Myrtaceae, Sapotaceae, and Sapindaceae will sprout and regrow after being felled. None of the rosewood trees sprouted. 92.6% of the tree species in this study produced lemur fruits. This study shows evidence of regeneration of the timbered rainforest. Therefore, monitoring trees after timber exploitation is critical to realizing that, far from being a lost cause, degraded rainforests can recover over time.

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Using stable isotopes to study vervet-human interactions

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Vervet monkeys are dietary generalists that often live among humans. Here we use stable carbon ($\delta^{13}\text{C}$) and nitrogen ($\delta^{15}\text{N}$) isotope analysis of vervet hair to explore interactions between vervets and humans. Stable isotope studies of diet are based on the principle that "you are what you eat." Vervets with little human interaction eat primarily C_3 vegetation, but in areas where C_4 crops (e.g., corn, sugarcane) are prevalent, carbon from C_4 plants

can become incorporated in vervet tissues; and because the $\delta^{13}\text{C}$ values of C_3 and C_4 plants are highly different, the $\delta^{13}\text{C}$ values of vervet hair can be used to gauge a population's reliance on C_4 crops or processed human foods. Nitrogen isotopes are also useful in this context as they track trophic level, physiological state, and habitat.

We collected 102 hair samples from nine populations of vervet monkeys. During hair collection behavioral observations of the monkeys were conducted to determine the degree to which humans have impacted each site and to note the consumption of human foods by each population. We found that vervet populations with significant human contact often have higher or more varied $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ values. The stable isotope data also suggested greater human-vervet interaction (crop raiding) than expected at two sites, and this was verified with subsequent behavioral observations. The increase in intrapopulation variability at sites with high human-vervet interaction suggests highly distinct individual foraging strategies.

Environmental stress and molar wear in three populations of mantled howling monkeys (*Alouatta palliata*)

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Dietary abrasives in plant foods and adherent exogenous grit produce tooth wear limiting the functional life of teeth. Cross-population studies of wear rates in a single species in different habitats may point to the relative contributions of these factors. In this pilot study, we examine wear in populations of *Alouatta palliata* from La Pacifica, Costa Rica (88 specimens), Bocas del Toro, Panama (19), and Rivas, Nicaragua (59). The sites differ in mean annual precipitation (MAP), with Bocas del Toro receiving more than twice the MAP of Rivas or La Pacifica (~3500 mm vs. ~1250 mm). Additionally, Rivas specimens were collected downwind of active plinian volcanoes. Tooth wear on each molar is expressed as the ratio of exposed dentin area to total tooth area in the occlusal plane. Assuming a dental eruption sequence of m1-m2-m3 and similar timing of tooth eruption in all populations, wear rate is the slope of m1 wear/ m2 wear (and m2 wear/ m3 wear). Total molar wear is: $\text{Log}_{10} (\Sigma \text{wear on m1-3}) / \Sigma \text{occlusal area of m1-3}$. Contrary to expectations, total wear does not differ significantly among the populations. Also Bocas, (high MAP) has a higher wear rate than lower MAP La Pacifica. And, despite the ash raining intermittently from nearby upwind volcanoes at Rivas, the Rivas wear rate is similar to La Pacifica. Wear on the anterior seems to be greater in individuals collected on the volcanic slopes, so perhaps oral preparation removes most of the exogenous grit.

Does an increased ability to discriminate between red and green lead to decreased red pelage coloration in primates?

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Recent work has investigated the link between pelage coloration and visual system in primates. Contrary to their predictions, Kamilar and colleagues found that trichromatic species display less red pelage when compared to monochromatic and dichromatic species, and that pelage coloration was not correlated with sexual selection or light levels (using mass dimorphism and activity pattern as proxy variables). We further tested these relationships by using an expanded species sample ($n=118$) and adding two additional independent variables relating to the potential influence of sexual selection and sociality: sexual dichromatism and median group size. We collected color data from preserved primate skins representing an additional 26 species. Photos were calibrated for color accuracy and red/green ratios were calculated at twenty landmarks to determine maximum and mean ratios for each species. Phylogenetic generalized least squares models were used to test whether red/green ratios were significantly correlated with female visual systems and the other variables outlined above. Our results agree with those of the previous analysis, demonstrating that polymorphic and routinely-trichromatic primates have significantly lower red/green ratios ($p < 0.05$) than dichromatic and monochromatic species. Other predictor variables did not contribute significantly to linear models. These results suggest that the enhanced ability of trichromatic individuals to discriminate between red pelage and green backgrounds may allow members of such species to maintain the same level of color differentiation visible to conspecifics while reducing the overall actual color difference between their pelage and green backgrounds, which may reduce associated fitness costs such as visibility to predators.

Forelimb and hind limb articular scaling in cercopithecoids, hominoids, and modern humans

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The scaling of joints relative to body mass, especially in the lower limb, is thought to be unique in modern humans as a result of being bipeds. The scaling of forelimb and hindlimb articular surface linear dimensions was studied in a sample of 179 individuals in 13 species of cercopithecoids and hominoids, and 163 individuals in two populations of modern humans. The relationships between articular surface measurements and body mass were compared between taxa. Humans are unique in having large hip and knee joints and small distal humeri for their body mass. Compared to cercopithecoids, non-human hominoids generally have larger joints, presumably for increased mobility. Articular surfaces scale with slight positive allometry in both cercopithecoids and hominoids, but are more positively allometric in humans. This is true for all joints, not just the femoral head as has been shown in earlier studies. The scaling relationships between joints were also investigated. Hip to knee proportions are similar in all groups, while the elbow and

shoulder show differential scaling due to the particularly large humeral head of apes and very small elbow in humans. Humeral head to femoral head proportions show a clear separation of groups based on the degree of forelimb/hindlimb dominance in locomotion. These results demonstrate the dual effects of mechanical loading and joint excursion on articular surface size. Modern humans are unusual in both the relative size of forelimb and hindlimb articulations, and the high positive allometry of all joints.

Nonmetric dental trait markers in prehistoric Polynesians: A descriptive analysis

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Dental morphology can be used to infer population ancestry and link human groups. However, typifying Polynesian populations using dental nonmetric traits can prove difficult as Sunda-Pacific groups tend towards the worldwide averages of trait frequencies. This tendency towards the means, combined with high standard deviations due to the small sample size of reference groups, makes comparisons difficult. This study aims to showcase the dental nonmetric traits of two Polynesian populations and demonstrate the importance of improving comparative population sample size.

The first author observed 17 traits in 195 dentitions from Tonga and the Cook Islands. Though these are the largest prehistoric Tongan and Cook Islands populations recorded for nonmetric dental traits, low statistical power precluded advanced statistical analysis. However, frequency of trait expression can provide valuable information when comparing trait expression in populations.

There are no significant differences between sites ($p < 0.05$). Trait frequency variation between the combined samples and comparative global populations (Scott and Turner, 1997) are also presented. While many of the nonmetric traits fall within expectations, four traits follow the frequency patterns of Sinodonty rather than Scott and Turner's "Polynesians." Shoveling and double-shoveling (UII) are much higher than expected (52.94% and 20.59%, respectively) and Carabelli's trait (UM1) and the fifth cusp (LM1) are present less often than other Polynesian populations (13.11% and 6.78%, respectively). It is unlikely that these populations display Sinodontic traits due to shared ancestry with northern Asian populations, but the dearth of comparative data means that these relationships cannot be adequately explored.

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The impacts of "bottom-up" deforestation patterns on lemur geographic ranges

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Current primate species range maps are two-dimensional and fail to account for elevation. In some mountainous tropical regions containing

primates, such as eastern Madagascar, forests are experiencing "bottom-up" deforestation patterns in which deforestation operates in increasingly higher elevation. In this paper, we use a regional analysis of GIS data to determine how "bottom-up" deforestation patterns affect lemur habitat availability in the altitudinally complex eastern humid forests of Madagascar. We assessed amount of forest and non-forest by elevation within the geographic range of twelve lemur species living in eastern humid forest. We found eastern humid forest occurs at significantly higher elevations than non-forest in all species ranges except *Hapalemur griseus*. Lowland forest predominated in five species ranges (*H. aureus*, *H. griseus*, *P. candidus*, *P. furcifer*, and *V. rubra*) while montane forest dominated ranges of seven species (*A. laniger*, *E. rubriventer*, *H. simus*, *I. indri*, *P. diadema*, *P. edwardsi*, and *V. v. variegata*). No species range had a majority of high altitude cloud forest within their range. If "bottom-up" deforestation continues to occur, then species with ranges consisting of mostly lowland forest are at risk of losing habitat. Additionally, species at higher elevations are at risk from upslope distribution displacement if species within lower ranges move upslope following the deforestation pattern. It is imperative to consider the three dimensional impact of deforestation patterns on primate species ranges to understand how lemurs respond to global warming, forest loss and fragmentation, and anthropogenic pressures and to improve the efficacy of conservation decisions.

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Using an integration model to predict hominoid jaw shape

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Dental arcade shapes have changed dramatically throughout hominin evolution. Besides an overall reduction of canine size, jaws underwent gracilization and postcanine dental reduction in the *Homo* lineage; and increased robusticity and postcanine dental enlargement in the *Paranthropus* lineage. Mandibles and maxillae evolve together as functionally integrated structures, however little is known about how patterns and degrees of integration vary interspecifically.

Here we use three-dimensional landmark-based geometric morphometrics to analyze CT-scans of matching upper and lower jaws of adult extant *Homo* (pre-industrial), *Pan*, *Gorilla*, *Pongo* and *Hylobates*. We use partial least squares (PLS) analysis to evaluate the pattern and degree of integration. Using multivariate statistics we predict mandible shape from the maxilla and vice versa. By comparing the predicted shapes with the actual data we assess the accuracy of our integration model.

We show that arcade shape differs significantly among hominoids, with marginal overlap between hominids. Hominoids share the same pattern of morphological integration. The

species differences in arcade shape plus the similar integration patterns result in accurate predictions of antagonistic jaw shapes: they fall within the actual range of variation of each taxon.

The results on integration patterns and shape prediction offer three main applications when interpreting the hominin fossil record. First, it will assist in identifying combinations of isolated jaws that belong to a particular taxon; second, it may be used in restricted fossil sites to find matching pairs of specific individuals; and third, it provides a model for the reconstruction of deformed fossil specimens.

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Dynamic patterns of gene expression in the human brain during postnatal development

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The human brain is characterized by an extended period of enhanced plasticity. In order to understand the molecular underpinnings that enable this heightened plasticity we examined gene expression levels in the cerebral cortex of 37 individuals during postnatal development. Data from individuals ranging from < 1 year old to 53 years old were collected using a genome-wide microarray, using tissue samples derived from the normal margins of surgically resected tissue. In order to identify genes that may relate to plasticity, we developed an approach that identifies transcripts with greater inter-individual variation among children (< 15 years old) than among adults (> 15 years old). We found 337 transcripts showing this pattern (pFDR<0.25; 93 transcripts with pFDR <0.1). Interestingly, in addition to identifying genes with known roles in the nervous system (e.g., *BDNF*) we found significant overrepresentation of genes with known roles in the immune system (pFDR=0). To strengthen our findings we used immunohistochemistry to confirm that three proteins (HLA-E, C1q, NP2) encoded by genes in our list of 337 transcripts are present in microglia and/or neuronal cells derived from human temporal tissue. In addition, we re-ran our analyses using a previously published dataset derived from samples collected postmortem and found similar patterns. These findings suggest that the extended period of heightened neuronal plasticity during childhood is characterized by more dynamic gene expression and reinforce recent findings that genes traditionally annotated

to the immune system may also play important roles in normal brain development.

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Primate diversity at the close of the Paleogene: Perspectives from the late Oligocene Nsungwe Formation of southwestern Tanzania

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The late Oligocene is among the least sampled intervals in primate evolutionary history, with described primates from Afro-Arabia limited to a handful of genera collected north of the equator. Missing temporal and geographic data have important implications for understanding key transitions in Oligo-Miocene primate communities, including 1) the decline of parapithecoid and propliopithecoid anthropoids, 2) the diversification of lorissiforms, 3) the emergence of Old World monkeys, and 4) the features that distinguish stem catarrhines from the earliest hominoids.

Fossils from the ~25 Ma Nsungwe Formation in the Rukwa Rift Basin of southwestern Tanzania reveal an intriguing mosaic of primate taxa comprised of the latest-surviving parapithecoid anthropoids living alongside diminutive novel lorissiforms, together with the oldest fossils documenting the crown catarrhine divergence. These finds help to bridge an important temporal and geographic sampling gap, providing key data to test hypotheses about the emergence and fate of major primate clades. For example, parapithecoid and propliopithecoid anthropoids thrived in the early Oligocene of northern Africa, yet are notably absent from well sampled early Miocene deposits in eastern Africa. Nsungwe Formation discoveries document that these groups persisted minimally until the latest Oligocene. And although the fossil record for the earliest crown catarrhines has long proved elusive, recently discovered *Nsungwepithecus* and *Rukwapithecus* are the first fossils old enough to support hypothesized crown catarrhine divergence time estimates of 25-30 Ma based on molecular studies. Taken together, specimens preserved in the Nsungwe Formation fauna offer a tantalizing glimpse into primate diversity at the close of the Paleogene.

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A bigger role for physical anthropology in and outside the university

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Concerns raised about the future of physical anthropology (PA) during the AAPA symposium in 2013 included: 1) confusion about the nature of PA given current advances in the sciences and interdisciplinary collaborations, 2) lack of original theoretical and methodological innovations, and 3) the need for re-examination of ethical issues as PA evolves. There was little acknowledgement of impacts of PA beyond research efforts at PhD-bearing institutions. Most majors are trained where the terminal degree is a BA or MA and pressures on faculty are different but complementary (less pressure to publish but more time with students expected). A narrow focus on PhD-granting settings limits PA's potential. An analysis of AAA's Guide to Programs and institutional data can provide insights.

We analyzed 359 anthropology programs subdivided by terminal degrees: (PhD, MA, BA/BS; N = 103, 65, 191, respectively): mean institution size (26,142.93, 21,255.18, 11,270.63), mean number of physical anthropologists (3.97 ± 0.3, 1.85 ± 0.2, 0.72 ± 0.1), mean number of total anthropology faculty (19.0 ± 1.0, 9.5 ± 0.5, 2.8 ± 0.2), and cultural to physical faculty ratio (3.2 ± 0.4, 2.2 ± 0.2, 1.98 ± 0.2) and curricula. The persisting low representation of PA relative to socio-culturally-trained faculty exacerbates the above concerns. Original solutions to contemporary challenges would be facilitated if the ratio is more balanced, diverse students aggressively recruited, and interdisciplinary undergraduate training more rigorous (more typical at PhD-bearing institutions) and includes active promotion of the PA subdiscipline and its modern application in diverse professional fields.

Comparative anatomy of ear ossicles in African apes and modern humans – Introducing a geometric morphometric measurement protocol

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Analysing the morphology of the middle ear ossicles is complicated by their minute size and complex shape. Hence, conventional linear and angular measurements are prone to error and do not capture three-dimensional shape characteristics. Such methodological limitations may well be the reason that previous quantitative studies only found distinct great ape and modern human patterns of morphology, even though subtle differences in ossicle morphology between great ape species have been described previously. Here we introduce a geometric morphometric measurement protocol for ear ossicles, based on 3D landmarks and semilandmarks obtained from high-resolution computed tomographic images. We compare the shape of malleus and incus of *Gorilla gorilla*, *Pan troglodytes* and *Homo sapiens* using principal component analyses of Procrustes shape coordinates. We reveal distinct shape differences in both the malleus and incus between gorillas, chimpanzees, and modern humans, and demonstrate complete separation in

shape space with no overlap among groups. Differences between species are statistically significant ($P < 0.01$) and comprise changes in relative size and shape of corpus and manubrium of the malleus and intercrural curvature of the incus as well as changes in orientation and shape of the articular facets of both ossicles. This 3D analysis helps to infer the polarity of ossicle characters unique to modern humans, and provides the comparative context for future analyses of ear ossicles of extinct hominin taxa. Our findings also provide the basis for functional interpretation in relation to hearing capabilities. *Funded by the Max Planck Society.*

Musculoskeletal interpretation of labor induced stress on ancient Andean populations from Hualcayán (Ancash, Perú)

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During life, an individual's skeleton responds to habitual, labor related stress at its muscle attachment sites, called *entheses*, through the formation of new bone tissue and resorption of damaged bone tissue. Stress-related remodeling, or *enthesal change*, manifests itself in characteristic patterns depending on the severity to which musculature is pushed beyond its functional capacity. We conducted bioarchaeological investigation of enthesal change in the lower limbs of skeletal remains recovered from three commingled machay tombs at the ancient archaeological complex of Hualcayán in highland Ancash, Perú. This analysis illustrates the physical burden and resulting adaptive responses for individuals subsisting in the highlands between the Early Intermediate Period and Middle Horizon (ca. A.D. 1-1000). From an assortment of 193 bones (femur, tibia and calcaneus) 9 enthesal sites were ranked according to the degree of their stress related response. Specifically, the populations exhibit trends in enthesal remodeling and occupationally-derived skeletal conditions which are consistent with rigorous habitual activity over steep terrains; robusticity along the linea aspera and gluteal line was scored moderate or greater in 58% and 87% of cases respectively while bone spur development consistent with Osgood-Schlatter's syndrome was observed in 28% of cases. While past research on musculoskeletal markers often focuses on intact individuals with known life histories, this study applies known patterns of stress-related remodeling to commingled contexts in the ancient Andes. This study demonstrates the utilities and limitations of the investigation of musculoskeletal stress in commingled contexts and the importance of pursuing bioarchaeological research with less than ideal assemblages.

Incisor microwear textures point to status differences at Amarna, Egypt

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Incisor microwear texture analysis is utilized to indicate intergroup differences in diet, abrasive loads, and non-dietary anterior tooth use behaviors; however, it is used here to identify potential intragroup status disparities. The sample consists of New Kingdom Egyptians from Amarna, Pharaoh Akhenaten's capital city, using permanent maxillary central incisors. High-resolution dental casts were scanned using a Sensofar Plu white-light confocal profiler. Four adjacent labial surface scans were taken with a 100x objective lens, totaling a work envelope of 204x276 μm . Toothfrax and SFrax scale-sensitive fractal analysis software characterized the microwear features. Specimens were analyzed from four excavation areas of the South Tombs Cemetery, including the Upper, Middle, Lower, and Wadi Mouth areas ($n=35$).

The original hypothesis states the Amarna individuals would show similar microwear textures regardless of burial area; however, preliminary results indicate several differences among excavation areas. Specifically, the Upper site demonstrated the highest mean anisotropy value of all the areas, with the Middle, Wadi Mouth, and Lower sites having progressively lower values. Similarly, the Upper site *Tfv* mean value was the lowest, while other areas showed significantly higher means. Lastly, the low complexity average in the Upper site contrasted with the much higher values of the other sites. These pilot results suggest that the Upper site individuals relied on a softer diet and participated in minimal non-dietary anterior tooth use behaviors with low anterior loading regimes, while values from the other excavation areas indicate the opposite. When combined, these data point to potential status differences at Amarna.

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Osteoarthritis of the temporomandibular joint in the Chelechol ra Orrak skeletal assemblage, Republic of Palau

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Although disorders of the temporomandibular joint are extensively studied in the clinical literature, few recent archaeological studies have included evaluation of TMJ disorders, including osteoarthritis. This project examines the frequency and severity of TMJ osteoarthritis in the Chelechol ra Orrak cemetery skeletal assemblage, one of the oldest (ca. 1700-3000 BP) and largest human skeletal assemblages in Remote Oceania. To date, a minimum of 40 individuals, including 12 articulated burials, have been excavated from the site. Location, nature, and severity of surface changes on the mandibular condyle and glenoid fossa of the temporal were recorded from numbered and identified individuals following the system developed by Rando and Waldron (2012). Evidence of osteoarthritis was present in ~77%

of individuals scored, with both the left and right sides affected equally. Presence of osteoarthritis was observed in both males and females. Severity ranged from light to severe, with the most severe case recorded belonging to the oldest (aged 40-50) individual excavated thus far. Onset appears to begin early, with individuals exhibiting bony changes in their early to mid-20s. When correlated with dental wear, the side opposite the highest degree of wear tends to be the most extensively affected by osteoarthritis. The rates and patterns observed could be a result of the nearly universal practice of chewing betel (*Areca catechu*) by adults in this assemblage.

Biomechanics of the postorbital bar of *Eulemur fulvus* examined using finite element analysis

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A bony postorbital bar is among the key synapomorphies that define the primate clade, and it has been hypothesized that the bar evolved as an adaptation to insulate the eye from extrinsic movements caused by contractions of the temporalis muscle. However, this hypothesis does not consider the role, if any, that a bony postorbital bar might play in redistributing stress and strain concentrations around the face during feeding behaviors. Here we use finite element analysis to test the null hypothesis that the bony postorbital bar is essentially neutral with respect to the patterning of strain concentrations. A finite element model (FEM) was constructed from CT scans of a *Eulemur fulvus* skull, assigned the material properties of bone, and subjected to muscle forces and constraints that simulate a molar bite. A rough correspondence was observed between strains in the FEM and those derived from *in vivo* chewing experiments. The model was then modified by changing the material properties of the postorbital bar to represent ligament, and the model was re-analyzed. A comparison of the two models found that the presence of a bony postorbital bar reduces strains in the zygomatic root and lateral rostrum but intensifies strains in the zygomatic arch posterior to the postorbital bar. Thus, the presence of a bony bar is not mechanically neutral, but neither does it have a consistent global effect on strain magnitudes. Attention should be paid to whether natural selection might act on the stress patterns associated with the evolution of a bar.

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Developmental predictors of testosterone levels in adolescent Dogon boys

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Studies of the effects of early life adversity on maturation have usually been restricted to girls. Using 15 years of prospective, longitudinal data, we tested the hypothesis that social adversity accelerates puberty in Dogon males and we also tested for effects of stored energy reserves, growth trajectory, stunting, schooling, and urban migration on testosterone levels. Testosterone was measured in two pooled saliva samples collected 20 minutes apart between 9:00 a.m. and 10:00 a.m. and analyzed via ELISA in the CAF laboratory at the University of Michigan. We created structural equation models (in AMOS 20.0) to examine the effects of our predictor variables on adolescent testosterone levels. Our models tested for direct effects of predictor variables on testosterone as well as for indirect effects mediated by the latent construct of somatic capital. We controlled for age, wealth and being born in the hunger season (June). None of the measures of early life social adversity (e.g., polygyny, father absence) were predictive of testosterone levels (pg/mL) during puberty, except for maternal presence versus absence ($\beta = -.09$, $p < 0.01$), which may reflect a selection bias as offspring of deceased mothers usually die. Interestingly, we found that boys who had a rapid growth trajectory had higher somatic capital ($\beta = .17$) ($P < 0.001$) but lower testosterone $-.14$ ($P < 0.01$), which provides evidence for the life history trade-off between somatic effort and reproductive effort. Stored energy reserves were of paramount importance for sexual maturation in adolescent boys ($\beta = .36$, $P < 0.01$).

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The evolution of dietary niche competition in early Eocene euprimate communities in North America

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Euprimate adapids and omomyids first began to diversify in the early Eocene. However, the precise role that dietary competition played in the initial euprimate radiation is unclear. Previous research has shown that euprimates originated in the absence of dietary competition within the mammalian community but that the niches of adapids and omomyids overlapped with one another. This study's objective was to determine whether this pattern of dietary niche competition continued to define the evolution of adapids and omomyids through the early Eocene of North America.

Three competition hypotheses, each characterized by a unique temporal pattern of dietary niche overlap between euprimates and their potential non-euprimate competitors, were evaluated: non-competition, strong competition, and weak competition. Dietary niches were reconstructed for 14 middle Wasatchian (Wa3-5) mammalian families ($N=370$) using molar morphological measurements known to discriminate dietary regimes in extant mammalian communities. Measurements were calculated from 74 landmarks digitally placed on microCT scans of first and second mandibular

molars. Statistical overlap among dietary niches was determined using ANOVA of Euclidean distances derived from a PCA of these measurements.

Results indicate that the dietary niches of euprimates did not consistently overlap with any other taxon during the time period examined ($p < 0.05$), supporting the hypothesis of non-competition. Furthermore, correlation analysis of euprimate niche distributions showed that the dietary niches of adapids and omomyids diverged over time. This study demonstrates that, although the euprimate dietary niche was unique within the early Eocene mammalian community, dietary competition among euprimates was an important component of early euprimate evolution.

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Examination of the possible effects of collaring on the grooming behavior of female Black-handed Spider Monkeys (*Ateles geoffroyi*) on Barro Colorado Island, Panamá

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The advent of small radio transistors allowed researchers to remotely track animals. However, the effects of these collars on the health and or behavior of the animal(s) being studied, especially primates, have been largely unexplored. This study sought to understand if there were any significant differences in rates of grooming among collared and non-collared females. Specifically, did collared females exhibit a higher rate of auto-grooming, particularly around the collar or a lower rate of both initiating and receiving allogrooming? Over a period of 6 months (May 2012-Nov-2012) the grooming behavior of 6 collared females was compared to that of non-collared females in the single group of black-handed spider monkeys (*A. geoffroyi*) on Barro Colorado Island, Panamá. Grooming data were collected through the use of focal-animal sampling.

Through the use of chi-squared and Mann-Whitney U tests the results of this study indicate that collars did not adversely influence grooming behavior. Collared females did not have a lower rate of grooming overall, and did not exhibit a higher rate of auto-grooming around the collar. Additionally, collared females did not show evidence of a decreased rate of allogrooming in either initiating or receiving compared to non-collared females. Moreover, there was no difference in the median grooming bout durations for collared and non-collared females. It is our contention that these collars have not negatively influenced the grooming behavior of the study animals, and that in general – when applied properly – collars do not strongly influence the overall behavior of these primates.

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An integrated focus for the anthropological deeded body program

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The Anthropological Body Donation Program at the University of North Dakota has implemented components of the Bones and Behavior Working Group's "Integrative Measurement Protocol for Morphological and Behavioral Research in Human and Non-Human Primates" (hereafter referred to as IMP) into the processing protocols for donated remains. Published protocols for the documentation and analysis of donated bodies for skeletonization programs tend to feature the skeletonization process and metric analysis of the skeletal elements. The IMP includes measurements that can be taken on an intact body, such as skinfold thickness. This presentation demonstrates the practice of the IMP components in the body donation procedures used at UND, and reviews the practical impacts of implementing the IMP.

Sharing of protocols is not a new step across anthropological body donation programs, as mentors pass techniques to their students. The Anthropological Research Facility at the University of Tennessee uses and shares a questionnaire that addresses lifestyle parameters (such as occupation history) as well as medical history. Questionnaires to living donors, and documentation of medical histories have long been a part of skeletonization programs, as they are tools to address questions pertinent to human osteologists. Utilization of the IMP has allowed the Anthropological Body Donation Program at UND to acquire data that can address questions across the Primate order. The ultimate effect will be the creation of a database that has regional and temporal utility to forensic anthropologists, and homologous data of use to primatologists, human biologists, and functional and evolutionary morphologists.

Carbon and nitrogen isotope analysis of modern fauna at Laetoli, Tanzania

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Studies have shown that the ecosystem in which the Laetoli fossil sites occur is unusual in East Africa, including stronger woodland elements due to higher elevation. The greater C_3 component was further emphasized in isotope studies of the Pliocene large mammal fauna indicated that many species lacked specialization in either browsing or grazing (ie. following C_3 or C_4 pathways respectively), in strong contrast to other large mammal faunas of similar age in East Africa. Few isotope data, however, exist to characterize the modern isotope ecology, with the exception of sparse carbon and oxygen isotope data from modern tooth enamel. Therefore we analysed a broad range of modern faunal samples collected near the fossil sites for carbon and nitrogen stable isotope ratios. The sample consisted of 70 specimens of bone collagen, feathers, and quills from a wide range of taxa including non-migratory animals, such as

porcupine, tortoise, guineafowl and jackal, thus providing broad information about local conditions. The results show that despite Laetoli's woody vegetation, most animals including the birds and jackal indicated strong C_4 carbon contributions. In general the grazers showed slightly higher $\delta^{15}N$ values than the C_3 -feeders including dik-dik and giraffe, contrasting with Ambrose's Kenyan isotope ecology study. Interestingly, guineafowl and Grant's gazelle, which showed mixed carbon sources, also showed the highest $\delta^{15}N$ values for herbivores. Overall, the results depict a largely C_4 -dominated environment with a small number of C_3 -focused herbivores.

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Habitat reconstruction of Laetoli, Tanzania and its implications for understanding mosaic environments

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The Pliocene site of Laetoli in northern Tanzania has produced a large and diverse faunal assemblage, including specimens of *Australopithecus afarensis*. Paleoenvironmental reconstructions of the Upper Laetoli Beds (~3.6-3.85 Ma) have ranged widely from arid to semi-arid grasslands to closed woodland, and even gallery forest. The balance of evidence gathered in the last fifteen years suggests that the paleoecology was a mosaic of grassland-shrubland-woodland habitats.

This reconstruction does not, however, answer the question of how these different vegetation types were distributed on the Pliocene Laetoli landscape. In other words, was the inferred vegetational heterogeneity locally or regionally distributed? Central to answering this question is understanding if and how we can differentiate these different types of "mosaicism". In order to explore this issue further, ecological proxies derived from bovid and primate relative abundance data, dietary niche inference using data from isotopes and dental morphology, and gastropod community structure were examined locally by locality. The localities were limited to those that expose sediments between Tuffs 5 and 7 as most of the fossils have been recovered from this stratigraphic unit. This provides us with a fine-scale temporal resolution of how ecological heterogeneity is patterned across the landscape. The results show that the heterogeneity in the distribution of the vegetation occurred at the local level, whereas it was relatively uniform on the regional scale. These findings have important implications for interpreting how *Au. afarensis* might have used the available resources at Laetoli.

