Program of the seventy-eight Annual Meeting of the American Association of Physical Anthropologists

To be held at the

Sheraton Chicago Hotel and Tower

301 East North Water Street
Chicago, IL 60611

Dear attendees of the AAPA and concurrent conferences:

It gives me great pleasure to welcome you to our 2009 conference. With the support of my assistants, the program committee has put together an excellent program encompassing nearly 970 presentations. We tried to accommodate authors' preferences concerning presentation medium as much as possible. However, we gave higher priority to scientific cohesiveness of sessions, so that papers on similar topics were put in the same session. Indeed, some sessions are rather small because they contain a select number of paper which deal with a specific topic.

The online system of call for papers and abstract submission is less than perfect. I would therefore encourage our members to keep an eye on our website for the usual May mailing of the call for papers and for copies of previous conference programs.

The AAPA meetings start with our reception on Wednesday night, and end with the student-awards reception on Saturday evening. You will notice a few changes in the schedule of events. The most obvious one is that the posters will remain on display for an entire day, and that the poster authors are expected to be present for discussion once in the morning and once in the afternoon. To accommodate this, we reduced the size of posters to half what it was in the past. We hope that this will contribute to more scientific discussion, as will no doubt the fact that cash bars will be opened in the poster area at 5 pm. We invite you to socialize and meet colleagues around the poster area. Another change to our usual schedule is that the business meetings of allied organizations such as the AAAG, the ADA, the DAA, and the biocultural-interests group are scheduled for Friday night, to avoid conflict between them and the plenary session and the Wiley reception on Thursday night. Finally the Career-Development Committee session has been moved from its usual spot on Wednesday evening to Saturday 12-2 pm.

As usual, we are meeting with other associations, such as the Paleopathology, Paleoanthropology, the American Association of Anthropological Genetics and the Human Biology Associations. I am very pleased about the joint sponsored symposia with the latter two, namely "Detecting Natural Selection in Humans", co-sponsored by the Human Biology Association, and "Standing at the Crossroads: The Genetics of Morphology", co-sponsored by the American Association of Anthropological Genetics. Another special session is the Wiley-Liss symposium, titled "Human Natures and Human Cultures: Integrating Evolutionary Perspectives and Biocultural Approaches".

Our conference benefits from strong student and international components. We received 256 abstracts originating from outside of the USA, coming particularly from Europe, Latin American and Asia. We had 120 submissions from non-members, and 554 submissions from student members and student non-members.

I would like to thank my dear friend Anne Grauer, the local arrangements chair, for an excellent job in organizing the meeting. Working with her has been a pleasure. In addition, I want to thank my program committee, who tirelessly reviewed a very large number of abstracts. Finally, I could not have done this work without the support of my program assistants, Michelle Raxter and Rhonda Coolidge.

Welcome to Chicago, and enjoy an exciting program.

Lorena Madrigal

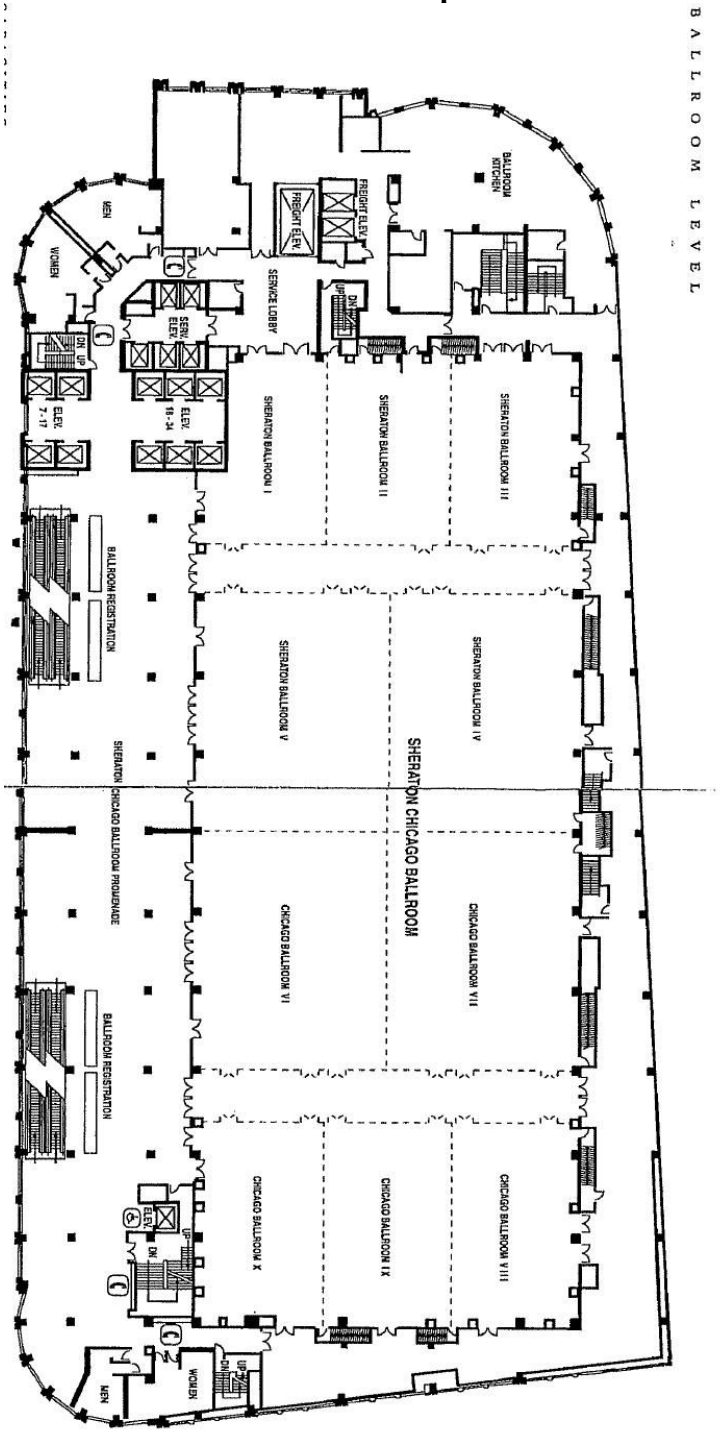
AAPA Vice President and
Program Committee Chair

Contents

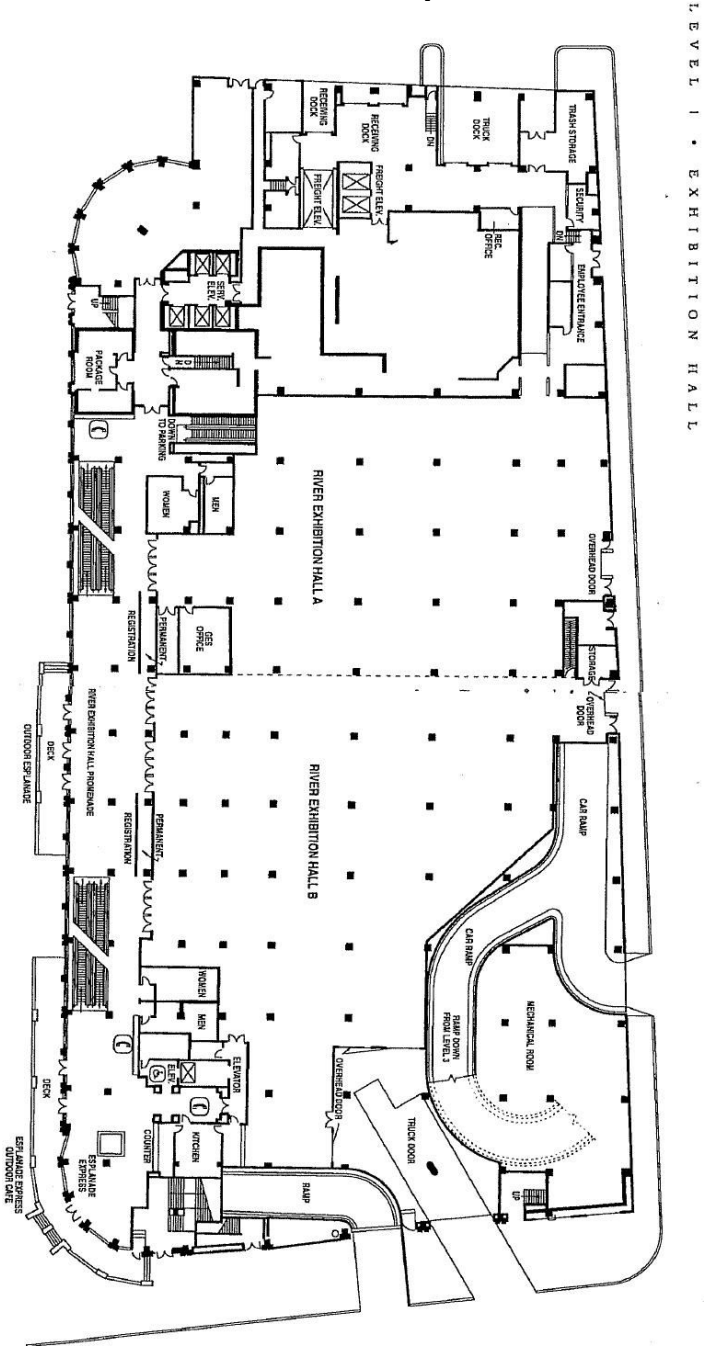
On the cover: Chicago riverfront skyline, photo by Anne Grauer.

Supplement 44 was mailed the week of 15 February 2009.

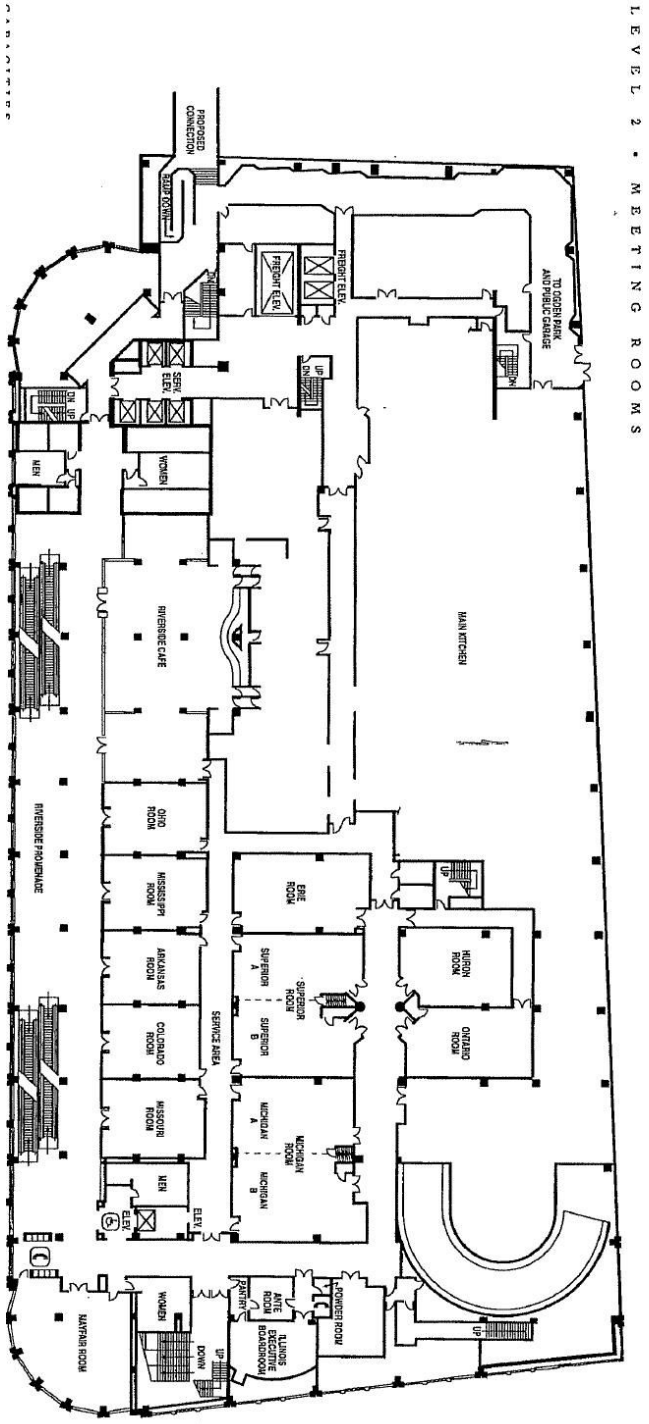
Floor Plan 1: the conferences will take place in four different levels.



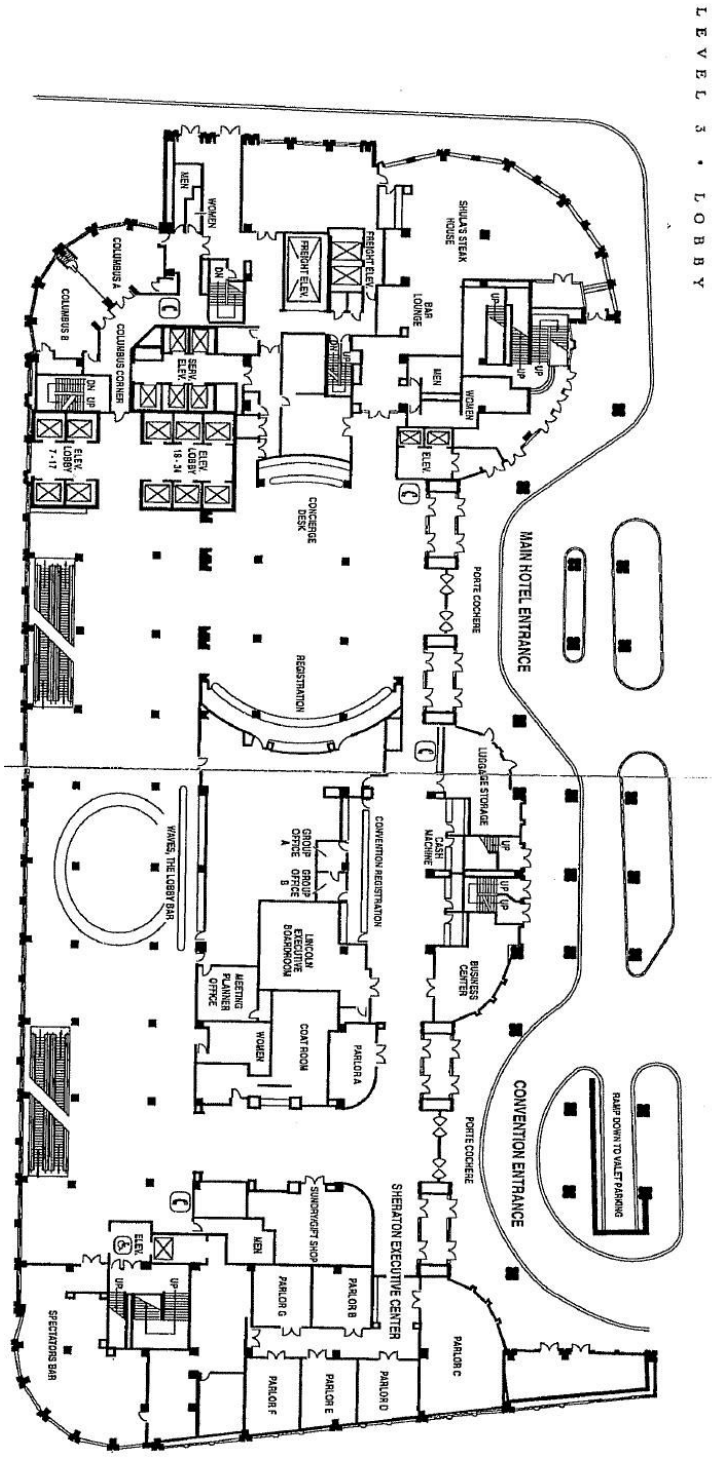
Floor Plan 2: the conferences will take place in four different levels.



Floor Plan 3: the conferences will take place in four different levels.



Floor Plan 4: the conferences will take place in four different levels.



The Conference at a Glance (Monday-Tuesday)

Room	Monday pm	Tuesday am	Tuesday pm	Tuesday evening
Chicago Promenade East	PPA Registration 7-9pm	PPA Registration, 8 am – 5 pm PA registration 8am - 5pm		
Chicago 8		PPA Workshop 9am-12pm	PPA Podium Session	
Chicago 9		PPA Symposium 9am-12pm		PPA Reception/ dinner/business meeting, 6 – 10pm
Chicago 10		PA Podium Session	PA Podium Session	
Mississippi				HBA Executive Committee Dinner, 6 – 10 pm HBA Registration 5-7pm
Ohio				Human Biology editorial board dinner 6:00-8:00
Parlor A		Speaker Ready / Computer Room	Speaker Ready / Computer Room	
Parlor G		Press/Job Interview	Press/Job Interview	

Key to acronyms:

AAAG American Association of Anthropological Genetics	**DAA** Dental Anthropology Association
AAPA American Association of Physical Anthropologists	**HB** *Human Biology*
ADA American Dermatoglyphics Association	**HBA** Human Biology Association
AJHB *American Journal of Human Biology*	**JHE** *Journal of Human Evolution*
AJPA *American Journal of Physical Anthropology*	**PPA** Paleopathology Association
	PA Paleoanthropology Association

The Conference at a Glance (Wednesday)

Room	Wednesday am	Wednesday pm	Wednesday evening
Convention Registration West	AAPA Registration, 8 am – 1 pm	AAPA Registration, 1 pm – 5 pm	
Chicago Promenade East	PA Registration 8:00am-12pm PPA Registration 8am-12pm HBA Registration 8:00am-12pm	HBA Registration 1-5pm	
Chicago 8	PPA Podium Session	PPA Podium Session 2pm-5pm	AAPA Reception, 8 – 11 pm
Chicago 9		Plenary Session/HBA Podium Session 12:30-6pm	AAPA Reception, 8 – 11 pm
Chicago 10	PA Podium Session, 8 – noon	PA Podium Session, 1 – 5 pm	AAPA Reception, 8 – 11 pm
Missouri Room	AJHB Editorial Board breakfast, 7:30 – 9 am	AJPA Editorial Board Meeting, noon – 2 pm	PPA Student awards
River Exhibition Hall B	HBA Poster Session PPA Poster Session	PPA Poster Session PA Poster Session	
Parlor A	Speaker Ready / Computer Room	Speaker Ready / Computer Room	
Parlor G	Press/Job Interview	Press/Job Interview	Press/Job Interview
Illinois Boardroom	AAPA Executive Committee Meeting, 7am – 6 pm	AAPA Executive Committee Meeting, 7am – 6 pm	
Mayfair room		HBA luncheon	HBA reception 6-9pm

The Conference at a Glance (Thursday)

Room	Thursday am	Thursday pm	Thursday Evening
Convention Registration West	AAPA Registration, 8 am – 1 pm	AAPA Registration, 1 pm – 5 pm	
River Exhibition Hall B	Session 1. Population History. Session 2. Skeletal Biology of Hunter-Gatherers. Session 3. Age Estimation. Session 4. Dental anthropology. Session 5. Health and Disease in Europe. Session 6. Isotopic studies. Session 7. Hominin craniofacial morphology and neural evolution. Session 8. Primatology: Exhibitors	Session 1. Population History. Session 2. Skeletal Biology of Hunter-Gatherers. Session 3. Age Estimation. Session 4. Dental anthropology. Session 5. Health and Disease in Europe. Session 6. Isotopic studies. Session 7. Hominin craniofacial morphology and neural evolution. Session 8. Primatology: Exhibitors	
Michigan Room A&B	HBA Registration, 8 am – 12 pm HBA Podium Session, 8:30 – 12:00	HBA Podium Session, 1:30-5:00pm	HBA Business Meeting, 5:00 – 6:00 pm
Superior Room A & B	Session 10. Bones, Genetics, and Behavior: Physical Anthropology at the Caribbean Primate Research Center.	Session 15. Bone remodeling. Isotopic Analysis of Diet and Paleopathology.	
Chicago 8	Session 11. Quantitative genetic approaches to human phenotypic evolution.	Session 16. Paleoanthropology Late Homo evolution.	Student Com AUCTION 8:00-10:00pm
Chicago 9	Session 9. Human Life History in Primate Perspective.	Session 14. Human Natures and Human Cultures: Integrating Evolutionary Perspectives and Biocultural Approaches.	AAPA Plenary Session, 6:15 – 7:45 pm (Chicago 9-10)
Chicago 10	Session 12. Assessing and understanding maturational processes.	Session 13. Non-human primate dental anthropology and functional anatomy.	AAPA Plenary Session, 6:15 – 7:45 pm (Chicago 9-10)
Chicago Promenade			Wiley Liss reception, 8:00-10:00 pm
Mayfair room			HBA Student reception, 7:00 – 9:30 pm