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Getting a grip on phenotypic quality: Shuar Health and Life History Project analysis of grip strength as an indicator of phenotypic quality and health

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Phenotypic quality is predicted to be related to a variety of life history outcomes. A growing literature shows handgrip strength (HGS) is a useful marker of phenotypic quality associated with health, testosterone level, bone density, aging, several psychological variables (e.g., aggression and female mate choice), and may also be associated with reproduction. Thus, HGS may be a useful proxy of fitness. HGS is primarily used in clinical studies, with its use in biological anthropology and psychology fairly limited. To further establish associations between HGS and health-related phenotypic quality in a subsistence-based, natural fertility, high pathogen stressed population, right and left HGS were measured in 546 indigenous Ecuadorian Shuar aged 3-90 years ($M=27.1$, $SD=18.1$; 311 female, 235 male). An ANOVA of HGS by sex shows that for both hands male HGS is greater than female HGS, with a significant age effect ($p<.001$ for each). Partial correlations (controlling for age and sex) show both left and right HGS positively associated with aspects of growth and health including: height, weight, body mass index (BMI), relaxed and flexed upper arm circumferences, glucose, cardiovascular disease risk (blood pressure, HDL and LDL cholesterol, and triglycerides), and Epstein-Barr Virus (EBV) antibody levels ($p<.001$ for all except EBV [$p<.005$]). HGS was also negatively associated with waist-to-hip ratio ($p<.001$). The only variables examined not significantly correlated with HGS were two immune measures (C-reactive protein and immunoglobulin E), total cholesterol, and digit ratio (2D:4D). Results suggest HGS is a useful marker of phenotypic quality and relatively long term health-related outcomes.

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Trabecular orientation of the proximal tibia covaries with orientation of the tibial condyles

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Tibial retroversion, or the deviation of the tibial plateau from the horizontal plane, represents a single measure of shape variation that potentially plays an important role in the biomechanical function of the knee joint. Reorientation of the articular surface alters the biomechanical loading environment of the tibial plateau, and trabecular bone structure may reflect the changed pattern of load distribution. The goal of this study is to examine the relationship between the angle of tibial retroversion and the primary orientation of trabecular bone in the proximal tibiae of adult humans. High-resolution x-ray CT scans were collected and retroversion angles were calculated for the medial and lateral condyles of each tibia. Volumes of interest were extracted from just below the subchondral cortex of each condyle. For each VOI, eigenvectors representing the three material axes that describe trabecular orientation were calculated using Quant3D. Results indicate that the retroversion angles of the medial and lateral condyles are highly correlated. In the lateral condyle, the retroversion angle is highly and positively correlated with the primary eigenvector orientation of the trabecular struts, suggesting that as retroversion increases, trabecular bone deviates increasingly from the expected axially-oriented columns. However, the medial condyle shows only a weak correlation between retroversion and trabecular orientation. These results indicate that internal trabecular orientation significantly covaries with external joint orientation in the lateral condyle, but not the medial condyle. The differences between the medial and lateral condyles could reflect distinct functional roles and loading regimes during bipedal locomotion.

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Study on the population affiliations of human remains from the Han cemetery in Xuecun, Henan, China

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Over half of the 287 Han Dynasty burials exhumed at the Xuecun site on the Central Plains of northern China have yielded skeletal human remains. The majority of these are buried with grave goods which probably represent different living habits and cultural background. This raises the questions of where the Han people of Xuecun site came from and whether they had an affiliation with contemporary populations in other parts of China. We compare 19 craniometric variables of the Xuecun sample with 16 pre-Qin sample groups and 14 Han and later groups. Craniometric differences between samples are compared using Euclidean distance and differential function analysis of Average Root-Mean-Square values, and patterns of ethnic groups are assessed using cluster analysis and principal coordinates analysis. The results suggest that the Han population of Xuecun inherited the features of the Ancient Central China Type of the Huaxia Ethnic Type. The possibility of integration with other nations (such

as the ancient 'Qiang' and other ancient nomadic peoples) cannot be excluded. In their cranial features, the Han people of Xuecun display a closer relationship with the modern Han Nation in south China than with those in the north.

Ecological distinctions among *Lemur catta* in different habitats: A comparison between two groups of ring-tailed lemurs in the northern and southern extremes of its range

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Ring-tailed lemurs have been studied in the wild for almost 50 years and are perceived as a highly adaptable edge species. However, this assumption has never been tested and most of what is known about this species is only from two gallery forest reserves. Here we research the limits of this species' ecological repertoire by comparing two groups of *L. catta* living in the extreme northern and southern portions of their range. The first group was studied within 10 ha of gallery forest in northwest Madagascar (Antserananomby). The second group was studied in semi-desert Didiereaceae-Euphorbiaceae bush habitat at the far southern tip of the country (Cap Sainte-Marie). The two focal groups were roughly equal in size and sex ratio. Only data from comparable months were analyzed. Population density estimates varied greatly between the sites (1.9 animals/ha vs 0.017 animals/ha). Major differences between the groups were found in: home range size, plant taxa consumed, primary plant parts consumed, and activity budgets. Similarities between the groups were found in: percentage of time spent in ground travel despite vastly different habitat types, day range distances, dietary diversity, and sunning behavior. Notably, the results between the sites are consistent with intra-site comparisons at Cap Sainte-Marie. We believe these findings reflect behavioral plasticity comparable to haplorhine edge species. However, results also indicate that some behaviors may be considerably fixed, possibly due to energy management needs. Thus, *L. catta* may be more susceptible to rapid environmental change due to physiological limitations than is currently appreciated.

The evolutionary history of the genus *Chlorocebus* inferred from whole genome sequencing

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With their abundance in savannahs and riverine forests of sub-Saharan Africa, vervet monkeys (genus *Chlorocebus*) are amongst the most widespread non-human primates and show considerable phenotypic diversity. Different classifications alternatively rank them as 4-6 species or as one single species with several sub-groups. We use whole genome sequencing data from 160 monkeys sampled over the whole continent to infer genetic relationships and evolutionary history. Identifying more than 50 million single nucleotide polymorphisms, this unique data set allows us to draw conclusions about the joint demographic history of the (sub)species and the speciation process. We use statistical software to identify signatures of past admixture events and apply coalescent based approaches to infer past and present-day rates of genetic exchange. Combining information from population genetic statistics (e.g., linkage disequilibrium, Wright's *F*_{st}, and Tajima's *D*) with dedicated statistical software, we scan for regions of genomic introgression and positive selection. Our analysis reveals both genomic regions of putatively divergent selection (suggesting local adaptation) and regions where selected alleles appear to have swept through all populations (suggesting global selective pressures). By mapping the vervet genome to the annotated human reference, we characterise the gene content of putatively selected regions and find an enrichment for immune response genes and other gene families of biological interest. Besides unraveling the evolutionary process in this species, our results are valuable due to the role of vervet monkeys in medical research. Notably, they are the most common natural host of the Simian immunodeficiency virus (SIV).

Lead in colonial Antigua revealed by cortical bone trace element spatial patterns

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Renewed interest in trace element analysis has resulted from the application of synchrotron radiation techniques that enable the differentiation between elements present in bone due to biogenic uptake and from the burial environment. We are currently analyzing the spatial patterns of lead uptake between different ancestral populations associated with a nonsegregated Royal Naval cemetery (1793-1822) in Antigua to gain perspective on the social determinants of lead poisoning. Lead was a common component in many items during colonial times including tableware, water catchment systems and distillation equipment. In

this paper we will discuss the evidence for biogenic lead uptake in ten samples and expand on the variation in lead at a time when it was so pervasive. The high spatial resolution of the lead synchrotron radiation X-ray fluorescence (SR-XRF) maps revealed different levels of 'labeling,' with lead identified in cement lines, osteons, and individual lamellae. Ten samples were tested with inductively coupled plasma mass spectrometry (ICP-MS) and the average lead concentration was 125 ppm (range 13 ppm to 335 ppm). Interestingly, the sample with the lowest concentration was obtained from the skeletal remains of an individual who was a crew member of the HMS Pyramus and died shortly after arriving in Antigua. By scanning the sample with SR-XRF the low lead level finding was confirmed. This paper will discuss the significance of this result and expand on the advantage of utilizing SR-XRF as a method to confirm the biogenic uptake of this toxic trace element.

Variation of proximal femoral angular orientation in human and non-human primates

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Humans display a wide range of variation in the orientation of the femoral head, which can range from -18° of retroversion (facing posteriorly) and to 26° of anteversion (facing anteriorly), posing a challenge to anthropologists attempting to infer function from femoral morphology and clinicians presented with the task of accurate reconstruction of the area. The high amount of variation has been suggested to be unique to humans.

To test this hypothesis that humans are more variable than other taxa, femoral version angles were compared within a sample of 149 femora of 8 species of modern human and non-human primate femora. Laser scan data were collected and reconstructed to create 3D digital polygonal models of each bone. First, clinical studies of human were replicated by quantifying orientation relative to a tabletop plane. Second, true functional angle were established using Polyworks software (Innovmetric, Inc) using centers of joint movement at the hip and knee and muscle attachments. All data were collected three times and the average used for analysis. Observed ranges were analyzed statistically using Pearson's product-moment correlation coefficient, Bartlett's *F*-test and coefficients of variation within and among sample groups.

Contrary to our predictions, human were not significantly more variable than other species regardless of body size, locomotion style, or degree of sexual dimorphism. This study serves as a launch pad for further research into the study of how environmental conditions affect the growth and morphology of the femur, and of the relationship between femoral and acetabular version.

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Testing theories of suicide in 245 cultures

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Biological anthropologists have extensively studied injuries and mortality due to interpersonal violence. Yet today, suicide is responsible for more deaths than all wars and homicides combined. This project tested several theories of suicide using ethnographic data from 245 societies in the Human Relations Area Files (HRAF), representing a broad range of human cultural diversity.

Two types of data were extracted from the HRAF: specific cases and methods of suicide, and emic and etic models of suicide. Prominent theories of suicidal behavior were then operationalized, producing a set of variables that were used to code these accounts in order to test those theories against the ethnographic literature. These theories included: a group of related anthropological explanations for suicide, which partially see it as a means for relatively powerless individuals to retaliate against powerful others in situations of conflict; theoretical models from clinical psychology, which emphasize escape from pain, burdensomeness on others, lack of social integration, and emotional dysregulation; and a theory from evolutionary biology that views suicide as a costly signal of need.

Hierarchical cluster analysis of these variables demonstrated that the loss of social partners, a sense of burdensomeness, and the desire for escape formed a group, supporting clinical psychological theories. Shame—an adaptive response that aids in regulating social relationships and signals regret—was the most frequent cognition associated with suicide. Strangulation was the most common suicide method, followed by poisoning, cutting/stabbing, gunshot wounds, drowning, jumping, starvation and burning. We discuss the implications of these findings for biological anthropology.

Ancient DNA sequencing on the Ion Torrent PGM and Proton Platforms: Genetic diversity of haplotype D4b1a2a1a at Nuvuk, an ancient Thule Village

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Mitochondrial haplogroup D is the second most common haplogroup in northern Asia and is present at high frequency in central and eastern Asia, as well as in the Americas. One subclade of D4, D4b1a2a, based on phylogeographic distribution seems to have originated in southern Siberia and spread northward into northern Asia and the Americas post-LGM. A further subtype of this lineage (previously known from mtDNA HVSI sequence as D3 but now putatively D4b1a2a1a) is present in the Inuit/Iñupiat populations of North America at low frequency (~5%), is shared with some Siberian Chukotkans, and is absent in more southern Amerindian populations. To help further characterize the sequence variation present in this haplotype, we attempted

full mitochondrial genome sequencing of two individuals from recent archaeological excavations at Nuvuk, a long-term Thule/Iñupiat village at Pt. Barrow, AK.

Two previously typed samples for the HVSI sequence variants associated with D3/D4b1a2a1a were directly dated, with median intercept calibrated dates of 1269 and 1313 AD. We attempted both shotgun sequencing and mtDNA hybridization probe capture prior to using Ion Torrent PGM and Proton sequencing technologies. Preliminary sequence suggests these genomes fall within the haplotype(s) expected in modern North Slope populations and in the greater Beringian mtDNA gene pool.

We describe our experience optimizing the Ion Plus Fragment Library Kit, as well as success rates using the mapping software packages of BWA, Bowtie2, and the Ion-specific TMAP algorithms on Ion Torrent sequencing data. Our sequencing metrics are compared to previously published ancient mitochondrial genomes.

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Assessing the real effects of X-ray imaging on recent fossils: Facts vs. speculations

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X-ray imaging using conventional or synchrotron sources is widely used in palaeoanthropology.

Even if these techniques are generally considered as structurally non-destructive, irradiation can have strong effects on DNA of living organisms. In the case of ancient DNA (aDNA), contradictory results have been published; from no effect, to extremely alarmist speculations. The conditions in fossils are different from those in living organisms (e.g. no water), therefore, extrapolations are not sufficient to understand the effects of X-rays on aDNA.

We conducted a series of irradiation experiments with synchrotron polychromatic beam on fossil cave bear test samples (teeth and bones), followed by aDNA extraction and quantification. We tested both a classical setup used to image complete specimens at 30 microns and a high dose setup. The delivered dose was directly measured using a radiotherapy dosimeter.

Important losses of aDNA can indeed occur, but only for extreme irradiation conditions that

are never used for complete specimen scanning and not reachable with conventional scanners. Preliminary results show that the most common scanning conditions have no significant effect on the amount of aDNA, neither on aDNA fragment length. Sub-micron resolution scans with synchrotron can significantly affect aDNA, but the irradiated volumes are typically in the order of ten mm³, with scanning geometries ensuring a minimum irradiation of the rest of the specimen.

To ensure that CT imaging does not alleviate future aDNA studies, we propose to respect good scanning practices and common sense to avoid unjustified, non adapted or unnecessary irradiation of recent fossils.

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Bonobos are xenophilic

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Human prosocial behavior is an evolutionary puzzle because it extends to unrelated strangers. The parochialism hypothesis proposes that this prosociality toward stranger (i.e. xenophilia) evolved through group selection made possible by human-unique culture and warfare. Alternatively, the first impression hypothesis proposes that xenophilia can evolve through individual selection due to the selfish benefits of expanding one's social network and it may not be unique to humans. We tested these hypotheses by measuring xenophilia in bonobos (*Pan paniscus*), our closest living relative known for peaceful intergroup interactions and strong alliances with the immigrating sex. In a food delivery task we found that bonobos voluntarily delivered out-of-reach food items to a stranger from a neighboring group even though they received no immediate, tangible rewards. We then examined contagious yawning, a well-established indicator of social affiliation, between two groups of bonobos that have never met before. We found that bonobos yawned contagiously with complete strangers. In support of the first impression hypothesis, our results suggest that xenophilia is present in a species without cultural norms and warfare. We propose that bonobo xenophilia might have evolved due to the benefits of forming alliances with immigrants.

The ontogeny of human and macaque prenatal brain and tooth growth

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Studies of human ontogeny suggest that different organ systems follow a common prenatal trajectory that diverges after birth, with brain development showing the most rapid growth in the first few postnatal years. Dental development is a relatively stable marker of maturation, having a growth trajectory that is more buffered from environmental variance than skeletal development. Surprisingly little is known about prenatal and postnatal dental growth relative to overall growth. Here we examine the ontogenetic relationship between body mass, stature, brain and tooth growth in 24 human and 22 *Macaca nemestrina* fetal remains. Endocranial volumes were segmented from virtual reconstructions of skulls using micro-computed tomography (micro-CT) and high resolution magnetic resonance imaging. Virtual tooth sections were generated from micro-CT models cut bucco-lingually across dentine and pulp horn tips. The sum of tooth areas of each individual was measured as a proxy for dental growth. We find that for both genera, prenatal dental growth follows a course that is significantly different from neural and somatic patterns. Standardized measurements of brain volume, body mass, and stature increase linearly with gestational age, whereas tooth area increases exponentially. This may be due to varying additive growth processes. The relationship between dental and brain growth is statistically indistinguishable between humans and macaques, which suggests that human fetal development follows a generalized primate trend that has been extended over a prolonged gestational period.

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In vitro sarcomere-length operating range of the masseter and temporalis muscles in *Macaca fascicularis*

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The force a muscle fiber can generate varies with sarcomere length. While some vertebrate muscles operate over a narrow range of sarcomere lengths (L_s), sarcomere-length operating ranges (L_sOR) vary by muscle and species. Despite the functional importance of L_s for generating bite forces and jaw movements, we know relatively little about L_sOR for primate jaw muscles. Here we examine L_sOR in four adult female *Macaca fascicularis* by transecting their mandibular symphyses and fixing one side in occlusion, the other in maximum jaw gape. We estimated L_sOR of the superficial masseter and temporalis for each specimen by measuring *in situ* L_s in the muscles fixed in occlusion and in maximum gape. We also examined the effect of L_s normalization on fiber length (L_f) estimates.

Average L_s and L_f were significantly longer ($p < 0.05$) in muscles fixed in maximum gape compared to occlusion. Non-normalized fibers were as much as 72% longer than normalized fibers. Following L_s normalization, differences in L_f between gaped and non-gaped sides were non-significant, emphasizing the importance of L_s normalization for accurately estimating muscle architectural variables. Preliminary results show a greater masseter L_sOR (2.19-4.06 μ) compared to the temporalis (2.01-3.41 μ). Maximum L_s for both muscles are near the theoretical maximum physiologic limit at wide gape. The greater operating range for the masseter is consistent with findings for marmosets and tamarins, and likely relates to its importance for facilitating muscle stretch and gape. These results suggest that L_sOR may have an important physiological impact on feeding behavior and masticatory evolution in primates.

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Validation of a model for estimating sarcomere length operating range of the superficial masseter muscle in primates

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Sarcomere lengths vary with muscle stretch and influence a muscle's physiological output. For the jaw muscles, variation in sarcomere length (L_s) across jaw gapes affects jaw-muscle forces, bite forces and jaw movements. Obtaining *in vivo* estimates of sarcomere-length operating range (L_sOR) for the jaw muscles has proven difficult for most primate species. In lieu of measuring L_sOR *in vivo*, investigators have modeled L_sOR using jaw-muscle architectural parameters collected from cadavers with jaws fixed in occlusion to estimate L_s at maximum jaw gape.

To model superficial masseter L_sOR , we collected three-dimensional landmark data to estimate muscle excursion as a function of joint angle from occlusion to maximum gape in an adult female *M. fascicularis* skull. We incorporated estimates of jaw-muscle architectural variables from female *M. fascicularis* and our muscle excursion estimates from the dry skull into a model to estimate L_s as a function of jaw angle, fitting the excursion data with a quadratic polynomial using Matlab. At maximum jaw gape, our modeled estimate of L_s exceeded an *in vitro* estimate of $L_s = 4.39 \mu$ measured from four adult female *M. fascicularis* cadavers with jaws fixed at maximum gape. While we consider this initial result sufficient to support the approach, additional species comparisons with *in vitro* L_s data at maximum gape are needed to further refine and validate the model.

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Pair-living and pair-bonding in the Red-Bellied Lemur, *Eulemur rubriventer*

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Pair living primates vary in the degree that they are bonded and exhibit allomaternal care, and whether or not they mate monogamously. The strepsirrhini are an excellent taxon to investigate the evolution of pair-living/bonding, as they exhibit this variation. We present a synthesis of our work on monogamous red-bellied lemurs, using long-term data from Ranomafana National Park, Madagascar and recent data from Duke Lemur Center. We tested the Resource Defense Hypothesis (RDH) for the evolution of pair-living, and determined whether pairs were bonded. We found support for the RDH. All wild groups lived in stable pairs that persisted >1 year, and as long as six years. Agonism rates were extremely low within (0.007/hr, n=19) and between (0.01/hr, n=18) groups, but were 10 times higher during food abundance. Interspecific agonism occurred four times more often. Ano-genital scent-marking was highest in males ($X^2=6.54$, $df=1$, $p < 0.02$), and most frequent during food abundance ($X^2=5.1$, $df=1$, $p < 0.03$). All group members (pair-mates and offspring) were strongly bonded—each stayed within 5m of another individual ~90% of the time, and in contact >20% of the time. Males and females were equally likely to approach or initiate contact with each other. Frequent twinning, coordinated hormonal changes during gestation, and facultative allomaternal care in red-bellied lemurs suggest that infant care needs may select for strong pair-bonds, though pair-bonds do not necessitate monogamous mating in all lemurs (e.g., fat-tailed dwarf lemurs). Allomaternal care among lemurs may increase infant survival (though not reproductive rates), potentially selecting for obligate pair-bonding in red-bellied lemurs.

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Are takeover frequency and variability in male quality keys to solving the folivore paradox?

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Since folivores are thought to be less affected by within-group feeding competition than many other primate species, they are expected to live in large groups thereby exploiting benefits of grouping, such as predation avoidance. However, many folivores form small groups; far below the threshold to avoid within-group scramble competition. This has been called the "folivore

paradox". Social factors, such as infanticide risk, rather than ecological factors, are thought to limit group size for these species; but this does not explain why groups do not grow to be large enough to become multi-male, thereby inducing paternity confusion and lowering infanticide risk. Here, we use agent based modeling to examine infanticide risk, takeover frequency, group size, and group compositions in two models, one where males vary in their quality and one where male quality is constant. This allowed us to determine whether variation in male quality and takeover frequency explains the folivore paradox. We found that when males did not vary in quality in our models larger groups with multiple males occurred and infanticide risk was higher due to an increased takeover frequency and more male immigrations. However, when males varied a lot in quality, a single male could monopolize a smaller group of females more easily and prevent male immigration and takeovers. This led to a lowered infanticide risk and smaller groups with fewer males and females. In our models, the folivore paradox was explained by infanticide risk mediated by variability in male quality and takeover risk. *Funding was provided by NSERC and the Government of Canada (DFAIT).*

Exploring the relationship between anthropoid cuboid morphology and expressed locomotor behavior

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The relationship between morphology and locomotion within primates is often discussed, but not always well understood, in part due to the logistical difficulty of obtaining comparative data concerning the precise relationships between joint morphology and kinesiology during locomotion. Of those studies that attempt to quantitatively explore the link between morphology and locomotor behavior, few have used three-dimensional morphological variables. In this preliminary study, we investigate the relationship between the shape of the cuboid bone and locomotor behavior in a wide range of extant anthropoid primates.

Shape data consisted of semi-landmark patches placed on the proximal and distal articular facets of 240 laser surface scanned anthropoid cuboids. A 2-Block PLS analysis was used to explore the correlation between Procrustes-aligned shape data and locomotor variables extracted from the literature. We also explored the potential influences of allometry and phylogeny on cuboid shape.

On both PLS1 (53% of total covariance) and PLS2 (37%) there is a significant correlation between cuboid shape and locomotion. PLS 1 separates knuckle-walking great apes from arboreal and terrestrial quadrupedal monkeys while PLS 2 separates modern humans from nonhuman primates. Shape differences

associated with PLS 1 are minimally explained by allometry ($r^2 = 0.16$), but for PLS 2 the relationship is stronger ($r^2 = 0.43$), mainly due to the distinctly large size of the modern human cuboid. While results do indicate a phylogenetic signal, they also suggest that cuboid morphology across extant anthropoids is often indicative of locomotor behavior.

Did you hear that? Properties of deadwood that influence aye-aye (*Daubentonia madagascariensis*) extractive foraging

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The aye-aye (*Daubentonia madagascariensis*) is an endangered nocturnal lemur with adaptations for accessing structurally defended foods, including continuously-growing incisors, an elongated, flexible middle finger, and an advanced auditory system. In some seasons, ~90% of the aye-aye's diet consists of two structurally defended resources: (i) the larvae of wood boring insects, extracted after the aye-aye gnaws through decomposing bark (deadwood), and (ii) the seeds of *Canarium* trees. Aye-ayes have massive individual home ranges (approximately ~120-215 ha for males and 30-40 ha for females) possibly due to the limited resource availability. Identification of the limiting dietary factor(s) is critical for our understanding of aye-aye behavioral ecology and future efforts to conserve this flagship species of Madagascar. To investigate whether aye-ayes equally accessed all deadwood resources within their range, we surveyed two 100 x 100 m forest plots, both within the known territories of two GPS collared aye-aye individuals (one male, one female) at Sangasanga, Kianjavato, Madagascar. Within the plots, only two out of the total of 233 deadwood resources (0.85%) were accessed by the aye-ayes. This suggests that a different critical aye-aye food resource, such as *Canarium*, may be the critical limiting resource. Alternatively, properties of deadwood might impact net nutritional gain from extractive foraging. To test whether any structural or spatial variables explain aye-aye deadwood foraging preferences, we recorded tree species, height, DBH, position in relation to *Canarium* resources, and images of the internal tree composition and density using a 3D acoustic tomograph for each accessed and un-accessed deadwood resource.

Social influences on longevity in blue monkeys

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Many gregarious primates engage in long-lasting affiliative relationships with their group-mates. Such relationships can confer short-term physiological advantages, which may translate

into long-term survival. Indeed, recent studies of baboons documented that engaging in such relationships confers fitness benefits, including enhanced longevity, to adult females. Evidence for such a trend is difficult to obtain because it requires lifelong records from many individuals. We used a long-term dataset on social behavior and life history of wild adult female blue monkeys (*Cercopithecus mitis stuhlmanni*) to see whether similar effects were evident in this female-bonded cercopithecine. Our data set included 75 parous females of known age with social behavior documented for 2-6 years each. We used accelerated failure time regression, modeling the hazard of dying as a function of the strength of bonds with other adult females (based on a composite sociality index of grooming and spatial association) and bond consistency (average number of annual changes in closest partners). These variables were uncorrelated. Bond strength and consistency interacted in their effect on mortality risk: females with strong relationships increased their mortality risk when relationships were less consistent. Females with weak relationships decreased their mortality risk when relationships were less consistent. Our findings confirm that social relationships affect longevity and create a more complex view of how they may do so.

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Dietary ecology of the chimpanzees (*P.t. verus*) at the Tonkolili Site: Analyzing resource's chemical properties in proportion to their risk factor

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As Chimpanzees increasingly find themselves in situations where they compete with human communities for resources, determining the basis for crop raiding is crucial to conservation efforts. This study is separated into two research objectives. The first focus collected generalized data regarding feeding ecology. Data collection included locating feeding sites, identifying resources, and noting both the abundance of sites and preferred resource availability; this data provides insight into Tonkolili chimpanzee nutrition, resource distribution, and ranging patterns. After the preliminary data was collected a curious trend regarding resource distribution in respect to location emerged. This trend shows that many feeding sites are located in close proximity to neighboring villages. Noting that the Tonkolili site comprises of a previously hunted, unhabituated group of chimpanzees, the risk of obtaining resources within close proximity to the village is high. We have hypothesized that this behavior is rewarded by taste, nutrient levels, and/or pharmaceutical properties. Out of this hypothesis rises the secondary focus of our study, to test the properties of local fruit and foliage samples in correlation to their risk factor. We quantified this data by the utilization of spectroscopy analysis and the examination of parasite load in fecal samples. Results show high levels of Triglycerides and lipoproteins present in frequently raided cultivated food sources such as

Elaeis guineensis versus wild staples such as *Dialium guineense*. These results provide evidence that the quality of the cultivated resources transcends the risk involved in obtaining them, shedding light on the crop raiding tendencies of these chimpanzees.

Adventures at the anthropology-anatomy interface: Palmaris longus agenesis (PLA) variation and evolution

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Prior to the coalescence of four-field anthropology in the USA during the early 1900s, physical anthropologists frequently found employ in anatomy departments. Today, fewer physical anthropologists work as allied health science educators and researchers. Consequently, most contemporary research on soft-tissue human anatomical variation is conducted from clinical rather than evolutionary perspectives. In this talk we explore how muscle variation data derived from cadaveric collections, along with comparative and functional data, can inform evolutionary hypotheses. We review both antique physical anthropology and modern clinical literature on the frequency of palmaris longus agenesis (PLA), and present novel data from LMU-DCOM's cadaver laboratory: 9% of our European-descent population exhibited either bi- or unilateral PLA, consistent with previous studies on other European populations (e.g., Thompson 1921, Thompson 2001), and in contrast to the low frequency of PLA reported in African (e.g., Adejuwon 2012), Asian (e.g., Roohi 2007), and Native American (e.g., Machado 1967) populations. Interestingly, both reverse palmaris longus and *palmaris longus accessorius ad flexorem digiti minimi* were observed. No correlation of PLA was found with plantaris agenesis; this is unsurprising given the small sample size but is consistent with Vanderhoft's (1996) report with a sample size of 22, suggesting genetic and/or developmental decoupling of palmaris longus and plantaris. We discuss possible evolutionary mechanisms for this curiously common and remarkable anatomical variant's inconsistent presentation within and between populations, as well as directions for future research, such as the potential for conducting anatomical variation GWAS and establishing an online anatomical variant database.

Adaptations of *Cebus nigritus* and *Callithrix jacchus* to habitat changes and tourism in Rio de Janeiro, Brazil

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Habitat loss and degradation are affecting two of Rio de Janeiro, Brazil's most common primates: the black horned capuchin (*Cebus nigritus*) and the common marmoset (*Callithrix jacchus*). Habitat destruction, degradation and tourism have all deeply impacted the lives of these primate species and each must adapt to new surroundings, predators, food choices and human interaction in order to survive. Both

occupy the same city, Rio de Janeiro; yet have different and unique behavioral and biological adaptations to changes in habitat. There are a plethora of tourist locations in Rio de Janeiro that are also home to wild primates. Over the course of four weeks, I visited several tourist locations such as Sugarloaf Mountain, Corcovado (The Christ Statue), Jardim Botânico, Parque Lage as well as a clinic facility that rehabilitates primates once harmed in the wild. In these popular tourist locations the primates are becoming reliant on human interactions. This can create a dependency on typically unhealthy and unnatural foods to the primates' diet. These interactions may also transmit disease from human to primate. Through my observations, I recorded multiple instances of primate feeding (indirect and direct) as well as situations of primate abuse in tourist locations. The primates are learning to navigate the hectic urban jungle of Rio de Janeiro and to adapt and survive to the tourist populations in this ever-changing city.