The Conference at a Glance (Friday)

Room	Friday am	Friday pm	Friday evening
Convention Registration West	AAPA Registration, 8 am – 1 pm	AAPA Registration, 1 pm – 5 pm	
Chicago 7		AAPA Luncheon 12:00 pm-2:00 pm	
River Exhibition Hall B	Session 17. Body Mass Estimation Reconsidered. Session 18. Population biological variation and disease. Session 19. Paleopathology and Bioarchaeology. Session 20. Hominin Evolution. Session 21. The non-hominin Primate Fossil Record. Session 22. Primate functional and comparative anatomy. Exhibitors	Session 17. Body Mass Estimation Reconsidered. Session 18. Population biological variation and disease. Session 19. Paleopathology and Bioarchaeology. Session 20. Hominin Evolution. Session 21. The non-hominin Primate Fossil Record. Session 22. Primate functional and comparative anatomy. Exhibitors	
Chicago 8	Session 23. Primatology. Communities, growing up, reproduction, life history and ecology.	Session 29. Ecology and Evolutionary Biology of Primate Lactation. Session 30. The genetics of craniodental variation and evolution.	
Chicago 9	Session 24. Detecting Natural Selection in Humans.Session 25. Human population variation and disease.	Session 31. Infant Carrying in Human Evolution. Session 32. Chimpanzee behavior.	
Chicago 10	Session 26. Hominin evolution.	Session 34. Primate brain, cognition, growth, learning, and reproductive biology.	AAPA Business Meeting 8-11 pm
Michigan A & B	Session 27. Paleopathology. trauma, interpersonal violence and warfare.	Session 33. Standing at the Crossroads: The Genetics of Morphology.	
Superior A & B	Session 28. Genetic variation, population and phylogenetic studies.	Session 35. Skeletal Biology: Postcranial Variation. Locomotion.	
Mississippi			JHE Editorial Board Dinner 5:30-8:00 pm
Arkansas			Primate Biology/Behavior Interest Group Meeting, 7:00 – 8:00pm
Ohio			AAAG Business Meeting, 7:00 – 8:00 pm
Parlor C			DAA Business Meeting, 7:00 – 8:00m
Parlor G	Press/Job Interview	Press/Job Interview	Biocultural Interests group 7:00-8:00pm
Parlor A	Speaker Ready / Computer Room	Speaker Ready / Computer Room	ADA Business Meeting, 7:00 – 8:00 pm

The Conference at a Glance (Saturday)

Room	Saturday am	Saturday pm	Saturday evening
Chicago Promenade			AAPA Student Awards Reception, 6:00-7:30 pm
Parlor C	Teaching Outreach program: fossils, bones & primates: enriching high school teaching. 8:00 am-12:00 pm.		
Parlor G	Press/Job Interview	Career development 12-2. Press/Job Interview 2-5	
Parlor A	Speaker Ready / Computer Room 1-4	Student Awards Com Meeting 5-6	
River Exhibition Hall B	Session 36. Primate feeding, dietary and behavioral ecology. Session 37. Non-human primate functional anatomy. Session 38. Functional skeletal biology and mechanical stress. Session 39. Forensic anthropology. Session 40. Postcranial variation. Functional skeletal biology of locomotion. Session 41. Genetic variation, population and phylogenetic studies. Session 42. Measuring human variation. The distribution of human diversity. Session 43. Paleoanthropology: Primate Evolution. Morphology and function in fossil and living human and non-human primates. Teaching efforts. Exhibitors	Session 36. Primate feeding, dietary and behavioral ecology. Session 37. Non-human primate functional anatomy. Session 38. Functional skeletal biology and mechanical stress. Session 39. Forensic anthropology. Session 40. Postcranial variation. Functional skeletal biology of locomotion. Session 41. Genetic variation, population and phylogenetic studies. Session 42. Measuring human variation. The distribution of human diversity. Session 43. Paleoanthropology: Primate Evolution. Morphology and function in fossil and living human and non-human primates. Exhibitors	
Chicago 8	Session 48. Hominin craniofacial morphology and neural evolution. Homo evolution.	Session 51. What makes us human? Views from the genome.	
Chicago 9	Session 49. Skeletal Biology: Craniometric and Nonmetric Variation.	Session 52. Early hominin evolution.	
Chicago 10	Session 50. Primatology. Primate feeding, dietary and behavioral ecology.	Session 55. Primate locomotion and ranging. Non-human comparative functional anatomy.	
Michigan A & B	Session 46. Human reproductive ecology. Session 47: Anthropological genetics: Human population studies.	Session 54. Bio-archaeology	
Superior A & B	Session 44. Dental anthropology. Session 45. Human Biology. Assessing and understanding maturational processes.	Session 53. Population biological variation and disease. Measuring body composition. The socio-cultural context of malnutrition.	

Conference Schedule.

For a schedule of individual AAPA poster and podium presentations, see page 19.

Tuesday March 31, 2009.

Paleopathology Association Functions

8:00am - 5:00pm Registration. Chicago Promenade East.
9:00am - 5:00pm Workshop and Podium Sessions. Chicago 8.
6:00pm - 10:00pm Association Reception, Dinner, Business Meeting. Chicago 9.

Paleoanthropology Association Functions

8:00am - 5:00pm Registration. Chicago promenade east.
9:00am - 5:00pm Podium/Poster Sessions. Chicago 10.

Human Biology Association Functions

5:00pm - 7:00pm Registration. Mississippi.
6:00pm - 10:00pm Executive Committee Dinner. Mississippi.

Human Biology **(Journal)**

6:00pm – 8:00pm Editorial Board Dinner. Ohio.

Wednesday April 1st, 2009. Morning sessions.

Paleopathology Association Functions

8:00am - 12:00pm Registration. Chicago Promenade East.
9:00am - 5:00pm Podium/Poster Sessions. Chicago 8. River Exhibition Hall B.
6:00pm - 7:00pm Student Awards Reception.

Paleoanthropology Association Functions

8:00am - 12:00pm Registration. Chicago Promenade East.
9:00am - 5:00pm Podium/Poster Sessions. Chicago 10. River Exhibition Hall B.

Human Biology Association Functions

7:30 am – 9 am AJHB Editorial Board breakfast. Missouri Room
1:00pm - 5:00pm Registration. Chicago Promenade East.
9:00am - 12:00pm Poster Session. River Exhibition Hall B.
12:30pm - 6:00pm Plenary/Podium Session. Chicago 9.
6:00pm - 9:00pm Reception. Mayfair room.

Wednesday April 1st, 2009. Morning sessions.

American Association of Physical Anthropologists Functions

9:00 am-5:00 pm. Registration. Convention Registration West.
8:00 am.-6:00 pm. Executive Committee Meeting. Illinois Boardroom.
12:00pm-2:00 pm. American Journal of Physical Anthropology Editorial Board Luncheon. Missouri.
7:30pm - 10:00pm Exhibitors. River Exhibition Hall B.
8:00-pm-11:00 pm. Reception and Cash Bar. Chicago 8-10.

Thursday April 2nd, 2009. Morning sessions.

Human Biology Association Functions

8:00am - 12:00pm Registration. Michigan A & B
8:30am - 5:00pm Podium Sessions. Michigan A & B
12:00pm - 1:30pm Luncheon.
5:00pm - 6:00pm Business Meeting. Michigan A & B
7:00pm - 9:30pm Student Reception. Mayfair.

Thursday April 2nd, 2009. Morning sessions.

American Association of Physical Anthropologists Functions

8:00 am-5:00 pm	Registration. Convention Registration West.
8:00 am-5:00 pm	Exhibitors. River Exhibition Hall B.
8:00 am-6:30 pm.	Session 1. Skeletal Biology: Approaches to Population History. Contributed posters (1-27). River Exhibition Hall B.
8:00 am-6:30 pm.	Session 2. Skeletal Biology of Hunter-Gatherers. Invited poster symposium. (28-35). River Exhibition Hall B.
8:00 am-6:30 pm	Session 3. The Coming of Age of Age Estimation. Invited poster symposium. (36-55). River Exhibition Hall B.
8:00 am-6:30 pm	Session 4. Skeletal Biology: dental anthropology. Contributed Posters. (56-79). River Exhibition Hall B.
8:00 am-6:30 pm	Session 5. Reconstructing Health and Disease in Europe: The Early Middle Ages through the Industrial Period. Invited poster symposium (80-93). River Exhibition Hall B.
8:00 am-6:30 pm	Session 6. Skeletal biology: isotopic studies. Contributed posters (94-105). River Exhibition Hall B.
8:00 am-6:30 pm	Session 7. Paleoanthropology: Hominin craniofacial morphology and neural evolution. Contributed posters (106-122). River Exhibition Hall B.
8:00 am-6:30 pm	Session 8. Primatology. Vocalization and communication. Growth and development. Non-human primate dental anthropology. Aggression, Morbidity, Mortality, and Stress. Contributed posters (123-198).
8:00 am.-12:00 pm	Session 9. Human Life History in Primate Perspective. Invited podium symposium. *Chicago 9.*
8:00 am.-12:00 pm	Session 10. Bones, Genetics, and Behavior: Physical Anthropology at the Caribbean Primate Research Center. Invited podium symposium.
8:00 am.-12:00 pm	Session 11. Quantitative genetic approaches to human phenotypic evolution. Invited podium symposium. *Chicago 8.*
8:00 am.-12:00 pm	Session 12. Human Biology. Assessing and understanding maturational processes. Demography. Contributed papers. *Chicago 10.*

Thursday April 2nd, 2009. Afternoon sessions.

1:00 pm-5:00 pm.	Session 13. Primatology. Non-human primate dental anthropology and functional anatomy. Contributed papers. Chicago 10.
1:00 pm-5:00 pm.	Session 14. Human Natures and Human Cultures: Integrating Evolutionary Perspectives and Biocultural Approaches. Wiley-Liss Invited podium symposium. Chicago 9.

Thursday April 2nd, 2009. Afternoon sessions.

1:00 pm-5:00 pm.	Session 15. Skeletal Biology: Bone remodeling. Isotopic Analysis of Diet and Paleopathology. Contributed Papers. Superior Room A & B.
1:00 pm-5:00 pm.	Session 16. Paleoanthropology. Late Homo evolution. Contributed papers. Chicago 8.
6:15 pm-7:45 pm	Plenary session: Adventures, misadventures, and ethical issues in field work: what physical anthropologists get themselves into, and what students think about it. Chicago 8-10.
8:00 pm-10:00 pm	AAPA Auction. Chicago 8-10.
8:00 pm-10:00 pm	Wiley-Liss reception. Chicago promenade.

Friday April 3rd, 2009. Morning sessions.

Human Biology Association Functions

8:00 am-10:15 pm. Detecting Natural Selection in Humans. Invited podium symposium. Co-sponsored by the Human Biology Association and the AAPA. Chicago 9.

American Association of Physical Anthropologists Functions

8:00 am-5:00 pm	Registration. Convention Registration West.
8:00 am-5:00 pm	Exhibitors. River Exhibition Hall B.
8:00 am-6:30 pm.	Session 17. The Weight of the Matter: Body Mass Estimation Reconsidered. Invited poster symposium. (1-10). River Exhibition Hall B.
8:00 am-6:30 pm.	Session 18. Human Biology. Population biological variation. The cultural context of disease and violence (11-33). River Exhibition Hall B.
8:00 am-6:30 pm.	Session 19. Skeletal Biology: Paleopathology and Bioarchaeology. Contributed posters (34-82). River Exhibition Hall B.
8:00 am-6:30 pm.	Session 20. Paleoanthropology. Hominin Evolution. Contributed Posters (83-113). River Exhibition Hall B.
8:00 am-6:30 pm.	Session 21. Paleoanthropology: The non-hominin Primate Fossil Record. Contributed Posters (114-133). River Exhibition Hall B.
8:00 am-6:30 pm.	Session 22. Primatology: Mammal and primate functional and comparative anatomy. Primate Locomotion and Ranging. Contributed Posters (134-200). River Exhibition Hall B.
8:00 am-12:00 pm.	Session 23. Primatology. Communities, growing up, reproduction, life history and ecology. Contributed papers. Chicago 8.
8:00 am-10:15 pm.	Session 24. Detecting Natural Selection in Humans. Invited podium symposium. Co-sponsored by the Human Biology Association. Chicago 9.
10:15 am-12:00 pm.	Session 25. Human Biology. Human population variation and disease. Contributed papers. Chicago 9.
8:00 am-12:00 pm.	Session 26. Paleoanthropology. Hominin evolution. Contributed papers. Chicago 10.

Friday April 3rd, 2009. Morning sessions.

8:00 am-12:00 pm. Session 27. Skeletal biology. Paleopathology. Trauma, interpersonal violence and warfare. Contributed papers. Michigan A & B.

8:00 am-12:00 pm. Session 28. Primatology. Primate brain, cognition, growth, learning, and reproductive biology. Contributed papers. Superior A & B.

12:00 pm-2:00 pm AAPA Luncheon: John van Wyhe, Ph.D. Director, The Complete Work of Charles Darwin Online. University of Cambridge. "Mind the Gap: Charles Darwin's True Story". Chicago 7.

Friday April 3rd, 2009. Afternoon sessions.

1:00 pm-3:15 pm Session 29. Ecology and Evolutionary Biology of Primate Lactation: Recent advances and future directions. Invited podium symposium. Chicago 8.

3:30 pm-5:00 pm. Session 30. Anthropological genetics. The genetics of craniodental variation and evolution. Contributed Papers.
Chicago 8.

1:00 pm-4:00 pm. Session 31. Infant Carrying in Human Evolution. Invited podium symposium. Chicago 9.

4:00 pm-5:00 pm Session 32. Chimpanzee behavior. Contributed papers.
Chicago 9.

1:00 pm-5:00 pm. Session 33. Standing at the Crossroads: The Genetics of Morphology. Symposium co-sponsored by the American Association of Anthropological Genetics (AAAG). Invited podium symposium. Michigan A & B.

1:00 pm-5:00 pm. Session 34. Anthropological genetics: Genetic variation, population and phylogenetic studies in non-human primates. Evolutionary and phylogenetic studies in humans. Contributed papers. Chicago 10.

1:00 pm-5:00 pm. Session 35. Skeletal Biology: Postcranial Variation. Functional skeletal biology of locomotion. Contributed papers. Superior A & B.

Friday April 3rd, 2009. Evening functions

American Association of Anthropological Genetics Functions
7:00-8:00 pm Business meeting. Ohio.

Dental Anthropology Association Functions
7:00-8:00 pm Business meeting. Parlor C.

Biocultural Interests Group Functions
7:00-8:00 pm Business meeting. Parlor G.

American Dermatoglyphics Association Functions
7:00-8:00 pm Business meeting. Parlor A.

Primate Biology and Behavior Interests group Functions
7:00-8:00 pm Business meeting. Arkansas.

JHE Editorial Board Dinner.
5:30-8:00 pm. Mississippi.

AAPA business meeting
8:00-11:00 pm. Chicago 10.

Saturday April 4th 2009. Morning sessions.

American Association of Physical Anthropologists Functions

8:00 am-5:00 pm	Registration. Convention Registration West.
8:00 am-5:00 pm	Exhibitors. River Exhibition Hall B.
8:00 am.-12:00 pm	Teaching outreach Program. Fossils, Bones & Primates: Enriching High School Teaching. Parlor C.
8:00 am-6:30 pm.	Session 36. Primatology. Primate feeding, dietary and behavioral Ecology. Contributed posters. (1-34). River Exhibition Hall B.
8:00 am-6:30 pm.	Session 37. Primatology. Non-human comparative functional anatomy. Contributed Posters. (35-57).
8:00 am-6:30 pm.	Session 38. Skeletal Biology: functional skeletal biology and mechanical stress. Contributed posters. (58-86). River Exhibition Hall B.
8:00 am-6:30 pm	Session 39. Skeletal Biology: Forensic Anthropology. Contributed posters (87-116). River Exhibition Hall B.
8:00 am-6:30 pm.	Session 40. Skeletal Biology: Postcranial Variation. Functional skeletal biology of locomotion. Contributed posters (117-128). River Exhibition Hall B.
8:00 am-6:30 pm.	Session 41. Anthropological genetics: Genetic variation, population and phylogenetic studies in human and non-human primates. Contributed posters (129-150). River Exhibition Hall B.
8:00 am-6:30 pm.	Session 42. Human Biology: Measuring human variation. The distribution of human diversity. The influence of humans on other species' genomes. Contributed posters (151-165). River Exhibition Hall B.
8:00 am-6:30 pm.	Session 43. Paleoanthropology: Primate Evolution. Morphology and function in fossil and living human and non-human primates. Contributed posters. (166-183). River Exhibition Hall B.
8:00 am-10:15 pm.	Session 44. Skeletal Biology: dental anthropology. Contributed Papers. Superior A & B.
10:30 am-12:00 pm.	Session 45. Human Biology. Assessing and understanding maturational processes. Contributed papers. Superior A & B.
8:00 am-10:15 pm.	Session 46. Human biology. Human reproductive ecology. Contributed papers. Michigan A & B.
10:30 am-12:00 pm.	Session 47: Anthropological genetics: Human population studies. Contributed papers. Michigan A & B.
8:00 am-12:00 pm.	Session 48. Paleoanthropology: Hominin craniofacial morphology and neural evolution. Homo evolution. Contributed Papers. Chicago 8.
8:00 am-12:00 pm	Session 49. Skeletal Biology: Craniometric and Nonmetric Variation. Postcranial variation. Contributed Papers. Chicago 9.
8:00 am-12:00 pm	Session 50. Primatology. Primate feeding, dietary and behavioral Ecology, and evolution. Contributed papers. Chicago 10.

Saturday April 4th 2009. Afternoon sessions.

American Association of Physical Anthropologists Functions

12:00pm-2:00 pm.	Career Development Program. Parlor C
1:00 pm-5:00 pm.	Session 51. What makes us human? Views from the genome. Invited podium symposium. Chicago 8.
1:00 pm-5:00 pm.	Session 52. Paleoanthropology. Early hominin evolution. Contributed papers. Chicago 9.
1:00 pm-5:00 pm.	Session 53. Human Biology. Population biological variation and disease. Measuring body composition. The socio-cultural context of under and overnutrition. Contributed papers. Superior A & B.
1:00 pm-5:00 pm.	Session 54. Skeletal Biology: Bio-archaeology. Contributed papers. Michigan A & B.
1:00 pm-5:00 pm	Session 55. Primatology. Primate locomotion and ranging. Non-human comparative functional anatomy. Contributed papers. Chicago 10.
6:00 pm-7:30 pm.	Student Awards Reception. Chicago Promenade 6-7:30 pm.

AAPA Poster and Podium Presentation Schedule. For a schedule of all conference events, see page 13.

Thursday April 2nd, 2009. Morning sessions.

Session 1. Skeletal Biology: Approaches to Population History. Contributed posters. *River Exhibition Hall B.*

Chair: Brian E. Hemphill California State University, Bakersfield

8:00-8:30 am: Poster set-up

6:00-6:30 pm: Poster take-down

10:00-10:30 am and 2:00-2:30 pm: Author of even number posters present for discussion

10:30-11:00 am. and 2:30-3:00 pm: Author of odd number posters present for discussion

1. **Paleoamericans in a Late Pleistocene context: assessing morphological affinities.** M. HUBBE, K. HARVATI, W. A. NEVES.
2. **Preliminary craniometrical results on Canadian Amerindian inter-regional variation**. RIBOT I., LETTRE J.
3. **Relatedness and temporal variability in Woodland period cemeteries in the Lower Illinois Valley.** JASON L. KING.
4. **Identifying the descendents of the Chaco Anasazi.** M.A. SCHILLACI, W.J. BUSTARD, D. VLAK.
5. **An Inter and Intra-Cemetery Craniometric Assessment of Biological Distance and Social Organization of the Middle Woodland Ray and Gibson Sites.** CHAD A. WILLIS AND JANE E. BUIKSTRA.
6. **Cranial variability in 19th century Tucson.** M.K. SPRADLEY, J.T. HEFNER, N.P. HERRMANN.
7. **Continuity and transformation during the terminal Middle Horizon (AD 950 – 1150): a bioarchaeological assessment of Tumilaca origins within the Moquegua Valley, Peru.** R.C. SUTTER, N. SHARRATT
8. **Origins of enslaved labor force from 18th century colonial Albany inferred from mtDNA: Africans, Native Americans, and Madagascarians?** E.J. LEE, L.M. ANDERSON, V. DALE, D.A. MERRIWETHER.
9. **Biological variation resulting from Inka imperialism.** J.D. BETHARD.
10. **Craniometric divergence of Japanese inhabitants due to gene flows from Prehistoric Northeast Asians.** H. ISHIDA, T. HANIHARA, O. KONDO.
11. **The Swatis of northern Pakistan—Emigrants from Central Asia or colonists from peninsular India?: a dental morphometric investigation.** B.E. HEMPHILL.
12. **Considerations for the Population History of the Wakhan Corridor: An Odontometric Investigation of Wakhi Biological Affinity and Diachronic Analysis of Biological Interaction Between Northern Pakistan and South Asia.** P.W. O'NEILL AND B.E. HEMPHILL.
13. **The people of the Xiongnu culture (3_{rd} century B.C. to 2_{nd} century A.D.): Insights into the biological diversity of the earliest Eurasian nomadic steppe empire.** R.W. SCHMIDT, B. CHRISTY, A. BURCH, A.R. NELSON, N. SEGUCHI
14. **Rome if you want to: immigrants in the Empire.** K. KILLGROVE.
15. **Mandibular torus in the Greenlandic Norse**. M. SNECK, G.R. SCOTT, K.L. LEEPER.
16. **Recognizing population displacements and replacements in prehistory: A view from North Africa.** C.M. STOJANOWSKI.
17. **The working class at Hierakonpolis. Nubian or Egyptian?.** K. GODDE.
18. **Craniofacial evolution in Polynesia: A geometric morphometric study of population diversity.** T.J. BUCK, U. STRAND VIÐARSDÓTTIR
19. **A life in the cane fields: osteological patterns of life time activity among enslaved Africans from Newton Plantation, Barbados.** K.A. SHULER, R.S. CORRUCCINI.
20. **Inferring the health and status from two bioarchaeological populations recovered from Bridgetown, Barbados.** C. CRAIN, K. FARMER.
21. **Bone Health in African Americans from Enslavement through Reconstruction** WEDEL V.

Thursday April 2nd, 2009. Morning sessions.

22. **Arthritic lipping of limb bone joint surface areas among 19th century Midwestern workers.** M.L. WEBB AND F.L. WILLIAMS

23. **The life in lines – Chronology of stress markers in the enamel microstructure and the possible association of pathological changes in bone in a child from the late Neolithic in Syria.** CARSTEN WITZEL, STEFAN FLOHR AND JÖRG A. BECKER.

24. **The state of health of Roman Republic to Imperial Roman period burials from the necropolis of Aquinum, Italy**. R.R. PAINE, R. VARGIU, G.R. BELLINI, D. MANCINELLI, P. SANTORO, A. COPPA.

25. **Lethal neural tube defects from the Dakhleh Oasis, Egypt: an analysis of three cases.** S.L. MATHEWS, D.J. COPE, S.M. WHEELER AND T.L. DUPRAS.

26. **Osteochondrodysplasias in prehistory: new evidence from the V-VIth dynasty at Giza, Egypt.** C.F. HORTON, G.D. RICHARDS.

27. **Health and lifestyle of ancient pastoralists from Mongolia.** J.J. BEACH, M.L. MACHICEK, A.R. NELSON.

Session 2. Skeletal Biology of Hunter-Gatherers. Invited poster symposium. *River Exhibition Hall B.*

Organizers M. Anne Katzenberg and Kathleen Faccia. Discussant: Jerome Cybulski.
8:00-8:30 am: Poster set-up
6:00-6:30 pm: Poster take-down
10:00-10:30 am. and 2:00-2:30 pm: Authors present for discussion
2:30-3:00 pm: discussion with all presenters and organizers.
Traditionally hunter-gatherers have been thought of as small-scale societies who did not produce large cemeteries. However, more recent research on the diversity of hunter-gatherer groups and their interactions with the landscape reveals numerous examples of hunter-gatherer cemeteries with sample sizes that are sufficient to provide insights into past biological adaptations. This symposium brings together researchers who have studied skeletal remains of earlier hunter-gatherers from many parts of the world, addressing such research questions as diet and subsistence, health, biomechanical adaptations and mobility.

28. **Regional patterns among Holocene hunter-gatherers of southern Africa.** SUSAN PFEIFFER AND JUDITH SEALY

29. **Ecogeographic variation in the ontogeny of hunter-gatherer physique and skeletal robusticity.** JAY STOCK

30. **Ecomorphology and adaptation among foragers from Hokkaido Island, Japan.** D.H. TEMPLE.

31. **Mechanical stress and activity among middle Holocene foragers of Siberia's Cis-Baikal region.** A.R. LIEVERSE,

32. **3D micro-CT analysis of age-related changes in prehistoric Lake Baikal hunter-gatherers.** K. FACCIA, H. BUIE.

33. **Infant feeding practices in Holocene Siberian hunter-gatherers: an intra-long bone analysis of stable nitrogen isotope ratios.** A. WATERS-RIST, V.I. BAZALIISKII, M.A. KATZENBERG.

34. **Hunter-fisher-gatherer dietary adaptations in Neolithic and Bronze Age Siberians.** M.A. KATZENBERG, H.G. MCKENZIE, A.W. WEBER AND O.I. GORIUNOVA.

35. **Ethnohistory, stable isotopes and high latitude hunter-gatherer diet.** D.R. YESNER, L.A. BORRERO.

Session 3. The Coming of Age of Age Estimation. Invited poster symposium. *River Exhibition Hall B.*

Organizers: Lyle W. Konigsberg and Susan R. Frankenberg.
8:00-8:30 am: Poster set-up
6:00-6:30 pm: Poster take-down
10:00-10:30 am. and 2:00-2:30 pm: Authors present for discussion
4:00-5:00 pm: All presenters gather for discussion.
Discussants:Jean-Pierre Bocquet-Appel, Centre National de la Recherche Scientifique Paris. Jutta Gampe, Max Planck Institute for Demographic Research Rostock, Germany. B. Holly Smith. University of Michigan Museum of Anthropology Ann Arbor, Michigan

Estimation of age from skeletal, dental, or soft tissue data forms an important component of several research areas within physical anthropology. Specifically, there are four contexts within which such estimations may be of use. First, the determination of skeletal or dental developmental age in living subadults serves as a basis for evaluating maturation against known chronological age. Second, estimates of age-at-death aid in forensic identifications. Third, estimates of age-at-death are a useful by-product of estimating the age-at-death structure for paleodemographic samples, and the age estimates serve as an important covariate in further bioarchaeological analyses. Finally, age-at-death is an important variable in examining the evolution of human and general primate life history from fossils. Because of these four different avenues of research there is a considerable amount of interest in problems of age estimation, but it is not always the case that methodological developments in one area influence developments in the other areas. This symposium brings together researchers from all four areas in the hopes of examining common research themes and exploring how recent developments from other areas can contribute to and expand their research.

36. **An estimated demographic profile of fisherman-foragers (Cabeçuda, Lagoa do Imaruí, Laguna, Santa Catarina, Brazil, 2670+- 300 calBP), using TCA technique for aging and paleodemographic estimators.** J. BLONDIAUX, J.-P. BOCQUET-APPEL, S.M.F. MENDONÇA DE SOUZA, S. NAJI

37. **The fertility/mortality discussion in paleodemography revisited**. J.L. BOLDSEN.

38. **Assessing age at death in adult dentitions: a new approach using three-dimensional microcomputed tomography and its application to fossil samples**. R. CASPARI, J.A. MEGANCK, J. RADOVČIĆ, D. BEGUN, T. KROLL, S.A. GOLDSTEIN.

39. **Age determination by magnetic resonance imaging of the knee: a preliminary study.** F. DEDOUIT, J. AURIOL, P. OTAL, J. BRAGA, D. ROUGE, H. ROUSSEAU, N. TELMON.

40. **The effect of adult age estimates on inferences about sex patterns of mortality.** S.N. DEWITTE.

41. **Analysis of interpopulation variation in fourth rib aging**. E.H. KIMMERLE, L.W. KONIGSBERG.

42. **Testing the normality assumption in transition analysis**. L.W. KONIGSBERG, S.R. FRANKENBERG.

43. **Extracting adult survivorship information from fossil samples: the uses and limitations of OY ratios.** S.-H. LEE, R. CASPARI.

44. **Dental eruption, age estimation, and life histories in papionin primates.** S.R. LEIGH, R.M. BERNSTEIN, L.W. KONIGSBERG

45. **Estimating age from developing teeth: a comparison of methods.** H.M. LIVERSIDGE, B.H. SMITH, M MABER.

46. **Exact determination of year-of-birth in unidentified corpses using the human eye lens**. N. LYNNERUP, H. KJELDSEN, S. HEEGAARD, C. JACOBSEN, J. HEINEMEIER.

47. **Epiphyseal union in the medial clavicle: evidence for secular change in skeletal maturation.** N.R. SHIRLEY, R.L. JANTZ.

48. **Three-dimensional laser scan models of pubic bones as an age estimation tool for adult males.** S.B. SHOLTS, S. WÄRMLÄNDER, P.L. WALKER.

49. **A comparison of estimated age-at-death distributions using bioarchaeological and forensic methods.** N. M. UHL, N. V. PASSALACQUA

50. **Reduced adult mortality and the expansion of the human bio-cultural niche in the Late Pleistocene.** A.P. VAN ARSDALE

51. **Calibrated Expert Inference and the construction of unbiased paleodemographic mortality profiles.** S. WEISE, J.L. BOLDSEN, J. GAMPE, G.R. MILNER

52. **[Inter]Facing age: a test of the ADBOU age estimation software in a forensic context.** R.J. WILSON, B.F.B. ALGEE-HEWITT.

53. **Modeling death in late prehistoric west-central Illinois.** J.J. WILSON

54. **Phase versus Component Systems in age-at-death estimation I: The methodology and usage of Component Systems.** NICHOLAS V. PASSALACQUA AND NATALIE M. UHL

55. **A new approach for age estimation by recruitment of the first metatarsal bone.** D. SCHAMALL, M. TESCHLER-NICOLA, C. LOEWE, F. KAINBERGER, M.L. PRETTERKLIEBER.

Session 4. Skeletal Biology: dental anthropology. Contributed Posters. *River Exhibition Hall B.*

Chair: Simon W. Hillson University College London

8:00-8:30 am:	Poster set-up
6:00-6:30 pm:	Poster take-down
10:00-10:30 am. and 2:00-2:30 pm:	Author of even number posters present for discussion
10:30-11:00 am. and 2:30-3:00 pm:	Author of odd number posters present for discussion

56. **Tooth development models predict Carabelli cusp variation: interaction effects and epigenetic mechanisms.** T.C. WESTON, D. GUATELLI-STEINBERG, J.P. HUNTER,T.K. BETSINGER.

57. **Shrinkage: an age old problem.** R.K. SCOPA KELSO, K. DRISCOLL, AND B.I. HULSEY.

58. **A radiographic comparison of root growth during eruption in modern human mandibular M2s.** K.K. CATLETT, H.M. LIVERSIDGE.,M.C. DEAN

59. **Near-eruption proportional root lengths of the mandibular canine and premolars** SMITH SL

Thursday April 2nd, 2009. Morning sessions.

60. **Dental attrition patterns in two late prehistoric skeletal collections from the Estremadura region of Portugal: comparisons and results.** A.J. WATERMAN AND B.C. HORWATH,

61. **Basques in an Indo-European sea: a perspective from tooth crown morphology.** SCOTT GR

62. **Dental aging using multiple tooth wear indicators in conjunction with antemortem tooth loss.** P. SELINSKY.

63. **Baby death and baby teeth: analysis of dental defects in the deciduous dentition from Tell Abraq (2300 B.C.)** J.L. THOMPSON, D.L. MARTIN, D.T. POTTS.

64. **The skeletal remains from Kamennyi Ambar 5, a Middle Bronze Age Sintashta site of early metallurgy. Part I: dental pathology.** M.E. KOVACIK, M. JUDD, B. HANKS, D. RAJEV, A. EPIMAKHOV

65. **Biological structure of the Early and Middle Holocene Gobero site burial complex, Niger, Western Sahara desert.** K.A. MILLER, C.M. STOJANOWSKI.

66. **Buccal dental microwear pattern as an indicator of dietary behaviour in a human Neolithic tooth sample from Abu Hureyra.** M. ALROUSAN, A. PEREZ-PEREZ, T. MOLLESON.
67. **Permanent-tooth emergence among the Gullah of St. James Island (Outer Banks, South Carolina).** J.E. SPENCE, DEBBIE GUATELLI-STEINBERG.

68. **Dental microwear texture analysis of the Amarna workers.** J.R. SCOTT, K.L. KRUEGER, B. KEMP, J.C. ROSE.

69. **Dental Health in Prehistoric Central California: Sex Differences in Two Windmiller Populations from the Sacramento Valley.** K.E. KOLPAN AND E.J. BARTELINK.

70. **Caries and dental abscess prevalence among Florida Archaic Hunter-gatherers from the burial sites of Gautier (8BR193), Bay West (8CR200), and Windover (8BR246).** C.E. HERRICK, H.A. WALSH-HANEY, D. KLIENFELDER, K.L. SHEPHERD, L.E. GIBSON

71. **Evidence for subsistence strategy differences in pre-contact Ipiutak and Tigara of Point Hope, Alaska**. F.C. MADIMENOS.

72. **Anthropological study of dental metric and non-metric traits in 5 Chinese minorities in Yunnan Province**. KANAZAWA.

73. **Tooth use in Aboriginal Australia.** A. CLEMENT, S. HILLSON, I. DE LA TORRE, G. TOWNSEND.
74. **Diet, culture change, dental disease and tooth wear in prehistoric southern Peru**. S. HILLSON, M. KOLP-GODOY ALLENDE, S. GUILLEN.
75. **Dental Morphological Traits in Pre-Incaic Populations of the Andes: Interpreting the Biocultural Evolution in the Osmore Valley.** C. ARGANINI, A. CUCINA, G.F. DE STEFANO, A. COPPA.
76. **Preliminary analyses of dental health in Middle Horizon (AD 500-1000) San Pedro de Atacama, northern Chile.** B.M. DAVERMAN, L.M. KING, AND C. TORRES-ROUFF.

77. **Meat, bread, scratches and pits: Analysis of dental microwear on Byzantine monastic dentition from Jerusalem.** KATHRYN KEEGAN, SUSAN GUISE SHERIDAN, PH.D., JAIME ULLINGER, MA.

78. **In vivo turnover rates in human buccal dental-microwear.** A. ROMERO, J. GALBANY, N. MARTINEZ-RUIZ, J. DE JUAN.

79. **Development of M1 enamel thickness.** P. MAHONEY.

Session 5. Reconstructing Health and Disease in Europe: The Early Middle Ages through the Industrial Period. Invited poster symposium. Dedicated to the memory of Phillip L. Walker: great friend, terific scholar, and important contributor to the project.

River Exhibition Hall B.

Organizers: Richard H. Steckel, Clark Spencer Larsen, Charlotte Roberts and Phillip L. Walker**.**

8:00-8:30 am: Poster set-up

6:00-6:30 pm: Poster take-down

10:00-10:30 am. and 2:00-2:30 pm: Authors present for discussion

Over the past eight years a collaborative team of over 40 researchers has been working to update and extend to Europe methods of health reconstruction used in the History of Health in the Western Hemisphere project (*The Backbone of History*, Cambridge University Press, 2002). After defining a data collection protocol (http://global.sbs.ohio-state.edu) and preparing laptop-based software, the team has been coding data from previously studied skeletal collections from sites across Europe and the Mediterranean region. This symposium presents the results of analysis of health and lifestyle indicators based on approximately 15,000 individuals from the early Middle Ages through the nineteenth century.

80. **The European Project: Introduction to Goals, Materials and Methods**. Richard Steckel, Clark Larsen, Phillip Walker, Charlotte Roberts.

81. **Contextual dimensions of European health and lifestyle: the archaeological and historical record.** R. JANKAUSKAS , C. ROBERTS , R.H. STECKEL , C.S. LARSEN , P.L. WALKER , J. BLONDIAUX , G. GRUPE , G. MAAT , G. MCGLYNN , A. PAPATHANASIOU , M. TESCHLER-NICOLA , U. WITTWER-BACKOFEN , A. AGNEW , S. ASSIS , Z. BERECZKI , B. BERTRAND , T.K. BETSINGER , M. BINDER , S. BOULTER , C. BOURBOU , A. BOYLSTON , M. BRICKLEY , L. BÜRLI , C. COOPER , A. COPPA , J. COUGHLAN , A. DROZD , E. DURING , C. ELIOPOULOS , J. ENG , F. ENGEL , S. FOX , M. FURTADO , G. GERHARDS , S. GROVES , K. HARKINS , P. HOLCK , M. HOLST , G. HOTZ , R. IVES , T. JAKOB , J. JENNINGS , H. JUSTUS , K. KAMINSKA , A. KJELLSTRÖM , C. J. KNÜSEL , T. KOZLOWSKI , A. LAGIA , C. LOPES , S. MANOLIS , A. MARCSIK , C. MARQUES , C. MOENKE , C. NIEL[7], S.A. NOVAK , F. NOVOTNY , J. PECK , I. POTIEKHINA , B. REGA , R. RICHMAN , F. RIJPMA , J. ROSE , J. RUIZ , P. SANNEN , P. SCIULLI , M. SMITH, A. SOFICARU , M. SPANNAGL , R. STORM , G. STROUD , E. SUBIRÀ , D. SWALES , V. TRISTAROLI , E. TYLER , S. ULRICH-BOCHSLER , S. VATTEONI , V. VILLAR , R. WIGGINS , L.L. WILLIAMS .

82. **Summary Measurement of Health and Wellbeing: The Health Index.** R.H. STECKEL , A. KJELLSTRÖM , J. ROSE , C.S. LARSEN , P.L. WALKER , J. BLONDIAUX , G. GRUPE , R. JANKAUSKAS , G. MAAT , G. MCGLYNN , A. PAPATHANASIOU , C. ROBERTS , M. TESCHLER-NICOLA , U. WITTWER-BACKOFEN , A. AGNEW , S. ASSIS , Z. BERECZKI , B. BERTRAND , T.K. BETSINGER , M. BINDER , S. BOULTER , C. BOURBOU , A. BOYLSTON , M. BRICKLEY , L. BÜRLI , C. COOPER , A. COPPA , J. COUGHLAN , A. DROZD , E. DURING , C. ELIOPOULOS , J. ENG , F. ENGEL , S. FOX , M. FURTADO , G. GUNTIS , S. GROVES , K. HARKINS , P. HOLCK , M. HOLST ,G. HOTZ , R. IVES , T. JAKOB , J. JENNINGS , H. JUSTUS , K. KAMINSKA , C. J. KNÜSEL , T. KOZLOWSKI , A. LAGIA , C. LOPES , S. MANOLIS , A. MARCSIK , C. MARQUES , C. MOENKE , C. NIEL , S.A. NOVAK , F. NOVOTNY , J. PECK , I. POTIEKHINA , B. REGA , R. RICHMAN , F. RIJPMA , J. RUIZ , P. SANNEN , P. SCIULLI , M. SMITH , A. SOFICARU , M. SPANNAGL , R. STORM , G. STROUD , E. SUBIRÀ , D. SWALES , V. TRISTAROLI , E. TYLER , S. ULRICH-BOCHSLER , S. VATTEONI , V. VILLAR , R. WIGGINS , L.L. WILLIAMS .

83. **The history of European oral health: evidence from dental caries, dental abscesses. antemortem tooth loss**. U. WITTWER-BACKOFEN , A. COPPA, C.S. LARSEN , R.H. STECKEL , P.L. WALKER , J. BLONDIAUX , G. GRUPE , R. JANKAUSKAS , G. MAAT , G. MCGLYNN , A. PAPATHANASIOU , C. ROBERTS , M. TESCHLER-NICOLA , A. AGNEW , S. ASSIS , Z. BERECZKI , B. BERTRAND , T.K. BETSINGER , M. BINDER , S. BOULTER , C. BOURBOU , A. BOYLSTON , M. BRICKLEY , L. BÜRLI , C. COOPER , J. COUGHLAN , A. DROZD , E. DURING , C. ELIOPOULOS , J. ENG , F. ENGEL , S. FOX , M. FURTADO , G. GUNTIS , S. GROVES , K. HARKINS , P. HOLCK , M. HOLST , G. HOTZ , R. IVES , T. JAKOB , J. JENNINGS , H. JUSTUS , K. KAMINSKA , A. KJELLSTRÖM , C. J. KNÜSEL , T. KOZLOWSKI , A. LAGIA , C. LOPES , S. MANOLIS , A. MARCSIK , C. MARQUES , C. MOENKE , C. NIEL , S.A. NOVAK , F. NOVOTNY , J. PECK , I. POTIEKHINA , B. REGA , R. RICHMAN , F. RIJPMA , J. ROSE , J. RUIZ , P. SANNEN , P. SCIULLI , M. SMITH, A. SOFICARU , M. SPANNAGL , R. STORM , G. STROUD , E. SUBIRÀ , D. SWALES , V. TRISTAROLI , E. TYLER , S. ULRICH-BOCHSLER , S. VATTEONI , V. VILLAR , R. WIGGINS , L.L. WILLIAMS .