Male resource-control and female mate choice in tufted capuchin monkeys (*Cebus apella nigritus*)

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Although evidence for female mate choice in non-human primates is relatively scarce, tufted capuchin monkeys (*Cebus apella*) have been proposed to demonstrate strong female mate choice due to females' active solicitation in mating interactions, and the lack of any obvious male coercion to mate. Tufted capuchin females tend to prefer the alpha male and direct most of their solicitations to him. This preference has been hypothesized to result from the fact that, by differentially directing aggression to other group members, alpha males can effectively allow or prevent others from gaining access to contestable foods and females may preferentially mate with these males so as to obtain direct benefits in terms of tolerance over food resources for themselves or their offspring. However, due to difficulties imposed by natural settings (e.g., a lack of control over food distribution and contestability), no study has thus far directly tested this hypothesis. In this study, we conducted controlled provisioning experiments with two study groups over two consecutive mating seasons in Iguazú National Park, Argentina, manipulating the abilities of males to control access to food. We then examined whether females (N=12) showed a stronger preference for alpha males in the year in which when food was more clumped. Results did not support the food monopolization hypothesis, as females' preference for the alpha males did not differ between the clumped and dispersed conditions. We discuss possible reasons for this result, including phylogenetic constraints and the possibility of other indirect benefits females receive in exercising mate choice.

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Patterns of dental decoration and social identity among the Prehispanic Maya

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This poster explores the biocultural and social significance of dental modifications among the Classic and Postclassic period Maya populations, using systematically recorded data from 32 archaeological dental series. Employing a pathway approach, we estimate the ages at which teeth were modified and explore subsequent measures of maintainance and corrections at later ages associated to tooth wear and decay. Our results indicate that cultural interventions were performed at early young-adult age. When sexes are compared, differences in presence, techniques and styles of dental decorations were noted; as for status, only the "Ik" and "E" patterns appear to adhere to elevated status and to males. Intentional modifications changed from the Classic to the Postclassic period, with a significantly loss of decorations during the Postclassic. Among Classic period populations, distinctive techniques were employed by the practitioners in obtaining the desired morphology and visual effects in the dentitions, which express collectively diverse regional and local traditions. Interestingly, maintainance and correction of inlaid teeth were mainly due to occlusal wear; contrarily to what expected, little evidence can be found of infectious dental decay associated to decorations and modifications, regardless of the age of the individual. Variability through time, by sex and, to some extent, by status reveal important cultural meanings and the emblematic notions of Maya tooth work. Beyond notions of the desirable and individual choice, and in light of the acceptance of pain and possibly functional loss, they must have epitomized deeply embedded worldviews anchored in the body and its anatomical constituents.

What can we learn from the Levantine Mousterian Kebara hominins?

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The human remains originated from Middle Palaeolithic layers at Kebara (Mount Carmel, northern Israel) were uncovered during excavations conducted by M. Stekelis (1951-1965) and the current multidisciplinary Israeli-French project that lasted from 1982 to 1990. The dates demonstrate a long period of human occupation from unit VI to XII (ca. 64,000 to 48,000 years B.P). More than 30 years after the discovery of the last Kebara hominins, many questions concerning their taxonomic position within the south-western Asian fossil record remain unanswered. This hominin sample demonstrates a distinct variable set of anatomical features that combine primitive retentions, traits shared with European Neanderthals, as well as modern-like and "unique" characters. The aim of this presentation is to emphasize that the situation in south-western Asia is more complex

than the dichotomy generally accepted (Neanderthals *versus* early modern humans) and principally to discuss aspects of the Kebara human remains that permit to evaluate their position within the Levantine Mousterian hominin sample.

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Cephalopelvic disproportion: Assessing the possible role of asymmetry and developmental instability

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Previous research attempting to link external pelvic morphology to internal capacity has aimed to isolate which living women might be at highest risk for cephalopelvic disproportion. The strongest known correlation links a restricted pelvic canal to short adult height relative to a populational mean, typically attributed to developmental instability (DI). DI often results in directionally random bilateral asymmetry, correlated with lower fitness and fecundity.

This study sought to: a) examine patterns of directional and absolute asymmetry (DA and AA) in the pelvis and pelvic canal; b) test whether skeletal AA correlates with pelvic capacity; and c) test whether these relationships are stable among populations and sexes. In total, 102 osteometric measurements were taken from 128 skeletons (female n=65, male n=63) from five geographic regions.

Results show:

1. The pelvis exhibits a left-bias in DA. The pelvic canal exhibits a mosaic pattern: the anterior canal exhibits a right-bias, whereas the posterior exhibits a left-bias.
2. Asymmetry in several measures of the non-canal pelvis negatively correlate with pelvic capacity. By contrast, asymmetry in several measures of the canal exhibit positive correlations.
3. The medio-lateral dimension of the pelvic midplane bears the strongest correlations with measures of asymmetry.

These results suggest that non-canal pelvic asymmetry may impose constraints upon pelvic morphology and obstetric dimensions. Canal asymmetry, by contrast, may increase pelvic capacity. Females appear to exhibit mechanisms both to protect against maladaptive decreases and to capitalize upon adaptive increases in pelvic capacity resulting from AA, although the influence of biomechanics requires further consideration.

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Plesiadapiform primates from the Chadronian of North Dakota

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Plesiadapiform primates are a major component of Paleocene faunas in North America. Whereas the majority of plesiadapiform taxa are extinct by the early Eocene, three families – the Microsypidae, the Paromomyidae, and the Picromomyidae – have been recorded from middle Eocene faunas. In this study, we describe single specimens of a paromomyid and a microsypid from the earlier Chadronian Medicine Pole Hills local fauna, North Dakota, thus extending the ranges of these two families into the late Eocene.

The paromomyid specimen is a phenacolemurine P⁴ most consistent with *Ignaciuss* but also exhibiting characteristics found in *Phenacolemur*. The microsypid specimen is a uintasoricine M₁ or M₂ most similar to *Uintasorex* and *Choctawius*. However, it differs considerably from species of either genus.

The presence of a paromomyid and a uintasoricine in the Medicine Pole Hills local fauna suggests that the Great Plains province may have served as a refuge for plesiadapiforms after their disappearance from the Rocky Mountain province. This assertion finds support in the persistence of other mammalian taxa, including the rodent family Sciuravidae (*Prolapsus*), the ischyromyid rodent genus *Leptomomus*, and the primate family Omomyidae (*Chumashius* and *Mytonius*), in Chadronian faunas of the Great Plains after their disappearances from the Rocky Mountains.

Glimpsing internal variation and inequality through bioarchaeology: A consideration of dental health and paleodiet in Larache (AD 400-1000), San Pedro de Atacama, Chile

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The common narrative for the Middle Period (AD 400-1000) in the Atacama Oases speaks of unparalleled prosperity and peace. While it seems clear that this period had tangible benefits for some Atacameños, the distribution of those benefits, and the concomitant costs for individual wellbeing, merit further exploration. Food carries import that extends beyond nutrition to incorporate and respond to social processes and can be used to communicate key aspects of identity, including social status. Here, we use biochemical, in the form of stable isotope analyses, and bioarchaeological techniques focused on dental health, to assess diet in individuals from the cemetery of Larache

(n=50), which shows evidence in the mortuary context of distinctions in social class.

Isotopic data show a primarily carbohydrate based diet. The prevalence of oral pathologies also supports this scenario, resulting in high rates of caries (32.0%) and AMTL (36.1%). However, these patterns are not evenly distributed. When we compared the values obtained for foreign and local individuals, as determined through radiogenic strontium isotope analyses, we see that foreign individuals evidenced higher consumption of maize (a C₄ plant), and lower prevalence of caries and AMTL, suggesting that individuals born outside the oases had differential access to local resources. In light of these results, we argue that the population of the Atacameño oases did not share equally in the benefits of this period's burgeoning affluence and that there was some evidence of tensions and inequalities present in Atacameño society despite seemingly widespread prosperity.

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You can trepan if you want to or you can leave your skull alone: Patterns in ancient cranial surgery at Kuelap, Chachapoyas, Peru

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Previous bioarchaeological investigations of trepanation in ancient Peruvian societies have produced generalized regional surveys or identified novel cases from poorly contextualized collections, often focusing on the relationship between these surgeries and violence. In order to assess the frequency and patterning within a single population, I examine evidence of trepanation practices at the large, well-documented sample from Kuelap in the northern highland region of Peru. The sample includes 155 complete adult crania with 18 cases of trepanation, which appears a high frequency overall. Unfortunately, the chronology for all individuals is not clear, but while there is minor variability in trepan size and location on the vault, all were performed using a single technique of overlapping small drill holes created by a stone borer. No trepanned juveniles were observed, but both male (13.0%) and female (8.3%) adults were trepanned with a high success rate (70.0%) demonstrating the skill of these ancient medical practitioners. Only two cases were associated with perimortem fractures. This paper highlights the importance of taking a population based approach to study pathological conditions in order to develop a better understanding of frequency, success rates, and possible motivations for these surgeries.

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No chin left behind: The morphological integration and variation of the modern human mentum osseum

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The chin, or mentum osseum, is an anatomical feature that resists simple classification. The evolutionary process responsible for the

development of the modern human form of the chin is also difficult to describe, although the 'modern' form is often used to differentiate modern humans from archaics. The current study examines two questions related to the 'modern' chin; 1) it is part of a morphologically integrated set of craniofacial characteristics, and 2) what is the range of variation in chin form among modern populations?

A diverse modern human sample of 104 individuals from three university collections was analyzed in order to test the degree of integration found in the mentum osseum. Eighteen linear measurements from the mandible, face, and cranium were taken. In order to evaluate the chin, five discrete traits were examined in order to attain the Mentum Osseum Score (MOS). Ordered logistic regressions were used to analyze the measurements and the MOS. Results indicate that the mentum osseum is not statistically correlated with the majority of measurements from the mandible and cranium and may vary independently. The results also demonstrate that the mentum osseum is variable in modern human populations, although certain features appear to be fixed. These results indicate that the chin may not have been the result of biomechanical pressures or morphological integration, as are many features of the cranium; therefore, current adaptive models to explain the etiology of the chin may be insufficient.

Open science and paleoanthropology

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Online tools now enable much broader participation in anthropological research, including participation by dedicated communities and the public at large. New developments in education delivery, including the "massive open online course" (MOOC) have begun to create large global communities of nontraditional students, motivated to deepen their engagement with biological anthropology. We have recently taught a MOOC on the topic of human evolution, engaging participants with interactive scientific exercises. Here we report on the level and results of participation, including the level of representation from different countries worldwide, the rate of participation across the 10 weeks of the course, and the breadth of data collected from public participants. We describe results from four characteristic exercises, each of which involved development of a global database of student-generated data. We also discuss the impact of the curricular development project underlying the course, in which one unique feature has been original video production by graduate student researchers. Another has been the creation of accessible course content that could be featured in this global classroom comprised of many ages and diverse backgrounds. This project demonstrates one path by which paleoanthropological research can build public engagement and participation while producing novel results and supporting graduate student research development.

Knock-kneed and bow legged: Identifying genu valgum in dry bone

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The presence of genu valgum in adults is a diagnostic feature indicating vitamin D deficiency, known as osteomalacia. It is understood that genu valgum is the torsion of the proximal tibia, forcing the lateral side to be more weight bearing. A living individual with genu valgum is easily identifiable; the knees angle in and touch one another when the legs are straightened and the individual is not able to touch their feet together while standing. This condition may cause an individual severe pain as well as walking problems. The clinical literature describes genu valgum in living children and adults as well as how best to treat the condition. Unlike the clinical literature the archaeological literature lacks a clear description of genu valgum. It is only described as "knock-knees," a deformation in the knees, there are no further guidelines on identifying the condition in dry bone. A more rigorous definition of the condition in dry bone would improve the understanding and knowledge concerning the prevalence of this condition in the past as well as its association with vitamin D deficiency. Osteomalacia is difficult to diagnose unless the condition is in an advanced stage. A more detailed understanding of all the diagnostic features, including genu valgum, will facilitate a more accurate diagnosis. This research discusses the condition and proposes a new way to identify genu valgum in adult dry bones.

The skeletal evidence for leprosy at St. Mary Magdalen hospital, Winchester

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Excavations by the University of Winchester at the Saxo-Norman and medieval leprosy hospital of St. Mary Magdalen, Winchester, between 2009 and 2012, have revealed the remains of sixty individuals, fifty of which are from the cemetery areas in use during the life of the hospital. This poster presents the results of the skeletal analysis of these individuals and demonstrates an unusually high percentage with evidence for multibacillary leprosy.

Individuals were subject to standard non-destructive skeletal analyses, including age estimation, sex determination, metrical and non-metrical data recording, and documentation of evidence for trauma and pathology, focusing on the evidence for leprosy in the facial skeleton, hands, feet and distal lower limbs.

The analysis demonstrated evidence for multibacillary leprosy in forty-two of the fifty individuals from the cemeteries (84%), a much higher percentage than previously recorded in other leprosy hospitals in the UK (Chichester and Lincoln are around 20%) but similar to the percentage recorded at Naestved, Norway. The demography of the population is also unusual, with twenty-two individuals (44%) being under the age of twenty-five. There is also very clear evidence for multibacillary leprosy in non-adults, something previously only rarely seen. This suggests that the disease was long standing,

affecting the development of the facial skeleton and maxillary dentition (*leprogenic odontodysplasia* was recorded in four individuals).

The extent of skeletal evidence for leprosy at the site is exceptional, demonstrating that the condition was recognised and distinguished from other diseases, with individuals being identified and institutionalised at a young age.

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Social and ecological predictors of DNA methylation in wild baboons

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Social environmental influences can have profound effects on health, survival, and other fitness-related traits, in humans and other primates. Gene regulatory mechanisms appear to contribute to these effects. In particular, DNA methylation levels—an epigenetic mark that is developmentally plastic and environmentally sensitive—can respond to social and behavioral cues. However, we know little about the frequency or magnitude of such effects at a genome-wide scale, especially in natural primate populations. We conducted genome-wide profiling of DNA methylation levels in 46 wild male baboons with known life histories, members of the well-studied baboon population of the Amboseli basin, Kenya. We used multiplexed reduced representation bisulfite sequencing (mRRBS) to test for associations between DNA methylation and two major socioecological influences: social status (maternal dominance rank) in early life; and resource quality/abundance. We measured CpG methylation levels at over 250,000 sites, representing approximately 60% of genes and CpG islands in the baboon genome. We find that both resource abundance and early life social status leave a signature in genome-wide DNA methylation: sites associated with each variable were enriched over those expected by chance. Further, although the effect sizes for individual CpG sites were modest, the aggregate information contained in the DNA methylation data set provided good predictive power for inferring environmental conditions (e.g., high or low maternal rank) from DNA methylation patterns alone. Together, our data support the idea that DNA methylation patterns are responsive to natural environmental variation, and can remain stable over many years of a baboon's life.

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Functional morphology of the talo-crural joint in Old World monkeys, and evaluation of locomotion in *Paracolobus*

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Controversy exists as to the locomotor repertoire of *Paracolobus*, terrestrial or arboreal. Singular Warp analysis of the cross covariance matrix of the talo-crural joint in a diverse sample of Catarrhini has shown that the *first* Singular Warp in adult (M3) specimens reflects substrate use. Similarities were observed in distantly related taxa (Superfamily), and differences within genera (*Pan* spp., *Gorilla* spp. and *Macaca* spp.) and within species (*H. sapiens*). Study of the ontogeny of joint shape revealed an epigenetic behavioral signal in adult specimens, a marker of substrate use. *Paracolobus* articular shape is compared to extant Old World Monkeys.

Paracolobus chemeroni, KMN-BC-3, the holotype specimen, is a large bodied adult (M3 fully erupted) with cranium and mandible, as well as, associated postcrania including the left talus and left distal tibia. Left talus and tibia high quality casts were laser scanned and reconstructed with 27 landmarks placed on the appositional articular surfaces. It was compared to a diverse cohort with both arboreal and terrestrial profiles. Generalized Procrustes analysis, Relative Warps analysis, multivariate regression and Singular Warp analysis were performed.

Results demonstrated an arboreal pattern of appositional articular shape consistent with use on medially placed curvilinear surfaces with irregular surface movement. The *first* Singular Warp demonstrated sorting with arboreal shape.

The current study utilized Singular Warp analysis of the talo-crural joint of a known and studied fossil specimen to provide insights into its locomotor repertoire and suggests the feasibility of using this modality to identify evidence of substrate use in the fossil assemblage.

Dental microwear, isotopes, and diet in Medieval Holbæk, Denmark (AD 1200-1573)

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The medieval period in Denmark (11th-16th century) was a time of great social and economic change. This poster seeks to analyze dietary patterns of individuals from a medieval site in Holbæk, Denmark who lived during this historically tumultuous period. A previous isotopic analysis indicated a mixed terrestrial C3 based diet with varying amounts of marine foods (Jørkov 2007). Here, we compare the existing isotopic data with collected data from dental microwear, macrowear, and caries in order to provide a more complete picture of diet and subsistence patterns of these individuals during their latter years. Specifically, we assess any dietary differences between males, females, and non-adults. Results suggest that there were some dietary and behavioral differences between males and females. A subset of males were also discovered with entirely different dietary patterns. This study contributes a better understanding of variation in medieval European populations.

Comparative developmental morphology within the genus *Chlorocebus*

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Vervet monkeys (*Chlorocebus* spp.) range across Africa and the Caribbean. Despite this wide geographical range, very little work has explored comparative variation among localized populations of these closely related and socially comparable taxa. Over the course of 30 years, using a standardized protocol, we collected body weights and measurements from 2197 individuals in 8 countries representing three groups, including *C.aethiops aethiops* (258 M, 244 F), *C.aethiops pygerythrus* (383 M, 418 F) and *C.aethiops sabaenus* (390 M, 493 F). Individuals were trapped and anaesthetized in the wild, measured and weighed, and were assigned age categories based on dental eruption sequences. Using this cross-sectional dataset, we examined variation in developmental patterns within and across taxa. Mean differences in body weight across age/sex and taxon were analyzed using ANOVA and Tukey posthoc tests. We found that *C.aethiops* were significantly smaller than *C.a.pygerythrus* in males for all age categories and in females for age category 4 and older, while *C.a.sabaenus* was of intermediate size until adulthood, when both sexes become significantly larger than *C.a.aethiops*. Adult male *C.a.pygerythrus* and *C.a.sabaenus* ultimately reach equivalent size, while adult female *C.a.sabaenus* are significantly smaller. If, as phylogenetic studies suggest, *C.a.aethiops* represents the ancestral growth pattern, then the developmental trajectories seen in *C.a.pygerythrus* and *C.a.sabaenus* may represent relatively rapid convergent evolution towards larger male body size, with a divergent pattern of growth in female *C.a.sabaenus* leading to relatively smaller female size and exaggerated sexual dimorphism.

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Allometric outliers within a modern human reference sample

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Estimates of body size (mass and stature) are sensitive to overall size and allometric differences between the target specimen and the reference sample. The R statistic has been used to quantify the allometric differences between fossil hominin specimens and a modern human reference sample, but this study examines 32 modern human individuals that depart

allometrically from the rest of a large, diverse modern human sample (N = 600).

Three measurements each of the humerus and femur were included in this analysis. Body mass for each individual in the reference sample was estimated using a leave-one-out procedure, and both a classical calibration and profile likelihood regression. Finally, the R statistic was calculated. Individuals with significant R values depart allometrically from the reference sample. This is further confirmed through differences in classical calibration and profile likelihood estimates, and calculation of the Darroch and Mossiman shape variables. The Darroch and Mossiman variables allow us to see the departure of individual skeletal measurements and whether they are "too big" or "too small" compared to the reference sample. Skeletal dimensions that differ allometrically are then removed from the body mass estimation to improve accuracy.

Analyses restricted to modern humans often assume allometric similarity, and while only 5% (32/600) of the individuals in this sample have high R values, a significant allometric departure can have a profound effect on individual estimates of size. Calculation of the R statistic before estimating body mass informs the appropriate analysis—which regression method to use and which variables to exclude.

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Social change and dental health in Early Bronze Age southern Levant

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Beginning well after the transition to agriculture, the Early Bronze Age (ca. 3500 – 2000 BCE) of the southern Levant witnessed widespread cultural and social change, as evidenced by agricultural intensification, the construction of fortified, walled towns, new irrigation systems, and increasing population density. In particular, orchard crops (such as figs, grapes and olives) were gaining in importance. Early Bronze I saw a coalescence of people into large villages, which became more densely settled in EB II-III, the zenith of the Early Bronze Age. By EB IV, there was a "collapse," as evidenced by dispersal into the rural hinterland. Shortly thereafter, large towns appear once again, and population density increases as people being to populate urban towns during the Middle Bronze Age (2000 – 1550 BCE). This cyclical nature of growth and contraction offers a unique opportunity to explore its effects on human health. This project explored the effects of such change on dental health in particular at the only two southern Levantine sites with skeletal collections that span the entire Early Bronze Age: Tell es-Sultan (Jericho) in Palestine, and Bab edh-Dhra', Jordan. As evidenced in molars at Bab edh-Dhra' and Jericho, dental caries did not change significantly over the Early Bronze Age (n=839; p = 0.25), while antemortem tooth loss increased over time (n=2573; p<0.01). These changes likely resulted from increased use of orchard crops, and may

reflect changing demography during social change.

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How can bioarcheology of early medieval Slavic populations in the Central Europe profit from 3D technologies?

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Central European Slavic settlements in the 11th century represent the roots of societal development during the subsequent millennium and the answers to questions concerning the origins. Known for their relatively rapid social changes and distinct demographic shifts the early Medieval Slavic populations have been viewed as very suitable for assessments of living conditions and environmental stress markers.

We analyzed skeletal remains of early Medieval Slavic populations uncovered in multiple Central European sites in order to reconstruct growth and development, quality of food intake and social environment while employing a set of morphological methods linked exclusively to new computer-assisted 3D technologies (3D laser scanning, photogrammetry, computed tomography). 3D technologies provided us with a visual and descriptive platform on various levels of resolution as well as with freedom in restoring fragmentary archeological specimens. Sexual dimorphism, skeletal robustness, body mass, fluctuating asymmetry, and modularity were explored in skeletal sites addressed regularly in similar studies (e.g., stature, morphology of long bones, dental enamel hypoplasia) and in addition, sites uneasy to investigate with traditional descriptive approaches (fractured crania, middle ear bones, inner ear skeletal structures) were added.

We can conclude that while reconstructing living conditions from morphology of skeletal remains bioarcheology can profit greatly from PC-assisted 3D techniques. In particular small-sized, and frequently neglected, but taphonomically persistent elements of temporal bones and teeth can be of great informative value.

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Measurement of short-term linear growth using knemometry among the Shuar

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Childhood linear growth is a strikingly dynamic individual process when evaluated over short-term (e.g. daily or weekly) intervals. Recognizing that individual variation in growth is likely nonrandom and related to environmental stimuli and/or health, obtaining data concerning short-term growth is essential to understanding the biology of childhood development. Knemometry (the accurate measurement of lower leg length, LLL) is one of few methods capable of detecting short-term childhood growth. Here we present data on the use of a custom portable knemometer to measure short-term LLL growth among indigenous Shuar children inhabiting the challenging environment of the Ecuadorian Amazon. Knemometry and standard anthropometric measures were collected from 339 children age 4 to 12 years. Using a total of 1,208 measurements, we calculate a grand technical error and instrument precision of 0.18 mm for our device. Instrument precision did not differ by participant sex ($p = .108$) or age ($p = .134$) and possessed no relationship with participant BMI ($p = .558$). Weekly LLL growth values ($n = 385$) from a subsample of 212 children were used to calculate an average Shuar weekly LLL growth rate of 0.51 mm/week (s.d. = 0.85 mm/week). Preliminary analyses suggest that, on average, females experience greater weekly growth than males ($p = .011$) while children of both sexes living in moderately market-integrated communities experience greater weekly growth than children from more isolated areas ($p = .024$). Shuar short-term growth is further explored, paying particular attention to the role of somatic energy stores in mediating growth.

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Occipital bunning and overall cranial shape in a longitudinal growth sample of extant humans

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Occipital bunning, the distinctive posterior projection of the occipital squama found in Neandertals and some anatomically modern humans, is a commonly cited but poorly understood anatomical feature. Because its functional significance has yet to be definitively determined, some authors suggest that the occipital bun develops as a by-product of forces working elsewhere in the cranium. The influence of overall neurocranial profile size and shape, as well as other factors such as cranial base flexion variability on occipital bunning, however, has never been quantitatively studied from a developmental perspective.

This study assesses the developmental timing of occipital bunning in the Burlington Growth Centre longitudinal craniofacial growth study. Landmarks and sliding semi-landmarks were measured from lateral radiographs in individuals spanning 3.0 to 19.8 years of age. Measured individuals represent the extremes of adult variation in occipital squama convexity in both

males ($n=12$) and females ($n=4$). Partial least squares analysis (PLS) was performed to assess patterns of correlation between occipital bone shape and other aspects of cranial midline morphology.

Results show that bun morphology, when present, develops very early in childhood. No significant correlation was found between frontoparietal midline morphology and occipital squama convexity at any age group, suggesting that a long, low cranial vault is not an accurate predictor of bun prominence in extant humans. External vs. internal occipital squama bone contours were significantly correlated at every age group. Finally, increased cranial base flexion was correlated with bun prominence, with this correlation becoming stronger with age.

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Growth trajectories and infectious diseases during the peri-pubertal transition in Toba girls

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Puberty can be interpreted as the transition in energy allocation from somatic growth to reproductive function. The timing and tempo of this transition exemplifies a classic life history trade-off. However, few studies have considered the impact that immune challenges can take during this transitional period. The goal of this study was to examine how common childhood illnesses/infections affect growth trajectories in peri-pubertal Toba girls of northern Argentina.

This longitudinal study followed $n=28$ Toba pre-pubertal girls over three years. Data were collected monthly to assess growth and health status. We examined associations between length velocity and weight velocity with fever, gastrointestinal (GI) infections, parasitic infection, colds, bronchitis, pneumonia, and the flu. Differences in length and weight velocity with and without reports of infections were also examined.

All girls reported some form of infection during the study period, but none of them resulted in hospitalization. Overall, growth trajectories followed the expected pattern for the peri-pubertal period. Interestingly, we found a positive correlation between the number of infections and changes in weight and in waist and arm circumference ($p's < 0.03$), but no correlation with changes in height or body mass. Growth velocities were not affected by the presence of infections (all $p's > 0.30$).

Our results suggest that allocating energy to growth is prioritized over fighting infections. However, although childhood illnesses appear to be common in this population, they do not seem to exert a significant impact on the growth trajectories of these girls.

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Dichromacy in *Eulemur fulvus*: Implications for foraging ecology

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Primate colour vision phenotypes have been extensively studied, as has the evolution of opsin gene diversity as a function of foraging efficiency. While catarrhines are routinely trichromatic, and almost all platyrrhines are polymorphic trichromats, catheheral strepsirrhines have been found to be either dichromats or polymorphic trichromats. In the latter case, a polymorphism (G/C) is located at position 285 on exon 5 of the long-wavelength sensitive opsin. Here, we provide the results of a non-invasive study of brown lemur (*Eulemur fulvus*) colour vision genotypes, resulting phenotypes, and discuss potential ecological consequences.

We collected lemur feces from 27 free-ranging *Eulemur fulvus* in Ankarafantsika National Park, Madagascar and extracted DNA using a QIAamp fecal DNA extraction kit (QIAGEN). In total, 26 of the 27 animals sampled yielded DNA, which was amplified using primers designed from known *Eulemur fulvus* sequences (GenBank accession number AB111464). Genotyping was completed on an Applied Biosystems® StepOnePlus™ Real-Time PCR instrument using the melting curve analysis program.

Our results indicate that *Eulemur fulvus* - unlike other members of their genus - possess strictly dichromatic cone function, which may indicate selective pressure to maintain dichromatic colour vision because of its utility in both nocturnal and diurnal foraging. We discuss our genetic results in light of species-specific foraging ecology under diurnal and nocturnal illumination conditions.

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Life history changes in three hominin lineages (*Australopithecus afarensis*, *Australopithecus robustus*, early *Homo*) as inferred from mandibular remains

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Changes in life history, particularly the timing and pattern of somatic growth, are an important derived feature in living humans. Identifying when such changes occurred during our evolutionary past enables inference about important behavioral ecology characters from fossil remains. And yet examination of patterns of growth and timing of developmental stages in cross-sectional, fragmentary fossil samples is especially difficult. This study utilizes mandibular remains from three of the more well-represented fossil hominin lineages—*Australopithecus afarensis*, *Australopithecus robustus*, and early *Homo*—in order to infer changes in the pattern and timing of mandibular development at key stages in hominin evolution. A hypothesis of equivalence is tested in the pattern of growth and development across these

groups, with comparisons against an ontogenetic human sample used to establish a baseline. The mandible is an ideal fossil element to examine this question given its relative abundance, inherent age properties, and its dynamic and continuous change up to and through adulthood. The results here support a divergence in the early Pleistocene between the *Homo* and *robustus* lineages, with the former showing a pattern that overlaps more broadly with contemporary humans, and the latter displaying more substantial changes during early adolescence relative to contemporary humans.