84. **The history of European infectious diseases: skeletal evidence of tuberculosis, leprosy, and treponematosis**. C. ROBERTS , T. BETSINGER , R.H. STECKEL , C.S. LARSEN , P.L. WALKER , J. BLONDIAUX , G. GRUPE , G. MAAT , G. MCGLYNN , A. PAPATHANASIOU , M. TESCHLER-NICOLA , U. WITTWER-BACKOFEN , A. AGNEW , S. ASSIS , Z. BERECZKI , B. BERTRAND , T.K. BETSINGER , M. BINDER , S. BOULTER , C. BOURBOU , A. BOYLSTON , M. BRICKLEY , L. BÜRLI , C. COOPER , A. COPPA , J. COUGHLAN , A. DROZD , E. DURING , C. ELIOPOULOS , J. ENG , F. ENGEL , S. FOX , M. FURTADO , G. GERHARDS , S. GROVES , K. HARKINS , P. HOLCK , M. HOLST , G. HOTZ , R. IVES , T. JAKOB , R. JANKAUSKAS , J. JENNINGS , H. JUSTUS , K. KAMINSKA , A. KJELLSTRÖM , C. J. KNÜSEL , T. KOZLOWSKI , A. LAGIA , C. LOPES , S. MANOLIS , A. MARCSIK , C. MARQUES , C. MOENKE , C. NIEL , S.A. NOVAK , F. NOVOTNY , J. PECK , I. POTIEKHINA , B. REGA , R. RICHMAN , F. RIJPMA , J. ROSE , J. RUIZ , P. SANNEN , P. SCIULLI , M. SMITH , A. SOFICARU , M. SPANNAGL , R. STORM , G. STROUD , E. SUBIRÀ , D. SWALES , V. TRISTAROLI , E. TYLER , S. ULRICH-BOCHSLER , S. VATTEONI , V. VILLAR , R. WIGGINS , L.L. WILLIAMS .

85. **Socio-culturally mediated disease: rickets and scurvy.** M. BRICKLEY , T. KOZLOWSKI , R.H. STECKEL , C.S. LARSEN , P.L. WALKER , J. BLONDIAUX , G. GRUPE , R. JANKAUSKAS , G. MAAT , G. MCGLYNN , A. PAPATHANASIOU , C. ROBERTS , M. TESCHLER-NICOLA , U. WITTWER-BACKOFEN , A. AGNEW , S. ASSIS , Z. BERECZKI , B. BERTRAND , T.K. BETSINGER , M. BINDER , S. BOULTER , C. BOURBOU , A. BOYLSTON , L. BÜRLI , C. COOPER , A. COPPA , J. COUGHLAN , A. DROZD , E. DURING , C. ELIOPOULOS , J. ENG , F. ENGEL , S. FOX , M. FURTADO , G. GUNTIS , S. GROVES , K. HARKINS , P. HOLCK , M. HOLST , G. HOTZ , R. IVES , T. JAKOB , J. JENNINGS , H. JUSTUS , K. KAMINSKA , A. KJELLSTRÖM , C. J. KNÜSEL , A. LAGIA , C. LOPES , S. MANOLIS , A. MARCSIK , C. MARQUES , C. MOENKE , C. NIEL[7], S.A. NOVAK , F. NOVOTNY , J. PECK , I. POTIEKHINA , B. REGA , R. RICHMAN , F. RIJPMA , J. ROSE , J. RUIZ , P. SANNEN , P. SCIULLI , M. SMITH , A. SOFICARU , M. SPANNAGL , R. STORM , G. STROUD , E. SUBIRÀ , D. SWALES , V. TRISTAROLI , E. TYLER , S. ULRICH-BOCHSLER , S. VATTEONI , V. VILLAR , R. WIGGINS , L.L. WILLIAMS .

86. **The history of growth disruption in European children: evidence from hypoplastic teeth**. M. TESCHLER-NICOLA , A. MARCSIK , R.H. STECKEL , C.S. LARSEN , P.L. WALKER , J. BLONDIAUX , G. GRUPE , R. JANKAUSKAS , G. MAAT , G. MCGLYNN , A. PAPATHANASIOU , C. ROBERTS , U. WITTWER-BACKOFEN, A. AGNEW , S. ASSIS , Z. BERECZKI , B. BERTRAND , T.K. BETSINGER , S. BOULTER , C. BOURBOU , A. BOYLSTON , M. BRICKLEY , L. BÜRLI , C. COOPER , A. COPPA , J. COUGHLAN , A. DROZD , E. DURING , C. ELIOPOULOS , J. ENG , F. ENGEL , S. FOX , M. FURTADO , G. GUNTIS , S. GROVES , K. HARKINS , P. HOLCK , M. HOLST , G. HOTZ , R. IVES , T. JAKOB, J. JENNINGS , H. JUSTUS , K. KAMINSKA , A. KJELLSTRÖM , C. J. KNÜSEL , T. KOZLOWSKI , A. LAGIA , C. LOPES , S. MANOLIS , C. MARQUES , C. MOENKE , C. NIEL , S.A. NOVAK , F. NOVOTNY , J. PECK , I. POTIEKHINA , B. REGA , R. RICHMAN , F. RIJPMA , J. ROSE , J. RUIZ , P. SANNEN , P. SCIULLI , M. SMITH , A. SOFICARU , M. SPANNAGL , R. STORM , G. STROUD , E. SUBIRÀ , D. SWALES , V. TRISTAROLI , E. TYLER , S. ULRICH-BOCHSLER , S. VATTEONI , V. VILLAR , R. WIGGINS , L.L. WILLIAMS .

Thursday April 2nd, 2009. Morning sessions.

87. **The history of anemia and related nutritional deficiencies in Europe: evidence from cribra orbitalia and porotic hyperostosis.** A. PAPATHANASIOU , P.L. WALKER , R.H. STECKEL , C.S. LARSEN , J. BLONDIAUX , G. GRUPE , R. JANKAUSKAS , G. MAAT , G. MCGLYNN , C. ROBERTS , M. TESCHLER-NICOLA , U. WITTWER-BACKOFEN , A. AGNEW , S. ASSIS , Z. BERECZKI , B. BERTRAND , T.K. BETSINGER , M. BINDER , S. BOULTER , C. BOURBOU , A. BOYLSTON , M. BRICKLEY , L. BÜRLI , C. COOPER , A. COPPA , J. COUGHLAN , A. DROZD , E. DURING , C. ELIOPOULOS , J. ENG , F. ENGEL , S. FOX , M. FURTADO , G. GUNTIS , S. GROVES , K. HARKINS , P. HOLCK , M. HOLST , G. HOTZ , R. IVES , T. JAKOB , J. JENNINGS , H. JUSTUS , K. KAMINSKA , A. KJELLSTRÖM , C. J. KNÜSEL , T. KOZLOWSKI , A. LAGIA , C. LOPES , S. MANOLIS , A. MARCSIK , C. MARQUES , C. MOENKE , C. NIEL , S.A. NOVAK , F. NOVOTNY , J. PECK , I. POTIEKHINA , B. REGA , R. RICHMAN , F. RIJPMA , J. ROSE , J. RUIZ , P. SANNEN , P. SCIULLI , M. SMITH, A. SOFICARU , M. SPANNAGL , R. STORM , G. STROUD , E. SUBIRÀ , D. SWALES , V. TRITSAROLI , E. TYLER , S. ULRICH-BOCHSLER , S. VATTEONI , V. VILLAR , R. WIGGINS , L.L. WILLIAMS .

88. **Body size and activity inference: femur length and midshaft index.** G. MAAT , R.H. STECKEL , C.S. LARSEN , P.L. WALKER , J. BLONDIAUX , G. GRUPE , R. JANKAUSKAS , G. MCGLYNN , A. PAPATHANASIOU , C. ROBERTS , M. TESCHLER-NICOLA , U. WITTWER-BACKOFEN , A. AGNEW , S. ASSIS , Z. BERECZKI , B. BERTRAND , T.K. BETSINGER , M. BINDER , S. BOULTER , C. BOURBOU , A. BOYLSTON , M. BRICKLEY , L. BÜRLI , C. COOPER , A. COPPA , J. COUGHLAN , A. DROZD , E. DURING , C. ELIOPOULOS , J. ENG , F. ENGEL , S. FOX , M. FURTADO , G. GUNTIS , S. GROVES , K. HARKINS , P. HOLCK , M. HOLST , G. HOTZ , R. IVES , T. JAKOB , J. JENNINGS , H. JUSTUS , K. KAMINSKA , A. KJELLSTRÖM , C. J. KNÜSEL , T. KOZLOWSKI , A. LAGIA , C. LOPES , S. MANOLIS , A. MARCSIK , C. MARQUES , C. MOENKE , C. NIEL , S.A. NOVAK , F. NOVOTNY , J. PECK , I. POTIEKHINA , B. REGA , R. RICHMAN , F. RIJPMA , J. ROSE , J. RUIZ , P. SANNEN , P. SCIULLI , M. SMITH , A. SOFICARU , M. SPANNAGL , R. STORM , G. STROUD , E. SUBIRÀ , D. SWALES , V. TRISTAROLI , E. TYLER , S. ULRICH-BOCHSLER , S. VATTEONI , V. VILLAR , R. WIGGINS , L.L. WILLIAMS .

89. **History of degenerative joint disease in Europe: inferences about lifestyle and activity.** C.S. LARSEN , P.L. WALKER , R.H. STECKEL , P. SCIULLI , H.D. KLAUS , J. BLONDIAUX , G. GRUPE , R. JANKAUSKAS , G. MAAT[7], G. MCGLYNN , A. PAPATHANASIOU , C. ROBERTS , M. TESCHLER-NICOLA , U. WITTWER-BACKOFEN , A. AGNEW , S. ASSIS , Z. BERECZKI , B. BERTRAND , T.K. BETSINGER , M. BINDER , S. BOULTER , C. BOURBOU , A. BOYLSTON , M. BRICKLEY , L. BÜRLI , C. COOPER , A. COPPA , J. COUGHLAN , A. DROZD , E. DURING , C. ELIOPOULOS , J. ENG , F. ENGEL , S. FOX , M. FURTADO , G. GUNTIS , S. GROVES , K. HARKINS , P. HOLCK , M. HOLST , G. HOTZ , R. IVES , T. JAKOB , J. JENNINGS , H. JUSTUS , K. KAMINSKA , A. KJELLSTRÖM , C. J. KNÜSEL , T. KOZLOWSKI , A. LAGIA , C. LOPES , S. MANOLIS , A. MARCSIK , C. MARQUES , C. MOENKE , C. NIEL , S.A. NOVAK , F. NOVOTNY , J. PECK , I. POTIEKHINA , B. REGA , R. RICHMAN , F. RIJPMA , J. ROSE , J. RUIZ , P. SANNEN , M. SMITH , A. SOFICARU , M. SPANNAGL , R. STORM , G. STROUD , E. SUBIRÀ , D. SWALES , V. TRISTAROLI , E. TYLER , S. ULRICH-BOCHSLER , S. VATTEONI , V. VILLAR , R. WIGGINS , L.L. WILLIAMS .

90. **Historical patterns of traumatic injury and violence in Europe.** P.L. WALKER , R.H. STECKEL , C.S. LARSEN , J. BLONDIAUX , G. GRUPE , R. JANKAUSKAS , G. MAAT , G. MCGLYNN , A. PAPATHANASIOU , C. ROBERTS , M. TESCHLER-NICOLA , U. WITTWER-BACKOFEN , A. AGNEW , S. ASSIS , Z. BERECZKI , B. BERTRAND , T.K. BETSINGER , M. BINDER , S. BOULTER , C. BOURBOU , A. BOYLSTON , M. BRICKLEY , L. BÜRLI , C. COOPER , A. COPPA , J. COUGHLAN , A. DROZD , E. DURING , C. ELIOPOULOS , J. ENG , F. ENGEL , S. FOX , M. FURTADO , G. GERHARDS , S. GROVES , K. HARKINS , P. HOLCK , M. HOLST , G. HOTZ , R. IVES , T. JAKOB , J. JENNINGS , H. JUSTUS , K. KAMINSKA , A. KJELLSTRÖM , C. J. KNÜSEL , T. KOZLOWSKI , A. LAGIA , C. LOPES , S. MANOLIS , A. MARCSIK , C. MARQUES , C. MOENKE , C. NIEL , S.A. NOVAK , F. NOVOTNY , J. PECK , I. POTIEKHINA , B. REGA , R. RICHMAN , F. RIJPMA , J. ROSE , J. RUIZ , P. SANNEN , P. SCIULLI , M. SMITH , A. SOFICARU , M. SPANNAGL , R. STORM , G. STROUD , E. SUBIRÀ , D. SWALES , V. TRISTAROLI , E. TYLER , S. ULRICH-BOCHSLER , V. VANNA , S. VATTEONI , V. VILLAR , R. WIGGINS , L.L. WILLIAMS .

91. **Periosteal appositions: a non-specific index of the history of health in Europe.** C. MARQUES , J. BLONDIAUX , R.H. STECKEL , C.S. LARSEN , P.L. WALKER , G. GRUPE , R. JANKAUSKAS , G. MAAT , G. MCGLYNN , A. PAPATHANASIOU , C. ROBERTS , M. TESCHLER-NICOLA , U. WITTWER-BACKOFEN , A. AGNEW , S. ASSIS , Z. BERECZKI , B. BERTRAND , T.K. BETSINGER , M. BINDER , S. BOULTER , C. BOURBOU , A. BOYLSTON , M. BRICKLEY , L. BÜRLI , C. COOPER , A. COPPA , J. COUGHLAN , A. DROZD , E. DURING , C. ELIOPOULOS , J. ENG , F. ENGEL , S. FOX , M. FURTADO , G. GERHARDS , S. GROVES , K. HARKINS , P. HOLCK , M. HOLST , G. HOTZ , R. IVES , T. JAKOB , J. JENNINGS , H. JUSTUS , K. KAMINSKA , A. KJELLSTRÖM , C. J. KNÜSEL , T. KOZLOWSKI , A. LAGIA , C. LOPES , S. MANOLIS , A. MARCSIK , C. MOENKE , C. NIEL , S.A. NOVAK , F. NOVOTNY , J. PECK , I. POTIEKHINA , B. REGA , R. RICHMAN , F. RIJPMA , J. ROSE , J. RUIZ , P. SANNEN , P. SCIULLI , M. SMITH , A. SOFICARU , M. SPANNAGL , R. STORM , G. STROUD , E. SUBIRÀ , D. SWALES , V. TRISTAROLI , E. TYLER , S. ULRICH-BOCHSLER , S. VATTEONI , V. VILLAR , R. WIGGINS , L.L. WILLIAMS .

92. **Stable isotope analysis.** G. MCGLYNN, G. GRUPE.

93. **Conclusion/discussion**

Session 6. Skeletal biology: Isotopic studies. Contributed posters. ***River Exhibition Hall B.***
Chair: Michele R Buzon Department of Anthropology Purdue University

8:00-8:30 am:	Poster set-up
6:00-6:30 pm:	Poster take-down
10:00-10:30 am. and 2:00-2:30 pm:	Author of even number posters present for discussion
10:30-11:00 am. and 2:30-3:00 pm:	Author of odd number posters present for discussion

94. **From the cradle to the grave: A stable isotopic examination of infant and child diet in a Virginia slave population.** C. J. YODER, A.L. BERKOWITZ, D.C. BOYD, AND C.C. BOYD.

95. **Diet versus locale: isotopic support for causal roles in pathological conditions at Machu Picchu, Peru.** B.L. TURNER, J.D. KINGSTON, G.J. ARMELAGOS.

96. **Residential mobility and dietary patterns at the prehistoric site of Gatas, southeastern Spain.** E.A. PREVEDOROU, M. DIAZ-ZORITA BONILLA, J.E. BUIKSTRA, G. GORDON, A. ANBAR, K.J. KNUDSON.

97. **Stable isotope and mtDNA evidence for geographic origins at the site of Vagnari (2nd- 4th centuries AD), Italy.** T.L. PROWSE, T.E. VON HUNNIUS, AND J.L. BARTA.

98. **Wari Emissaries in the Southern Nasca Region of Peru: the oxygen isotope evidence.** ERIN L. HENRY, CORINA M. KELLNER, MARGARET J. SCHOENINGER.

99. **Stable isotope analysis of diet among Bronze Age and Iron Age inhabitants of Xinjiang Uyghur Autonomous Region, China**. J.T. ENG, Q. ZHANG, H. ZHU.

100. **Dining with the Danes in Roman Iron Age Denmark**. M.L.S. JØRKOV, N. LYNNERUP.

101. **Dietary variability in pre-contact central California: evidence from stable sulfur, carbon, and nitrogen isotopes of bone collagen.** B.T. FULLER, E.J. BARTELINK.

102. **Oxygen isotope analysis of tooth enamel carbonate from the New Kingdom site of Tombos**. M.R. BUZON AND G.J. BOWEN.

103. **Investigating the use of Bromine as a Palaeodietary Indicator.** A.E. DOLPHIN, A.J. NELSON, R.R. MARTIN, S.J. NAFTEL.

104. **Evaluating diagenetic alterations affecting stable isotopes in bone using C/P and CI values: a comparison of four sample preparation methods for FTIR analysis.** M.M. BEASLEY, C. CARMEN.

105. **Oxygen isotopes as a biomarker for sickle cell disease.** L.J. REITSEMA.

Session 7. Paleoanthropology: Hominin craniofacial morphology and neural evolution. Homo evolution.

Contributed posters. ***River Exhibition Hall B.***

Chair: Robin M. Bernstein George Washington University

8:00-8:30 am:	Poster set-up
6:00-6:30 pm:	Poster take-down
10:00-10:30 am. and 2:00-2:30 pm:	Author of even number posters present for discussion
10:30-11:00 am. and 2:30-3:00 pm:	Author of odd number posters present for discussion.

106. **Cranial modularity: patterns of stability of the facial module in *Homo* and non-*Homo* representatives as tested by the Flury hierarchy.** J.Y. ANDERSON.

107. **3D imaging and study of old fossils.** G. GUIPERT, B. MAFART, G. ONORATINI.

108. **The effects of experimentally reduced facial dimensions on the growth of the nasal septum and premaxilla in *Sus scrofa***. N.E. HOLTON, R.G. FRANCISCUS, T.E. SOUTHARD, S.D. MARSHALL, M.A. NIEVES, S.B. REIMER.

109. **Internal nasal floor configuration in contemporary fetal and postnatal subadult *H. sapiens*.** C.L. NICHOLAS, R.G. FRANCISCUS.

110. **The nasal cavity of Pleistocene hominins: implications of climate-related variation among modern humans.** M.L. NOBACK, F. SPOOR.

111. **Clarifying tibial torsion in the Dmanisi tibiae in comparison to African apes and modern humans.** T. JASHASHVILI.

112. **The utility of rodent assemblages in testing niche specialization in hominins.** T.L. CAMPBELL, P.J. LEWIS.

113. **The morphology of KNM-ER1805: a reconsideration of an enigmatic specimen.** RICCI L. GROSSMAN.

114. **A nearly complete hominin radius from Area 41 of the Koobi Fora Formation (East Turkana, Kenya).** F.M. KIRERA, I.J. WALLACE, B.A. PATEL.

115. **Paleopalynological Investigations at FwJj14E, a Hominid Footprint Site in Ileret, Northern Kenya.** SARITA AMY MORSE

116. **A palaeomagnetic age of about 990,000 years for the Cornelia-Uitzoek fossil vertebrate, hominin and Acheulian site, South Africa.** A.I.R. HERRIES, J.S. BRINK, B. BOUSMAN, V. EISENMANN, J. GOWLETT, R. GRÜN, J. HANCOX, J. MOGGI-CECCHI, L. ROSSOUW.

Thursday April 2nd, 2009. Morning sessions.

117. **Anatomical representations of the human body: a comparative study of sites with evidence for cannibalism.** C. MUSSINI, B. MAUREILLE, A.E. MANN, B. VANDERMEERSCH.

118. **Inferred body proportions of a southern European Neandertal, Palomas 92.** E. TRINKAUS, M.J. WALKER, J. MAKI, M.V. LÓPEZ, J. ORTEGA.

119. **Comparative functional morphology and bilateral asymmetry of the clavicle in the Regourdou (Neanderthal) and Chancelade (late Upper Paleolithic) adult skeletons (Western France): a high-resolution endostructural analysis.** V. VOLPATO, C. COUTURE, B. VANDERMEERSCH, A. MAZURIER, R. MACCHIARELLI.

120. **The facial reconstruction of the Lapedo Child.** B.E. PIERSON, F. ALMEIDA.

121. **The evolution of the human hand: making a fist.** MICHAEL MORGAN AND DAVID CARRIER. Poster originally not here.

122. **Dietary diversity in Early and Middle Miocene catarrhines from Kenya.** A. GROSSMAN.

Session 8. Primatology. Vocalization and communication. Growth and development. Non-human primate dental anthropology. Aggression, Morbidity, Mortality, and Stress. Contributed posters. ***River Exhibition Hall B.***

Chair: Anthony Di Fiore. New York University and NYCEP

8:00-8:30 am: Poster set-up
6:00-6:30 pm: Poster take-down
10:00-10:30 am. and 2:00-2:30 pm: Author of even number posters present for discussion
10:30-11:00 am. and 2:30-3:00 pm: Author of odd number posters present for discussion

123. **Loud calls as a tool in identifying the purple-faced langur (*Trachypithecus vetulus*) subspecies of Sri Lanka.** A.R.A. BAXTER, C. ESCHMANN, H.P. DOUGLAS, K.A.I. NEKARIS.

124. **A preliminary report on the interaction between ambient acoustics and primate vocalizations in the Ecuadorian Amazon.** M.N. COLEMAN, A. DI FIORE, E. FERNANDEZ-DUQUE.

125. **Genetic determinants for capuchin alarm calls? Comparisons between the alarm calls of a previously unstudied group of wild white-throated capuchin monkeys (*Cebus capucinus*) and previously published alarm call analyses reveal no significant difference.** ANDREW R. HALLORAN AND CHRISTINA T. CLOUTIER.

126. **Whispers in the dark: bioacoustic signatures of owl monkeys.** J.P. HERRERA, L.L. TAYLOR, C. K. WOLOVICH, AND S. EVANS.

127. **Sex differences in vocalization patterns in the northern muriqui monkey *(Brachyteles hypoxanthus).*** L. ARNEDO, F.D. MENDES, K. STRIER.

128. **The facial display repertoire of geladas.** S.D. DOBSON, T.J. BERGMAN, J.C. BEEHNER

129. **A link between fecal testosterone and an honest signal - the loud 'wahoo' vocalizations of chacma baboons.** D. M. KITCHEN, D. L. CHENEY, R. M. SEYFARTH AND J. C. BEEHNER.

130. **Comparing social cognitive, non-social cognitive, and resting brain activity in chimpanzees.** S.K. BARKS, L.A. PARR, E. HECHT, J.R. VOTAW, J.K. RILLING.

131. **Relative prefrontal cortex surface area in *Pan troglodytes* and *Homo sapiens*.** I.D. GEORGE, R.H. BLANKS, C.C. SHERWOOD, R.C. MCCARTHY, D.C. BROADFIELD.

132. **Changes in urinary dehydroepiandrosterone sulfate (DHEA-S) levels with age in juvenile captive chimpanzees (*Pan troglodytes*).** S.F. ANESTIS, M. BLANCO, R.G. BRIBIESCAS.

133. **Infant development and the use of gestures in a captive group of white-cheeked gibbons (*Nomascus leucogenys*).** E.J. INGMANSON

134. **Ontogeny and behavior of *Propithecus edwardsi* (Milne-Edwards' sifaka).** T.A. CLARKE, G.X. RAZANATSILA, P.C. WRIGHT.

135. **Regularities of growth patterns in wild catarrhines.** D.R. BOLTER

136. **Hormonal correlates of growth in mandrills (*Mandrillus sphinx*).** R.M. BERNSTEIN, J.M. SETCHELL, L.A. KNAPP, E.J. WICKINGS.

137. ***Mandrillus* facial features may signal size and fitness information to conspecifics: an allometric study**. E.B. KLOPP.

138. **Ontogenetic differences in scrotal coloration among South African vervet monkeys**. J.L. DANZY, J.D. PAMPUSH, J.P. GROBLER, J.G. LORENZ, T.R. TURNER.

139. **Dental enamel increments reveal relationships to ecological factors in cebid primates.** R. HOGG.

140. **Three-dimensional digital morphology of small–bodied platyrrhine molar teeth.** S.B. COOKE AND A.L. ROSENBERGER.

141. **Postcanine occlusal loading and relative dental arcade width in pitheciine primates.** J.A. LEDOGAR.

142. **Tooth wear, age and diet in a living population of baboons from Amboseli (Kenya).** J.GALBANY, J.ALTMANN, A.PÉREZ-PÉREZ, S.C. ALBERTS.

143. **Accentuated lines in baboon tooth enamel reflect weaning.** STRESS W. DIRKS, L.T. HUMPHREY, M.C. DEAN, T.E. JEFFRIES
144. **Molarization in extant primates.** L. LUCAS, G.T. SCHWARTZ, M.A. SPENCER.

145. **Dental wear in African apes: is a certain amount of attrition advantageous?** A.A. ELGART.

146. **Sex differences in canine crown fluctuating asymmetry *Gorilla gorilla*: A result of ontogenetic mechanisms underlying adult canine size sexual dimorphism?** S.A. MARTIN, D. GUATELLI-STEINBERG, P.W. SCIULLI.

147. **Taxonomic and phylogenetic significance of Lorisiform female genital morphology.** S.W. FOLEY.

148. **Agent-based simulation modeling of primate sociality.** DI FIORE A.

149. **The effects of travel costs on group size: a phylogenetic approach**. M.M. KOWALEWSKI, G.E. BLOMQUIST, B. URBANI.

150. **Integrative measurement protocol for morphological and behavioral research in human and nonhuman primates.** S.C. ANTÓN , J.J. SNODGRASS, C. CROWDER, A. DI FIORE , D.L. DUREN, E. FERNANDEZ-DUQUE, W.R. LEONARD, S.R. LEIGH, F.C. MADIMENOS, W.S. MCGRAW, E. MIDDLETON , C. SCHMITT , R.J. SHERWOOD, S. STINSON, P. STUBBLEFIELD, T. TURNER, C.R. VALEGGIA, F.J. WHITE.

151. **Noninvasive assessment of dioxin exposure in *Pygathrix* at the Endangered Primate Rescue Center, Cuc Phuong National Park, Vietnam.** D.K. BROCKMAN, R.O. HARRISON.

152. **What urine can tell us about protein balance in wild orangutans.** B.E. CROWLEY, C.D. KNOTT, S. HARYATI, A. ZULFA, M.E. BLAKELY, E.R. VOGEL.

153. **Maternal influence on orangutan gestural and behavioral development.** E.A. CARTMILL AND R.W. BYRNE

154. **Modeling chimpanzee site-suitability: a useful addition to the primatologist's "toolbox".** E. OTÁROLA-CASTILLO, S.L. BOGART, AND S.M. LINDSHIELD.

155. **Methodological challenges in field-based primate parasitology.** S.K.MARTIN, H.V. RAKOTOARIVLO, S.J.KUTZ.

156. **Levels of resolution in the geographic distribution of pelage color characters as diagnostic taxonomic markers. An example from the *Callicebus* Cupreus-group.** W.D. Moore.

157. **Testing multiple hypotheses explaining primate species richness.** J.L. MARSHACK AND J.M. KAMILAR.

158. **Association between fracture patterns, healing and locomotor tendencies in nonhuman primates: implications for the origins of human health.** H. JARRELL, W.S. MCGRAW.

159. **Trauma and pathology in the Gombe chimpanzees.** C.A. KIRCHHOFF.

160. **Separating interventions during agonistic and affliative dyadic encounters by captive male and female bonobos**. K. J. BOOSE, B. STOUGH AND D.M. KITCHEN.

161. **The evolution of female sexuality: Are females responsible for relaxed male–male competition among chimpanzees in Budongo Forest?** S.J. O'HARA

162. **Two group takeovers, infanticides and pregnancy terminations in *Theropithecus gelada* at Guassa, Ethiopia.** P.J. FASHING, N. NGUYEN, J.T. KERBY, L.M. LEE, N. NURMI, V.V. VENKATARAMAN.

163. **Differential response to predators in the Gray's Bald-faced saki monkey (*Pithecia irrorata*): A playback experiment.** D.B. ADAMS, E.M. ERHART.

164. **Salivary testosterone and dominance in captive brown tufted capuchins (*Cebus apella*).** T. MOCHIZUKI, S.F. ANESTIS, R.B. BRIBIESCAS.

165. **Female behavior and the one-male unit social structure among the Gola baboons.** S. BEYENE.

Thursday April 2nd, 2009. Morning sessions.

166. **Do vervet monkey day journeys maximize energy yield?** S.P. HENZI, A.S. BARRETT, L. BROWN AND L. BARRETT.

167. **A moving target: How do primates estimate predation risk in space and time?** L.R. BIDNER

168. **Natural knock-out: changes in female social networks as a consequence of mortality in female chacma baboons.** L. BARRETT, D. LUSSEAU, S.P. HENZI.

169. **Strong deviations from the priority-of-access model in Barbary macaques (*Macaca sylvanus*): the influence of female behavior and male-male coalitions** BISSONNETTE A, N. BISCHOFBERGER, C.P. VAN SCHAIK.

170. **Future friends or foes: male-immature interactions in wild phayre's leaf monkeys.** KOENIG A, J.R. GARTEN, R.S. ZULUETTA, C. BORRIES.

171. **Root growth during first molar eruption in extant great apes.** S. ROSS, J. KELLEY, C. DEAN.

172. **Subspecific variation in prenatal craniofacial growth pattern in the Japanese macaque (*Macaca fuscata*).** W. YANO, N. EGI, T. TAKANO, N. OGIHARA.

173. **Craniofacial Shape Changes in *Pongo pygmaeus pygmaeus* – sexual dimorphism and bimaturism.** S SENCK, S. KATINA, W. HENKE, G.W. WEBER.

174. **Ontogenetic allometry of limb bone strength in capuchin monkeys (*Cebus albifrons* and *Cebus apella*): implications for locomotor development and life history.** J. W. YOUNG, D. FERNÁNDEZ.

175. **Ontogeny of play in captive spider monkeys.** VANREGENMORTER, E.M.

176. **Seasonal influences on the weaning process in Nicaraguan mantled howler monkeys (*Alouatta palliata*).** MELISSA RAGUET-SCHOFIELD.

177. **Energy inputs, not skill learning, determine age at maturity in orangutans and other primates.** C.P. VAN SCHAIK, L. DUNKEL, E. VOGEL, K. ISLER.
178. **Longevity in wild mouse lemurs: old but not mousy.** S. ZOHDY, S. J. KING, M.B. BLANCO, P.C. WRIGHT, J. JERNVALL.

179. **The influence of arboreality on longevity in mammals: A test of the evolutionary theory of aging.** M.R. SHATTUCK, S.A. WILLIAMS.

180. **Does Environmental Unpredictability Drive Lemur Life Histories?** C.J. TOBOROWSKY, W.A. BARR, R.J. LEWIS.

181. **Auditory sensitivity in the Lemuridae: A preliminary report.** M.A. RAMSIER, A.J. CUNNINGHAM, N.J. DOMINY.

182. **The context of spider monkey whinnies: Party composition and activity.** J.T. WALZ, M.A. RODRIGUES.

183. **The monkey who cried wolf: tufted capuchin monkeys use anti-predator calls to usurp resources from conspecifics.** B.C. WHEELER.
184. **Poster available for organizers.**
185. **Modifications to a fecal hormone extraction method: implications for storage of fecal hormone metabolites.** D.J. PAPPANO, J.C. BEEHNER.

186. **Observing Stress in Captive Western Lowland Gorillas (*Gorilla gorilla gorilla*) through Behavioral Observations and Fecal Cortisol**. B.K. SMITH, M.J. REMIS, S.R. WILLIAMS.

187. **Hormones and dominance rank in a large captive group of bonobos (Pan *paniscus*).** ZELLMER LJ, THIMKE EA, MUEHLENBEIN MP.

188. **Lemur pregnancy in the wild: Noninvasive monitoring of reproductive function in Milne-Edwards' sifaka, *Propithecus edwardsi*, in Ranomafana National Park, Madagascar.** S. R. TECOT, S. KING, J. JERNVALL, P.C. WRIGHT

189. **Social and hormonal mechanisms underlying male reproductive strategies in black howler monkeys (*Alouatta pigra*).** S. VAN BELLE, T. E. ZIEGLER, A. ESTRADA, K. B. STRIER.

190. **Pair bonding in socially monogamous primates: a comparative study of the white-cheeked gibbon (*Nomascus leucogenys*) and the white-faced saki (*Pithecia pithecia*).** A.L. POYAS AND T.Q. BARTLETT.

191. **Are capuchins good models for the "grandmother" hypothesis?: What socio-spatial behavior of females with dependent infants can tells us.** A.E. STINESPRING HARRIS, R.M. BERNSTEIN.

192. **Grooming for tolerance? Behavioural interchange in wild tufted capuchin monkeys (*Cebus apella nigritus*).** B. TIDDI, E. POLIZZI DI SORRENTINO, F. AURELI, C.H. JANSON, G. SCHINO.

193. **Linearity and strength of male chimpanzee dominance hierarchies at Ngogo, Kibale National Park, Uganda.** DAVID P. WATTS, HAN DE VRIES.

194. **Social Tension and Risky Behaviors Among Male Chimpanzees at Ngogo, Kibale, Uganda.** H. M. SHERROW.

195. **Triadic conflict behavior and female dominance in captive *Pan paniscus.*** C.L.R. PAYNE.\

196. **Dominance rank and reproductive success in male chimpanzees (*Pan troglodytes schweinfurthii*).** E.E. WROBLEWSKI, C.M. MURRAY, B.F. KEELE, J.C. SCHUMACHER-STANKEY, B.H. HAHN, A.E. PUSEY.\

197. **Scaling relationships between molar crown, root and jaw size in anthropoid primates.** K. KUPCZIK, A.J. OLEJNICZAK, M.M. SKINNER, J.-J. HUBLIN.

198. **Instantaneous center of rotation of the mandible during chewing in primates.** LISA BANG AND CALLUM ROSS

Session 9. Human Life History in Primate Perspective. Invited podium symposium. *Chicago 9.*

Organizers: Benjamin Campbell & Sylvia Atsalis.
Human life history is marked by an extended period of childhood growth and lengthy juvenile development, extensive parental investment, extended adult life span, and menopause. The evolutionary relationship of these and associated traits to those of nonhuman primates remains a matter of active debate. In this session we explore and compare life history patterns of humans and other primates. In so doing, we hope to highlight how different parameters have played a role in the evolution of primate life histories, and to distinguish between those traits that are derived and therefore specific to humans from those that represent generalized aspects of primate life history.

8:00-8:15 am.	**Childhood, adolescence, grandmotherhood and the non-symmetrical, variant nature of human life history.** B. BOGIN
8:15-8:30- am.	**The intrauterine environment as a life history precursor: perspectives from the callitrichine primates.** JULIENNE N. RUTHERFORD.
8:30-8:45 am	**Comparing patterns of natural selection on life history traits in humans and lemurs.** R.R. LAWLER
8:45-9:00 am	**Energy pooling and implications for the unique traits of the human life history strategy.** K.C. SHARROCK, M.W. REICHES, S.F. LIPSON, K. KRAMER, P.T. ELLISON.
9:00-9:15 am	**Maternal physiological guidance of offspring developmental trajectory: transgenerational adaptation to novel niches.** J.C. WELLS, J.T. STOCK.
9:15-9:45- am	**Architecture of life history events in vervet monkeys (*Cercopithecus aethiops*).** P.L. WHITTEN AND T.R. TURNER
9:30-9:45- am	**Hamadryas baboons as an analog for social evolution in *Homo erectus*.** L. SWEDELL, T. PLUMMER.
9:45-10:00 am	**Chimpanzee omnivory and the evolution of human life history.** C.B. STANFORD.
10:00-10:15 am.	**Changing environments, developmental plasticity and life history traits.** G.R.BENTLEY, L.L. SIEVERT, K. BEGUM, T. SHARMEEN, A. NUNEZ DE-LA MORA, AND SHANTHI MUTTUKRISHNA.
10:15-10:30 am	**Break**
10:30-10:45- am	**Aging comparisons between humans and chimpanzees**. K. HAWKES
10:45-11:00 am	**Male Reproductive Aging in Comparative Primate Perspective.** B.CAMPBELL.
11:00-11:15- am	**Comparing reproductive aging in wild and captive apes.** S. ATSALIS, E. VIDEAN.
11:15-11:30- am	**Microevolution of size, shape and timing changes in human pygmies.** B.T. SHEA, E.B. WAXENBAUM.
11:30-11:45 am	**Intergenerational transfers, lifespan and human aging.** HILLARD KAPLAN M. GURVEN, J. WINKING, P. HOOPER, J. STIEGLITZ, K. HINDE, D. EID.
11:45 am-12:00 pm	Discussion.

Thursday April 2nd, 2009. Morning sessions.

Session 10. Bones, Genetics, and Behavior: Physical Anthropology at the Caribbean Primate Research Center. Invited podium symposium. *Superior Room A & B.*

Organizer: Qian Wang
Discussants: Joan Richtsmeier; Jim Cheverud (Generics); Dario Maestripieri (Behavior)

The introduction of rhesus macaques to Cayo Santiago, Puerto Rico in 1938, and the subsequent development of the Caribbean Primate Research Center (CPRC) for biomedical research, has been stimulating numerous studies in Physical Anthropology. These monkey colonies, and the derived skeletal collection in CPRC with precise demographic data, provide rare opportunities for morphological, developmental, functional, genetic, and behavioral studies of the whole life cycle of rhesus macaques as a human analogue. This symposium celebrates
seventy years of unique contributions of CPRC to the scientific community, offers a stage to display recent and ongoing physical anthropological research, and demonstrates how vast research opportunities still remain in this rhesus macaque province.

8:00-8:15 am. **Physical anthropology at the Caribbean Primate Research Center: past, present, and future.** D.C. DUNBAR.

8:15-8:30 am. **Developmental origin of covariation between traits.** K. WILLMORE, J. BUIKSTRA, J. M. CHEVERUD, J. T. RICHTSMEIER.

8:30-8:45 am. **Digit length ratio (2D:4D) and female dominance rank in rhesus macaques from Cayo Santiago.** E.C. NELSON, C.L. HOFFMAN AND M.S. GERALD

8:45-9:00 am. **Forelimb ontogeny and its relationship to anatomical mechanical advantage in rhesus macaques (*Macaca mulatta*) from Cayo Santiago.** C.D. FELLMANN.

9:00-9:15 am. **Ontogeny of sex difference in skull biomechanics of Rhesus macaques from Cayo Santiago.** Q. WANG.

9:15-9:30 am. **Fragile spines on Cayo Santiago: bone mineral density, trabecular morphology and the potential for exploring the genetics of osteoporosis in rhesus monkeys.**
J.E. TURNQUIST, A.M. CERRONI, B. HALLGRIMSSON.

9:30-9:45 am. **The effect of genes on cortical bone microstructure: Lessons from the Cayo Santiago skeletal collection.** L.M. HAVILL

9:45-10:00 am. **Genetic and social group influences on postcranial morphology in rhesus macaques of Cayo Santiago**. L.A.P. KOHN, Z. BLEDSOE.

10:00-10:15 am. **Quantitative genetic analysis of primate cranial morphology: Cayo Santiago and beyond.** J. ROGERS, J. JOGANIC, K. WILLMORE, J. RICHTSMEIER, C. ROSEMAN, AND J. CHEVERUD.

10:15-10:30 am. **Break**

10:30-10:45 am. ***OPRM1* gene variation influences neuroendocrine function but not behavior in rhesus macaque (*Macaca mulatta*) mothers.** M.L. SCHWANDT, S.G. LINDELL, J.D. HIGLEY, S.J. SUOMI, M. HEILIG, C.S. BARR.

10:45-11:00 am. **Variation over time in grooming kin bias among female rhesus macaques on Cayo Santiago supports the time constraints hypothesis**. C.M. BERMAN, E. KAPSALIS

11:00-11:15 am. **Female age of first reproduction at Cayo Santiago: heritability and shared environments.** G.E. BLOMQUIST.

11:15-11:30 am. **The social adaptations of rhesus macaques: the secret of their success?** D. MAESTRIPIERI.