The role of grit and phytoliths in wearing primate teeth

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Particles posing a wear threat to the dental enamel of primates must be both hard and with the correct angle of attack. Most natural 'grit' particles possess sufficient hardness, but are often rounded without effective attack angles. Plant phytoliths are less hard, but often sharp. We hypothesize that these silica particles fracture easily during mastication and that this is important in understanding their effect. Phytoliths were extracted from *Dactylis glomerata* and *Ampelodesmos mauritanicus* grasses with grit extracted from Kuwaiti landscapes. Particles were nanoindented with a cube corner to obtain hardness (*H*), elastic modulus (*E*), and toughness (*K_{IC}*). Individual grit particles were also subjected to compression tests and failure strengths calculated. For grit (n=15): $E=94.16\pm 2.29$ GPa, $H=13.53\pm 0.19$ MPa and $K_{IC}=0.68\pm 0.08$ MPa.m^{1/2}. For phytoliths: *Dactylis glomerata* (n=17) $E=20.2\pm 1.19$ GPa, $H=2.76\pm 0.11$ MPa and $K_{IC}=0.28\pm 0.04$ MPa.m^{1/2}; *Ampelodesmos mauritanicus* (n=12) $E=21.6\pm 2.51$ GPa; $H=3.03\pm 0.10$ MPa and $K_{IC}=0.22\pm 0.05$ MPa.m^{1/2}. Grit particles (n=22) of measured diameter failed at forces of 0.9–150N. Failure strengths ranged between 52.6–283.5 GPa, increasing as particle size decreased. Being 2.5x as hard as enamel, grit is a plausible wear agent and it fractures at low forces, rendering fragments with dangerous attack angles. Phytoliths are unlikely to wear enamel due to low hardness, so their sharpness is immaterial. However, existing evidence suggests that they deter vertebrate herbivores. If they fracture in the mouth, this could deceive a primate into believing that it is consuming grit. Thus, phytoliths could represent an example of

functional mimicry: an example of a feeding deterrent operating by deceit.

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Land of contrast: Osteological analysis of human remains from Salango, Ecuador and a comparison of paleopathologies between coastal and highland sites in Ecuador

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This paper reports the results of a two-part study comprising: (1) a standard osteological analysis of human skeletal remains located in three burial urns from Site 35 in the coastal region of Salango, Ecuador, followed by (2) a comparison of pathologies and traumas observed in remains from two distinct regions, the coastal region and the inland regions. The urns at Site 35 contain approximately 700 skeletal elements and fragments from at least 12 individuals. The age range is infant to adult, with remains from numerous juveniles. Several pathologies observed are general indicators of poor nutrition (cribra orbitalia, enamel hypoplasias, and dental caries) and malnourishment (porotic hyperostosis, which is a condition related to anemia and iron deficiency); an additional observation is intentional cranial modification. These overall health indicators are subsequently compared to six additional sites in Ecuador - Cotocollao, Cumbaya, Real Alto, Agua Blanca, Ayalan, and the Plaza San Marcos - to determine whether any general trends can be observed in the patterns of health and also to determine how the results from Site 35 fit within these general trends. Site 35 demonstrates the highest frequency of dental caries and no discernable trauma, both of which differ from observations in the other coastal and inland sites. Each site exhibits evidence of infectious disease, but the frequency increases in both inland and coastal sites over time. Finally, indicators such as trauma and dental disease show a decline in overall health for sites from the latest time periods, especially highland sites.

Neandertal and recent human female pelvises: Are they really different?

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The differences between the Neandertal pelvis and the recent human pelvis have historically been explained by locomotion, body size, or obstetric differences between the two populations. While Kebara 2 provides a clear example of a Neandertal male pelvis, no Neandertal female pelvis is as well preserved. Therefore, studies on the pelvic differences between the two populations have not been able to demonstrate conclusively how their female pelvises differ. Since pelvic evolution is often explained by obstetric changes, it is important to identify that differences exist between Neandertal and recent human female pelvises and how those differences manifest.

Here, I test the null hypothesis that there are no quantifiable differences between female Neandertal and recent human pelvises. I compare

the five Neandertal os coxae that can be confidently estimated as female to a larger sample of recent human female pelvis. For each os coxa, I took 235 measurements that were selected because they could be taken on the fragmentary female Neandertal fossils. For each measurement, I randomly sampled one Neandertal and one recent human to create a ratio, and repeated this process 10,000 times. Using this method, I developed a distribution for each measurement that shows how often and to what degree Neandertal and recent human females varied for a specific pelvic measurement. These results indicate which features of the female Neandertal os coxa sample may have differed from the recent human female form, and therefore may be relevant to the evolution of childbirth.

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Variability in the dietary patterns in Bronze Age Italy

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Bronze Age is a crucial moment of change in Europe: new crops, new agricultural systems and livestock farming are introduced leading to more complex societies. The variability and the development of these communities are reflected in the dietary patterns, as can be described by stable isotope analyses. This communication aims at presenting diachronic and geographic dietary patterns using bone collagen stable isotopes analyses (C, N) from 165 human and 61 fauna samples from nine Bronze Age sites (2300-1120 BCE) located in North, Central and Southern Italy. Results highlight, on one hand, a more variable diet in the North than in the rest of Italy and different dietary habits can be identified in each area. On the other hand, data indicate that the diet appears to have been uniform for the EBA and LBA compared to the MBA where a different dietary pattern, based on C₄ plants (millets), emerges. The results describe the introduction and consumption of C₄ plants during EBA-MBA transition, with a diffusion trend starting from Northern Italy and a very homogeneous diet based on terrestrial food (C₃ plant) in the South.

Heterogeneity in the dietary regimes of West Indian enslaved labourers as reconstructed from stable isotopes

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European colonies in the West Indies relied upon enslaved Africans and their descendants to provide the labour that their economically valuable sugar plantations required. The exposure of historic cemetery sites in recent years by inclement weather and modern development has led to the archaeological excavation of an increasing number of burial grounds where these enslaved labourers were interred. These investigations have increased our knowledge about the experiences of enslaved populations of African origin in the West Indies during the 18th and 19th centuries. This paper presents $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ values from bone collagen and $\delta^{13}\text{C}$ values from bone apatite from three sites on adjacent islands (Antigua, n=7; Montserrat, n=10; and Guadeloupe, n=60). The former two islands were once British, while the latter remains French. The Antigua site is particularly interesting in that it does not represent the burying place for plantation slaves, but that for very highly trained enslaved tradesmen who worked in the nearby Royal Naval dockyard. Overall, the isotopic values from bone apatite are consistent with what is known of the diet of enslaved labourers from the historic record regarding the stable carbohydrates in the diet. However, the isotopic values of bone collagen indicate greater variation in the protein component of the diet than expected. The data and discussion underlines the variability of slave diet from different islands and contexts.

Early childhood in Yucatec Maya subsistence agriculturalists

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Human life history is characterized by extended juvenile dependence with well-defined periods of infancy, childhood, and adolescence. The transition from infancy to early childhood (weaning) is a life history event marked by changing energy allocation and distinct endocrinological, immuno-nutritional, and biosocial shifts. Representing the onset of nutritional and immunological independence, early childhood is biologically significant but also an understudied developmental phase. To address this knowledge gap, we document children's growth from weaning to age five (n=75, age 2.5-5) in a Yucatec Maya village. We evaluate whether between-sibling resource competition increases post-weaning at the cost of growth. Family size in traditional societies might confound the opposing effects of older and younger siblings on resource competition: older siblings may assist in food production and care of younger siblings; in contrast, newborns "displace" vulnerable weanlings, monopolizing maternal attention. We therefore hypothesized that the addition of younger siblings would negatively affect early childhood growth, while the effect of older siblings would be negligible. We find that girls with older siblings (not boys) weighed less than girls with no older siblings.

The relationship was dose-dependent: weight decreased as older sibling number increased. Growth in height was not affected by older sibling presence in boys or girls. Displacement by a younger sibling negatively affected growth (height and weight) in both boys and girls. Our results suggest that early childhood is a vulnerable time for children in natural fertility populations. Results are discussed in relation to theories of parental investment, reproductive trade-offs, and biosocial child development.

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Gelada herds increase predation success of Ethiopian wolves on rodents

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Mixed species associations generally form to increase foraging success or to aid in the detection and deterrence of predators. While mixed-species associations are common among mammals, those involving carnivorous predators and potential prey species are seldom reported. We documented commensal associations between two mammals endemic to the Ethiopian Highlands: Ethiopian wolves (*Canis simensis*), carnivorous solitary foragers, and geladas (*Theropithecus gelada*), highly social grazing monkeys. The non-aggressive, tolerant, and prolonged nature of the associations between these species contrasts with the defensive and flight responses of geladas toward other potential predators. Ethiopian wolves spent a higher proportion of time foraging and preyed more successfully on rodents when among geladas than when alone, indicating that gelada herds increase the vulnerability of subterranean rodents to predation by Ethiopian wolves. These results suggest that Ethiopian wolves habituate gelada herds to their presence through non-threatening behavior, thereby foregoing opportunistic foraging opportunities upon vulnerable juvenile geladas in order to feed more efficiently on rodents. Establishing proximity to geladas could be an adaptive strategy for critically-endangered Ethiopian wolves to elevate foraging success and thereby facilitate population growth.

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Dynamic CT scanning as a tool for measuring thumb kinematics

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Visualization and quantification of motion occurring at the human basal thumb joint during functional tasks is particularly difficult due to the complex 3D arrangement of the small bones with multi-planar range of motion and skin motion

artifacts. Because of the limited applicability of standard motion capture techniques, we investigated the feasibility of dynamic CT scanning to visualize and quantify thumb kinematics.

Dynamic CT scanning was performed during passive opposition of the human thumb using a custom-build motion simulator. Motion was recorded continuously during 10 seconds, resulting in 26 image frames. Post-processing software (Mimics 16.0, Materialise, Belgium) was used to manually segment the radius, scaphoid, trapezium and first metacarpal from each frame of the dynamic scan. This resulted in a time series of 3D bone reconstructions. Translation vectors and rotation matrices were calculated using custom Matlab code and motion at the radiocarpal (RC), scaphotrapezium (ST) and trapeziometacarpal (TMC) joints was visualised with helical axes. Validation of the method was performed using radio-opaque beads.

During passive thumb opposition, movement in the RC, SC and TMC joints was confirmed, with largest motion occurring at the MTC joint and smallest motion at the ST joint. Results of the validation process point to a high precision (RSD < 0.80%) and high accuracy (%error < 3.5%) of the dynamic CT scanning method.

Non-gated dynamic CT scanning appears to be a valuable method to visualize and quantify complex bone motion in situ, and offers great opportunities for obtaining a better understanding of the function of thumb.

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Interactions are important: Mass, velocity, burden, and gradient effects on walking energy expenditure

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Few equations for predicting the energy expenditure of walking exist, and those that are available are limited. Most studies have failed to include normally occurring conditions like walking with burdens or on gradients and those that have included burden transport on gradients do so only in partial combination with other variables. Consequently, the importance of interactions among variables remains unclear.

To better understand the importance of interactions in predicting the energy expenditure of walking, we collected VO_2 on 10 women who completed 5 minute walking trials consisting of combinations of velocity (v), burden mass (b), and gradients (g). Conditions included slow, normal, and fast velocity categories (averages among individuals: 0.67, 1.18, 1.61 m/s, respectively), burdened (10 kg) and unburdened, with gradients of -16%, -8%, 0%, 5% and 10%. We created a new predictive equation from all possible interactions of these three condition variables plus participant body mass (m). We also tested the ability of standard equations (Pimental et al. (1979); Ardigo (2003); and equations 1a and 1b from Kramer (2010)) to predict our VO_2 data.

Our best-fit predictive equation for all conditions explains 81% of variation in our data. Interaction among the variables (gmv, b^2mv and g^2m) proved particularly important (p-values <

0.001). The best-fit equation from the literature is that of Pimental and colleagues (1979), explaining 67% of the variation in VO_2 , but it is not applicable for use with negative gradient trials. Future work will continue to explore the impact of interactions on energy expenditure in walking.

Multi-locus genetic analysis of Circum-Caribbean populations and its implications for the prehistoric and historic peopling of the region

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The islands of the circum-Caribbean region are of great interest to anthropologists because the area bore witness to seven millennia of prehistoric human occupation and interaction, followed by 500 years of forced and voluntary migrations from Africa, Europe, and most recently Asia. A geographic crossroads intersecting North and South America, as well as the Old and New Worlds, these islands offer a unique biogeographic perspective on the complex processes of settlement and colonization first outlined by archaeologists and historians. In order to gain a better understanding of the history of the Caribbean peoples, we employed the Illumina-based GenoChip SNP microarray to genotype 300 participants from various islands of the Caribbean region, including Dominican Republic, Puerto Rico, St. Vincent, Trinidad and Bermuda. The GenoChip includes 180,000 anthropologically informative autosomal, Y-chromosome and mtDNA SNPs which enables a high-resolution analysis of ancestry for both individuals and populations. Our results show a strong presence of indigenous markers in every population, with autosomal DNA frequencies as high as 20% in some Puerto Rican participants and up to 9% in Bermuda, the latter was uninhabited when first discovered by Europeans in the 17th century. Across all markers, populations from the Lesser Antilles appear more similar to those in South America and Africa, whereas populations from Puerto Rico, for example, show greater affinities to other regions in the Americas, as well as Europe. These different patterns suggest that both prehistoric and historic events likely influenced the genetic make-up of the different Caribbean populations in unique ways.

An analysis of *Homo erectus* vertebral canal morphology and its relationship to vertebral formula variation in recent humans

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Recent humans have a modal vertebral formula of 12-thoracic:5-lumbar vertebrae (12T:5L) under both anatomical and functional definitions. However, all early hominins for which vertebral formulae can be determined appear to possess six functional lumbar vertebrae while maintaining the same total number of thoracolumbar elements (11T:6L). An elongated lumbar column facilitates lordosis during upright bipedal locomotion, and it remains unclear why its functional length reduced in later *Homo*. It has been suggested, based primarily on analyses of KNM-WT 15000, that elongated lumbar columns are prone to abnormalities including spinal stenosis, an abnormal narrowing of the vertebral canal linked to increased pain and severity of spinal cord injuries. However, the realization that early hominins possess functionally elongated lumbar columns while maintaining the recent human mode of five traditionally-defined lumbar vertebrae only recently occurred, necessitating a reassessment of vertebral canal morphology in comparison to recent humans with the same vertebral formula (11T:6L). Using surface areas, landmarks and semilandmarks collected on scaled photographs, I compared vertebral canal and centrum size and shape of three thoracolumbar vertebrae from recent humans with modal and non-modal vertebral formulae ($n=69$), KNM-WT 15000, and Dmanisi D2672. KNM-WT 15000's small lumbar vertebral canals fall within recent human ranges. Based on analyses in MorphoJ, the canals of both D2672 and KNM-WT 15000 fall within shape expectations of recent humans with 11T:6L configurations. These results cast doubt on the interpretation of the KNM-WT 15000 vertebral canal as pathological and suggest that vertebral formulae need to be considered in comparative studies.

Testing the limitations of ancient DNA sampling in Bayesian coalescent analysis

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The field of ancient genetics applied to the study of population evolution across space and time has illustrated the difficulty of reconstructing demographic history based on contemporary genetic information alone. Contemporary genetic data record the sum of all evolutionary processes to date, but are strongly influenced by the most recent, significant events in the history of a population. The analysis of ancient DNA is a powerful approach for investigating the historical dynamics of populations that have undergone recent significant shifts in population size. The strength of this approach lies in the ability to directly observe genetic information from multiple populations at multiple points in time. Current Bayesian coalescent methods, which allow for the joint estimation of demography, biogeography, and substitution rates, are particularly well suited for ancient population inference because they may seamlessly incorporate data from different time points to

produce robust inferences of population dynamics. However, commonly used Bayesian coalescent methods are limited by necessary assumptions that may dramatically increase the complexity and difficulty in obtaining accurate coalescent inferences. In this study, we explore alternative complex demographic models using simulation data and test the discriminative power of limited sample sizes of ancient DNA data sets. We focused on the ability of Approximate Bayesian Computation analysis based on a small ancient DNA data set (10 samples to 80 samples) to correctly discriminate between 256 variants of a population event that takes place in the Holocene, particularly if the populations has undergone another recent population shift within the last 200 years.

Facial biomechanics of *Australopithecus afarensis* based on AL 444-2

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Early reconstructions of the facial morphology of *A. afarensis* emphasized its primitive, apelike features. However, more recent descriptions of AL 444-2 reconsidered the overall morphological pattern, and several features are now seen as notably derived: relatively deep mandible, less prognathism than originally interpreted, and a forward masseter position relative to that of great apes. Rak's (1983) biomechanical interpretations of the *A. afarensis* face were framed by the earlier interpretations of apelike morphology for this species, but to date there has been no reassessment based on updated morphological evidence and advances in biomechanical methods.

Here we apply finite element (FE) methods to assess mechanical hypotheses of *A. afarensis* facial morphology. A digital reconstruction of the AL 444-2 cranium, based on CT scans, was

used to develop the FE model. Muscles were modelled with force vectors originating on the cranium and inserting on the reconstructed AL 444-2 mandible. The model was loaded with muscle forces based on chimpanzee muscle data, and constrained at the TMJs and premolar and molar bite points. Results of loadings on the P³ and M² indicate that the strain distributions in AL 444-2 share similarities with those observed in Sts 5 (*A. africanus*) and MH1 (*A. sediba*). These strain distributions differ in important ways from those in OH 5, particularly in the nasal and infraorbital regions. Our results raise interesting questions about whether gracile australopithecids share a general masticatory strain pattern that differs from those seen in *Paranthropus* and *Pan*, despite morphological diversity among gracile australopithecid species.

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Do Bornean orangutans (*Pongo pygmaeus wurmbii*) in a peat-swamp habitat experience energetic stress during periods of fruit scarcity?

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The peat-swamp forests of Central Kalimantan are characterized by annual fluctuations in fruit availability, with low fruit periods lasting 3-11 months and 0-3% of the trees producing fruits. Thus, these habitats are challenging environments for large, arboreal frugivores like orangutans, which experience multi-year lactation and the longest juvenile dependency period of any primate. Variation in the availability of fruit resources and subsequent energetic intake can influence female reproductive rates and thus impact reproductive success. Previously, we found a positive relationship between energy intake and fruit availability at the Tuanan Research Station, Central Kalimantan. However, it remains unknown if these animals are energetically stressed as a result of reduced caloric intake.

Here, we examine if seasonal variation in energy intake influences energetic condition in wild orangutans at Tuanan by examining urinary C-peptide of insulin, urea concentration, and the presence of ketones. We predicted that during periods of reduced caloric intake, we would detect lower C-peptide concentrations, urea concentrations, and an increase in the presence of ketones in urine samples. We used a novel technique to examine skeletal muscle breakdown by quantifying 3-methylhistidine (3MeHIS) in urine. Elevated 3MeHIS is expected once fat reserves are exhausted and caloric intake remains

below energy expenditure. We found a significant positive relationship between energy intake and C-peptide levels ($p=0.005$), and a negative relationship between intake and urea concentration ($p=0.04$) and 3MeHIS ($p<0.05$). These episodes of fruit scarcity and energetic stress appear to influence the timing of conception in the Tuanan orangutans.

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Variation in catarrhine os coxae morphology: Phylogenetic implications in a comparative context

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It is important to better understand the unique shape of the hominin pelvis against its wider catarrhine context. Such understanding may prove valuable when reconstructing phylogeny in fossil primates, including hominins. Inevitably, the primate postcranium reflects variation in locomotor and postural adaptation, thus explaining the divergence in pelvic shape between bipedal hominins and other primates. However, previously undertaken 3D geometric morphometric analyses using 30 extant catarrhine taxa have indicated a relatively strong phylogenetic signal in os coxae shape, with clear taxonomic distinctions between hominoids and cercopithecoids. Moreover, congruence between genetic and morphological distance matrices based on the cranium and pelvic bone suggest the cranium and pelvis to be equally reliable, although neither anatomical region was able to reconstruct the precise genetic relationships of these taxa. Here, we undertook an analysis focused on the genetic congruence of the temporal bone compared with the os coxae. Our results confirm that temporal bone shape can reconstruct the molecular relationship between humans and great apes, while os coxae shape failed to do so. However, when *Hylobates* was included in the analyses, neither anatomical region recovered the correct molecular relationships. Taken together, these results highlight that, in general terms, there is no *a priori* reason to favor cranial data over os coxae anatomy when testing fossil primate phylogenetic hypotheses. However, it is vitally important to consider the taxonomic scale at which phylogenetic studies are being conducted, as such decisions affect the ability to employ phylogenetic bracketing when inferring the evolutionary history of the bipedal hominins.

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Discovering differences in dietary patterns between indigenous Madagascar ethnic groups

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Madagascar is one of the most biologically diverse places in the world. Yet ethnographic

accounts of indigenous ethnic groups list the use of similar staple food sources such as rice, maize, sweet potatoes, and taro. To more clearly illustrate dietary differences between the indigenous ethnic groups, stable carbon and nitrogen isotope analysis was conducted on hair samples from indigenous populations.

Rice, sweet potatoes, and taro use a C3 photosynthesis pathway, while maize utilizes C4 photosynthesis. Small differences in plant consumption would create different carbon isotope signatures for the ethnic groups. In addition, meat, fish, and dairy are not indicated to be major dietary components, but differences in their consumption would influence both the carbon and nitrogen isotope signatures for these ethnographic groups. The combination of these two stable isotope signals would create a unique isotopic signature for each group.

The hair samples were taken from ten adult males chosen from four ethnic groups: Comorian, Merina, Sakalava, and Tsimihety. A multivariate analysis of variance showed significant differences ($p < 0.05$) between groups based on the analysis of the stable isotopes. Further pairwise comparisons using Hotelling's T-squared tests confirmed statistical differences between the ethnic groups, with the exception of Sakalava and Tsimihety ($p = 0.356$).

Overall, the nitrogen values were more informative in defining differences between the cultural groups. This indicated that although meat, fish, and dairy, may not be major dietary components, their usage is more culturally significant and varied than previously thought. *Supported by the Anthropology Department at the University of Colorado in Denver.*

Bayesian analyses of >100 Yemeni mitochondrial genomes and implications for dispersals out of Africa

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The southern dispersal route (SDR) out of Africa argues early anatomically modern humans (AMH) crossed the Bab el-Mandeb strait into Yemen and followed the coast of the Indian Ocean into eastern Eurasia. If AMHs migrated along the SDR and left modern descendants, one expects older Yemeni clades in the human mitochondrial genome tree. Alternatively, if AMHs did not migrate along the SDR or did but did not leave modern Yemeni descendants, one expects younger clades instead.

Our Yemeni samples includes 90 genomes generated using indexed library sequencing on the Illumina HiSeq 2000 primarily from haplogroups L3, M1, and N1, 23 Yemeni genomes previously generated using Sanger sequencing from a wider array of haplogroups, and previously published sequences. We targeted haplogroups L3, M, and N as the evolution of these haplogroups is associated with the first migrations out of Africa. We used BEAST v1.7 to generate time-measured phylogenies for whole mitochondrial genomes to test for monophyly of

Yemeni sequences and estimate the ages of Yemeni clades.

Our topologies show that Yemeni sequences are diverse across haplogroups L3, M1, and N1. We found clades of predominantly Yemeni sequences within studied haplogroups (e.g., M1a5 and L3d1a1a) but limited evidence of strict monophyly. Clades were also found to be young ranging between 4-18 kya. Our results suggest no evidence for mitochondrial descendants of the SDR in modern Yemen; however, high levels of diversity and close relationships of Yemeni sequences to both African and Eurasian sequences reinforce Yemen as a nexus between Africa and Eurasia. *Samples sequenced were collected with support of NSF grant BCS-0518530 and analyzed with support of NSF grant BCS-1258965.*

Radiological correlation of experimental and ancient Egyptian human mummification

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Twenty years ago, Ronn Wade and Bob Brier produced MUMAB (Mummy, University of Maryland At Baltimore), the first modern mummy embalmed in the ancient Egyptian tradition, to serve as the centerpiece of the Mummy Replication Project. The mummy was created to better understand the process of the Egyptian mummification tradition, and has been studied over the past two decades to assess the success of the embalming process, as we know it, at halting decomposition.

This paper discusses radiological findings from high-resolution computed tomography scans and magnetic resonance imaging, and places them in the context of the embalmers' firsthand experience. The aim of the study was to examine the assumptions mummy researchers make in the radiological study of Egyptian mummified remains, and their correlation with the process as it was actually carried out.

The scans were reviewed by four of the authors (AW, RB, GC, & RG), and described in relation to our current understanding of the ancient Egyptian mummification tradition. The results were then reviewed by the embalmers (BB & RW) for a commentary impossible to receive from the embalmers of ancient Egypt.

For the most part, the radiological review correlates well with the biological profile of the donor body and with the mummification procedures carried out. Intermittent resin use in the wrappings and damage from tissue sampling were correctly identified. There were, however, discrepancies between the interpretation and procedure for the transnasal craniotomy lesion, intracranial residues, transabdominal evisceration incision, diaphragm incision, and the exact nature of some packing materials.

Match it up: Reliability of the cervical vertebrae in positive identification in practice and theory

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We discuss the accuracy and reliability of positive identifications derived from the forensic anthropologist's comparison of cervical vertebrae spinous process morphology—in practice. In addition, we question the necessity of Euclidian matrices and simulated antemortem and postmortem radiographic samples when making these forensic identifications—in theory.

The Scientific Working Group for Forensic Anthropology (SWGANTH) posted best practice standards and recommended that reliability statements appear alongside confidence intervals. Yet, the SWGANTH standards for antemortem versus postmortem radiographic comparisons used for a positive identification (1) do not require minimum number concordance points or (2) minimum congruency point thresholds. Nevertheless, Euclidian matrices and simulated antemortem radiographs tend to be the subject of several publications. While we do not eschew statistical validity, we support SWGANTH best practices by providing evidence of positive identifications substantiated via other lines of evidence.

Based upon experience with Florida medical examiner districts, forensic anthropologists do not tend to evaluate ante- and postmortem radiographs in the blind. Rather, while present at autopsies we discuss identification methods with the forensic pathologist and scene information with law enforcement personnel. Access to medical records, enables the forensic anthropologist to complete a proper superimposition using antemortem and postmortem radiographs. We build upon Walsh-Haney's previous study involving thoracic vertebrae to focus upon the accuracy of cervical vertebrae spinous process morphology to establish the positive identification. In particular, the flame-like morphology of the bifurcated cervical spinous processes shape makes these bony landmarks easy to identify and use to rule a decedent in or out.

Tough terrain: The effects of incline walking on the human cost of transport curve

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Understanding how the human cost of transport (CoT) curve is reshaped during incline walking can elucidate what morphological traits or behavioral modifications may be selected for in order to minimize the energetic expense to traverse hilly terrain. In this study, eight males walked on a treadmill at 4 speeds (1 slow, 2 medium, 1 fast), self-selected from a series of options. Participants walked at all 4 speeds at both the level and at a 12% incline for a total of 8 conditions. All speeds and conditions were performed for five minutes in a randomized order while participants' metabolic rates were collected. Participants were given a minimum of 4 minutes rest between each condition. Separate

CoT equations were calculated for the level and incline conditions; from these equations, the acuteness of the CoT curve (x^2), the minimum cost of transport (MinCoT), and the speed at which the MinCoT occurred (SpMinCoT) were determined. While there were no significant differences between the curvature of level and incline CoT curves, the SpMinCoT was significantly slower (1.45ms^{-1} versus 1.38ms^{-1} , $p=0.039$) walking on the incline and the minCoT was significantly higher (96% higher, $p<0.001$) during incline walking. Additionally, participants chose to walk at significantly slower speeds on the incline than on the level surface ($p<0.01$). These results suggest that hill-walking not only reduces total distance traveled in a given amount of time, but is enormously energetically costly, meaning hilly terrain may have been a strong selection pressure on locomotor morphology.

Bilateral cortical bone remodeling in the human appendicular skeleton

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"Wolff's Law" suggests habitual use of the dominant side should be in evidence via greater bone mass on that side. To examine this supposition, the humeri, radii, ulnae, femora, tibiae and fibulae of a single individual were collected. The individual had been a carpenter in life, and died at the age of 65. The femora and humeri were each sectioned on a band saw into 10 segments, each representing 10% of the length of the bones. For each of the resulting 9 sections, geometrical properties, including Imin, Imax and cross sectional area were calculated using the BONEJ plug-in for IMAGEJ software. No significant difference was found between the left and right femurs ($\alpha < .05$). This is not unexpected as the two lower limbs will be used symmetrically in most individuals. In an individual where one arm is dominant and is consistently used at frequent peak stresses (e.g., using a hammer), substantial bilateral asymmetry might be expected. However, when the humeri are compared, differences in geometrical properties are not significant. This reflects results found in other vertebrates. At midshaft, left and right humeri are nearly identical. When just the distal four sections are compared, the differences in Imax approach significance ($p = 0.058$). This is likely due to rugosity in the muscle attachments on the right distal humerus. The basic form remains identical on right and left sides. Future analysis will include all the major long bones, as well as histological examinations at the same sites.

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Comparative physical indicators of health in Mexican immigrant and Mexican children

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Numerous risk factors influence the high rates of obesity and diabetes for immigrant Latinos, and children exhibit a particularly high incidence. We investigated risk factors as part of a multidisciplinary health education program in Missouri. We collected data on diet, activity level, and physical health indicators from Mexican immigrant children aged 2-13, and compared results to those from their native Mexican region. We predicted to find fewer overweight children in Mexico, particularly in the rural area, and expected Mexican children to spend more time engaged in physical activity and to eat fewer high-fat foods.

We measured 56 children in our 18-month program in Springfield, Missouri, and 203 in Mexico (approximately half rural, half urban). Measurements collected include: height, weight, waist and mid-upper arm circumference, triceps skinfold, and blood pressure. Parents answered questions about family health history, nutrition, and activity level. We include results for body mass index (BMI), waist circumference, and some behavioral indicators.

Thirty-nine percent of our local study group had BMI greater than the 85th percentile, compared with 29% in the Mexican sample. Waist circumference measurements above the 75th percentile were similar (56% in local, 54% in Mexico). The urban Mexican group exhibited more overweight than the rural, and boys more than girls.