11:30-11:45 am. **Factors influencing maternal investment and infant survivorship in *Macaca mulatta*.** C. L. Hoffman

11:45-12:00 **Discussants:** JOAN RICHTSMEIER; JIM CHEVERUD (Generics); DARIO MAESTRIPIERI (Behavior)

Session 11. Quantitative genetic approaches to human phenotypic evolution. Invited podium symposium. *Chicago 8.*

Organizers: Noreen von Cramon-Taubadel, Tim Weaver
In recent decades, physical anthropologists have increasingly recognized the importance of using model-bound approaches to test competing evolutionary explanations for human and primate morphology. As such, theoretical and analytical methods drawn from quantitative and population genetics provide a framework for distinguishing between neutral forces (e.g. genetic drift) and non-neutral forces (e.g. diversifying natural selection) of evolution. Determining the relative impact of these forces in shaping the morphological diversity we observe within and between populations or species is crucial to understanding the processes by which morphological evolution occurs. In addition, knowledge of the relative impacts of neutral versus selective forces on morphology can guide our use of anatomical traits for reconstructing population history and phylogeny, which has obvious implications for the use of morphology in phylogenetic reconstructions of extinct species. This symposium will showcase some recent research applying these quantitative genetic approaches to patterns of morphological diversity at both the intra- and inter-specific level to both living and extinct taxa of hominins and other primates. Moreover, the papers will collectively highlight the advantages of an explicitly quantitative genetic approach for analyzing morphological diversity patterns and demonstrate its importance to evolutionary anthropology.

8:00-8:15 am. **Geographic structure of global craniometric variation.** J.H. RELETHFORD.

8:15-8:30 am. **Australian craniofacial evolution: drift, selection, or all of the above?** E.A. CARSON.

8:30-8:45 am. **Identifying selection and genetic drift in the landmark-based 3D cranial morphology of modern humans.** H.F. SMITH

8:45-9:00 am. **The paradox of human cranial variation.** T.D. WEAVER

9:00-9:15 am. **Geographic structure of craniofacial variation in modern human populations: an R-matrix approach.** T. HANIHARA, H. ISHIDA.

9:15-9:30 am. **Population history and cranial morphology in a large human skeletal dataset.** K. HARVATI, M. HUBBE, D.V. BERNARDO, T. HANIHARA

9:30-9:45 am. **Quantitative genetics and evolution of shape: populations to phylogenies.** C. P. KLINGENBERG.

9:45-10:00 am. **Investigating the relative neutrality of individual bones in the modern human cranium.** N. VON CRAMON-TAUBADEL.

10:00-10:15 am. **Natural selection, random genetic drift, and the study of morphological variation.** C.C. ROSEMAN.

10:15-10:30 am. **Break**

10:30-10:45 am. **Evolutionary processes underlying variation in early *Homo.*** L. SCHROEDER, R.R. ACKERMANN, C.C. ROSEMAN

10:45-11:00 am. **Quantitative genetic insights on the evolutionary processes operating on human skull shape.** N. MARTÍNEZ ABADÍAS.

11:00-11:15 am. **Ancient demography, not climate, explains within-population phenotypic diversity in humans.** A. MANICA, L. BETTI, F. BALLOUX, W. AMOS, T. HANIHARA.

11:15-11:30 am. **Parallel evolution of papionin craniofacial morphology.** J. CHEVERUD, A. SCHMITZ, C. ROSEMAN.

11:30-11:45 am. **Natural selection and genetic drift in Old World Monkeys skull evolution.** F. B. OLIVEIRA, G. MARROIG.

11:45-12:00 **Discussion.** T WEAVER.

Session 12. Human Biology. Assessing and understanding maturational processes. Demography. Contributed papers. *Chicago 10.* Chair: Daniel E Brown University of Hawaii at Hilo.

8:00-8:15 am **Relationships between menstrual attitudes, health, and behavioural characteristics.** L.MORRISON, L.LARKSPUR, M.CALIBUSO.

8:15-8:30 am. **Correlates of urinary catecholamine excretion rates differ depending upon the situation of measurement in young working women.** H.M. VAN BERGE-LANDRY, G.D. JAMES.

8:30-8:45 am. **Dietary intake and hot flash frequencies in Bangladeshi residents, Bangladeshi migrants, and European women in London.** L.L. SIEVERT, T. SHARMEEN, K. BEGUM, S. MUTTUKRISHNA, O. CHOWDHUR, G.R.BENTLEY.

8:45-9:00 am. **Energy expenditure and body composition in a multiethnic sample of school children in Hawaii.** D.E. BROWN, L.A. GOTSHALK, L. ALLEN, A. GOODLOE, H.A.T. TEFFT AND T. FERNANDEZ.

9:00-9:15 am. **Maturation of the temporal bone as non-neural constraint for speech perception: transformation of the speech signal during language development.** L.A. HOGAN

9:15-9:30 am. **Remodeling patterns of the human occipital bone: A preliminary report.** E.F. KRANIOTI, A. ROSAS, S. GARCÍA-VARGAS, A. ESTALRRICH.

9:30-9:45 am. **Longitudinal analysis of grip strength over the lifespan.** R.W. NAHHAS, A.C. CHOH, M. LEE, W.C. CHUMLEA, R.J. SHERWOOD, D.L. DUREN, B. TOWNE, R.M. SIERVOGEL, S.A. CZERWINSKI.

9:45-10:00 am. **Growth and nutritional status in an indigenous lowland Ecuadorian population.** J.J. SNODGRASS, A.D. BLACKWELL, F.C. MADIMENOS, T.J. CEPON, T.R. GANDOLFO, L.S. SUGIYAMA.

10:00-10:15 am. **Differential Mortality in the 19th Century Johnstown and Sheffield Floods: A Study of Age and Gender.** L.L. WILLIAMS AND C.C. COX.

10:15-10:30 am. Break

Thursday April 2nd, 2009. Morning sessions.

10:30-10:45 am. **Measuring selection and demographic sustainability in a 19th century population.** C.S. SPARKS.

10:45-11:00 am. **Paleodemography of a Predynastic Egyptian skeletal sample: exploring different age indicators and analytical approaches.** E.K. BATEY.

11:00-11:15 am. **Welcome back Paleodemography. An archaeological case study in medieval France (AD 1300-1500).** S. NAJI, E. HERRSCHER.

11:15-11:30 am. **Bioarchaeology and demography of 17th century mass graves at the Barbican Site, York, England.** CHAMBERLAIN, AT

11:30-11:45 am. **Neighborhood Mortality and the Scarlet Fever Pandemic in 1875 Binghamton, New York** SHERIDAN KE

11:45-12:00 **The Implications of Demographic Changes on the Craniofacial Morphology of the Modern Portuguese.** KATHERINE E. WEISENSEE.

Thursday April 2nd, 2009. Afternoon sessions.

Session 13. Primatology. Non-human primate dental anthropology and functional anatomy. Contributed papers. *Chicago 10.*

Chair: Anne M. Burrows Duquesne University

1:00-1:15 pm. **Measurement of fallback food hardness in the field**. P.W. LUCAS, C. ZISCOVICI.

1:15-1:30 pm. **Galago exudate-acquisition: it's not about the toothcomb.** A.M. BURROWS, L.T. NASH

1:30-1:45 pm. **Mechanical properties of great ape tooth enamel** P.J. CONSTANTINO, J.J.-W. LEE, T.M. SMITH, P.W. LUCAS, B.R. LAWN.

1:45-2:00 pm. **Comparative anatomy and evolution of the pectoral and forelimb musculature of primates: a new insight** R. DIOGO, B. WOOD.

2:00-2:15 pm. **Hominoid brain organization: histometric analyses of striate and extrastriate areas.** A.A. DE SOUSA, C.C. SHERWOOD, A. SCHLEICHER, K. AMUNTS, P.R. HOF, K. ZILLES

2:15-2:30 pm **Patterns of cranial integration in *Pan*, *Gorilla*, *Pongo* and *Homo*: similar or different?** N.SINGH, K.HARVATI, J.J HUBLIN & C.KLINGENBERG.

2:30-2:45 pm. **Endocranial shape asymmetries in extant hominids accessed via skull based landmark analysis of 3D reconstructions from CT images.** A. BALZEAU, E.P. GILISSEN.

2:45-3:00 pm. **Ontogenetic scaling of facial orientation and basicranial flexion in the African apes.** E.R. LESLIE, B.T. SHEA.

3:00-3:15 pm. **Break**

3:15-3:30 pm. **Palatal strain during cantilever bending: a case study of *Macaca fasicularis***. J.L. HOTZMAN, D.J. DAEGLING

3:30-3:45 pm. **Three dimensional anatomy of the anthropoid bony pelvis**. C.V. WARD.

3:45-4:00 pm. **Examination of pressure distribution across the manus of knuckle-walking apes.** S. A. MATARAZZO

4:00-4:15 pm. **Chimpanzee hind limb muscle recruitment patterns during quadrupedalism and bipedalism.** A.D. GOSSELIN-ILDARI, S.G. LARSON, J.T. STERN JR.

4:15-4:30 pm. **Examining functional interpretations of variation in African ape hand and foot bone morphology.** R.S. JABBOUR.

4:30-4:45 pm. **Sulcus topography and asymmetry of the common chimpanzee parietal cortex.** E.P. GILISSEN, M. SULIGA, R. DEKLERCK, E. NYSSEN, R. ACHTEN, J.M. ERWIN, P.R. HOF, C.C. SHERWOOD.

4:45-5:00 pm. **Gimme a break – the uniqueness of midtarsal flexion within the primate foot.** T.M. GREINER, K.A. BALL.

Session 14. Human Natures and Human Cultures: Integrating Evolutionary Perspectives and Biocultural Approaches. Wiley-Liss Invited podium symposium. *Chicago 9.*

Organizers: James M. Calcagno Agustin Fuentes

Anthropologists of every subfield are generally well-versed on the individual concepts of culture and evolution. Discussions of the relationships between these two central concepts have been problematic, with current perspectives often mired in the same disputes ever since Darwin. However, emerging theory and practice involving culture and evolution appear to be leading to something new and exciting. The social impact of theorizing on

the evolutionary influences on human behavioral patterns should not be feared, and can instead be of global benefit. Although one might expect that biological and evolutionary anthropologists would be at the forefront of the investigation of this interrelationship, in many ways we have been on the sidelines, as evolutionary psychology became a dominant perspective, with some archaeologists also making important strides in this arena. This symposium aims to create greater awareness within biological anthropology, and between the subfields of anthropology, on such matters by taking stock of relevant perspectives and searching for common ground. The goal is not to dismiss alternative perspectives, but to identify and focus upon possible agreements and mutual concerns, with the assumption that each approach has something valuable to offer.

1:00-1:15 **Evolution, culture, and the role of biological anthropology.** JAMES CALCAGNO

1:15-1:30 **Developmental perspectives on the evolution of the brain and cognition**. KATHLEEN GIBSON

1:30-1:45 **Paleoanthropology and cultural anthropology: could and should the twain meet?** BERNARD WOOD

1:45-2:00 **Primatology and evolutionary psychology: The importance of comparative and phylogenetic analyses in the study of human psychological adaptations.** JAMES RONEY & DARIO MAESTRIPIERI

2:00-2:15 **Forum/Discussion focused on previous papers, audience included**

2:15-2:30 **Using psychology experiments to simulate the cultural evolution of archaeological artifacts**. ALEX MESOUDI

2:30-2:45 **New Frameworks of Understanding for the Origins of Agriculture.** BRUCE SMITH

2:45-3:00 **Evolution and human behavior: perspectives from human behavioral ecology.** REBECCA BLIEGE BIRD.

3:00-3:15 **Forum/Discussion**

3:15-3:30 **Break**

3:30-3:45 **The importance of the concept of culture to anthropology.** ROBERT SUSSMAN

3:45-4:00 **Cultural meaning, social structure, and health in evolutionary perspective.** LANCE GRAVLEE

4:00-4:15 **Political economy as a framework for linking biocultural and evolutionary approaches in human biology research.** KATHRYN HICKS & BILL LEONARD

4:15-4:30 **Biological Anthropology, Culture, and Evolutionary Theory.** AGUSTIN FUENTES

4:30-4:45 **Forum/Discussion**

4:45-5:00 **Discussion** - All speakers and audience

Session 15. Skeletal Biology: Bone remodeling. Isotopic Analysis of Diet and Paleopathology. Contributed Papers. *Superior Rooms A & B.*

Chair: Holger Schutkowski University of Bradford, UK

1:00-1:15 pm. **Quantitative histomorphometric evaluation of the Endosteal Lamellar Pocket: Comparing digital and point-count methods for the measurement of modeling drift remnants in the long bones of adults.** C.M. MAGGIANO, I.S. MAGGIANO, S. STOUT.

1:15-1:30 pm. **High resolution radiometric and stable isotopic analysis of pre-Columbian Puerto Rican paleodiet.** PESTLE, WILLIAM J.

1:30-1:45 pm. **Stable isotope perspectives on diet at the Old Frankfort Cemetery.** M.R. SCHURR,

1:45-2:00 pm. **Ranking food. Diet and social variation in early medieval populations from southwest Germany.** H. SCHUTKOWSKI.

2:00-2:15 pm. **A three-variable analysis of carbon and nitrogen isotope values discriminates between dietary energy and protein sources in prehistoric humans.** A.W. FROEHLE, C.M. KELLNER, AND M.J. SCHOENINGER.

2:15-2:30 pm. **The early European settlers in the New World: Life and death at La Isabela, Santo Domingo, Dominican Republic (1493-1498).** A. CUCINA, A. COPPA, P. ZABALA, M. VELOZ MAGGIOLO, V. TIESLER.

2:30-2:45 pm. **Classifying axial developmental defects in skeletal cases: Cranial or caudal?** K.L. SHEPHERD, H.A. WALSH-HANEY, C.E. HERRICK, L.E. GIBSON.

2:45-3:00 pm. Paper withdrawn. Space available to organizers.

Thursday April 2nd, 2009. Afternoon sessions.

3:00-3:15 pm. **The problem of distinguishing spina bifida occulta from clefting without neural tube defect in the sacrum: what is an anthropologist to do?** D.M. MULHERN, C.A. WILCZAK, E. B. JONES.

3:15-3:30 pm. **Break**

3:30-3:45 pm. **Immunoepidemiology of schistosomiasis in ancient Nubia.**
A.R. CAMPBELL.

3:45-4:00 pm. **High Infant Mortality in Ancient Arabia: Endemic Infections and Marriage Patterns at Tell Abraq (c. 2300 BC).** KATHRYN M. BAUSTIAN; DEBRA L. MARTIN; JENNIFER L. THOMPSON;

4:00-4:15 **pm. Diseases of the vertebral column in a Bronze Age nomadic population from the southern Silk Road, Xinjiang, Western China.** J. GRESKY, T.H. SCHMIDT-SCHULTZ, M. SCHULTZ.

4:15-4:30 pm. **Paleopathology of a 19th-century cemetery in Tucson, Arizona.**T.L. LEHER, S.B. BLACK.

4:30-4:45 pm. **Health status of the Ipiutak at pre-historic Point Hope, Alaska.** G.R. DABBS

4:45-5:00 pm. **Nutrition and epidemiology in the prehistoric population of San Pedro de Atacama, northern Chile, under the influence of Tiwanaku Empire.** P. DA GLORIA, M. HUBBE, W. NEVES, M.A. COSTA.

Session 16. Paleoanthropology. Late Homo evolution. Contributed papers. *Chicago 8.*

Chair: William L. Jungers Stony Brook University Medical Center

1:00-1:15 pm. **Natural selection, longevity, and the Neandertal-modern interface.** J. HAWKS.

1:15-1:30 pm. **The Neanderthal face is not cold adapted.** T. C. RAE, T. KOPPE, C. B. STRINGER.

1:30-1:45 pm. **Functional implications of the unique Neandertal face.** A. MAROM, Y. RAK.

1:45-2:00 pm. **The Neanderthal bony labyrinth reconsidered, introducing a new geometric morphometric approach.** P. GUNZ, F. SPOOR, R. TILGNER, J.-J. HUBLIN

2:00-2:15 pm. **Dental tissue proportions in the deciduous dentition of the immature individuals from Roc de Marsal (Neanderthal) and La Madeleine (late Upper Paleolithic), Dordogne, France. Implications for dental developmental patterns.** P. BAYLE, J. BRAGA, A. MAZURIER, R. MACCHIARELLI

2:15-2:30 pm. **Comparison of Fluctuating Dental Asymmetry in Neandertals and Inuit.** C. BARRETT, D. GUATELLI-STEINBERG, P. SCIULLI.

2:30-2:45 pm. **Mind the gap. A finite element study of the retromolar space and its relation to cortical thickness distribution in the mandibular ramus.** F. GRÖNING, M.J. FAGAN, P. O'HIGGINS.

2:45-3:00 pm **Hominin dental structure and development revealed non-destructively by multiscale synchrotron imaging** P. TAFFOREAU, J.-J. HUBLIN, T.M. SMITH.

3:00-3:15 pm. **Using 3-D geometric morphometric techniques to further understand the relationship between Neanderthals and *Homo sapiens*.** J.A. MINETZ.

3:15-3:30 pm. **Break**

3:30-3:45 pm. **Qualitative and quantitative analyses of the Holocene Khoesan dentition.** W. BLACK, R.R. ACKERMANN, J. SEALY.

3:45-4:00 pm. **Craniofacial shape and allometry in sister taxa of disparate body sizes: *Nasalis larvatus* and *Simias concolor*.** B.C. FRAZIER, J.T. RICHTSMEIER.

4:00-4:15 pm. **The brain morphology of Homo Liujiang cranium fossil by 3-D CT.** X.J. WU, W. LIU. W. DONG, J.Q. QUE, Y.F. WANG.

4:15-4:30 pm. **LB1's endocast compared to those from other hominins.** D. FALK, C. HILDEBOLT, K. SMITH, M.J. MORWOOD, T. SUTIKNA, JATMIKO, E.W. SAPTOMO, F. PRIOR.

4:30-4:45 pm. **The hobbits (*Homo floresiensis*) were not cretins.** W.L. JUNGERS, D. FALK, C. HILDEBOLT, K. SMITH, F. PRIOR, M.W. TOCHERI, C.M. ORR, S.E. BURNETT, S.G. LARSON, T. DJUBIANTONO, M.J. MORWOOD.

4:45-5:00 pm. **Glacial cycling, large mammal community composition, and trophic adaptations in the Western Cape, South Africa.** A.L. RECTOR, B.C. VERRELLI.

Session 17. The Weight of the Matter: Body Mass Estimation Reconsidered. Invited poster symposium. ***River Exhibition Hall B.*** **Organizers: Megan K. Moore and Shamsi Daneshvari. Discussant**: Christopher Ruff

8:00-8:30 am: Poster set-up
6:00-6:30 pm: Poster take-down
10:00-10:30 am. and 2:00-2:30 pm: Authors present for discussion

Methods to estimate body mass fall into two main categories: morphometric and biomechanical, as outlined by Auerbach and Ruff (2004). Body mass estimation has been applied to issues ranging from human evolution to human identification. We are just coming to terms with the biomechanics of the adult skeleton, but the collagen-rich juvenile skeleton poses a completely different set of challenges. With the modern trend of obesity in both adults and juveniles, this topic has gained more clinical immediacy. The purpose of this symposium is to pull together the current methods of body mass estimation from across the different sub-disciplines to provide a comprehensive assessment of both the potential applications as well as pitfalls of current approaches. Improving the methodology can lead us to better application of body mass estimation in the future for primatology, paleoanthropology, bioarchaeology, as well as forensic anthropology.

1. **The substance of subsistence: body mass and nutrition in Pre-Columbian North America.** B.M. AUERBACH
2. **Body mass revisited: a new method to improve the accuracy of individual estimates.** S. DANESHVARI.
3. **Relationships among skeletal dimensions correlated with body mass.** O. M. PEARSON, S. DANESHVARI, AND V. S. SPARACELLO.
4. **A comprehensive regression tree to estimate body mass from the skeleton considering pathology, cross-sectional geometry and bone density.** M.K. MOORE
5. **Childhood obesity and the angle of the femoral neck: Relationship with slipped capital femoral epiphysis (SCFE) and adolescent tibia vara.** C. SEARS & M.K. MOORE.
6. **Body condition as a potential indicator of body mass outliers in modern human populations.** C.W. RAINWATER, L.L. CABO-PEREZ.
7. **Bayesian Approaches to Measuring Body Mass in Subadults from Kulubnarti, Grasshopper Pueblo, and Inamgaon.** G. ROBBINS AND L. COWGILL.
8. **Investigation of the relationship between body mass and cremains weight.** S.E. MAY.
9. **Musculoskeletal markers of the lower limb: A look at obesity's effect on modern American males.** E. KNAPP, R. WILSON, K. GODDE.
10. **Body mass estimation from mid-thoracic ribs in humans**. K.L. EAVES-JOHNSON.