Results are interpreted based on differences in reported diet and behavior, particularly activity levels. We discuss the influence of cultural factors, parental perceptions of health, and the effects of immigration. This work contributes to the investigation of causes of inter-population differences in type 2 diabetes.

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The balance between body size and task in assessing the meaning of pelvic width for human locomotion

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Among sexually dimorphic features of the human skeleton, a few are particularly important for locomotion, namely: overall size, the shape of the pelvic girdle, and the proportions and lengths of the lower limbs. Across populations, males are absolutely larger in terms of mass, stature and lower limb length, whereas females have wider pelvises relative to size. Variation between the sexes in these traits has consequences for the energetic cost of transport (CoT) and the speed of travel; we thus expect that these morphological differences lead to sex-specific energetic costs and strategies of mobility. Here, we present data on the energetic differences between males and females ($N=39$) walking with and without loads across a range of speeds. Without loads, males have significantly faster optimal walking speeds (10.9%, $p=0.019$), higher costs at their optimal (minimal CoT) speed (23.4%, $p=0.002$), and a more acute optimal walking curve (thus an increased penalty

for walking at sub-optimal speeds) (22.1%, $p=0.276$). People with relatively wider bi-trochanteric breadths (for their mass; generally females) have lower costs at their optimal speed ($p=0.036$). Additionally, during loaded walking, a relatively wider pelvis increases both stride length ($p<0.001$) and speed flexibility ($p<0.001$), providing a morphological offset for load-related costs. These data suggest that females' wide pelvises provide energetic benefits during both loaded and unloaded walking.

Exercise-induced bone formation is poorly linked to peak strain magnitude

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The distribution of material within diaphyseal cross sections is thought to be affected by the magnitude of local mechanical strains engendered by customary loading. Based on this assumption, anthropologists analyze diaphyseal shape in fossil hominins to infer habitual locomotion and posture. For example, individuals with lower limb diaphyseal cross sections that are elliptical and reinforced in the sagittal plane are inferred to have engaged in large amounts of walking/running that bent diaphyses in the anteroposterior direction. However, direct evidence is lacking that loading indeed affects diaphyseal shape in a predictable fashion by promoting bone formation disproportionately in areas of the diaphyseal surface where mechanical integrity is most challenged. This study quantified the strain environment of the mid-diaphyseal sheep tibia during treadmill running using strain gages and examined whether this exercise-related mechanical milieu induces bone formation primarily in diaphyseal regions that experience the highest strain magnitudes. Juvenile animals were run on a treadmill for 90 days or served as controls. Tibial periosteal bone formation was measured with fluorescent label injections and quantified site-specifically in 16 equal angle sectors subdividing mid-diaphyseal sections positioned about the experimentally determined neutral axis. Running exercise was found to significantly enhance total tibial periosteal bone formation. However, rather than being biased toward areas of maximal strain, significant exercise-induced bone formation occurred around nearly the entire diaphyseal circumference, including in areas directly adjacent to the neutral axis where strains were lowest. These results indicate that caution is necessary when anthropologists use diaphyseal shape to infer functional loading history.

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Hazard Model estimation of prehistoric growth rates

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Despite advances in hazard modeling and age-at-death estimation techniques, paleodemographic analyses are still hampered by assumptions of a zero population growth rate. In this paper, we use agent-based modeling simulations as well as ethnographic data to assess the applicability and accuracy of a Rostock compliant, indirect hazard model approach recently proposed by Gage (2010) to estimate the average population growth rate (r).

Simulated age-at-death distributions were created in the agent-based modeling program NetLogo, using age-specific death and growth rates derived from ethnographic life tables. Maximum likelihood analysis was used to fit a 5 parameter Siler model, with an additional parameter representing r , which was then compared with the initial simulated values. Simulations were conducted with varying sample sizes and death rates to test the ability of the model to recover the original parameters. To empirically assess the model's ability to accurately recover the growth rate parameter, we tested the fit of age-at-death distributions culled from ethnographic studies. The studies selected had parameters similar to those found in typical paleodemographic assemblages. The results demonstrate that with sufficiently sized skeletal assemblages, reasonable estimations of prehistoric growth rates can be used to correct hazard models for demographic non-stationarity.

Socio-economic factors affecting the threat status of non-human primates

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While direct threats such as habitat disturbance, illegal logging, and bushmeat hunting have been identified as major challenges facing primate populations, the underlying economics driving these threats have not received the same amount of attention. The focus of this study is to examine the socio-economic factors that may increase or decrease human behavior that adversely affects the percentage of primates classified as vulnerable, endangered, and critically endangered. Data was collected on the percentage of land protected, literacy, female literacy, population density, GDP per capita, unemployment, consumer price index (CPI), and external debt for the 88 countries that have non-human primates. Analysis included global and continental comparisons. On a global level, there was a significant relationship between unemployment and the percentage of threatened primates ($F_{1,61} = 10.38, p < .05$). On a continental level, there were significant relationships between literacy ($F_{1,17} = 8.05, p < .05$) and female literacy ($F_{1,17} = 7.34, p < .05$) in Asia and CPI ($F_{1,16} = 3.09, p < .10$) and female literacy ($F_{1,16} = 4.88, p < .05$) in Central and South America. As the complexity of these issues make drawing conclusions from this data set difficult, the results highlight the need for conservation strategists and funding agents to consider a wider array of tactics when looking at broad threats to primate populations. Additionally, primatologists working in these countries should consider collaborating with cultural anthropologists and economists.

Science, storytelling, and the place of race in evolutionary narrative

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As a science of discovery, aimed at creating the storyline of human evolutionary history, paleoanthropology depends upon a combination of empiric evidence and storytelling. Data driven scientific discoveries in the field and the laboratory rework individual segments of an overarching narrative that like creation myths, takes the form of the heroic epic. Evolving hominins face natural challenges and tests which they are not biologically equipped to endure. Endowed with the gift of intelligence, they become fully human by overcoming these challenges. Despite its scientific basis, this story about how we became who we are, often serves to reify deeply held beliefs about human diversity and our relationship to the rest of nature. The power and esteem of science can obscure the pernicious aspects of these myths. Scientific methods can sometimes deconstruct myths, such as the purported uniqueness of humans, as has been accomplished through advances in primatology. But sometimes deconstructing myths requires different techniques such as grounded observation, reflexivity, and historical analyses as demonstrated through analyses of gendered interpretations of male and female biology and behavior. Against this back drop, this poster will use graphic storytelling to tackle the ways that the folk beliefs regarding race, persist within evolutionary discourse. The scientific truth that no races exist within the human species today will be set against analyses and interpretations of ancient DNA that reduce past variation to genetic typologies.

Sex, age and caries: Sex differences of caries frequency in Medieval London c. 1120-1250

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Tooth decay is one of the most common oral infections observed in bioarchaeological assemblages. Sex differentials in caries frequency are commonly examined, with most studies finding that females tend to have a higher frequency of caries compared to males. Less research has examined differences in caries between males and females with respect to age in past populations. Findings from living populations indicate that caries frequencies are higher in females, at least in part, because of the effects of estrogen and pregnancy. We are interested in the interaction of age, sex, and caries in medieval London, during a period of repeated famines, which might have exacerbated underlying biological causes of caries sex differentials. We examined caries in adults dating to c. 1120-1250 AD in the St. Mary Spital cemetery ($n=143$) to test the hypothesis that men and women have different caries frequencies with respect to age. Using hierarchical log-linear analysis to control for the effects of age on caries frequencies, the results show that the maxillary

caries frequency is higher in females ($p=0.043$), and that the caries by age distribution differs between the sexes ($p=0.09$), with a consistent increase in frequency with age for females, but not males. The difference in caries frequencies is not explained by differences in the age distributions of the sexes. Differences in the age patterns of caries for males and females could be the result of biological factors that present during old age, differences in diet, or differential access to resources during famine.

Black handed spider monkey (*A. Geoffroyi*) density in a human altered landscape in Costa Rica: A comparison between national parks and private reserves

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From January to August 2013 the population of black handed spider monkeys (*Ateles Geoffroyi*) were surveyed with the aim to estimate the population density of this endangered species (IUCN 2013) on a private reserve located on Costa Rica's Osa Peninsula. The estimates of populations of this species of spider monkey are rare (Campbell 2008) and those that have been conducted focus on national parks under state protection (Weghurst 2007). Our study was conducted on land owned and managed by Osa Conservation at Piro ~15km from Corcovado National Park. The land is surrounded by a matrix of farm land and human modified forest. Our results indicate that there is a significant difference between the density of Corcovado populations for black handed spider monkeys and populations of the same species outside the National Park. Weghurst (2007) found a density of 68.45 ± 26.25 while we found a density of 24.59 ± 10.54 . Reasons for this discrepancy are thought to include habitat preference and human pressure from land modification and hunting.

Research funded by The Society for Environmental Exploration and Osa Conservation.

Evidence in support of a two-prong colonization of Guam with data from the Naton Beach Site

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The archaeological investigation at the Naton Beach site resulted in the recovery of human remains dating from the Pre-Latte and Latte periods of Guam. This is the first site to have recovered such a large sample of the earliest inhabitants, the Pre-Latte. One of the on-going research issues is the timing and origination of founding groups to Guam. A recent study of mtDNA indicated a two-prong colonization of Guam with a founding settlement by the Pre-Latte approximately 3500 years ago with a subsequent migration around 1000 years ago of the Latte people. Data from the Naton Beach site offers evidence in support of this theory. The data includes biological and cultural indications that the two groups are distinct. Biological differences of the dentition indicate Pre-Latte

tooth sizes that are significantly larger than the Latte tooth sizes. There is a significant difference in 15 dental nonmetric traits between the two groups. Cultural differences between the two groups include unique dental modifications found on one group and not on the other. The dental modifications include labial abrasion of the upper anterior teeth of Pre-Latte individuals and betel nut staining of Latte individuals. The mortuary data further supports different treatment of the dead with variation in burial position, placement, and items of funerary offerings that is unique between the two groups. Explanations for these differences are best explained by a two-prong settlement of Guam with the Pre-Latte establishing permanent residence first and the Latte people colonizing the area more than 1000 years later.

Osteometric analysis of human skulls from the Shenmu-Dabaodang Eastern Han dynasty site: Evidences in physical anthropology for the Xiongnu secession

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The Xiongnu divided into two groups in the first century A.D. — the Northern Xiongnu and the Southern Xiongnu, who submitted to the Eastern Han Dynasty. Whether the people of the Northern and Southern Xiongnu belong to the same physical type has been a topic of debate. Our research of the Xiongnu skulls excavated from the Shenmu-Dabaodang Han Dynasty sites shows they have close morphological similarities to modern East Asian groups with hypsicrany. There is a pierced hole on the left side of the M22 male skull, implying the medical custom in the Xiongnu. We concluded from the statistics for skulls of the Northern and Southern Xiongnu from places of such as the ancient Great Wall in Inner Mongolia in China, Mongolian Plateau, and the area of Baikal that the people of the Northern Xiongnu have close similarities to modern North Asian groups with physical features of hyperbrachycrany, orthocrany and euryeny, while the Southern Xiongnu in China mainly consisted of people with hypsicrany and metriocrany and belonged to modern East Asian groups. The Southern Xiongnu is probably a new Xiongnu alliance integrated with small-scale cluster groups like Linhu and Loufan, etc. Different physical features might be the cause of secession. Our research applies the methods of physical anthropology to testing the historical record of the Xiongnu stated in *Shih Chi* by Sima Qian.

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The condition of the divided zygoma in Orangutans

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The zygoma in the midface is a crucial area dissipating stresses associated with feeding activities. Yet naturally, sometimes the zygoma is divided by extra sutures into two or more parts, though the mechanism remains unclear. Preliminary morphometric and functional analyses have revealed that the divided zygoma condition would unfavorably change overall

morphology of the midface and the pattern of stress distribution in the face during mastication. This trait has a high incidence in Eastern Asian populations of modern humans (3% or higher), is often seen in hybrid baboons, yet rare in another papionin species *Macaca mulatta* (0.3%). Thus, it is hypothesized this trait indicates wide genetic variety indicating hybridization or the formation of new population or species. In this study, the collections of great apes in the Smithsonian Institution, American Museum of Natural History, Cleveland Museum of Natural History, and Field Museum of Natural History were screened for this zygoma abnormality with a prediction of low incidence. Results demonstrated that the incidence in Orangutan is around 3%, comparable to that of Eastern Asian humans. Yet this trait is not detected in Gorillas and common Chimpanzees. Most orangutan specimens with this feature (either unilaterally or bilaterally) are collected from natural habitats in Borneo (Indonesia and Malaysia), where the presence of multiple *Pongo* species and subspecies has been proposed. Along with high incidence of supernumerary dentition and high variations in skeletal robusticity, the divided zygoma bone may suggest the hybridization and introgression among Bornean *Pongo* populations.

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Arm swing length: Which is most predictive—step length or walking velocity?

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Arm swing length has been observed to vary with walking velocity. The mechanical function of arm swing as a counterbalance to leg movement has been suggested as an explanation for these observations. If this explanation is valid, then step length should be a better predictor of arm swing length than velocity, even though velocity and step length are correlated. We hypothesize that the variation in arm swing length can be explained more by step length than by walking velocity in shod and unshod walking conditions.

Thirteen women completed 30 shod and 30 unshod trials at self-selected slow, medium, and fast velocities. An eight-camera system collected kinematic data by tracking infrared reflective markers placed on participants. For each trial, we calculated average walking velocity and step length from the calcaneal tuberosity and measured two distances that the distal arm travelled in a step: arm swing length measured from the travel of the radial styloid process (RSAL) and the ulnar styloid process (USAL).

Arm swing length does not differ between shod and unshod conditions (RSAL: $p < 0.69$; USAL: $p < 0.74$). Using linear regression, arm swing length is significantly associated with both step length (RSAL: $p < 0.001$, $r^2 = 0.46$; USAL: $p < 0.001$, $r^2 = 0.53$) and walking velocity (RSAL: $p < 0.001$, $r^2 = 0.37$; USAL: $p < 0.001$, $r^2 = 0.43$). In stepwise regression, walking velocity and the interaction of walking velocity with step length were removed in favor of step length.

Our hypothesis is not rejected: arm swing length is more closely associated with step length than walking velocity in both shod and unshod walking conditions.

Torso shape and locomotor adaptation in anthropoid primates

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It is generally assumed that great apes share a homologous pattern of torso morphology related to adaptations for below-branch arboreality that is found in an intermediate state in hylobatids and atelines. This presumed variation in torso structure is pivotal to interpreting fossil ape and hominin body shape and locomotor adaptation. Paleoanthropologists have also presumed that certain morphologies of the ribs, vertebrae and pelvis reflect these presumed differences in torso shape and locomotor adaptation. However, little is actually known about the overall 3D shape of the primate torso, or how this is reflected in the morphology of individual bones.

To evaluate torso shape, 56 anthropoid cadavers were CT-scanned. In addition, landmark and metric data were collected from the pelvis, vertebrae, ribs, and sterna of over 200 anthropoid skeletons. Morphology of the intact torso and that of individual bones were compared across taxa and among locomotor groups, and covariation was assessed among skeletal elements and with aspects of whole torso shape.

Results broadly support previous hypotheses about basic skeletal variation among taxa for individual bones. CT scan data, though, show more varied and subtle patterns of overall torso shape among taxa than previously appreciated, not all of which are tightly correlated with measures taken on isolated bones. These data support the hypothesis that variation in torso form is associated with locomotor adaptation in anthropoids, albeit in a more complex way than previously appreciated, and provide more precise insight into likely selection for variation in torso structure and its evolution among anthropoid primates.

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Osteological analysis of juvenile skeletal remains: Tiber River Valley, Lazio Region, Vacone, Italy

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As standardized archaeological practices become more common in the Mediterranean Region, post-Classical finds formerly considered unimportant, such as human remains, are receiving increasing attention. These non-structural finds reveal themselves to be very informative of cultural and demographic changes in this area after the fall of the Roman Empire. The Roman Villa site of Vacone 1 in the Tiber

River Valley provides a recent example with the unexpected discovery in 2012 of juvenile human remains interred in a ruined room corner. Work in 2013 revealed the juvenile to be 4 years \pm 12 months old, though of a stature comparable to an individual approximately three years of age. No pathological conditions or evidence of trauma or malnutrition were noted; however, the skeleton does exhibit uncommon features, such as strong shoveling on all developing upper adult incisors, and numerous Wormian bones along the lambdoidal suture. The well-preserved ilia indicate that the juvenile is biologically male, though the young age makes this conclusion very uncertain. Full documentation and analysis of the juvenile remains are presented here from an osteological and cultural perspective, in order to place the grave in the context of the evolving use of the villa following its ruin, and provide information regarding the changing demographics of the region.

An investigation of mobility patterns in the late prehistoric communities of central Spain (Madrid) using $^{87}\text{Sr}/^{86}\text{Sr}$ isotope ratios

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This study uses strontium isotope ratios ($^{87}\text{Sr}/^{86}\text{Sr}$) from the dental enamel of 85 individuals interred at Chalcolithic and Bronze Age burial sites near Madrid, Spain in order to identify possible migrants in these late prehistoric communities. Strontium isotopes are absorbed into animal and plant tissues through the soil and through water and food intake. The geologic history of a region and the types of rocks and sediments in the subsurface can result in measurable differences in bioavailable strontium ratios in animal and plant life. Dental enamel formed during childhood is not remodeled later in life. Therefore it preserves the $^{87}\text{Sr}/^{86}\text{Sr}$ ratio of an individual's childhood place of origin. Based on the results of this study, only 4/86 (4.6%) of the sampled individuals clearly exhibit non-local $^{87}\text{Sr}/^{86}\text{Sr}$ isotope ratios, suggesting that migration was uncommon. However, as this methodology cannot discern individuals that may have moved from other regions with similar geologic landscapes it is likely that the number of migrants in this sample may be significantly higher. Based upon the $^{87}\text{Sr}/^{86}\text{Sr}$ ratios, all four identified human migrants originate from regions with substantially older lithological features. Possible places of origin are being investigated.

Funding for this project was provided by the Instituto de Historia (CSIC)(Spain).

The effects of the potato blight on a rural Dutch population: Demographic and osteological data on morbidity and mortality during a three-year subsistence crisis

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The 1845 potato blight devastated populations from mainland Europe as well as Ireland. In the Netherlands, rye and wheat crop failures in 1846 and 1847 caused a three-year period of food scarcity that caused the death of up to one-third of the population. However, the impact of this subsistence crisis on rural populations is less well known. The human skeletal remains from the rural village of Middenbeemster, The Netherlands, permit a precise assessment of the effects of the 1845-1847 crisis. Archival information about the year of birth and death for over 150 skeletons of known sex permit demographic and osteological research. The size of bones from subadults who died during this period is compared to age- and sex-matched cohorts from periods of purported better nutrition. Enamel hypoplasia, a defect that forms in growing teeth during physiological stress, is compared among a) subadults who died during this period, b) individuals who survived this period while their teeth were forming, and c) individuals who did not live during this period while their teeth were forming. Archival data provide age-specific mortality rates from 1832 to 1866 against which the patterns from 1845-1847 are compared. In 1845 there was a marked increase in the death of infants under the age of one-year, who are small in size compared to earlier and later period infants. Individuals who survived this period show a significantly higher frequency of enamel hypoplasia. These results show the effect of a historically documented subsistence crisis on osteological and demographic patterns.

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Long heads and jagged teeth: Expanding the northern frontier of prehistoric Mesoamerican identity

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Archaeologists have long recognized the enduring prehistoric connection between Mesoamerica and the southwest US through a number of elements of material culture. But few direct biological connections have been established. Recent excavations at *El Cementerio* [SON P:10:8], a late Ceramic period (cal. A.D. 943-1481) mound in central Sonora (northwest Mexico) have recovered a number of burials that exhibit cranial and dental modification characteristic of patterns observed in Mesoamerica and along the west Mexican coast. Most individuals (85.7%)—of all ages and sex—exhibit an elongated form of anterior-posterior cranial modification. A small percentage of these individuals (17.2%) also exhibit dental modification of the maxillary incisors, but is restricted to males older than 16 years old. Both attributes are present throughout the occupation of the site and similar to biocultural traits recorded at sites associated with Mexican west coast archaeological traditions further to the south along the Sinaloa coast. However,

material culture from the site suggests an unbroken investment in local traditions (i.e.-ceramic production) not related to larger cultural spheres of influence to the south. We suggest that cranial and dental modifications at the site reflect the manipulation of a broader Mesoamerican/Mexican west coast identity among communities following a local investment strategy.

Funding for this project was provided by Arizona State University.

Coalition networks associated with alpha male replacements in chimpanzees at Ngogo

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Male chimpanzees (*Pan troglodytes*) form strong social bonds with each other, but also compete for status. Rank is positively related to reproductive success. Multiple case studies show that alliances can help particular males to attain and retain high rank, but the general influence of coalition strategies on male status has received little formal study. I used social network analysis to examine how the structure of male coalition networks varied in association with the tenures of different alpha males and with alpha replacements at Ngogo (Kibale National Park, Uganda). The unusually large Ngogo community has been observed continuously since 1995, during which time it has had 22–33 adult males and four alpha males. Results show that (1) coalition networks at Ngogo have high density, with coalitions not limited to a few high-ranking males; (2) nevertheless, rank and coalition centrality are positively related; (3) network centrality of two long-time (9y, >7y) alpha males were initially high, but declined late in their tenures; (4) the male with the shortest alpha tenure (1.5y) had relatively low network degree strength and centrality measures, while his successor had the highest values among all males; and (5) successful challenges for alpha status sometimes, but not always, involved significant changes in network structure. Ngogo data confirm the important influence of coalition strategies on male chimpanzee status competition, but also highlight the role of individual variation in behavior and the influence of variation in the number of males per community.

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The influence of thermal stress on sexual dimorphism

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The influence of climate on skeletal morphology is well-established, having been observed numerous times in investigations of ecogeographic principles such as Bergmann's and Allen's rules, but relatively less attention has been paid to the influence of climate on sexual dimorphism. Theoretically, the degree of sexual dimorphism is expected to decrease in environmentally stressed populations since energy would be better allocated to activity,

immune function and reproduction over sexual selection. Investigation into this hypothesis, however, has shown inconclusive results.

In this study, two skeletal populations of distinct ecogeographic stressors are compared: one originates from circumpolar Alaska (n=104) while the other originates from temperate Missouri (n=99). Data were collected at six areas of the pelvis. The pelvis, being uniquely constrained by locomotion requirements, obstetric demands, and body breadth dimensions, is both a particularly dimorphic area of the skeleton and an excellent area to observe whether ecogeographic principles influence morphology.

Only one variable—sacrum breadth—showed significant differences in dimorphism between the two populations ($p=0.050$), indicating that thermal stress may not be an important influence on the magnitude of sexual dimorphism. While only one significant difference in sexual dimorphism was found, the populations still differed significantly in all pelvic measurements. Most interestingly, there were more differences observed between females than between males, which suggests that the female pelvis is perhaps more elastic than expected. Finally, more variability existed between males and females in the Missouri sample than the Alaskan sample, suggesting that climatic effects are best observed at temperature extremes.

Comparison of quantitative- and molecular-genetic differentiation in humans and chimpanzees

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In a pioneering study in 1994, Relethford used craniometric data to estimate the amount of among-region genetic differentiation (F_{ST}) in humans. His quantitative-genetic estimates closely matched those from classical-genetic (blood groups, protein polymorphisms) and molecular-genetic (at the time, mitochondrial DNA) data. For all of these characteristics, typically, only ~10% of the variation is found among groups from different geographic regions (e.g., Asia vs. Europe). This close correspondence between quantitative- and molecular-genetic estimates of differentiation is consistent with the idea that neutral evolutionary processes (genetic drift, mutation) have been important in producing cranial differences among human groups.

However, how do humans compare with other species? Are we unusual? How do similarities or differences with other taxa illuminate the evolutionary mechanisms underlying the morphological differentiation of humans? Chimpanzees provide a useful starting point for placing the human results in a broader comparative context, because common chimpanzees and bonobos are the extant species most closely related to humans.

To address these questions, I use 27 cranial measurements on a sample of 1,734 humans and 263 chimpanzees to estimate the amount of genetic differentiation between pairs of groups (pairwise F_{ST} between regions for humans and between species or sub-species for chimpanzees). Consistent with Relethford's results, the human craniometric estimates are

quite similar to published molecular-genetic estimates. In contrast, the chimpanzee craniometric estimates are much smaller than published molecular-genetic estimates. It appears that cranial evolution in humans has been less constrained than in chimpanzees.

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Covariance of the pelvis and distal limb morphology in anthropoids: A morphological integration study

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Bipedal locomotion is inferred from a suite of anatomical features throughout various locations in both the axial and appendicular skeleton. Morphological integration studies demonstrate that certain anatomical complexes are more susceptible to variability depending on their genetic regulatory pathways and various selective pressures. For instance, recent work suggests that the primate pelvis displays low levels of integration thereby permitting the variation observed across taxa. Like the pelvis, the foot is also a complex series of individual bones heavily influenced by locomotor behavior and is similarly variable among anthropoids. This study seeks to detect the covariance of certain pelvic traits with those of the foot, as they are two regions that must be substantially modified in order to facilitate certain locomotor behaviors, including bipedalism.

Using 3D landmark data taken from the bones that comprise the innominate, and bones representing both the medial and lateral aspects of the foot (medial cuneiform and cuboid), two-block partial least squares (2B-PLS) analysis was used to identify potential covariance of traits found in these two complexes across 16 primate genera. Our results indicate that overall pelvic shape significantly ($P<.005$) covaries with both medial cuneiform and cuboid shape. This covariance was very similar to that found between the two tarsals. Analyses of these structures thus imply a high degree of integration (73%) between pedal elements and the pelvis, with most correspondence relating to features of the ilium. The phylogenetic and locomotor interpretations of these findings are discussed within an integration-based framework.

The ontogeny of heel-strike and impact transient

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Human walking is characterized as a habitual heel-striking plantigrade gait. Yet, children only begin walking with a distinct heel-strike around the age of 3 years, and therefore, the role of foot posture is not well understood during lower limb ontogeny. Research suggests that a heel-strike

may lead to injury during running due to the magnitude of impact transient forces after ground contact. Our previous research showed heel-strikes during walking in adults (n=10) leads to impact transients significantly higher ($HS=0.56\pm 0.13BW$ s) than non-heel-strike landings ($NHS=0.14\pm 0.11BW$ s, $p<0.0001$), indicating the ability to reduce impact transient forces through changes in foot posture. Thus, adopting a non-heel-striking gait may arise to avoid violent ground impact forces. Mature ($>3.5yo$, n=14) and immature ($<3.5yo$, n=13) child gaits both display average impact transients significantly higher than adult heel-striking gaits ($CM=0.77\pm 0.23BW$ s, $p=0.005$, $CI=0.77\pm 0.21BW$ s, $p=0.004$). However, the immature gait group varied significantly in the location of ground contact ($cv=1.94$). Accordingly, impact transients were significantly reduced as average ground contact location moved anterior to the ankle joint in immature gaits ($R^2=0.54$, $p=0.004$). The location of ground contact in the mature gait group did not significantly differ from adults ($p=0.19$). These changes in impact forces may be crucial to understand the development of adult foot morphology. Given recent debate on early hominin foot posture, this study contributes new data to our understanding of non-heel-strike gaits and the ontogeny of heel-strike during human evolution.

The Qesem Cave mandibular premolars and molar from a morphometric perspective

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Classic description has been published for the Middle Pleistocene hominin teeth from Qesem Cave in Israel, pointing out the ambiguous morphological affinities to anatomically modern humans (AMH) and Neanderthals (NEA). The teeth were associated with an Acheulo-Yabrudian Cultural Complex. Of particular interest are the mandibular P₃ and P₄, dated to ~350ka, and a lower M_{1/2} post-dating 300ka. The Qesem teeth and comparable material were μ CT scanned at the Vienna Micro-CT Lab. Cervical and crown outlines were collected from the 3D surface models (P₃= 21; P₄= 19; M_{1/2}= 25) of the dental crowns and sampled with 24 semilandmarks that were analysed through Geometric Morphometric methods.

Results confirm that the Qesem premolars (from the same individual) are very small compared to NEA but lie in the mid-range of AMH (both groups separate well for size). Mauer is in the NEA range. For premolars and molars, there is almost no allometry present. Qesem premolars' shape is still closer to archaic humans, i.e. NEA and Mauer. We thus recognize a pleiomorphic shape combined with a size reduction. The Qesem lower molar, in contrast, features a grade 3 trigonid crest, not seen in moderns, but in NEA. Size and shape are close to NEA as well. Explanations are that 1) premolars and molars originate from different

populations, or, 2) if from the same population, premolars show a strong tendency towards size reduction (probably related to alternative food processing), but still feature an archaic shape, while molars are very similar to NEA in size and shape.

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Gene loss and protein evolution in *Propithecus verreauxi* detected using exome sequencing and *de novo* assembly

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Sifaka lemurs exhibit some remarkable phenotypic traits, including relatively slow life histories, anatomical features specialized for vertical clinging and leaping, and a complex array of scent marking behaviors. Conceivably, aspects of this phenotypic evolution might be due to species-specific changes in the protein coding regions of the genome (exome). To better understand protein evolution in sifakas, we sequenced the exomes of four *Propithecus verreauxi* individuals – a mother-daughter pair and two unrelated males – from Beza Mahafalay Special Reserve in southwest Madagascar. We targeted the coding region of the genome using NimbleGen SeqCap v2.0 human capture probes (44.1 mb coverage) and sequenced the exomes on a single lane of an Illumina HiSeq 2000. We assembled and genotyped exomes *de novo* using Cortex. Based on flanking sequences, we mapped variants to the mouse lemur (*Microcebus murinus*) genome assembly (micMur1) and then identified homozygous variants shared consistently by all four sifakas, but differing from the mouse lemur. After quality control and removing duplicate reads, we assembled 19.7 GB of sequence for a mean of 112x exome coverage. We identified ~300,000 species-specific homozygous variants shared by all four sifakas. Of those, ~4500 had “moderate” or “high” predicted functional effects, including nonsynonymous changes and splice site variants, as well as mutations that would likely result in the loss of gene function, such as premature stop codons and frameshift mutations. These effects were disproportionately concentrated in relatively few functional categories, including sensory perception (e.g. olfactory and taste receptors), secretion systems, and growth and development.

Systemic stress in the Ohio River Valley during the early Contact period: Enamel hypoplasia and delayed growth at Neale's Landing, Blennerhassett Island, West Virginia

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We investigated evidence for systemic stress in human skeletons dated to the 16th century from Neale's Landing, Blennerhassett Island, West Virginia. The Neale's Landing individuals

total 34 individuals: 16 are juveniles and eight are less than one year of age suggesting a high juvenile mortality rate indicative of powerful systemic stress afflicting this population. We tested for evidence of systemic stress via two methods. First we scored for presence and location of linear enamel hypoplasias (LEH) by measuring the distance of hypoplastic lines from the cervico-enamel junction. Thirteen individuals (38%) exhibit evidence of LEH with 10 of these individuals (29%) with two or more hypoplastic lines in their dentition. The most commonly affected teeth were canines, maxillary first incisors, mandibular second incisors, and maxillary first molars. The mean age of LEH development was 3.34 ± 1.18 years. Second, we measured diaphyseal lengths of limb bones in each juvenile to track statural growth by age as determined by dental development. We compared diaphyseal lengths by age with other Native American populations from archaeological contexts and with healthy Euroamerican children. Juveniles from Neale's Landing do not significantly deviate in diaphyseal lengths for age compared with Archaic and Mississippian groups indicating similar growth trajectories among prehistoric Eastern Woodland populations. The Neale's Landing individuals, however, do show significantly shorter diaphyseal lengths for age compared with healthy Euroamericans indicating delayed statural growth during infancy and childhood, which suggests that Neale's Landing individuals endured systemic stress concomitant with nutritional deficits and infectious disease.

The effect of fluctuating asymmetry and stature on risks of mortality in a documented skeletal collection

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This research examines whether short stature and elevated levels of craniofacial fluctuating asymmetry (FA) correspond to an increased risk of early death in the Lisbon skeletal collection. Previous research from skeletal collections where age-at-death was estimated has suggested that both of these measures are related to growth disruption and early mortality in human populations. This research utilizes data from a collection where age-at-death is known in order to more accurately document mortality patterns. Maximum femur length was measured in 227 individuals and short individuals were identified by sex as those that were one standard deviation below the mean. Cranial landmark data were collected from 392 individuals. Geometric morphometric methods were used to calculate a FA score for each individual. Mean FA scores were calculated and individuals that had FA scores one standard deviation above the mean were classified as high FA. A Cox Proportional Hazards model was used to evaluate if short stature or high FA was associated with increased mortality risk. The results of the analysis demonstrate that neither variable has a significant influence of survival time. Moreover, the direction of risk associated with each variable are in opposite directions. Specifically, short stature is associated with a decreased risk of mortality and high FA is associated with an

increased risk of mortality in this sample. This research demonstrates the utility of known age samples to examine traits that are commonly used as health indicators in undocumented collections to better understand the significance of different measures of developmental stress.

Non-weight-bearing joint pain and body mass index: Data from the Osteoarthritis Initiative and their implications for understanding osteoarthritis etiology

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There are two types of osteoarthritis etiologies discussed in the anthropological literature: localized mechanical stresses and systemic biological factors. Although anthropologists acknowledge osteoarthritis etiology is multifactorial, osteoarthritis is still used for activity pattern reconstructions that depend on the concept that localized mechanical stresses are key in osteoarthritis formation. To determine whether osteoarthritis is caused mainly by localized mechanical stresses or mainly by systemic biological factors, this study examines data (N = 4769) on weight-bearing joints (i.e., hip, knee, ankle), non-weight-bearing joints (i.e., shoulder, elbow, wrist), and body mass index (BMI) from the National Institutes of Health Osteoarthritis Initiative (OAI) public use data set. If osteoarthritis is produced principally by localized mechanical stresses, then BMI should only affect weight-bearing joints. Osteoarthritis was recorded on each joint as present or absent based on self-reported symptoms that included joint pain and stiffening. BMI was based on a height to weight ratio and values were placed in five categories (1 < 18.5, underweight; 2 = 18.5 – 25, normal weight; 3 = 25.01 – 30, overweight; 4 = 30.01 – 35, obese; 5 > 35, morbidly obese). Osteoarthritis symptoms were more frequent in individuals with higher BMIs in all weight-bearing joints (Chi-squares ranged from 11.676 to 62.908; Ps < 0.02) and in four out of six non-weight-bearing joints (Chi-squares ranged from 9.694 to 27.321; Ps < 0.05). These results suggest that systemic biological factors may be more important than localized mechanical stresses in osteoarthritis etiology.

So long after Darwin, do we know how complex developmental traits evolve?

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The theory of natural selection is still the default explanation for functional traits in organisms. Mendel provided a simple, gene-centered view of traits; he wasn't interested in evolution but his ideas led to genes being assumed to be the material basis for the traits' evolution. However, modern genome mapping and comparative developmental genetics seem to be giving us different messages about the genetic mechanisms of evolution. Mapping results suggest that morphological and behavioral traits are polygenic, which would lead them to evolve gradually, by natural selection as Darwin suggested, a view central to the 20th century 'neodarwinian' synthesis. Polygenic traits

change, respond to selection and drift in ways that would lead to a fluid genomic basis, but one that was very *non*-prescriptive and hence non-preserving of specific contributing genes. That model would also be wholly consistent with the uniformitarianism that Darwin believed in, as does modern evolutionary theory. Yet developmental genetics reveals highly conserved, specific genomic bases both in terms of gene sequence and developmental mechanism, that seem far more 'Mendelian', by invoking discrete genetic contributors with major effects. How can such retrospective evolutionary specificity and contemporary gradualism be united in a consistent evolutionary dynamics? The issues will be illustrated with various data examples including from our own and others' work involving craniofacial development and other traits, in humans and animal models. Our ability to reconstruct evolution with more than Just-So stories depends on the answer.

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Re-evaluation of promontorial arterial dominance in fossil adapiforms

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Presence, route, and development of cranial arterial pathways have been shown to provide indications of relative ancestry and relationships in primates even though canal size does not necessarily correlate with artery size. Information on relative area of the promontorial and stapelial bony canals has never been comprehensively quantified for statistical evaluation in primates. In particular, we are interested in better evaluating the arterial patterns of fossil adapiforms since some species (notably *Mahgarita* and more recently *Notharctus*) have been described as being "promontorial dominant" and thus more haplorhine-like. Here we compare *Cantius*, *Notharctus*, *Smilodectes* and *Adapis* to a sample of extant primates using microCT scans. Images of the arterial pathways were created using Avizo 7.1 software. The cross-sectional area was measured for three canals: the main stem of the internal carotid artery, its promontorial branch, and its stapelial branch. Each canal was measured in three places along its length and the average area was taken. We calculated the ratio of promontorial artery area to stapelial artery area. Among the extant strepsirrhines of our sample this ratio ranges from 1.14-1.88, while tarsiers are significantly different with an average of 8.95. *Cantius* (1.51), *Notharctus* (1.02) and *Adapis* (1.58) are most similar to sampled lemurs, while *Smilodectes* (8.44) is surprisingly similar to tarsiers. These initial results illustrate the importance of these data for accurately assessing similarities between adapiforms and extant primates. We continue to expand our sample of fossils and extant taxa as

these metrics may have important implications for primate phylogeny.

Morphological and metric variation in the dentognathic remains of *Ardipithecus ramidus* from Gona, Ethiopia

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Here, we examine the morphology of the hominin dentognathic fossils (Semaw *et al.*, 2005) recovered from the 4.3-4.6 Ma Sagantole Formation in the Gona project area, Afar Regional State, Ethiopia. These fossils from seven individuals include isolated teeth, a mandibular corpus with M₁-M₂ and a fragmented mandible with nearly complete dentition. Additional morphological and metrical observations of these fossils support the original contention that the Gona specimens are similar to *Ar. ramidus* from the Middle Awash. However, the size and shape of the postcanine teeth also show differences with the Middle Awash *Ar. ramidus*. The Gona mandibular corpus breadth overlaps within the lower end of *Au. afarensis* and *Au. anamensis*. Corpus shape index (breadth/height) overlaps within the upper range of *Au. anamensis* and middle range of *Au. afarensis*. The ramus is vertical relative to the post-canine tooth row and its anterior margin is located at the M₂ mesial margin. The Gona mandible shows less receding symphysis compared to *Au. anamensis*, some *Au. afarensis* and most apes. The gracile gonial angle of the mandible lacks lateral eversion. Based on the small size of the lower canines and their overall morphology, both mandibles are considered to be female *Ar. ramidus*. The morphology of the Gona mandibles, such as less receding symphysis and a relatively broad corpus, reinforce the hominin status of *Ar. ramidus*.

Activity budgets and energy expenditure among hunter-gatherer children: Results from the Hadza of northern Tanzania

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The study of human energetics and activity patterns are critical to understanding human adaptation and are an important aspect of characterizing the nutritional ecology of human evolution. This study analyzes the daily activities of children among the Hadza hunter-gatherers of northern Tanzania and evaluates juvenile energy expenditure – an aspect of human energetics research that is notably absent from the literature. In camp scan sampling and out of camp focal follows were used to determine daily activity budgets of 162 children. Daily activities were then binned by activity category and coded for level of energy expenditure, based on the specific anthropometric data for each focal child. Results suggest that Hadza children spend the

majority of their day walking, playing, and resting, but also spend a significant portion of their day working – foraging, processing food, or tending to other children. We see a correlation between increase in age and increase in amount of time spent working and level of exertion. Children's activity energy expenditure is an important factor in estimating caloric requirements, and in the case of younger children, the energetic burden this places on caretakers. In the case of older children, energy expenditure on foraging, food processing and childcare can be used to calculate caloric returns and the potential for older children to provide energy that promotes the well being of younger children. This study demonstrates not only the energy costs of childhood activity, but also the energetic contributions older children make toward cooperative breeding efforts.

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The dance of bones: Concerns and thoughts about curatorial care of skeletal series

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The main factors influencing the constitution of archaeological human skeletons series are: inadequate excavation causing lost of bones' integrity, loss of small bones or even of whole infants' skeletons; inappropriate interpretation of funerary archaeological record that cause the mixture of individuals originally separated, the separation of individuals originally related or the separation of a single individual in different bone sets; and inadequacy in storage and handling that cause bones' degradation and contextual information loss.

These factors compromise the research potential of the series, but can have their influence minimized and could be bypassed through a curatorial strategy that involves a critical use of field information and collections' histories, establishing a dialogue among the skeletal material itself, its history and its documentation.

This integrated approach is strongly influenced by the proposals and curatorial actions developed by Dr Walter Neves since the 80s.

A long term curatorial program using this approach has been developed for the last 4 years at the Museum of Archaeology and Ethnology - University of São Paulo. During this time the program recovered the research potential of 3 shellmound human skeletal series excavated in 60's, 70's and 2000's. This strategy has promoting, for exemple, the recovery of infant bone from faunal samples and facilitates the reconstruction of burials that were misinterpreted, separated and damaged during inappropriate excavations. A direct result of this strategy is an important change in size, in age and in sexual structures of the skeletal series and also in the completeness of individual skeletons.

Resolving the pathological status of the Pleistocene Australian fossil WLH 50 with micro CT

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The controversial fossil WLH 50 has held a significant role in debates regarding modern human evolution in Australasia. The hyper-robust fossil is from Australia's Willandra Lakes and is currently held at the Australian National University and dated to around 20ka. Some researchers have argued that the fossil represents a genetic connection with ancient Java, presumably linking to a later migration into Australia, while others have dismissed the fossil as not having any role to play in debates about Australian origins, claiming that the robust morphology is the result of pathology. Aided by comparison with the Galler collection from the Centre for Evolutionary Medicine, Institute of Anatomy University of Zurich, we provide the first comprehensive differential diagnosis of WLH 50 where we consider among other pathologies Paget's disease, hyperostosis frontalis interna, hyperparathyroidism, chronic anaemia, iron deficiency anaemia, and chronic osteomyelitis. In this analysis we use micro CT scanning to try to resolve the issue of the fossil's pathological status.

Can't see the predators for the trees? Reconsidering the anti-predator benefits of sociality for rainforest primates

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Identifying the ultimate causes for group-living has been a central focus of primate socioecology for four decades. Given the well-documented anti-predator benefits of grouping in diverse taxa, primate behavioral ecologists generally accept that a reduction in individual predation risk has ultimately favored sociality in primates due to collective detection of predators, cooperative defense, and/or increased safety in numbers through dilution effects. However, empirical support for this view is equivocal. Here we review the anti-predator benefits that have been proposed for primate groups and the conditions under which they are likely to be effective. We then discuss recent experimental and observational work on forest-living monkeys and their felid and raptor predators. This work indicates that predators in dense forest detect their primate prey from distances that greatly exceed the distance that primates detect their predators, at least in part because these predators appear to rely largely on ambush rather than pursuit to hunt primates. Under these conditions, we suggest that the benefits of collective detection and cooperative defense are likely greatly limited. Because larger groups should be more conspicuous and easier to detect, it is quite plausible that the cost of increased attack rates on larger groups exceeds the benefits achieved

through dilution. We conclude that grouping may increase predation risk for primates in some conditions, although the extent to which this might be true will remain unknown until we better understand the hunting behavior of primate predators.

The effects of anterior pelvic tilt on walking kinematics in modern bipeds

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Pelvic function has long been a focus of researchers interested in the evolution of hominin bipedality and obstetrics. Walking kinematics in modern bipeds change during pregnancy widening the base of gait (Foti et al 2001). Although a broad base of support may maximize locomotor safety (Forzek and Staszkiwicz 2012), increased ankle separation conflicts with our functional understanding of hominin knee valgosity. We hypothesized that the wide base of gait observed in pregnancy may be linked to intrinsic constraints of the hominin hip and lower limb. We tested for the effects of natural pelvic tilt in 15 gravid females and experimentally induced pelvic tilt in 15 non-gravid females and 15 males on the variables of base of gait, limb rotation and foot abduction. Analyses of 3D positional data show that base of gait diameter and foot abduction angle significantly increased with anterior pelvic tilt ($p = 0.006$ and $p = 0.01$, respectively). Subjects who achieved anterior tilting greater than 30% of the baseline angle experienced significant external limb rotation ($p = 0.02$). There was a significant but weak relationship between pelvic tilt and valgus angle ($p = 0.01$, $R^2 = 0.22$). Although human pregnancy is associated with a widening of base of gait and external rotations of the lower limb, the similar effects of anterior pelvic tilting in non gravid females and males suggests that structural constraints of the hominin hip limit gait performance in gravid females and may be a factor in alternative forms of hominin ventral load carrying.

Application of non-parametric tests to compare multiple differing measures of similarity and computed synthetic variables or indices

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Studies by and collaboration among biological anthropologists can be hampered by differing methodologies or use of computed synthetic variables. Differences in methodologies may be minor applications of similar protocols, such as differences in the time periods used in focal sampling when recording primate behavior, or major incompatibilities in the parameters used to assess similar questions, such as using multiple physiological measures to assess metabolic condition. Studies may also use synthetic variables or indices that include multiple, but often differing, measures. These variables have complex or unknown underlying distributions making analysis complex or necessitating the use of less powerful non-parametric methods. One

approach to these problems is to repeat studies using standardized methodologies. We demonstrate two examples of the use of alternative powerful non-parametric statistical approaches that can be appropriately applied to these situations. We compare behavioral data collected using comparable but differing protocols on chimpanzees and bonobo to highlight similarity and dissimilarity in sex strategies of sociality despite protocol differences. We use sampled randomization tests to examine variation in metabolic syndrome in Siberian Yakut. A PCA of standard risk factors yielded a synthetic variable (first principle component) that was highly correlated with non-standard risk factors. Sampled randomization methods showed significant differences in this variable between selected groups allowing for more refined hypothesis testing than are possible with the use of a dichotomous categorization of metabolic syndrome. Broader application of these and similar methods greatly facilitate both analyses and collaborations without necessitating exclusion of data collected under differing protocols.

Diet in Medieval Lithuania: Stable carbon and nitrogen isotopic analysis of bone and dentin collagen from the site of Alytus

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The Baltic region was a vibrant center of power and economic prosperity in medieval Europe; Lithuania in particular. Until now, little stable isotopic analysis has been utilized to assess diet in this region during this time period. The aim of this study was to undertake a preliminary assessment of the composition of diet at late medieval Alytus (late 14th through early 18th centuries) from bone (N=35) and dentin (N=38) collagen samples. The stable carbon isotopic data suggest a diet primarily comprised of C₃ plants such as barley, rye, wheat, and flax, and animals consuming C₃ plants. The stable nitrogen isotopic data indicate little use of marine resources, and reflects the protein portion of the diet as including mainly terrestrial non-legumes. There were no differences in the pattern of resource consumption between adult males ($\delta^{13}\text{C}$ mean: -20.04, SE: 0.0612; $\delta^{15}\text{N}$ mean: 10.41, SE: 0.1938) and females ($\delta^{13}\text{C}$ mean: -20.14, SE: 0.0527; $\delta^{15}\text{N}$ mean: 10.08, SE: 0.2526). Additionally, the isotopic data suggest some use of freshwater resources. No differences are detected in the pattern of resource consumption across the adult lifespan. It has been shown that metabolism and physiology affect nitrogen isotope values, especially in bone exhibiting disease. No individual exhibited $\delta^{15}\text{N}$ values that suggest possible metabolic or physiological effects outside of 'regular' diet. The stable isotopic data is consistent with historical and archaeobotanical data indicating the utilization of predominately C₃ plants and terrestrial resources.

Dental processing of doum palm fruit by the Tana River mangabey (*Cercocebus galeritus*)

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Mangabeys of the genus *Cercocebus* have dental adaptations that are hypothesized for feeding on tough-skinned fruit, hard nuts, and seeds. These adaptations include large incisors that delay wear from puncturing tough-skinned fruit, enlarged premolars to increase surface area to crush seeds, and thick molar enamel to withstand crushing forces. However, there is not much data on how mangabeys dentally process their food items. I investigated how the Tana River mangabey (*C. galeritus*) dentally processes doum palm fruit (*Hyphaene compressa*), one of their top diet items and one of the most puncture resistant fruits in their diet. I took videos of mangabeys eating palm fruits in 2009. I analyzed 20 videos. Each time a mangabey introduced the fruit into its mouth was defined as an action. I identified six dental processing activities: incisal bites, incisal picks, incisal scrapes, canine punctures, postcanine scrapes, and postcanine crushes. I recorded 941 actions: 275 bites, 79 picks, 361 incisal scrapes, 1 puncture, 162 crushes, 22 postcanine scrapes, and 41 with multiple activities. The majority of actions with multiple activities involved the mangabey scraping the fruit with its incisors, and then biting or picking the loose fiber. Of 1629 individual activities, there were 339 bites, 98 picks, 933 incisal scrapes, 1 puncture, 217 crushes, and 41 postcanine scrapes. All postcanine crushes involved a small piece that the mangabey had bitten off the fruit with its incisors. One of the mangabey's most puncture resistance foods requires the use of their large incisors and their thickly enameled postcanines.

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Meet me in Coimbra: An international saga of interobserver error rates

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The Coimbra Method records qualitative changes at fibrocartilaginous entheses using specific features scored separately at the margin and on the enthesal surface. These features include porosity (fine and macro), bone formation, erosion, and cavitations. Initial tests of interobserver error in 2010 showed overall percentage agreements around 70%, but agreement on specific features such as bone formation and fine porosity were lower (52.5% - 61.9%), and the variability between observer pairs was high (65.3-78.1%).

On-line consultations between the international collaborators to refine feature

definition with the aim of decreasing interobserver error rates had limited success. Percentage agreement between four observers eventually improved to 85.8% and 77.9% for the subscapularis and common extensor origin, but only after intensive in-person collaboration and discussion. Difficulties included: 1) poor representation of features using photographs for training; 2) lack of a common understanding for descriptive terms even among experienced osteologists; 3) differences in visual acuity; 4) small changes in observer conditions such as lighting at different times of the day; and 5) the need to retrain together on each enthesis. The problems we encountered have implications for many types of qualitative scoring methods currently being used and compared across studies to draw broad conclusions in bioarchaeology. Even with seemingly clear descriptions and illustrations, it is likely that interobserver error rates are substantially higher than the published error rates between researchers who have not undergone intensive, collaborative training. While many osteologists recognize this difficulty, we suggest that the extent of the problem has been significantly underestimated.

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Gene expression and activity during primate pregnancies

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Biological processes during pregnancy are coordinated through interactions among the developing conceptus(es), the placenta, and the mother. Primate pregnancies vary in terms of gestation length, number of offspring, uterine anatomy, and placental anatomy. One approach that can elucidate the molecular underpinnings of this variation is the examination of patterns of gene activity (i.e. expression) among different primate species. Therefore, the focus of this study was to examine diverse patterns of gene expression in maternal and fetal tissues during primate pregnancies. In particular, we describe anthropoid specific gene families including galectins, pregnancy-specific glycoproteins, siglecs, gonadotropins, and placental lactogens whose expression is restricted to the placenta. Comparative analysis demonstrates that non-anthropoid taxa neither possess nor express

genes orthologous to these loci. Together these genes represent anthropoid synapomorphies that play diverse roles in growth and development, immunity, and endocrinology. Additionally, we present whole transcriptome data collected from the placentas of eight mammalian species. These RNA-Seq data were collected from term placentas, and they have enabled us to obtain a broad view of transcribed genes and non-coding loci in these species. Using the comparative method, we present primate and human-specific shifts in gene expression. Interestingly, many of the genes that are overexpressed in human placenta relative to other species are those implicated in the obstetrical syndrome, preeclampsia. Taken together, these findings suggest that lineage-specific patterns of gene expression are a common occurrence in primate evolution.

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Lower limb posturing behavior of western Tennessee: An analysis of the knee and ankle joint

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Pressure facets are used to identify habitual activities of past populations. This study determines if differences in posturing behavior of the knee and ankle exists between osteoarchaeological samples differing in subsistence economy. The primary facets examined were the tibial imprint (i.e., acute flexion) of the distal femur and the squatting facet of the anterior tibia. Two samples of contrasting subsistence strategy from the Lower Tennessee River Valley of west-central Tennessee were examined. The hunting and foraging sample included the Late Archaic (2500-1000 BC) sites of Cherry and Kay's Landing (N=85). The sedentary agriculturists sample included Mississippians from the Thompson Village site (~AD 1300-1500; N=99). Of the Archaic sample, 61.1% had one or more postural markers with 17.6% having only the tibial imprint and 14.1% with the squatting facet. The percentage of individuals with both markers was 12.9%. Of the Mississippian individuals, 68.6% presented with any marker with 32.3% having the tibial imprint and 8% with the squatting facet. The percentage of individuals with both markers was 6%. The results indicated that while postural facets were equivalently prevalent, there was a distinct difference in the prevalence of the kind of facet. Although ankle squatting behavior was more prevalent in the Archaic, it was not significantly so (p=0.2267). Acute knee flexion behavior was more prevalent in the Mississippian however not significantly so (p=0.2241). The behaviors undoubtedly relate to postural differences affecting the degree of ankle flexion. The postures may have correlates relating to specific activities or reflect cultural behavioral idiosyncrasies.

The effects of stone toughness on manual force distribution during stone tool production

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The increased robusticity and relatively larger joint surfaces of the derived modern human thumb are hypothesized to better withstand percussive and joint reaction forces associated with stone tool production. However, our previous research on manual force distribution during stone tool production demonstrated that the thumb experiences significantly lower forces compared with other regions of the hand.

These experiments were performed using flint, a material with a moderate fracture toughness and homogeneous composition relative to many of the materials used in the Early Stone Age. This raised questions regarding the influence of raw material on hand biomechanical during stone tool making. Here we test this hypothesis by conducting knapping experiments using two raw materials, Koobi Fora basalt and ignimbrite, that differ in material properties and are present in the East African archaeological record. We used a dynamic pressure sensor system to measure forces acting across the hand while subjects (n=41) produced flakes with both materials. Toughness values were determined using an edge chipping technique with an Instron machine mounted with a heavy-duty Vickers indenter.

Results show significantly greater forces on the 2nd and/or 3rd digits compared with the thumb in both of the tested materials (p<0.05), regardless of fracture toughness. Subjects with previous knapping experience demonstrated this pattern more consistently compared with novices. Our results show that manual force distribution does not vary according to the toughness of raw materials, and suggest that thumb forces decrease even further with knapping experience.

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Comparing isotopes and dental microwear textural properties in *Parapapio* from Makapansgat

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Paleoenvironmental reconstructions of Makapansgat suggest this middle late Pliocene site was governed by wooded terrain interspersed with C₄ grasslands. *Parapapio* fossils from the site exhibit a mixed C₃/C₄ signal with individuals falling between browsing and grazing ungulates. Underground storage organs of C₄ plants have been suggested as a likely source of this mixed

carbon isotope signal. To locate (or not) direct evidence of underground storage organ consumption, the enamel textural properties of four dental casts of *Parapapio* from Makapansgat (M 3147, MP 62, MP 223 and MP 239) were scanned using white-light confocal microscopy. The resulting point clouds were reduced using scale sensitive fractal analysis yielding four textural properties which were compared to those from *Alouatta palliata* (n = 11), *Cebus apella* (n = 13), *Gorilla gorilla gorilla* (n = 9), *Lophocebus albigena* (n = 15), *Pan troglodytes troglodytes* (n = 17) and *Trachypithecus cristatus* (n = 12). *Parapapio* specimens exhibit pronounced complexity, scale of maximum complexity and textural fill volume with respect to the comparative taxa indicating some hard objects were incorporated into the diet. Grit adhering to underground plant parts is offered as an explanation for these extreme enamel textural properties. However, the carbon isotopic value for M 3147 approximates that of grazers and yet it exhibits less pronounced enamel textural complexity compared to MP 223 and MP 239. Only textural fill volume parallels the relatively high C₄ value for M 3147 and the lower one for MP 239 suggesting this textural property may provide a habitat signal.

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Sexual selection and female mate choice in human evolution

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Sexual selection generally operates through two primary processes— intra-sexual selection, in which individuals compete with members of their own sex, and inter-sexual selection, in which individuals attract members of the opposite sex. In primates, the former tends to manifest as competition among males for females, which in its most direct form leads to sexual dimorphism. In the presence of strong sexual dimorphism, the extent of direct female mate choice may become limited, with females monopolized and coerced by much larger males. Here, we review the evidence for sexual selection signatures throughout human evolution, particularly in taxa where the degree of sexual dimorphism is unclear or disputed, such as in the cases of *Australopithecus afarensis* and early *Homo*. We consider the mechanisms of female mate choice that occur in extant primates and, using these, infer the mechanisms that may have been present in extinct hominins. Under interpretations of marked sexual dimorphism, the opportunity for direct female choice is likely to be reduced, with females instead relying on indirect choice, as well as post-copulatory mechanisms such as sperm competition. In contrast, fossil interpretations of relative sexual monomorphism are consistent with more potential for direct female choice. We conclude by considering whether the evidence for direct female mate choice in modern humans is likely

to be a recent product of reduced dimorphism and social monogamy, or whether it is likely that direct female mate choice has a long evolutionary history in the hominin lineage.

Childhood at Orendorf: Stress and growth in the Mississippian period

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Orendorf was a Mississippian period, fortified village and mound center located on the western bluffs overlooking the central Illinois River valley. Over the past decades, archaeological investigations have revealed that the site was occupied between cal. AD 1175 and 1250. Previous bioarchaeological studies of the Orendorf skeletal sample (n = 307) from village and mound contexts have investigated paleodemography, bio-distance and warfare-related trauma, largely focusing on the adult sub-assembly. The current research examines the juvenile component of the Orendorf skeletal assemblage and provides a new dimension to the larger body of research surrounding the site. The goal of this research is to understand and statistically model the relationships between age-at-death, skeletal growth and episodes of childhood stress and infection. This assessment includes long bone measurements, dental development, linear enamel hypoplasias, periostitis, and porous skull lesions. Hazard analyses revealed significant differences in juvenile survivorship related to both stress and infection. Orendorf juveniles with healed lesions lived significantly longer than those with active lesions and no lesions ($\chi^2 = 15.653$, p = 0.000). In this context, healed lesions are a marker of survival and reduced frailty relative to those that more quickly succumbed to stressors during early childhood. In contrast, active lesions are situated at the other end of spectrum as clear indicators of selective mortality. The results of this study provide additional insights regarding the Orendorf site and can serve as a model and body of comparison for other Mississippian and late Pre-Columbian skeletal samples.

Superstorm Sandy's Halloween surprise: Initial inventory and assessment of colonial-era burials from the New Haven Green

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On 29 October 2012, Superstorm Sandy devastated much of America's East Coast. In Connecticut, high winds toppled the Lincoln Oak, a large tree planted in 1909 on the New Haven Green. Within the exposed roots, a partial human skeleton was visible. This treefall provided a unique opportunity to study a Colonial era cemetery. Here, we present a review of six sets of human remains and associated artifacts recovered from the Lincoln Oak rootball. Both children and adults are represented in the sample. Our results combine analyses using osteological, isotopic, genetic, and radiological data. Several individuals exhibit pathologies that illuminate health and disease issues in New Haven prior to 1821. Associated artifacts such as coffin tacks and personal effects provide information about mortuary practices and potential context. The biological and archaeological evidence are discussed within the larger context of Colonial demographic and mortuary data. Our multidisciplinary approach combines the expertise of municipal historians and academic researchers, and demonstrates how coordinated efforts yield more meaningful results than any single line of inquiry. We suggest applying this approach when any human skeletal material or archaeological sites are exposed. *This research was supported by the Committee of the Proprietors of Common and Undivided Lands at New Haven and the Yale University Department of Anthropology.*

Mycobacterial cross-immunity: A possible factor in the medieval decline of leprosy

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Cross-immunity between leprosy and tuberculosis was postulated in the early 20th century, and it is hypothesized that this inter-relationship in antiquity may have been a causative factor in the decline of leprosy in mediaeval Europe.