Session 18. Human Biology. Population biological variation. The cultural context of disease and violence. Contributed posters. ***River Exhibition Hall B.*** Chair: Tiffiny A. Tung Dept of Anthropology Vanderbilt University

8:00-8:30 am: Poster set-up
6:00-6:30 pm: Poster take-down
10:00-10:30 am and 2:00-2:30 pm: Author of even number posters present for discussion
10:30-11:00 am and 2:30-3:00 pm: Author of odd number posters present for discussion

11. **Effect of cadmium on femoral bone structure in rats: an animal model for human exposure to this metal.** R. OMELKA, M. MARTINIAKOVÁ, B. GROSSKOPF, M. BAUEROVÁ, R. TOMAN.
12. **Effects of metabolic disorder on cerebellar development and morphology.** K.K. POPE, S.E. CHRIST, A.J. MOFFITT, D. PECK, K. ALDRIDGE.
13. **Morphological Integration of the Down Syndrome Face.** J. STARBUCK, R.H. REEVES, J.T. RICHTSMEIER.
14. **Presentation and heritability of skeletal dyplasia of the hand in the Jirel ethnic group of eastern Nepal.** K.D. WILLIAMS, J. BLANGERO, C.R. COTTOM, S. LAWRENCE, B. JHA, J. SUBEDI, S.A. CZERWINSKI, S. WILLIAMS-BLANGERO, B. TOWNE.
15. **Physical measurements as health indicators in Latino children of Springfield, Missouri: a pilot study.** S.E. WALKER-PACHECO.
16. **The time of blood pressure measurement influences the effects of age on blood pressure.** G.D. JAMES, H.M. VAN BERGE-LANDRY
17. **Patterns of genetic variation at *ICAM-1* in diverse African populations.** F. GOMEZ, G. TOMAS, J. ROCHA, AND S. A. TISHKOFF

18. **Divergence of human and chimpanzee chemokine receptor structure: 3Dimensional (3D) modeling of HIV-1 co-receptors**. J.F. BRINKWORTH.

19. **Investment in health resources: A pilot study using HDR indicators.** K. MUNNELLY

20. **Relationship between body morphology and lipid levels among the Mennonites of Henderson, Nebraska.** CHITTOOR, A. E. JUSTICE, M. H. CRAWFORD.

21. **The implications of cross-cultural variation in fluctuating asymmetry for its use as a measure of early-life exposure to stress.** B.N. YOUNG, A.M. HURTADO, J. BAKE, K. HILL.

22. **Chullpas, caves, and biological affinity: a case study from Marcajirca, Peru**. C.M. PINK, B. IBARRA ASENCIOS.

23. **Homicide at Qasr al-Hallabat: analysis of blunt force trauma in an 8th-10th century A.D. Jordanian skeletal sample.** M.A. PERRY and R.T. MONTGOMERY.

24. **Resting in War and Peace: A Bioarchaeological Study of Group Violence in Peruvian Prehistory.** D.S. KURIN.

25. **Straight to the bone: identifying cutmarks on human bone**. M. VELASCO, T.A. TUNG.

26. **A biomechanical approach to the identification of activity-related change in the upper limb in the Late Woodland period.** A.R. DEPALMA AND J.A. RHODES. PAPER WAS NOT ORIGINALLY HERE.

27. **Juvenile growth in the medieval English cemetery population of Hereford Cathedral Close.** D.A. WESTON, A.E. BOYLSTON, A.R. OGDEN, D. HURST. PAPER WAS NOT ORIGINALLY HERE.

28. **Nutrition and stature: the residents of the island of Gotland, Sweden killed in the Battle of Wisby, 1361**. M. MILLER.

29. **An ethnographic and bioarchaeological assessment of Zuni warfare and leadership.** K.E. KULHAVY.

30. **Risk of Dying from Warfare-Related Trauma: Determining the Impact of Pre-existing Conditions on Victim Selection.** D.W. STEADMAN, J.J. WILSON, AND G.R. MILNER.

31. **Patterns of violent and non-violent trauma in a medieval population from Giecz, Poland.** A.M. AGNEW, H.M. JUSTUS.

32. **Warfare and violence in the Iron Age of East Yorkshire.** S.S. KING.

33. **Victims of the Shimabara Rebellion in 1638 excavated from the Hara Castle site, Japan.** T. WAKEBE, K. SAIKI, K. OKAMOTO, M. YONEDA, H. ISHIDA

Session 19. Skeletal Biology: Paleopathology and bioarchaeology. Contributed posters. *River Exhibition Hall B.*

Chair: Sandra J. Garvie-Lok Dept. of Anthropology University of Alberta
8:00-8:30 am: Poster set-up
6:00-6:30 pm: Poster take-down
10:00-10:30 am. and 2:00-2:30 pm: Author of even number posters present for discussion
10:30-11:00 am. and 2:30-3:00 pm: Author of odd number posters present for discussion

34. **Stops and starts: growth, nutrition, and Harris lines.** MP. ALFONSO-DURRUTY.

35. **The effects of disease and malnutrition on skeletal growth.** K. MACCORD, J. CRAY.

36. **Trends in lumbar vertebral body and lamina osteophytes.** L.A. ZUKOWSKI, A.B. FALSETTI.

37. **Bioarchaeological insights into Health and Emerging Social Differentiation at Neolithic Tell Halula (Syria).** E. GUERRERO, J. ANFRUNS, I. KUIJT, M. SCHURR, M. MOLIST.

38. **A pain in the neck: vertebral osteoarthritis and related activity patterns in Early Bronze Age Jordan.** L.A. GREGORICKA, J.M. ULLINGER.

39. **Mining the steppes: community health during the Sintashta period.** M.A.JUDD, M.E.KOVACIK, B.HANKS, D. RAJEV, A.EPIMAKHOV

40. **Normality is relative: a populational approach to vertebral deformity in archaeological populations.** A.L. WATSON.

41. **Differential Diagnosis of a Possible Coccidioidomycosis Infection in New Mexico: AD 1712-1903.** A.K. GOFF, H.J.H. EDGAR.

42. **Assessment of childhood health using skeletal indicators in a 19th century quarantine cemetery from the Northeastern U.S.** D.C. MARTIN.
43. **Investigating patterns of Ontario Iroquoian infant and juvenile health and mortality.** C.L. FORREST
44. **Measuring Mimbres population health status during the pithouse to pueblo transition.** J.L. GRUBER, L.M. RANKIN-HILL.
45. **Preliminary determination of a possible β--Thalassemia causing genetic mutation in the Tipu Maya Skeletal Collection through DNA sequencing.** BHALLA N.
46. **A case of bilateral auditory exostosis from the Pacific coast of central-south Chile.** E. GAYTÁN, M.A. TORNOW
47. **Childhood health in Anglo-Saxon Britain: evidence from the Christian cemetery population of Church End, Cherry Hinton, Cambridgeshire**. K.T. BLUE.
48. **Sex, society & syphilis: an investigation of social identity-mediated patterns of acquired syphilis in early modern England (1500-1850).** ZUCKERMAN, M.K.
49. **Analysis of dental pathologies in a medieval Scandinavian sample, with a comparison to prevalence of cribra orbitalia.** S. CARRAHER, C. L. HANSON.
50. **Hypothyroidism in alpine medieval Switzerland.** C. PAPAGEORGOPOULOU
51. **olecular identification of brucellosis in human skeletons from Butrint, Albania**. M.J. MUTOLO.
52. **Osteoporosis in medieval human and sheep femurs from the site of Dubovany (western Slovakia).** M. MARTINIAKOVA.
53. **Human skeletal remains from the prehistoric site of Franjevac, Eastern Croatia.** P. RAJIĆ ŠIKANJIĆ, I. JANKOVIĆ, J. BALEN.
54. **Scurvy in a Late Roman Greek child: multiple lines of evidence.** S. GARVIE-LOK, C. PENNYCOOK, R. STARK.
55. **Pressure induced atrophy in the posterior cranial fossa – Suspicion of brain herniation.** S. KLINGNER, J. GRESKY, M. SCHULTZ.
56. **Bioarchaeological evidence for a regional pattern of trophy-taking in prehistoric central California**. V.A. ANDRUSHKO, A.W. SCHWITALLA, P.L. WALKER.
57. **Voices from the Past: An analysis of ancestry of a French Colonial cemetery in Biloxi, Mississippi.** D.N. COOK.
58. **From coprolites to ancient human microbiomes.** R.Y. TITO, C.M. LEWIS.
59. **Utah Lake skull cap: yet another Archaic buriaL?** S. D. SPENCER, D. C. COOK, J. B. COLTRAIN, H. D. KLAUS
60. **Evidence of treponemal disease in Archaic southern Illinois.** T.J. GOLDEN, S.M. FORD, T.L. PROWSE.
61. **A unique commingled burial at the Norris Farms 36 cemetery: questioning the "revered ancestor" hypothesis.** C.E. BIRD, A.R. MICHAEL.
62. **Mitochondrial DNA variation among ancient Adena populations from Kentucky.** D.A. BOLNICK, H.M. BONINE.
63. **Sexual dimorphism of antero-posterior deformation in prehistoric Mogollon crania from southern New Mexico.** L.D. REYES, M.L. MCCROSSIN.
64. **Schmorl's Nodes and the sexual division of labor in a Native American maize horticulturalist society**. S. ROONEY K. MACCORD, J. CRAY, M.E. KOVACIK.
65. **Understanding Middle and Late Archaic forelimb removal: an experimental approach.** R.A. LOCKHART C. W. SCHMIDT, S. A. SYMES.
66. **The excavation and analysis of an historic cemetery population from Indianapolis, Indiana.** A. J. KOEHL, J. J. BEACH, K. E. LATHAM, S. P. NAWROCKI.
67. **Insights into the historical and skeletal demography of an early Tucson cemetery.** N.P. HERRMANN, W.R. TRASK, M.P. HEILEN, L.W. KONIGSBERG
68. **Life and death at Butrint, Albania: paleopathology and mortuary behavior in Late Antiquity.** J.S. BEATRICE, T.W. FENTON, C.M. RAUZI, J.C. WANKMILLER, L.L. JENNY, D.R. FORAN
69. **Growth and development in a Peruvian archaeological sample.** C.A. BRADBURY, M. STREETER, J.E. BUIKSTRA

Friday April 3rd, 2009. Morning sessions.

70. **Growth and estimated skeletal height of Mochica juveniles, Peru (A.D. 900- 1750).** G.J. JAKUBOWSKA, S. H. BLATT.

71. **A contribution to bioarchaeological study of the social hierarchies in a population in the Sabana de Bogotá (Colombia).** GUZMAN, C. LANGEBAEK, N. ARAUJO, C. MORA, A. PAEZ, C. ROJAS.

72. **Bones in the Beach: Preliminary results from Isla San Lucas.** A.D. COHEN, M. FARALDO, G. VILLALOBOS, AND J.V. GUERRERO

73. ***In situ* analyses of partial human skeletal remains: Four key elements.** J. VENTURA, L.L. LOPEZ, AND M. FARALDO

74. **Analysis of cranial remains from the Zoroastrian Tower of Silence, Sanjan, India (1410-1450 AD).** A. DUTT.

75. **A re-evaluation of the traditional interpretation of British Prehistoric non-formal funerary and depositional practices.** J. T. TRACEY.

76. **Fractures of the metacarpal bones in a historical population.** B. MAFART, L. DEBONO

77. **Bioarcheology of the Late Upper Paleolithic burial Villabruna 1 (Val Cismon, Italy).** G. VERCELLOTTI, V. FORMICOLA.

78. **Reconstruction of the Poliziano skull using geometric morphometrics methods for further application in forensic analysis.** E. STANSFIELD (NEE BULYGINA), S. BENAZZI, G. GRUPPIONI.

79. **Arsinoe IV of Egypt, sister of Cleopatra identified? Osseous and molecular challenges.** F. KANZ, K. GROSSSCHMIDT, J. KIESSLICH.

80. **Hearths for the dead: The effects of secondary firing on human bone from northern Mesopotamia 2000-1600 BCE.** LAURA RAMOS.

81. **Juvenile burial from the Eneolithic site of Josipovac – Gravinjak, Croatia.** D. VLAK, I. JANKOVIĆ, S. MIHELIĆ.

Session 20. Paleoanthropology. Hominin Evolution. Contributed Posters. *River Exhibition Hall B.*

Chair: Michelle S.M. Drapeau Department of Anthropology Université de Montréal.

8:00-8:30 am: Poster set-up
6:00-6:30 pm: Poster take-down
10:00-10:30 am. and 2:00-2:30 pm: Author of even number posters present for discussion
10:30-11:00 am. and 2:30-3:00 pm: Author of odd number posters present for discussion

82. **3D landmark and semilandmark geometric morphometric analysis of the Zuttiyeh fronto-zygomatic fragment.** S. FREIDLINE, K. HARVATI, I. JANKOVIC, P. GUNZ, E. DELSON, J.J. HUBLIN.

83. **Integrated variation in facial orientation and the craniomandibular skeleton in the extant great apes.** S.N. COBB, H. BAVERSTOCK.

84. **Inferred body proportions of a southern European Neandertal, Palomas 92.** E. TRINKAUS, M.J. WALKER, J. MAKI, M.V. LÓPEZ, J. ORTEGA.

85. **Comparative functional morphology and bilateral asymmetry of the clavicle in the Regourdou (Neanderthal) and Chancelade (late Upper Paleolithic) adult skeletons (Western France): a high-resolution endostructural analysis.** V. VOLPATO, C. COUTURE, B. VANDERMEERSCH, A. MAZURIER, R. MACCHIARELLI.

86. **The facial reconstruction of the Lapedo Child.** B.E. PIERSON, F. ALMEIDA.

87. **Incisor Root Morphology in Neanderthals and *Homo sapiens*.** A. LE CABEC K. KUPCZIK, J. BRAGA, J.-J. HUBLIN

88. **Buccal dental microwear and tooth crown morphology in Neandertals and modern humans show significant correlations with prevailing climatic conditions throughout the Middle and Upper Paleolithic in Europe.** B. PINILLA, A. PÉREZ-PÉREZ.

89. **Occlusal molar microwear texture analysis of Middle and Upper Paleolithic juveniles.** S. EL ZAATARI AND J-J HUBLIN.

90. **Mimosa: a new Middle Stone Age fossil locality in the Free State of South Africa.** J. K. BROPHY, D.J. DE RUITER, J.S. BRINK.

91. **The Otjiseva skull reconsidered: a renewed look at the geological context, dating, and significance of a lost Namibian fossil.** G.S. McCall, H.E. Marsh.

92. **Cortical bone topography and cross-sectional geometric properties of two Upper Paleolithic adult femoral shafts: Cro-Magnon 1 and Chancelade (Western France).** L. PUYMERAIL, R. MACCHIARELLI.

93. **Differential growth of the maxilla and mandible as an explanation for variation in mentum osseum size.** J.E. SCOTT, N.E. HOLTON, R.G. FRANCISCUS, S.D. MARSHALL, T.E. SOUTHARD.

94. **Effects of habitual activity patterns on modern human elbow morphology: a comparison of elbow joint size among four modern human populations and *Homo neanderthalensis.*** H. CHIRCHIR.

95. **Upper Paleolithic Human Remains from Šandalja Cave, Istria, Croatia.** I. JANKOVIĆ, J.C.M. AHERN, I..KARAVANIĆ, T. STOCKTON, F.H. SMITH.

96. **The Aurignacian human remains from La Quina-Aval (Charente, France).** C. VERNA, V. DUJARDIN, E. TRINKAUS.

97. **Results from early excavation at Tam Hang, Laos**. L.L. SHACKELFORD, F. DEMETER, A.-M. BACON, P. DURINGER, E. EDOUMBA, T. SAYAVAONGKHAMDY.

98. **Short stature among contemporary populations of highland Indonesia.** E. INDRIATI, W.R. LEONARD. A.T. HASCARYO, R.A. SURIYANTO, T. KOESBARDIATI, J. HASTUTI, DB. MURTI.

99. **Liang Bua skeletal remains in comparative context: Stature in individuals, samples, populations, and species.** R. B. ECKHARDT, A. J. KUPERAVAGE, M. HENNEBERG.

100. **Insights from developmental genetics and reproductive isolation in hominin species.** C.A. KNOX, K.K. BURNITZ.

101. **Eurasian hominine origins: phylogenetic, paleobiogeographic and paleoenvironmental evidence.** M.C. NARGOLWALLA, D.R. BEGUN.

102. **New light on cranial bone adhering to matrix encasing Sts 5 ("Mrs Ples") from Sterkfontein, South Africa** POTZE, S. AND THACKERAY, J.F.

103. **Molar crown development in *Australopithecus afarensis* and aspects of hominin life history.** R.S. LACRUZ, F.V. RAMIREZ ROZZI.

104. **Buccal dental microwear analyses show that *Australopithecus afarensis* might have benefited from both closed woodland and open savannah environments independently of climatic conditions.** F. ESTEBARANZ, A. PÉREZ-PÉREZ, L.M. MARTÍNEZ, J. GALBANY, D. TURBÓN.

105. **Facial mechanics in early hominins: a study combining geometric morphometrics and finite elements analysis.** P. O'HIGGINS , S.N. COBB, L. FITTON, F. GRÖNING, R. PHILLIPS, M.J. FAGAN

106. **The significance of systematic sampling in paleoenvironmental reconstruction: A Case from Koobi Fora, Kenya.** V. M. IMINJILI, H. CHIRCHIR, R. BOBE. Poster originally not here.

107. **Interspecies orbit shape: An analysis of the morphological differences of the aperture in hominoids** D.R. SAMSON, P.R. HUSMANN.

108. **Metacarpal head torsion in apes, humans, and *Australopithecus afarensis*.** M.S.M. DRAPEAU.

109. **An Infant Hominid First Metatarsal from Hadar, Ethiopia.** H.A. HILLENBRAND AND BRUCE LATIMER.

110. **Variability selection and *Kolpochoerus heseloni* (Artiodactyla, Suidae): a model for the dichotomous morphologies of *Australopithecus afarensis*.** R.E. CUDDAHEE, R. BOBE.

111. **Taphonomy and paleoenvironment of Laetoli: the micromammal evidence.** C. DENYS, D. N. REED.

112. **New discoveries from Kromdraai, South Africa, relating to the type specimen of *Paranthropus robustus*, TM 1517**. THACKERAY JF, J. BRAGA, PAUL SABATIER S. POTZE, L. KGASI, F. SENEGAS.

Session 21. Paleoanthropology: The non-hominin Primate Fossil Record Poster, *River Exhibition Hall B.*

Chair: David R Begun University of Toronto

8:00-8:30 am: Poster set-up
6:00-6:30 pm: Poster take-down
10:00-10:30 am. and 2:00-2:30 pm: Author of even number posters present for discussion
10:30-11:00 am. and 2:30-3:00 pm: Author of odd number posters present for discussion

113. **Molecular divergence dates suggest an origin of crown primates near the K/T boundary.** J.A. HODGSON, L. POZZI, K.N. STERNER, C.B. STEWART, T.R. DISOTELL

114. **Great ape and human phylogeny.** A. BJARNASON, A.T. CHAMBERLAIN, C.A. LOCKWOOD.

115. **Community structure and history: patterns of ecospace among fossil primate communities.** S.L. MENZIES, K.E. REED.

116. **Trait independence in Eocene primate dental evolution**. K. E. CARTER.

Friday April 3rd, 2009. Morning sessions.

117. **The phylogenetic affinities of the Pondaung tali.** M. DAGOSTO, L. MARIVAUX, D.L. GEBO, K.C. BEARD, Y. CHAIMANEE, J.-J. JAEGER, B. MARANDAT, A.N. SOE, S.T. TUN, A.A. KYAW.

118. **New *Anapithecus* jaws from the late Miocene of Rudabánya, Hungary.** D.R. BEGUN, L. KORDOS.

119. **New primate fossils from the late Oligocene Nsungwe Formation, Rukwa Rift Basin, Tanzania.** N.J. STEVENS, P.M. O'CONNOR, E.M. ROBERTS, M.D. GOTTFRIED, J. TEMBA

120. **Differences in cercopithecid communities in the African Plio-Pleistocene.** A.E. SHAPIRO**.**

121. **Mosaic macaque morphology and its implications for the evolution of African papionin crania.** T.A. PEBURN.