Exposure to other Mycobacterial antigens, prior to exposure and infection by *M. leprae*, may stimulate high CMI, and a preponderance of high resistance (PB) leprosy. In human disease, tubercle bacilli are of two distinct genomic types: *M. tuberculosis* and *M. bovis*, of which *M. tuberculosis* is the more ancient. *M. tuberculosis* is predominantly a respiratory pathogen transmitted by inhalation, and therefore pulmonary tuberculosis is a population density dependent disease. *M. bovis* infection is primarily a disease of cattle, secondarily causing human gastrointestinal disease, and is sporadic.

Leprosy and pulmonary tuberculosis, on documentary and palaeopathological evidence, presented here with Chichester (12th-16th century) as an example, increased in prevalence during the early Middle Ages, with subsequent decline in leprosy, and continuance in tuberculosis.

Evidence of leprosy palaeopathology indicates that there was a relative decline in low resistance (MB) disease and increase in PB disease during the Middle Ages, with decline and eradication of

infectious leprosy. This may be due to TB antigen influence in leprosy CMI spectrum.

Cleaning and management of accelerometry data cleaning in free living populations

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Accelerometry is a widely used, non-invasive objective method for measuring physical activity and sedentary behavior in free living populations. Yet procedures and recommendations for accelerometry data cleaning and management are unconsolidated and can be difficult to find. This poster will provide a reference for accelerometry data cleaning and management by describing issues and decisions that must be made during data cleaning, the options available and their corresponding benefits and drawbacks. Issues discussed will include: wear time, missing data/non-wear time, sleep time, definition of a valid day of data, participant reactivity, cut-offs to classify sedentary behavior and physical activity intensity, epoch duration, what bout duration to use, and software available for data cleaning and management. This will be placed in a cross-cultural and cross-species context, discussing which issues may be more important in a variety of populations and ages, using examples such as the Yakut of Siberia and Pakistanis living in the UK. For example, a non-human primate will not have an issue with reactivity, while a human population that has received many physical activity related health messages may increase their physical activity at the beginning of the monitoring period. Alternatively, a human population that has not been exposed to public health messages may have very little reactivity. A comprehensive discussion of options for cleaning and managing accelerometry data will aid researchers in planning data collection and cleaning, improve the quality of analysis and research in physical activity of free living populations.

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Enamel defects as indicators of changing childhood stress: A comparative analysis of sites from the Bronze Age to the Byzantine Era in northern Jordan

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The geographical region known as the Levant has a deep history of political and cultural change. Archaeological investigations have generally focused on the large political centers, however examination of the small rural communities that produced the agricultural commodities for the cities can provide information about the citizens who made up the majority of the population. This study focuses on the Northern Jordan sites of Sa'ad (Late Roman/Byzantine), Ya'amun (Middle Bronze Age to Byzantine Era), Natfieh (Late Roman/Byzantine), and Yasileh (Late Roman).

This paper explores the relationship between linear enamel hypoplasia (LEH) defects and accentuated Striae of Retzius (Wilson Bands) from the Bronze Age to Byzantine Era in the Levant. LEH defects signal extreme childhood physiological stress associated with periods of prolonged nutrient deprivation. Wilson Bands are markers for less severe childhood physiological stress. Canines (n=531) were collected and dated using radiocarbon dating, grave goods, and/or tomb type. The prevalence of LEH defects was recorded for each tooth. They were then thin sectioned and analyzed using light microscopy to record the frequency of Wilson Bands.

The prevalence of LEH defects for each time period (Middle/Late Bronze Age= 52.2%; Late Roman/Byzantine= 63.8%) were parallel to those of comparable sites and reinforce the idea that childhood stress was more severe during the later periods. Wilson Bands were present in conjunction with LEH defects, but were also seen in the absence of LEH defects during all time periods suggesting that incidences of stress may be hidden if only LEH data is considered.

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Dental microwear and carbon isotope analysis of Maya elites from Cancuén, Guatemala

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Dental microwear analysis of prehistoric human teeth can provide profound insight into food ingestion and processing techniques, particularly when combined with stable isotope analysis of carbon. Microscopic wear patterns on teeth are commonly used to analyze the diets of both extant and extinct species; their application in bioarchaeological studies, however, has been less frequent. This study uses dental microwear texture analysis (DMTA) to quantify microwear in 3D on the teeth of Maya elites from Cancuén (Petén, Guatemala), who died when the city was attacked and defeated during the Classic Period. Replicas of a polyvinylsiloxane impression material were prepared and hardened with an epoxy resin and hardener. These replicas were scanned in four fields of view and analyzed with SSFA software to define the tooth surfaces in terms of complexity, scale of maximum complexity, anisotropy, heterogeneity, and textural fill volume. Dental microwear analysis allows for insight into diet and ingestive behavior during the final days or weeks of life by distinguishing between ingestion of tough, hard, or soft objects; these data are used in conjunction with carbon isotope results to infer on diet and food processing techniques during different times of life. Preliminary results demonstrate variability in C3 vs. C4 plant consumption during early childhood and the ingestion or processing of very brittle foods during the final weeks of life among the elites of Cancuén. Combining dental microwear analysis with

carbon isotope analysis provides a more comprehensive understanding of diet and processing behaviors across the lifecycle.

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Cercopithecoid molar size and shape variability in an evolutionary-developmental framework

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Developmental models of mouse molar morphogenesis describe a patterning cascade where earlier-forming teeth or cusps influence development of size and shape of later teeth or cusps. We present preliminary results of a novel approach testing this evolutionary-developmental model in adult mandibular molars of cercopithecoids. We hypothesize 1) shape variability increases from M₁ to M₃; 2) cusp variability increases in later-developing cusps, peaking with hypoconulids; and 3) hypoconulids decrease in size or are absent in species with smaller M₂S relative to M₁S. The sample consists of 3D surfaces of 20 M₁-M₃ tooth rows from *Cercocebus torquatus*, *Cercopithecus campbelli*, *Colobus polykomos*, and *Ptilocolobus badius*. Automated landmark analyses established biological correspondence among tooth components, generated pairwise distances between sampled teeth, and compared intrinsic variability between tooth types per species. M₃ cusp positions were recorded and variability between cusp positions was compared. Additionally, relative contributions of the hypoconulid to M₃ area were compared to M₂/M₁ area ratios. Results indicate trends supporting hypotheses 1 and 2, with statistical significance from analyses of size and shape. Limiting automated analyses to shape only, variance increases across the tooth row in *Cercocebus*, *Cercopithecus*, and *Ptilocolobus*, statistically significantly in *Cercopithecus* and *Ptilocolobus*. Hypothesis 3 is not supported, as relative hypoconulid contributions differ between colobines and cercopithecines contrary to predictions. However, within species hypoconulid contributions do increase with M₂/M₁ area. These results suggest that cercopithecoid molar morphogenesis is governed by a patterning cascade, but there may be important differences in morphogenetic processes related to phylogeny, function, or body size.

Iliac orientation and locomotor behavior in anthropoid primates

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The transition to below-branch locomotion in hominoids is hypothesized to involve a broadening of the torso accompanied by a more coronal orientation of the iliac blades. While generally supported in analyses of isolated hipbones, the hypothesis that hominoid ilia are more coronally oriented than those of monkeys has never been tested relative to the body's midline.

To investigate iliac orientation, laser scans were collected on 250 hipbones from 26 species of anthropoid primate, representing both suspensory and nonsuspensory taxa. Polygonal models from scan data were aligned to microscribe landmark coordinates collected from articulated pelvises of the same individuals. This enabled us to establish orientation of the hipbone relative to the midline plane. Best-fit planes were set to the lateral and medial iliac surfaces, sacral iliac surface, and the entire ilium. Angles were then calculated between these planes and the body's midline plane.

Results demonstrate significant differences between suspensory and nonsuspensory primates. Apes have ilia that face further dorsally, reflecting the change in the torso involved in the transition to below-branch suspensory locomotion. Overall iliac orientation was indeed more coronally oriented in apes compared with monkeys, as was the lateral surface of the ilium. The medial surface, however, did not differ among taxa. These results suggest that differential size changes among portions of the pelvis are responsible for the overall orientation differences among taxa, rather than a simple rotation of the ilia. These results demonstrate that iliac orientation can be used to reconstruct locomotor adaptation in fossil primates.

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Parasite prevalence in lemurs: Habitat disturbance and individual characteristics as explaining factors

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Parasite prevalence and associated infectious diseases play an important role in ecological, social and evolutionary processes, but the potential drivers of parasitic loads are still unclear. However, habitat disturbance as well as individual characteristics have been shown to influence parasite prevalence in several animal species. This study aims to explore general mechanisms and determinants of gastrointestinal parasite infections in prosimian primates. Methods included the non-invasive sampling of faecal samples from three sympatric, congeneric lemur species (*Eulemur rufifrons* and *E. rubriventer*) that were screened for eggs and larvae of parasites. We found two species of parasites that are considered as genuine parasites of these *Eulemur* sp.: *Callistaura* sp. and *Lemuricola* sp.. The prevalence of *Callistaura* parasites was significantly higher in lemurs

ranging in pristine areas compared to those who range in more disturbed areas. In addition, individual variation in age and sex turned out to be associated with parasite loads, as adults show a higher *Callistaura* prevalence compared to sub-adults. In terms of sex we find contrasting results, with males showing a higher prevalence of *Lemuricola* infections compared to females. In contrast, females are more heavily infected with *Callistaura* parasites than males, probably due to the different life cycles and transmission modes of these parasite species. The association between parasite prevalence and reduced host fitness, combined with the parasites' potential to spread infectious diseases among wildlife and human populations, underlines the importance of this project from an anthropological, ecological, and a conservation perspective.

Primate camouflage as seen by felids, raptors, and conspecifics

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Animal coloration has diverse functions, from mate attraction to predator avoidance. Anti-predator coloration can take myriad forms; one of the most common is the exhibition of colors similar to environmental backgrounds to create camouflage. Here, we ask whether primate pelages have evolved to match the backgrounds in which they are commonly found, and how this is influenced by body part and by visual system, modeling how pelages would be seen by dichromatic felid predators, trichromatic conspecifics, and tetrachromatic raptor predators. We collected 133 reflectance spectra of fur patches from 33 primate species, and 462 reflectance spectra of background foliage from 399 species of plants from online databases. We plotted these colors in multi-dimensional color spaces based on published retinal receptor sensitivities, and tested for visual system and body part effects using phylogenetically-controlled generalized linear mixed models. We found that vast areas of visual space are unused by pelage colors; they instead occupy an area that overlaps greatly with that of background foliage. Primates are 98% matched to background in dichromatic visual space, but this figure decreases to 83% in trichromatic space and 91% in tetrachromatic avian space. Trichromacy offers a statistically significant improvement in detection against background to dichromacy, but tetrachromacy is not a significant improvement over trichromacy. Body part has a significant effect, with caps and tails, which tend to be involved in conspecific communication, most contrasting to background, and bellies the least. Our study reveals new insights into the selective pressures that have shaped primate appearance.

Ancient domestic dog diversity in the Americas: A mitochondrial DNA analysis of pre-European contact dogs

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Dogs are hypothesized to have originated 15,000-20,000 years ago in Eurasia and to have migrated with humans into the Americas. Archaeological remains of dogs in North America date to as early as 9000 years before present (YBP). While dog remains are numerous across the Americas, samples from few regions have been analyzed for DNA variation. A more geographically diverse sample would inform the construction of the population history of domestic dogs in the Americas. Samples used in this study include 50 dogs recovered from Southern Illinois (1000-1500 YBP), which have excellent preservation. We expect that mitochondrial haplotypes, unique sequence variants, generated from these newly-sequenced dogs should be similar to other haplotypes found in pre-contact dogs of the Americas.

Sequences of the hypervariable region of the mitochondria generated from these ancient samples were compared to other published ancient and modern dog sequences. Thirty five dogs were sequenced and nine haplotypes have been found. Preliminary results indicate that the majority of the dogs share a single haplotype, A5. This haplotype is also found in Siberian dogs from 8000 YBP, which may share a source population. Another haplotype identified in the Southern Illinois population, part of the A1 subclade, was also found in an ancient Peruvian dog, further supporting evidence for a relationship between ancient dogs in North and South America. This widespread genetic continuity, similar to the genetic diversity observed in humans in the Americas, supports the potential of using ancient dog remains to answer questions about human history in the Americas.

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Some paleodemographic aspects of the South African Australopithecines

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Dr. Alan Mann's 1968 dissertation, whose title we have appropriated for this poster, was published by the University of Pennsylvania in 1975, as the first in their series of Publications in Anthropology. It was a brilliant, innovative study, and it was the first to apply occlusal wear-based seriation to estimate the dental age at death of fossil hominids. Many scientists subsequently used this approach to estimate dental ages, including us. Here, we review the influence of this aspect of Mann's work. For instance, it was the basis for Wolpoff's age estimation of the Krapina Neandertal sample, Bermúdez de Castro (et al)'s age estimations of the Sima de los Huesos dental remains, and was modified to provide Lovejoy's age estimations of the Libben

Native American dentitions. Dental ages thus determined were the most important single factor in multifactorial ageing of Todd collection individuals of known age. Further verification was demonstrated by the close relationship between occlusal wear-based ages of Krapina Neandertal teeth and systematic variation of age-related histological features determined from μ CT scans of their dental roots, by Caspari and colleagues. Finally, our comparisons of australopithecine age-at-death distributions with other hominid samples, all using modifications of Mann's approach, revealed demographic similarities in samples earlier than the European upper Paleolithic, at which time there was a great increase in the number of adults who lived to be old, as shown by Caspari and Lee. Mann's pioneering research in this area has withstood the test of time and continues to inspire.

The hierarchy in the grave: Investigating dental health of the owners and sacrificial victims in burials at the Imdang site, South Korea (A.D. 3rd -7th centuries)

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The purpose of this research is to compare the prevalence of dental pathologies between the owners and the sacrificial victims in ancient Korean burials, and to explore the correlation between oral health and the social status.

Through a macroscopic observation of 515 teeth from 35 individuals of the Imdang site, which dated between A.D. 3C and A.D. 7C., the prevalence of caries, chipping trait, and attrition score of teeth was compared between individuals of different social status (i.e., owners vs. sacrificial victims). For statistical analysis, the Chi-square test and Wilcoxon's test were conducted for each tooth type with the age-at-death controlled for, but sexes were pooled to maximize the sample size.

The results did not reveal a statistically significant difference in the prevalence of the caries and the attrition score between the owners and sacrificial victims despite the overall higher attrition score in the sacrificial individuals. Meanwhile, in the upper M1 and lower M2, the owners had more chipping traits than the sacrificial victims, of which difference is significant. These findings suggest not only the possibility that the prevalence of dental pathologies may be related to social hierarchy in ancient Korea but also the need to take the cultural and/or archaeological context into account as well to figure out more detailed etiologies of dental pathologies in the past populations. In addition, further research with a bigger sample size and more number of pathologic markers would be needed for deeper understanding of the multi-faceted nature of dental pathologies of ancient populations.

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The specificity encoded within GDF5 regulatory elements and understanding skeletal traits in primates

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While gene knockout studies in mice have revealed critical genes involved in skeletal formation, we can be left with a biased view of their functions in controlling traits, a likely consequence of pleiotropism. This may be especially relevant to how loss-of-function models have been interpreted to decipher modularity and integration in primate skeletal evolution. Recent genomic research in humans and stickleback fish indicate that approximately 70-90% of phenotypically relevant genetically encoded variation is found in the regulatory genome, and undoubtedly regulatory DNA functions on levels of remarkable specificity. Here, we discuss our recent findings on decoding the regulatory architecture for the Growth Differentiation Factor Five (Gdf5) gene, a bone morphogenetic protein critical for the formation of long bones and joints. We reveal a surprising level of specificity, with separate elements driving the expression of Gdf5 in unique: 1) anatomical regions (e.g., appendicular skeleton, axial skeleton, cranium); 2) skeletal tissue types (e.g., articular cartilage, interdigital mesenchyme, pre-cartilaginous mesenchyme); 3) limb types (e.g., forelimb, hindlimb); 4) limb domains (e.g., proximal limb, distal limb); and 5) specific joints (e.g., elbow versus knee; humeroradial versus humeroulnar joints). We discuss how this specificity is exceptionally important to understanding how genes orchestrate the patterning, morphogenesis, and maintenance of the skeleton during pre- and postnatal development. We place our findings in the context of primates, which possesses remarkable variation in long bone and joint morphologies, as well as sequence divergence in regulatory regions. Finally, we emphasize the connections between cis-regulatory function, haplotype structure, and morphology.

Scoring enthesal changes: A statistical analysis of two ordinal methods

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Enthesal changes have recently received attention as a methodology that can reveal differential use of various muscle groups by observing changes at the site origin and insertion. This research project tested the hypothesis that different ordinal methods of scoring enthesal changes cause significantly different results during research. A sample of 68 modern humeri was analyzed using two ordinal methods of scoring enthesal change. One method pioneered by Mariotti and colleagues uses site-specific descriptions for enthesal changes while the method devised by Hawkey and Merbs uses a more general scale. The methods were compared for their intraobserver error rates and instances of significant correlation to cross-sectional bone geometry

(CSBG). Results from the Mariotti method showed significant rates of intraobserver error when the entheses were analyzed individually using a Wilcoxon's signed-rank test; however, when all entheses were analyzed together the intraobserver error rate was found to be insignificant. This is important to take into consideration as a high degree of precision at one enthesis may cause the entire data set to appear precise. Both scoring methods were used to analyze the correlation between enthesal changes and CSBG. The Mariotti method was found to have multiple instances of a significant correlation with CSBG, while the Hawkey and Merbs method showed only one instance of significant correlation. The findings from this research demonstrate that the method used greatly affects identifiable correlations between enthesal changes and CSBG. Refined methods and more research are necessary before enthesal changes can be accurately used in activity reconstruction.

Assessment of skeletal muscle mass as a pathway linking early growth to adult diabetes risk in Cebu City, Philippines

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The rise of type-2 diabetes (T2DM) in previously unaffected populations is a global health crisis predicted to be among the leading contributors to all-cause mortality by 2030. One hypothesis to explain the rapid rise of diabetes and other cardiometabolic diseases proposes that early developmental conditions irreversibly impact body composition and physiology in a way that predisposes to developing chronic disease later in life. As the body's primary insulin-sensitive tissue, skeletal muscle is a likely candidate pathway linking early growth conditions to later metabolic disease risk. In particular, nutritional stress and growth faltering during early, critical periods in muscle development could lead to lifetime deficits in skeletal muscle mass (SMM), elevating risk of developing T2DM. Here we seek to clarify the potential role of SMM as a link between early growth patterns and adult T2DM risk factors among 20-22 year old participants of the Cebu Longitudinal Health and Nutrition Survey, a long-running study of a birth cohort living in metropolitan Cebu City, Philippines. Rates of overweight and obesity were low in this population (mean±SD BMI 21.0±3.1 and 20.7±3.2 for females and males, respectively). We find that early growth patterns (birth size and postnatal weight velocities) are significant predictors of SMM in both sexes. Further, early growth patterns also predict multiple diabetes risk factors (fasting glucose, fasting insulin, HOMA-IR, adiponectin). We present a model that considers the extent to which SMM explains variation in T2DM risk factors associated with early growth conditions, and discuss implications of these findings for global health policy.

Differences in shod versus unshod walking: Implications for kinematic studies applied to extinct hominins

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Most kinematic studies using modern human gait to provide insights into the movement of extinct hominins collect data from shod participants. Given that our hominin ancestors were habitually unshod, this methodology is potentially problematic if the kinematics of shod and unshod gait differ. We investigate whether or not differences are present by comparing the movement profiles of the lower limbs in shod and unshod walking.

Kinematic data was collected on 10 women using an eight-camera motion capture system. Participants walked at self-selected slow, medium, and fast velocities, performing 30 shod and 30 unshod trials. Average velocities were calculated for each trial, as well as the maximum and minimum angles made by the foot, calf, and thigh during the stride cycle relative to the horizontal (foot) and vertical (calf, thigh) axes in the sagittal plane. Paired t-tests indicated that for all individuals, velocities differed between shod and unshod trials ($p < 0.01$). Linear regression comparing shod and unshod lower limb angles was thus performed including velocity as a variable.

Foot ($p < 0.001$) and calf ($p < 0.01$) angles differ between shod and unshod trials at all velocities. Shod and unshod angles differed as much as 14 degrees at the foot and 8 degrees at the calf. Additionally, the magnitude of the differences is positively correlated with velocity in all individuals (foot: $p < 0.001$, calf: $p = 0.03$). These observed differences warrant a second look at previous kinematic studies. Future studies should consider using unshod participants to obtain data that is applicable to extinct bipeds.

The toxin-reduction hypothesis for geophagy: Evidence from pregnant chimpanzees

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Geophagy, or deliberate soil-eating, occurs widely among humans, non-human primates and other mammals and birds. The principal explanations for it are mineral acquisition and reducing the negative effects of toxins or digestibility-reducing compounds. Among humans the toxin reduction hypothesis is supported by the finding that geophagy increases during pregnancy, presumably because the fetus is particularly sensitive to teratogenic effects of toxins. We tested the toxin reduction hypothesis for chimpanzees of the Kanyawara community in Kibale National Park, Uganda. Kanyawara chimpanzees eat nuggets of soil from the sub-humus layer. We analyzed 6.3 years of behavioral records (2006 to 2012) covering 28673 hours of observation of sub-groups during which geophagy was recorded ad lib. We recorded 1298 geophagy bouts, averaging 0.045

soil eating bouts per hour of observation, with increased geophagy late in the day. Overall there were no differences in rates of geophagy between the sexes, or between seasons of high vs. low fruit abundance. However for 13 females observed both when pregnant and not, there was a significantly increased rate of geophagy during pregnancy (one-tailed $P = 0.014$). We found no difference between the geophagy rates during the first half and second half of pregnancy ($N = 12$, $P = 0.43$). These data support the toxin reduction hypothesis by providing the first evidence in a wild animal for an association of geophagy with pregnancy.

Long term research stations compound scientific value: Centre ValBio, Ranomafana National Park, Madagascar

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Evolution is a long-term and often stochastic process. Thus, understanding the evolutionary history of long-lived animals such as primates, as well as the complex ecosystems in which they interact, requires both collaborative and integrative research that spans several decades of behavioral, ecological, and climatic observations. Unfortunately, while it is obvious that long-term field research has tremendous value, there is currently no mechanism that provides basic funding for the long-term maintenance and continuation of field stations and collaborative research teams. Here, we describe how long-term field research (27+ years) at Centre ValBio has contributed to our understanding of the demography, behavior, interactions and habitats of 8 sympatric primates at Ranomafana National Park, Madagascar and how this long-term investment has yielded significant and sometimes surprising discoveries that would have otherwise been missed by shorter-term investigations. We emphasize the importance of collaborative efforts, highlighting new and innovative research on the human-primate interface of infectious disease, as well as the involvement of local and international NGOs, to ongoing success of projects. Moreover, we discuss innovative funding strategies and outline important steps toward moving forward and overcoming the challenges to maintaining long-term research.

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Investigation of skeletal remains from three mediaeval gallows hill sites in Estonia

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Execution sites have so far received scarce archaeological attention in the Baltic region. Here, we present analysis of skeletons from three mediaeval or early modern gallows hill sites in Tartu, Haapsalu, and Tallinn, Estonia. The Tartu and Haapsalu gallows hill sites were excavated by us in 2012 and 2013, while the gallows hill site in Tallinn was subjected to a rescue excavation in 1994. Human remains were encountered at all three sites, demonstrating that at least some of the executed victims were buried next to the gallows. In Tallinn, 51 heads were unearthed from the gallows mound. This suggests that decapitation was practiced at the site, which is further supported by numerous cut marks in cervical vertebrae. Fresh cut marks visible in different parts of the cranium (e. g. frontal and parietal bones) and also in other bones suggest that the beheading was sometimes preceded by torture. Seven skeletons were encountered next to the gallows construction, most of which had the head missing and some of which had their arms tied behind their backs. Overall, these results improve our understanding of execution practices in Estonia and the Baltic region.

Preliminary research on the age and sex distribution of Hanshu II culture burials (ca. 2250–2050 BP) in Houtaomuga site, China

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The reconstruction of mortality profiles of human remains from archaeological sites is always problematic. Previous studies have pointed out that the underrepresented infant human skeletons in archaeological settings are one of the key factors skewing our interpretation. Besides various methodological limitations, mortuary practices, cultural biases, and differential postmortem preservation can vigorously affect the proportion of infants in archaeological populations.

In this paper, we present a human skeletal sample (n=139) from the Hanshu II Culture (Bronze Age, ca. 2250–2050 BP) burials of Houtaomuga site in Jilin province, China. The high proportion of subadult individuals in the sample provides a unique opportunity to investigate the palaeodemography of the site.

This study estimates the age and sex distribution of the sample (M=32, F=35, sex indeterminate adult=8, and subadult=64), compares the mortality profiles with other contemporary sites in China, and discusses the biases of palaeodemography and the implications for ancient health. Age-specific mortality rates were calculated through a life table. The relationship between age-at-death and burial type are explored.

Slightly more than one quarter of the individuals (28.8%) died in infancy (0-2years). Mortality rates then decreased with age until adulthood, displaying a typical infant and child mortality pattern documented in pre-modern societies. A relatively high mortality rate (32.4%) in young adults (24-35years) may suggest harsher living conditions in this community when comparing with published palaeodemographic profiles from other contemporary sites. In addition all age categories and both sexes are represented suggesting the lack of preferential mortuary practices in this Bronze Age site.

Identification of genetic polymorphisms related to skin reflectance in the Japanese population

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The molecular mechanism of human skin pigmentation has been studied mostly on people of European ancestry, and little is known regarding Asian populations. We collected DNA samples from Japanese people residing in Okinawa, and examined the association of single nucleotide polymorphisms (SNPs) in pigmentation-related genes with skin reflectance measured with a spectrophotometer. We selected 57 SNPs in 21 genes that satisfied the following criteria; 1) associations of the SNPs with skin pigmentation in Europeans or people of European ancestry have been reported, and/or 2) selective sweep on the SNP or its adjacent region has been suggested in the sample of East Asians by previous studies. As a result of multiple regression analyses with a total sample of 653 individuals, each of rs74653330 (*OCA2*: A481T) and rs1800414 (*OCA2*: H615R) had a significant association after Bonferroni correction ($P < 8.77E-04$) with the skin reflectance of inner upper arm, which supports the independent effects of the derived alleles, 481T and 615R, on the lightness of skin in Japanese people. We also found a correlation between dark forehead and the derived allele of rs916977 in the non-coding region of *HERC2-OCA2* after controlling for the reflectance of inner upper arm, which suggests an association of this allele with tanning ability. The result of this study will help us further understand the difference in the evolution of light skin pigmentation between Europeans and Asians.

Does island dwarfing apply to relative brain size of Southeast Asian mammals?

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In 2004 a Late Pleistocene adult hominin skeleton (LB1) was discovered in the Liang Bua cave on the island of Flores, Indonesia. This specimen, allocated to *Homo floresiensis*, differs from the other two *Homo* species known from the region, *H. erectus* and *H. sapiens*, in its very short stature and by far the smallest endocranial volume ever reported for the genus. The initial hypothesis attributed these features to the "Island Rule", according to which large mammals undergo evolution of smaller body size on islands to reduce resource needs. Prior to the discovery of LB1, however, the island rule had rarely if ever been applied to brain size. As part of a comprehensive study to determine whether island dwarfing applies to brain size, we collected volumetric and linear measurements from museum skulls of pigs (n=64), deer (n=68), macaques (n=202) and gibbons (n= 101), the most prevalent large-bodied mammals endemic to Southeast Asian mainland areas and islands. Results from scaling endocranial volume relative to body size revealed no difference between continental island-living taxa and their mainland relatives, but relative brain size in pigs on oceanic islands was significantly smaller than on continental islands or mainland areas. Moreover, no dwarfing in body size related to island size was found with the primates studied (gibbons, macaques). These results indicate that island dwarfism is not a universal principle that consistently applies to body size or brain size and does not explain the tiny brain of *H. floresiensis*.

Talar articular surface curvature decreases allometrically among primates

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As animals increase in size, they reduce use of flexed-limb in favor of extended-limb postures, trading decreased joint mobility for increased stability and stress-reduction. Greater mobility has been associated with greater facet curvature. Therefore, allometric postural differences should also correlate with curvature: larger animals should have flatter (and more stable) joint surfaces that limit range of motion. Here, we examine the relationship between body size and curvature of several articular surfaces of the primate talus. One concave (ectal or posterior calcaneal) and two convex (lateral tibial and navicular) ovoid facets were cropped from microCT scan-generated surfaces from a comprehensive sample of primates. For each facet, a "sphere of best fit" was matched to the articular surface using Geomagic Studio. For facets with similar areas, flatter surfaces have "spheres of best fit" with greater volume, while tightly curved facets are best matched by spheres with lower volumes. The volume of this sphere was log-transformed and regressed against

literature-derived log-body mass using reduced major axis and phylogenetic least squares methods. Among all examined groups, the lateral tibial facet scales with positive allometry, indicating curvature decreases faster than expected from increasing body size alone. The navicular frequently scales with positive allometry, but isometrically among primates, strepsirrhines, loriformes and cercopithecoids. The ectal facet scales with isometry in most groups, except platyrrhines, catarrhines, and hominoids. These relationships remain significant even accounting for allometric increases in facet size. Different scaling patterns between concave and convex facets likely reflect their different roles promoting mobility and/or stability.

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The vervet microbiome: determinants of microbial community composition and insights into health and disease

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Next-generation sequencing techniques have enabled a surge of interest in the analysis of host-microbe relationships. Two main foci include identifying factors influencing microbiome variation and evaluating the role of the microbiome in host health and disease. In light of their considerable phylogenetic, socio-ecological, and geographic diversity and the extensive knowledge of their behavior, morphology and genetics, vervets (genus *Chlorocebus*) are an ideal clade in which to address these questions.

We applied 16S rRNA gene and metagenomic analyses to examine microbiomes of the vervet vaginal tract and rectum to understand microbiome variation and its relation to vervet biology. Results for both ecosystems indicate that wild and captive vervet microbiomes cluster with one another, distinct from other primates, suggesting an important effect of host genetics. However, vervet vaginal microbes paralleled microbes from other non-human primates in their lack of *Lactobacillus* ssp. dominance compared to humans. A Caswell's test of neutrality

supported a non-neutral, niche-determined model of microbial community assembly. The rectal microbiomes of wild and captive vervets (*Chlorocebus aethiops*) fed on a wild-foraged diet vs. a typical western diet, respectively, indicate that gut samples were distinguishable from one another, suggesting host diet is also an important factor affecting microbial variation. Whereas host genetics affected variation across a broad range of microbial taxa, the effect of diet on microbial variation was observed for only a subset of microbial taxa, largely within the Order Clostridiales, specifically the Lachnospiraceae and Ruminococcaceae families. We discuss the implications of these findings for host health and disease.

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Determining the number of impact events to a pig skull: A means for assessing blunt force trauma

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Blunt force trauma to the cranium is often the result of an extreme violent event, which can produce multiple fracture patterns. As a result, small fragments can be produced and they can make it difficult to place them in their proper anatomical context, hence impeding attempts to interpret the violent event. Determining the number of blows received by a victim is a critical but often difficult process. Such information is important in figuring out the context by which the trauma took place. To-date, there is very little published work on how anthropologists determine the number of blunt force impact events to the cranium. This project focuses on how cranial fracture patterns can indicate the number and placement of blows to the skull. In order to accomplish this research a double blind study was implemented, using six pig heads to create a field of variables. A volunteer struck the pig heads and the numbers of blows were recorded without our knowledge of them. Analysis of fractures patterns took place after the pig heads were defleshed. The analysis consisted of determining the number of blows for each pig head by tracing fracture patterns from grey-scaled photos. Assumptions about how force is transmitted through bone material guided us as we found specific impact events to the skull. Our observations were then tested on recent human forensic cases to determine if the method is transferable from the pig skull to the human skull.

Parallel climatic adaptation in the nasal anatomy of humans and bears

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Humans from cold and/or dry climates tend to have nasal passages that are taller, narrower, and longer than humans from hot, humid climates. The cold/dry configuration narrows the passages and maximizes mucosal surface area – characteristics that increase the capacity for heat

and moisture exchange in the nasal passages. While this pattern of variation appears to be the result of climatic adaptation, additional research is needed to truly test if adaptation has shaped human nasal variation. The most effective way to test if adaptation has occurred is to determine if similar patterns of variation developed independently in separate organisms in response to similar selective pressures. Like humans, members of the genus *Ursus* inhabit climates ranging from arctic to subtropical, and as such, provide an appropriate model for testing climatic adaptation patterns in humans. For this analysis, twenty-four *Ursus* crania from the Field Museum in Chicago were CT scanned: twelve *Ursus arctos* (brown, grizzly, and Kodiak bears) with arctic, temperate, and subtropical collection locations and twelve *Ursus maritimus* (polar bear) with collection locations exclusively from the arctic. If climatic adaptation occurred, the *U. maritimus* sample and *U. arctos* individuals from arctic regions should exhibit narrower nasal passages and/or greater mucosal surface area than *U. arctos* individuals from warmer climates. On the whole, the *Ursus maritimus* sample shows greater mucosal surface and narrower passages than the *Ursus arctos* sample, which is more variable. These results suggest that climatic adaptation played a role in shaping the nasal anatomy of both humans and bears.

Differences in the effects of age and sex on musculoskeletal stress markers (MSM) development among historic Japanese populations

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Musculoskeletal stress markers (MSM) are widely used to reconstruct physical activity of past populations. Recently, there have been indications that MSM are formed by multifactorial etiology; in particular, age and sex. Many researchers express skepticism about using MSM as an indicator to reconstruct physical activity. However, the influence of age and sex may depend on the type of social system. This study investigates the role of age, sex, and physical activity on MSM development.

For this purpose, MSM were examined from 363 individuals excavated from 15 sites in Japan. Archaeological evidence from the sites reveals that each population performed a variety of subsistence activities; the 15C samples were from fishermen and salt manufacturers; the 18C samples were from peasants, townspeople and samurai.

This study examines the hypothesis that the degree of influence age and sex has upon MSM is population specific, and differences may be explained by form of subsistence activity, sexual division of labor, and age group of the people, as chronological age of an individual in these societies likely contributed towards activities performed by an individual.

Results indicate that age and sex influence MSM development. However, the degree of influence varies between populations and reflects differences in social systems. This implies that differences can be attributed to age group and sexual division of labor in each population.

Therefore, MSM may be a valuable tool for the reconstruction of physical activity and has

implications for identifying social stratification specific activities, although with some limit. Supported by JSPS KAKENHI 11J04758.

The biomechanics of balance in common marmosets (*Callithrix jacchus*)

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A central problem for primates travelling on narrow branches is the management of disruptive rolling torques about the support. However, few quantitative data exist with which to evaluate the biomechanical strategies primates use to manage torques and maintain balance. To address this gap, we collected high-speed video of two common marmosets crossing an array of six custom-built force transducers fitted with broad (5cm) and narrow (2.5cm) diameter poles. By examining both applied torques and disruptive gravitational torques about the poles, we test two hypotheses: 1) left and right limbs exert equal and opposing torques, thus ensuring low net torque across a stride, and 2) disruptive gravitational torques will be inversely related to pole diameter, requiring significantly greater balancing forces (i.e., applied torques divided by the support radius). A preliminary dataset of 14 strides on the broad pole and 9 on the narrow indicates that right- and left-side torques have opposing orientations but similar magnitudes (right: 0.550 Ncm; left: -0.381 Ncm; $p > 0.05$), resulting in low mean torque that does not differ between substrates (5cm: -0.149 Ncm, 2.5cm: -0.048 Ncm; $p = 0.73$). Disruptive gravitational torques are greater on the narrower pole (5cm: 4.13 Ncm, 2.5cm: 1.28 Ncm), though not significantly so ($p = 0.167$). Requisite balancing forces, however, are nearly six times greater on the narrow support, a significant difference (5cm: 3.27N, 2.5cm: 0.56 N, $p = 0.025$). On-going analyses incorporating limb kinematics and kinetic measurements are focused on the degree to which grasping forces and segmental accelerations (e.g., tail movements) determine torque cancellations across the stride.

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Out on a limb: Developmental rules for the evolution of primate segment proportions

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The proportions of the bones comprising the individual limb segments (stylopod: humerus, femur; zeugopod: radius/ulna, tibia/fibula; autopod: metapodials, digits) reflect the summed effects of developmental factors on relative size, from earliest limb bud outgrowth, patterning and segmentation, to fetal and postnatal endochondral bone growth. However, it is unknown to what degree any individual event contributes to variation, and thus when and what selection may act upon to generate evolutionary change. Comparative analysis of macroevolutionary diversity of amniote limb proportions indicates that early processes of proximo-distal patterning and segmentation limit the initial middle (zeugopod) segment

proportions (~1/3 of total limb length) and thus the available variation, suggesting that deviations from this pattern must be generated by selection on variation in later growth. To address this hypothesis in primates, population-level data was collected for mean and variance in segment proportions compared within and among groups (species=71, limbs=140). Ontogenetic variation in proportions in humans, gorillas, gibbons, and galagos across fetal and postnatal growth was also examined. Results indicate that, as in other amniotes, variation in the middle segment exhibits reduced variance throughout development and averages ~1/3 of total limb length. Consistent with model predictions, primates exhibit deviations from initial middle segment proportions during later fetal and postnatal somatic growth. These results suggest that primates, including humans, escape early developmental constraints on middle segment proportions primarily via selection on variation in differential endochondral growth processes.

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Assessing the risks of maternal placentophagy: An analysis of environmental metals in human placenta capsules

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Maternal placentophagy, postpartum ingestion of the afterbirth by the mother, is ubiquitous among mammals but conspicuously absent in the ethnographic literature. One explanation for this absence suggests that with the emergence of regular fire use by human ancestors, smoke inhalation during pregnancy may have rendered placentophagy harmful due to metal accumulation in the organ. Despite a lack of evidence for maternal placentophagy in the cross-cultural record, it has recently become popular among a small but growing number of women in industrialized countries. Among these women, placenta is often ingested in dehydrated and encapsulated form and taken across the postpartum period for its many purported benefits. The effects of ingesting dehydrated placenta have not been systematically investigated, and the heavy metal content of processed placenta has never been explored. Thirteen human placentas were analyzed in both the unprepared and dehydrated forms using X-ray fluorescence analysis for 15 heavy metals in order to address whether environmental metal accumulation in the placenta might affect the metal content of the dehydrated organ. Analysis revealed that unprepared placenta retained detectable concentrations of iron and rubidium, while dehydrated tissue contained higher concentrations of these metals in addition to zinc and strontium. These results suggest that while some beneficial metals are retained in the placenta in both forms, potentially harmful metals may also be retained, warranting further investigation of heavy metal accumulation in placental tissue. Further analysis in mothers regularly exposed to smoke inhalation is needed to address the effects of smoke exposure on placental metal accumulation.

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Post-Pleistocene gracilization and the effects of terrain on the lower limbs of modern humans

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Modern humans demonstrate a decrease in lower limb robusticity throughout the Pleistocene, particularly with respect to anteroposterior rigidity of the femur and tibia (review in Holt, 2003). This trend continues into the Holocene, and it has been interpreted as the consequence of subsistence changes and technological advances that reduced the human work load (Ruff, 2008; Ruff et al., 1993). However, analyses of human remains spanning 19-4 ka in Italy (Marchi, 2008; Marchi et al., 2011) deviate from this trend, with a Ligurian Neolithic sample demonstrating unusually robust lower limbs that are reminiscent of highly-mobile Late Upper Paleolithic humans from the region. These relatively high levels of robusticity have been associated with mountainous terrain and intensity of mechanical loading.

The current analysis evaluates diachronic changes in lower limb robusticity for regional samples to evaluate the hypothesis that there was a post-Pleistocene decline in lower limb robusticity. Cross-sectional geometric properties are evaluated for Late Pleistocene, Holocene and modern human samples in Europe, Africa and Asia to evaluate *in situ* changes in each region. High levels of robusticity in several Holocene samples suggests that a post-Pleistocene decrease in robusticity may represent sampling bias rather than a biological trend. Femoral and tibial shape indices demonstrate significant associations with terrain and consequently types of loading on the lower limb, although measures of long bone rigidity demonstrate significant sexual dimorphism. It is less clear, however, how these correlations should be interpreted from a behavioral or subsistence strategy perspective.

A novel method of estimating facial ancestry using 3D images

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Genomic ancestry can be a useful summary statistic for example as a variable in augmenting assessments of medical risk, in genetic association studies, and for constructing genealogies. Obtaining these estimates are in some cases not possible due to unavailability of genetic material in addition to time and cost limitations. Here we demonstrate a workflow to calculate facial ancestry and show that it is highly correlated with genomic ancestry.

A dense mesh of 7150 quasi-landmarks was mapped on 3D images obtained for a sample of

849 individuals with varying levels of West African and European ancestry. Principal components on the aligned x, y, and z coordinates of the quasi-landmarks were carried out to construct a multi-dimensional 'face space'. West African and European consensus faces were constructed from the face space by averaging across 80 African and 80 European individuals respectively. The Malhabanobis distance between each face and the African consensus face was divided by the sum of the Malhabanobis distances of the face from the African and European consensus faces to get facial ancestry along the African-European axis. Here we report that this ratio is strongly correlated with genetic ancestry which was calculated from a panel of 68 ancestry informative markers ($r^2 = 0.531$), as well as RIP-A, another measure of facial ancestry calculated using a partial least squares regression method ($r^2 = 0.624$).

This method can be used to estimate facial ancestry where genetic material is not available.

When is a chirp more than a chirp? Characterization of a vocal call class in Ma's night monkey (*Aotus nancymaae*)

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Vocal calls have been extensively studied in the primate Order where they have been demonstrated to serve a pivotal role in primate communities. Primate vocalizations can communicate a variety of information including potential threats, internal states, and social status between conspecifics. We examined a vocal call class, referred to as "chirps", in Ma's night monkey (*Aotus nancymaae*), a poorly studied nocturnal primate. Our subjects consisted of seven pairs of monkeys housed in cages in a wooded area at the DuMond Conservancy for Primates and Tropical Forests in Miami, Florida. We recorded the subjects' vocalizations while cages were presented with a random sequence of four stimuli: owl vocalizations, a plastic snake wiggling by the cage floor, an experimenter walking by with a kennel, and a bright light.

Spectral and temporal analyses of the 421 chirps collected revealed that this call class comprises several distinct call types characterized by their shape on a sonogram. Moreover, call traits (e.g. starting frequency, peak frequency) appear to be pair-specific. The rate of chirps increased from an average of 16 per minute to 73 per minute during presentation of the snake and often caused similar increases in rate in nearby cages. Individuals remained silent while owl vocalizations were being played. These data suggest that while night monkeys have adopted a nocturnal lifestyle, their vocalizations show a range of variation comparable to diurnal primates, presumably like their ancestors. More research, particularly playback experiments, is needed to elucidate the possible functions of these call types.

Lower Pleistocene hominid paleobiodiversity in Southeast Asia: Evidence for a Javanese pongine taxon

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The Pleistocene deposits of the Sangiran Dome, at Java, have yielded over 200 hominid dental remains. Most of this material, predominantly consisting of permanent molars, is commonly attributed to *H. erectus*, even if some robust specimens have been tentatively allocated to other nonhuman taxa (*Meganthropus paleojavanicus*, *Pithecanthropus dubius*, *Pongo* sp.). Besides the impact of the intermittent glacio-eustatic fluctuations occurred along the Pleistocene on the evolutionary dynamics and variation patterns, this taxonomic uncertainty reflects the convergence in molar crown size and morphology between *Homo* and the Ponginae, notably in case of worn specimens.

In order to assess the hominid paleobiodiversity at Java during the Lower-Middle Pleistocene, we characterized by X-ray microtomography the 3D structural morphology of the M2 and M3 of the mandibular fragment Arjuna 9 ('Grenzbank Zone' of Sangiran). Because of its large dimensions and primitive morphology, this specimen was firstly compared to *M. paleojavanicus*, but later allocated to *H. erectus*. In the tooth endostructural analyses, we compared Arjuna 9 to the evidence from five permanent *H. erectus* molars from the Kabuh Formation of Sangiran and to a number of specimens representing extant and fossil humans (North African *H. heidelbergensis* and Neanderthals) and extant and fossil *Pongo*.

Results dealing with dental tissue proportions, enamel thickness distribution and geometric morphometrics of the enamel-dentine junction show that Arjuna 9 sets apart from the human pattern, notably from *H. erectus*, and more closely fits the pongine condition, thus pointing to a more complex Lower-Middle Pleistocene hominid paleobiodiversity at Java than previously thought.

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Prosimian primate life history profiles generated from the new Duke Lemur Center Database (coming soon to a URL near you!)

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Here we introduce the new Duke Lemur Center Database, an extraordinary and soon-to-be publicly available life-history resource for a phylogenetically diverse assemblage of endangered primates. To demonstrate the breadth of information therein, we present life history summaries, based on precise data and large sample sizes, describing 23 variables relating to longevity, reproduction, and body size in 25 captive prosimian primate species. Since its establishment in 1966, the DLC has been dedicated to the study and conservation of prosimians, with special interest in the lemurs of Madagascar. Data, including birth, death, reproductive, weight, husbandry, and medical records, have been collected throughout the history of the center, and the DLC database contains detailed information for over 4100 individuals representing 39 taxa. Until the development of this database, those data have been largely inaccessible to the research community. To remedy this, we have extracted colony information from extant captive animal databases from which data are difficult to retrieve and impossible to analyze (ARKS, MedARKS, and ZIMS), and combined it with a variety of previously non-databased in-house records using SAS® Enterprise Guide® software to produce a user-friendly analytic database. Our presentation outlines various methods by which investigators can freely access these data and provides an overview of direct and calculated variables now available. Furthermore, the data-rich life history profiles generated highlight the high levels of biological diversity observed among closely related prosimian species, and will provide a solid foundation on which a wide variety of future biological studies can be built.

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Developmental timing of heel-strike plantigrady in chimpanzees and gorillas

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Understanding the mechanics of African ape locomotion has important implications for scenarios of hominoid locomotor evolution. Ontogenetic differences between chimpanzees and gorillas in knuckle-walking frequencies and postures and the development of the manual skeleton support an independent evolution of knuckle-walking in apes. African apes also use heel-strike plantigrady (HSP) in which the heel makes initial contact with the substrate. Little is known about the relationship between knuckle-

walking and HSP, ontogeny of HSP in African apes, or the evolutionary relationships between ape and human HSP. We take a comparative, ontogenetic approach to test the hypotheses that, 1) knuckle-walking and HSP are mechanically linked, and 2) like knuckle-walking, HSP develops later and differently in infant chimpanzees than it does in gorillas, reflecting a fundamental difference in chimpanzee and gorilla HSP. Frequency and kinematics of HSP are compared using high-speed 3-D video recordings of terrestrial walking in infant chimpanzees ($n = 4$) and gorillas ($n = 2$) moving freely in large enclosures at the North Carolina Zoo.

Gorillas as young as six months old consistently use adult-like HSP and palm-back knuckle-walking hand postures. However, chimpanzees as old as fourteen months exhibit variable plantigrade postures along with palm-back and palm-in knuckle-walking postures, suggesting that hand and foot postures are decoupled, at least in chimpanzees. Differences in intermembral index and developmental timing of HSP and limb kinematics suggest two alternative, not mutually exclusive, hypotheses: that HSP develops at different rates for strictly mechanical reasons or that HSP evolved independently in chimpanzees, gorillas, and hominins.

Dental indication of health and stress of late Shang People in Anyang, China (ca. 1250 – 1046 B.C.)

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This present study examines the dental indicators of health and stress (caries, antemortem tooth loss, abscesses, and dental wear) on 269 skeletal human remains (5413 teeth) recovered from Anyang, the capital of the Late Shang Dynasty in China. The remains span about 200 years (ca. 1250 – 1046 B.C.), but archaeologically can be divided into early and late phases. The distribution of each dental stress indicator was carefully documented for each skeleton. Multivariate odds ratios of caries, antemortem tooth loss and abscesses were applied to assess differences across three age groups, two temporal phases and social status. Our data indicate that 1) the frequency of caries statistically significantly decreased from early phase to late phase; 2) decrease in caries was significantly greater in males than females; and 3) more pronounced dental wear was seen on people of late phase; 4) individuals of lower social status are more affected by dental stress, especially by abscesses, than those of higher status. The results indicate that more abrasive food may have appeared in the diet in late phase. Tooth wear likely predisposed people of late phase to antemortem tooth loss and abscesses, but it may have prevented caries by wearing down occlusal fissures. With the evidences from both isotopic and archaeological studies, this

study suggests that social and demographic pressure may have affected the lifestyle of late Shang people in Anyang. Oral health in general in late Shang people was declined through time.

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A bioarchaeological study of human remains from Jinggouzi, a Bronze Age cemetery site in North China

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This paper reports a synthetic study of human remains recovered from Jinggouzi (2500 B.P.), a Bronze Age cemetery site located in the eastern part of Inner Mongolia. The cemetery contains 133 skeletal individuals in 58 graves and can be dated back to the late Spring and Autumn and the early Warring States period. The remains represent one of the earliest skeletal populations in the region and is thought by some to be “DongHu” people, an ethnic group that was mentioned in early historic books/records. Through osteological analysis, ancient mitochondrial DNA and stable isotope analyses, the study aims to characterize bioarchaeological profiles of the remains. Craniometrically the features indicate close relationship with other North Asiatic indigenous groups such as XianBei and QiDan. Of the 43 ancient mitochondrial DNA samples, 60.9% belong to haplogroup D (high frequencies in modern Northern Chinese minority groups). The phylogenetic tree further suggests ancient XianBei population is their closest-related maternal group. Finally, paleodiet reconstruction through stable isotopes ($\delta^{13}\text{C}$ average -12.38% and $\delta^{15}\text{N}$ average 9.75%) suggests a semiarid environment and a nomadic subsistence practice. The combined bioarchaeological profile from morphology genetic affinities, and life history strongly indicates that the skeletal population was indigenous to the region and had a nomadic life style. The profile is so consistent with that of the historic “DongHu” group, the hypothesis that the remains were “DongHu” people cannot be rejected though many other lines of evidence should be consulted to verify and confirm this identity.

The origin of the skeletal human remains from Dabaoshan site (2300 – 2200BP) in south central Inner Mongolia, China

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South central Inner Mongolia of China has long been a place where two economically diverse cultures interacted: nomadic pastoralists from the north and sedentary agriculturalists to the south. Previous studies of human cranial variation of the early Iron Age (about 2000BP) in this region suggest that some populations may

have originated from the north and others from the south, revealing constant population migrations. Earlier archaeological studies from the region also indicated that cultural exchanges occurred across this area prior to the early Iron Age. Yet, it is unclear when and how such cultural exchanges or population migrations took place.

Human remains from Dabaoshan site (2300 – 2200BP), Inner Mongolia represent an earlier group of inhabitants in this region. Determining the origin of these people will help illuminate the dynamic interactions of cultures. Fifty-two individuals were compared with those from the South and the North to reconstruct the population affinities of the study sample. Both craniometric data and cranial discontinuous traits were used to conduct population comparisons through principal components and cluster analyses. Data of this study were further compared with published data from across Eurasia to explore the North-South patterns of variation.

This study indicates that the human remains of Dabaoshan are phenotypically more similar to those from the central plain of China (sedentary agriculturalists) than to the pastoralists from the north of China. This suggests that Dabaoshan population most likely originated in central China, demonstrating that human migrations in the region had begun prior to the early Iron Age.

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Preliminary analysis of ancient DNA on a late Neolithic population in Northeast China

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Haminmangha Site is located in the heart of Horqin grassland, and has a about 6000-year history. As one of the most ancient sites with the largest number of people in Northeast China by far, it can provide new insights to study the origin and migration of populations in Northeast China.

In this research, we investigate the mitochondrial haplotypes of 40 individuals from Haminmangha Site (including the house sites and the tombs); only 24 individuals yielded mtDNA data. These belong to haplotype D, B, M8Z, M8a, F and N*, which are wide spread in Northeast China. Possible links between the populations of the Haminmangha site and other more southern sites (Erlitou site and YinXu site) are also predicted by the above results. It seems that even by the late Neolithic the ancestry of Northeast Chinese was already very mixed. And ancient migrations may have occurred not only among the populations of Northeast China, but also have influenced the people living further south, even in the Central Plains to some extent.

Our next step includes evaluation of the Y chromosome, and, of course, additional sampling from Haminmangha Site and other nearby sites is necessary in the future.

Kinship analysis of ancient samples in the Noble Family cemetery of the Yuan Dynasty

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The Yuan Dynasty was the first foreign dynasty to rule all of China and lasted more than 200 years, but due to special customs and absence of a historical record, the archaeological cemeteries that belonged to the Mongols of the Yuan Dynasty were rarely discovered, especially those of the Mongolian noble Family. Archaeological excavations in Shuzhuanglou at Hebei province of China led to the discovery of 13 skeletons in 6 separate tombs, so far assumed to be of Mongol nobles of Korgis. A multidisciplinary approach including archaeological, anthropological, radiogenic isotopic and ancient DNA methods was applied to confirm the identity of the cemetery owners and resolve the kin relationships between individuals. Genetic kin relationship among some individuals was identified based on data from autosomal, mitochondrial, and Y-chromosomal markers. Evidence from the archaeological record, radiogenic isotopes and molecular evidence allows tentative identification of the cemetery owners. We demonstrate that concurrent analysis of multiple disciplines is an efficient method for individual and kinship identification of specimens obtained from old historic relics.

Ancient DNA analysis of human remains from Halahaigou, a Neolithic cemetery in China

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This research uses an ancient DNA approach to characterize the kinship of human skeletal remains (4500 BP) recovered from a Neolithic cemetery at Halahaigou Village, Chifeng, Inner Mongolia. Remains of 36 individuals from 27 burial pits were extracted and PCR-analyzed. Maternal mtDNA profiles were created using the D-loop region and coding SNPs; paternal profiles were created using 8 Y-SNPs. All ancient DNA data were obtained in dedicated ancient DNA labs at both at Jilin University and Institute of Archaeology, CASS following established protocols for vigorous contamination controls. The results show that mtDNA was successfully amplified in all samples, revealing 24 haplotypes (belonging to 8 haplogroups); Y-SNPs were positive only in 12 samples which all belong to one haplogroup (N). It is interesting

that there are multiple maternal groups and only one paternal group. Within the cemetery, among all seven double burial pits, five pits held a male and a female with a different mtDNA profile; one pit held two females with different mtDNA profiles; and one pit held two male skeletons with the same mtDNA profile. A sole burial pit with three individuals (two males and a female) shared the same mtDNA profile. Although it is difficult to determine specific kinship relationships based on mtDNA and partial Y-SNPs alone, this study demonstrates the usefulness of applying ancient DNA patterns to exclude other possibilities of kinship, adding important information to aid our understanding of past burial practices.

Isotopic evidence for the expansion of wheat consumption in Northern China: Not so fast

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Flotation and carbon dating indicate that wheat was introduced into northern China about 5000-4000 BP, eventually replacing millet as the dietary staple. However, it is unclear how wheat influenced diets in this established agricultural society and when millet lost its place to wheat. Because wheat and millet have distinct $\delta^{13}\text{C}$ values, stable isotope analysis can address these questions. Here, we review stable isotope data for over 400 human samples from 27 sites in northern China, dating from ca. 5000-1500 BP, summarizing the current evidence for dietary changes since the appearance of wheat. The results indicate that wheat had little influence on human nutrition at its first appearance. The first possible evidence for wheat consumption is seen in Xinjiang about 3800 BP. Further east in Qinghai, a shift from C₄- to C₃-based diet occurred roughly 4000-3500 BP. Further east, millet dominated diets for the following two millennia, although wheat remains have been widely recovered and its importance in agriculture was recorded in contemporary documents. It was only in the 6th century AD that a C₃ crop, probably wheat, became important in human diets in northeastern China. The importance of wheat in agriculture was not reflected in its importance in human diets. Instead, wheat-eating was constrained within Xinjiang and Qinghai for over 2000 years, and spread rather slowly to the east. This differs from the scenario depicted by palaeobotanical studies, illustrating the need for further stable isotope analyses to better characterize the millet-wheat transition in the region.

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Paleodemography of human remains from Hamin Mangha Site in Inner Mongolia: Evidence of forensic anthropology of cause of prehistoric disaster

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Many archaeological sites in China contain human remains in building contexts that suggest that they are the site of catastrophic events and mass disasters. The Hamin Mangha Site in Inner Mongolia (年代) exemplifies such a site. Human skeletal remains were recovered from a collapsed half crypt type house (F40), preserved by fire.

The site contains a minimum of 97 individuals. Paleodemographic analysis of Hamin Mangha site indicates that the average age at death is 26.8 years with mean age at death for males being 34.3 years and 30.6 for females. Mortality clusters in juvenile, young adult and middle adult age categories. There are no older adults. There are some differences in mortality of all ages. Compared to other sites, distribution characteristic of individuals' age at death of F40 appears more concentrated with half of individuals' age distributing from 19.5-35 years.

This is consistent with that of other sites such as Lajia and Miaoziyou which were formed by prehistoric disasters in China. The comparison of the Hamin group with the Lajia group and Miaoziyou group sites shows that the Hamin group and Miaoziyou group have more similar age profiles. This similarity may indicate that the cause of the Hamin Mangha site was similar to that of the Miaoziyou sites. That is, they both possibly relate to an outbreak of an acute infectious disease (pestilence). The human bone accumulation in F40 was formed because ancient humans put remains into the house successively and stacked centrally.

Stable nitrogen isotopes in modern and archaeological human tooth enamel

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Stable isotope analysis is a widely accepted source of information on ancient diet, subsistence strategies, migration, and ecological interaction. $\delta^{15}\text{N}$ provides analysis of protein source trophic level and marine content in diet by proxy. Because of the relatively short taphonomic lifespan of traditional sources of nitrogen isotopes (bone collagen, tooth dentin), a consistent source of analyzable nitrogen with a longer archaeological lifespan would substantially improve understandings of past diet in samples previously inaccessible for such analysis. Enamel from modern human third molars from Harvard Dental School, and human molars from the sixteenth century site of Teposcolula Yucundaa in Oaxaca, Mexico (n=27) were used to investigate the feasibility of measuring $\delta^{15}\text{N}$ in enamel, and to compare to dentine and bone collagen $\delta^{15}\text{N}$. Fine sampling with a hand drill yielded 30-60 mg of enamel per tooth, collected as separate outer and inner layers. The relationship between enamel and dentine-sourced $\delta^{15}\text{N}$ ratios was examined for isotopic differences and interpretive potential, and we report on the future outlook for this technique.

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