122. **3D geometric morphometric analysis of the mandible of *Rudapithecus hungaricus* from the late Miocene of Rudabánya (Hungary).** M.K. PITIRRI, N. SINGH, K. HARVATI, D.R. BEGUN, L. KORDOS.

123. **Locomotor adaptations of the humerus of *Mesopithecus pentelicus* and *M.* cf. *delsoni* from Greece.** D. YOULATOS, K. TOKALAKI, G.D. KOUFOS.

124. **Phyletic affinities of *Samburupithecus kiptalami*: a late Miocene proconsulid.** ANTHONY J. OLEJNICZAK, DAVID R. BEGUN, EMMA MBUA, JEAN-JACQUES HUBLIN.

125. **New fossil papionins from the Late Miocene of As Sahabi, Libya.** B.R. BENEFIT, R.M. SALEM, M.L. MCCROSSIN, N.T. BOAZ AND P. PAVLAKIS.

126. **Are there really any hominoid sclerocarp foragers in the middle Miocene? A closer look at the anterior dental evidence.** A.S. DEANE

127. **The endocast of *Microsyops annectens* (Microsyopidae, Primates) and brain evolution in stem primates.** M.T. SILCOX, A.E. BENHAM, J.I. BLOCH.

128. **A new paleontological site in the Zhaotong Basin of Yunnan Province, China.** D.F. SU, X. JI, J. KELLEY, N. G. JABLONSKI.

129. **The phylogenetic relationship of adapoids, omomyoids, plesiadapiforms, and extant euarchontans based on infraorbital foramen size.** MAGDALENA N. MUCHLINSKI.

130. **Fluvial transport of hominin-and carnivore-modified long bone fragments.** M.C. PANTE, R.J. BLUMENSCHINE.

131. **Poster available for organizers**

132. **Skull shapes, maps, and microscribes.** C. SIMONIS, M. FRIESS, F. DETROIT.

Session 22. Primatology: Mammal and primate functional and comparative anatomy. Primate Locomotion and Ranging. Contributed posters. ***River Exhibition Hall B.*** Chair: Kristiaan D'Août University of Antwerp and Centre for Research and Conservation. Belgium.

8:00-8:30 am: Poster set-up
6:00-6:30 pm: Poster take-down
10:00-10:30 am and 2:00-2:30 pm: Author of even number posters present for discussion
10:30-11:00 am and 2:30-3:00 pm: Author of odd number posters present for discussion

133. **Recovery and preservation of a mountain gorilla skeletal resource in Rwanda.** S.C. MCFARLIN, T.G. BROMAGE, A.A. LILLY, M.R. CRANFIELD, S.P. NAWROCKI, A. ERIKSEN, D. HUNT, A. NDACYAYISENGA, C. KANIMBA MISAGO, A. MUDAKIKWA.

134. **A comparative analysis of minicolumns in association versus primary motor, sensory and visual cortex in apes and humans.** K.TEFFER, M.S.PARK, K.TRAVIS, D.BUXHOEVEDEN, K.SEMENDEFERI.

135. **Neuronal propagation patterns during cortical neurogenesis individuate evolutionary units in the Human neocortex.** L.D. GLOTZER.

136. **Integration during ontogeny of the cranium of *Homo sapiens* and *Pan troglodytes*.** J.M. POLANSKI.

137. **Endocranial growth and development during postnatal ontogeny in chimpanzees (*Pan troglodytes*).** F. VENTRICE, F.V. RAMIREZ ROZZI, A.-M. GUIHARD-COSTA.

138. **Heterochrony of cranial features associated with wide jaw gapes in common marmosets (*Callithrix jacchus*).** A.L. MORK, C.J. VINYARD.

139. **Anthropoid body mass dimorphism: effects of taxonomic scale.**A.D. GORDON.

140. **Three-dimensional geo-morphometric analysis of the pelvis of *Alouatta*, *Lagothrix*, and *Ateles*.** E.R. MIDDLETON.
141. **Astragalar proximal facet shape: Differences in articular morphology among closely related hominoid taxa.** K. TURLEY, E. HENDERSON, S. FROST.
142. **New anatomical variants of the ethmoid complex in *Pan troglodytes*.** T. KOPPE, T. NISHIMURA, AND M. ARNDT.
143. **Comparative analyses of size of pneumatized spaces within temporal bones of extant species.** C.A. HILL.
144. **Factors contributing to hominoid shoulder morphology: muscle size, ontogeny, and behavior.** D.J. GREEN, M.W. HAMRICK, B.G. RICHMOND.
145. **Comparative forefoot form and function in *Homo sapiens* and *Pan*: joint orientation and *in vivo* kinematics.** N.L. GRIFFIN, B.G. RICHMOND, K. D'AOÛT, A.D. GORDON, AND P. AERTS.
146. **Associations of gait, support use and limb morphology in West African colobines: the effects of bounding on locomotor biomechanics.** W.S. MCGRAW AND D.J. DAEGLING.
147. **Classification of Hylobatidae: what does anatomy contribute?** A. L. ZIHLMAN, A.R. MOOTNICK , C. E. UNDERWOOD
148. **The Gibbon Hind Limb: What is it specialized for?** A.J. CHANNON, M.M. GÜNTHER AND E.E. VEREECKE
149. **Influence of locomotion on the hominoid humeral trochlea.** J. ROBERT, M.S.M. DRAPEAU.
150. **Scapula motion during walking in arboreal quadruped primates**. M. SCHMIDT.
151. **Effects of locomotion – Morphological differences in humeral cancellous bone of hominids and their relation to habitual loading conditions of the shoulder joint.** H. SCHERF, R. TILGNER, J.J. HUBLIN.
152. **The relationship between arm swinging behavior and postcranial morphology in *Ateles* and *Lagothrix*.** SCHMITT D., ROSE, M.D., TURNQUIST, J. E.
153. **Locomotor effects on trabecular bone structure in the proximal femur and humerus of primates.** T.M. RYAN, A. WALKER, M. TEST, AND I. CARLSON.
154. **Humeral and femoral cross-sectional shape of suspensory sloths and primates.** E.L.R. SIMONS, B.A. PATEL, C.B. RUFF.
155. **The ontogeny of humeral torsion and locomotor behavior in African apes: implications for interpreting the hominoid fossil record.** T.R. REIN, C. FELLMANN, S.E. INOUYE.
156. **Comparative prezygapophyseal shape variation in the nonhuman primate vertebral column.** G.A. RUSSO AND E.H. HARMON.
157. **Compliant feet in bipedalism: can elastic recoil contribute to propulsion?** E.E. VEREECKE & P. AERTS.
158. **Postcranial ontogeny in captive sifaka (*Propithecus verreauxi*).** R.E. WUNDERLICH AND T.L. KIVELL.
159. **The effects of digitigrade cheiridial postures on speed and gait in infant baboons.** A. ZEININGER, L.J. SHAPIRO, D.A. RAICHLEN.
160. **The effects of substrate size on quadrupedal locomotion in a small-bodied arboreal marsupial, *Petaurus breviceps* (sugar glider).** L.J. SHAPIRO, J.W. YOUNG.
161. **Coronoid process morphology and function in anthropoid primates.** T.B. RITZMAN, M.A. SPENCER.
162. **Rediscovery of the pygmy tarsier.** N. GROW, S. GURSKY.
163. **Isostress analysis of maxillary canines in cercopithecoid monkeys.** A.J. RAPOFF, W.S. MCGRAW, D.J. DAEGLING.
164. **Diet and craniofacial variation in three west African colobine species.** O.S. ULVI, W.S. MCGRAW.
165. **Morphological disparity in the cranium and dentition of "prosimian" primates.** E. M. ST CLAIR.
166. **The location of the jaw adductor resultant vector in strepsirrhines.** J.M.G. PERRY, A. HARTSTONE-ROSE
167. **Scaling relationships in the anthropoid temporomandibular joint.** C.E. TERHUNE,
168. **Jaw-muscle fiber architecture in great apes: a preliminary analysis of fiber length and physiologic cross-sectional area.** A.B. TAYLOR, J.R. SWANIKER, C.J. VINYARD.
169. **Testing the adaptive significance of the catarrhine symphysis using Finite Element Analysis.** O. PANAGIOTOPOULOU, S.N. COBB.

Friday April 3rd, 2009. Morning sessions.

170. **Changing faces: an examination of robust craniofacial features in *Macaca majori* and implications for the hominid fossil record.** A.L. SMITH, K. KUPZIK, M.J. FAGAN, L. ROOK, D.S. STRAIT, I.R. GROSSE, P. O'HIGGINS.

171. **Analysis of variation in masseter and temporalis EMGs during mastication in primates and treeshrews.** C.E. WALL, C.J. VINYARD, S H. WILLIAMS, W.L. HYLANDER

172. **Dental Development in the Taï Forest Chimpanzees Reappraised.** T.M. SMITH, B.H. SMITH, C. BOESCH.

173. **Testing an explanatory model for the variable presence of cusp 6 in *Pan* lower molars.** M.M. SKINNER, P. GUNZ, J-J. HUBLIN.

174. **The Use of A Repeated-Route System In Three Groups Of Phayre's Leaf Monkeys (*Trachypithecus Phayrei*) In Thailand.** S.A. SUAREZ.

175. **Ranging patterns of hamadryas baboons: random walk analyses.** A.L. SCHREIER, M.J. GROVE.

176. **Changes in sex ratios, home range size, and diet in the black howler monkey (*Alouatta pigra*) at the Calakmul Biosphere Reserve, Mexico.** K.A. RIZZO, A. STAHLER

177. **Carbon and nitrogen isotope variation among five sympatric lemur species from Betampona Natural Reserve, Madagascar.** P. SANDBERG, E. MERTZ, M. SPONHEIMER, D. VAN GERVEN.

178. **Mammalian limb loading and chondral modeling during ontogeny.** A.S. HAMMOND, J. NING, C.V. WARD, M.J. RAVOSA.

179. **Effects of habitat light intensity on the evolution of mammalian visual anatomy: implications for primate ecology and evolution.** C.C. VEILLEUX, R.J. LEWIS.

180. **Genetic and Behavioral Observations of "Kinda" Baboons (Papio cynocephalus kindae) in Zambia.** J.E.PHILLIPS-CONROY, C.J. JOLLY, A.S. BURRELL, J.A. ROGERS, A.H.WEYHE

181. **Intestinal parasites of Zambian baboons.** A.H. WEYHER, J.E. PHILLIPS-CONROY, AND C.J. JOLLY.

182. **Morphology of genetically-confirmed hybrids of *Alouatta pigra* and *A. palliata* from a natural hybrid zone in Tabasco, Mexico.** M.A. KELAITA & L. CORTÉS-ORTIZ.

183. **Are variations in tool use behaviors amongst wild chimpanzee populations the result of genetic differences or social learning processes? A phylogenetic assessment**. S.J. LYCETT, M. COLLARD, W.C. MCGREW.

184. **A landmark based approach to the study of the ear ossicles using ultra high resolution X-ray computed tomography data.** J.L. SCHMIDT, M.T. SILCOX, T.M. COLE III.

185. **Dietary diversity and dental microwear variability in *Theropithecus gelada* and *Papio cynocephalus*.** R.S. SCOTT, M.F. TEAFORD, P.S. UNGAR.

186. **Bloodletting and bone: possible links between cultural practices and porotic hyperostosis.** E. SHATTUCK, B.A., N.A. JASTREMSKI.

187. **Paper withdwawn.**

Session 23. Primatology. Communities, growing up, reproduction, life history and ecology. Contributed papers. ***Chicago 8.*** Chair: Jason M Kamilar Washington University

8:00-8:15 am. **Chest staining variation as a signal of testosterone levels in male Verreaux's sifaka**. R. J. LEWIS

8:15-8:30 am. **Morphometric data and patterns of growth in wild *Propithecus edwardsi* at Ranomafana National Park, Madagascar.** S.J. KING, T.L.MORELLI, S. ARRIGO-NELSON, S. TECOT, L.R. GODFREY, J. JERNVALL, P.C. WRIGHT.

8:30-8:45 am. **Tannin intake in spiny forest-dwelling *Lemur catta* at Berenty reserve, Madagascar during reproductive periods: do *L. catta* females ingest condensed tannins as a reproductive strategy?** L. GOULD, P. CONSTABEL, R. MELLWAY

8:45-9:00 am. **Growing as cheirogaleids: life history and age-related differences between eastern mouse and dwarf lemurs.** M.B. BLANCO, V. RAHALINARIVO AND L.R. GODFREY.

9:00-9:15 am. **Multilevel Societies in Colobines.** CYRIL C. GRUETER AND CAREL P. VAN SCHAIK.

9:15-9:30 am. **Habitat and P opulation Status of White-collared Lemurs (*Eulemur cinereiceps*) at Manombo, Madagascar: 10 years of Recovery after Cyclone Gretelle.** S.E. JOHNSON, C. INGRALDI, F.B. RALAINASOLO, H.J. RATSIMBAZAFY.

9:30-9:45 am. **The evolutionary implications of the cercopithecine cheek pouch for group size and sociality.** D.L. HANNIBAL.

9:45-10:00 am. **The Phylogenetic Structure of Primate Communities Within and Between Continents** L.M. GUIDI, J.M. KAMILAR

10:00-10:15 am. **Southeast Asian primate communities: the effects of ecology and history on species richness.** H.M. HASSEL-FINNEGAN, C. BORRIES, A. KOENIG.

10:15-10:30 am. **Break**

10:30-10:45 am. **A framework for understanding thermoregulation in primates.** N.G. JABLONSKI, E.A. KELLEY, R.W. SUSSMAN, G. CHAPLIN.

10:45-11:00 am. **Sexual selection and primate extinction risk.** J.D. ORKIN, J.M. KAMILAR.

11:00-11:15 am. **Natural birth control: seasonal increases in fecal progestins affect reproductive function in wild female Phayre's leaf monkeys (*Trachypithecus phayrei*).** A. LU, C. BORRIES, N.M. CZEKALA, J.C. BEEHNER.

11:15-11:30 am. **Using macroecological methods to examine across-site variation in chimpanzee behavior**. J.M. KAMILAR, J. MARSHACK.

11:30-11:45 am. **Savanna chimpanzee (*Pan troglodytes verus*) feeding ecology at Fongoli, Senegal.** S.L. BOGART, J.D. PRUETZ.

11:45-12:00 **Sex differences in western gorilla arboreality.** D. DORAN-SHEEH1, M. ANDRIANADY, J. LODWICK

Session 24. Detecting Natural Selection in Humans. Invited podium symposium. Co-sponsored by the Human Biology Association. *Chicago 9.* Organizer: Stephen T McGarvey.

The purpose of the symposium is to present the latest evidence, prospects and challenges for detection of natural selection in human populations. AAPA members and other attendees will be interested to hear about the methods and evidence for detecting the signatures of natural selection in human populations. In addition many of AAPA members conduct fieldwork in populations with a diversity of demographic histories sometimes indicative of relative isolation. Thus, we often wonder how we might apply tools to detect natural selection to our study populations, or offer data from our study populations to research groups skilled in asking these questions and applying these new tools.

8:00-8:15 am. **Selection, drift, and geography in recent human evolution.** GRAHAM COOP, JOSEPH K. PICKRELL, SRIDHAR KUDARAVALLI, JOHN NOVEMBRE, RICHARD M. MYERS, LUIGI LUCA CAVALLI-SFORZA, MARCUS W. FELDMAN, AND JONATHAN K. PRITCHARD

8:15-8:30 am. **Issues in Detecting Natural Selection in Humans.** JOSHUA AKEY.

8:30-8:45 am. **Genetics, Selection, Perception and the Human Face.** M.D. SHRIVER, D. LIBERTON, AND K. MATTHES, J. BOSTER AND D.A. PUTS.

8:45-9:00 am. **Characterizing the effects of background selection in the human genome** RYAN HERNANDEZ AND MOLLY PRZEWORSKI.

9:00-9:15 am. **Evolution and natural selection of skin color.** E.J. PARRA

9:15-9:30 am. **Natural selection for adiposity and metabolic traits.** S.T. MCGARVEY.

9:30-9:45 am. **Natural Selection and High Altitude.** LORNA G. MOORE, MEGAN WILSON, COLLEEN G. JULIAN, ABIGAIL BIGHAM, MARK SHRIVER.

9:45-10:00 am. **Natural selection and alcohol.** H. LI, S. GU, J.R. KIDD, K.K. KIDD.

10:00-10:15 am. **Discussant,** LYNN JORDE

10:15-10:30. **Break**

Session 25. Human Biology. Human population variation and disease. Contributed papers.

Chair: Cynthia M Beall Case Western Reserve University. ***Chicago 9.***

10:30-10:45 am. **Pulmonary artery hemodynamics of high and low altitude native Ethiopian Amhara.** C.M. BEALL, B. HOIT, N.DALTON, A. GEBREMEDHIN, K.P. STROHL, S.C. ERZURUM

10:45-11:00 am. **Ancestry-associated variation in endogenous antioxidant activity during high-altitude pregnancy.** C.G JULIAN, E. VARGAS, A. BINGHAM, M. SHRIVER, J.M. MCCORD, H. YAMASHIRO, M. J. WILSON, L.G. MOORE

11:00-11:15 am. **Tuberculosis transmission and maintenance in small, low-density populations.** J.T. ACHTERBERG.

Friday April 3rd, 2009. Morning sessions.

11:15-11:30 am. **Epidemiological profile of an urban immigrant population.** R.A. HALBERSTEIN.

11:30-11:45 am. **Culture matters: Genes, environment, and complex disease.** C.J. MULLIGAN, A.L. NON, C.C. GRAVLEE.

11:45-12:00 **The Paleolithic Disease-scape, the Hygiene Hypothesis, and the Second Epidemiological Transition**. G.J. ARMELAGOS, K.N. HARPER, A. R. CAMPBELL AND G. A. ROOK.

Session 26. Paleoanthropology. Hominin evolution. Contributed papers. *Chicago 10.*

Chair: Alfredo Coppa Dipartimento di Biologia Animale e dell'Uomo, Università di Roma.

8:00-8:15 am. **Late Pleistocene/Holocene human populations transition in Old World: the analysis of morphological dental traits.** A. COPPA, F. CANDILIO, A. CUCINA, F. DEMETER, A.KUTTERER, M. LUCCI, F. MANNI, A. OUJAA, S. ROUDESLI-CHEBBI, R. VARGIU.

8:15-8:30 am. **Megafaunal extinctions during the OIS 3-2 transition in Japan: A human blitzkrieg sensu lato model.** C.J. NORTON, Y. KONDO, A. ONO, Y. ZHANG, M.C. DIAB.

8:30-8:45 am. **A human mandible BH-1 from the Pleistocene deposits of the Mala Balanica cave (Sićevo gorge, Serbia).** M.ROKSANDIC, D.MIHAILOVIĆ, V.DIMITRIJEVIĆ.

8:45-9:00 am. **Morphometric analysis of the Herto cranium (BOU-VP-16-1): Where does it fit?** K.D. LUBSEN, J.L. MAYHER, R.S. CORRUCCINI.

9:00-9:15 am. **Facial biomechanics in *Australopithecus africanus:* implications for feeding ecology.** D.S. STRAIT, G.W. WEBER, S. NEUBAUER, J. CHALK, B.G. RICHMOND, P.W. LUCAS, M.A. SPENCER, C. SCHREIN, P.C. DECHOW, C.F. ROSS, I.R. GROSSE, B.W. WRIGHT, P. CONSTANTINO, B.A. WOOD, B. LAWN, W.L. HYLANDER, Q. WANG, D.E. SLICE, C. BYRON, A.L. SMITH.

9:15-9:30 am. **A morphometric analysis of the middle face in SK 847 and STW 53 in comparison to the maxillae of *Paranthropus*, *Australopithecus* and early *Homo.*** F.L. WILLIAMS, L. SCHROEDER, R.R. ACKERMANN.

9:30-9:45 am. **Size and scaling in the hominin brow.** BLUMENFELD J.

9:45-10:00 am. **Morphometric variability in *A. africanus*.** T.R. PETERSEN

10:00-10:15 am. **Important variations in dental trait expression at the EDJ throughout an *Australopithecus africanus* entire postcanine dentition.** J. BRAGA, F. THACKERAY, G. SUBSOL, J. TREIL, G. DASGUPTA.

10:15-10:30 am. **Break**

10:30-10:45 am. **Buccal dental microwear analyses in *Paranthropus boisei*, *Homo habilis* and *Homo ergaster* confirm that buccal microwaer is highly informative of dietary habits and ecological conditions in fossils hominin species.** L.M. MARTÍNEZ, A. PÉREZ-PÉREZ.

10:45-11:00 am. **New ages at first molar emergence in extant great apes and a reassessment of early hominin first molar emergence ages.** J. KELLEY, G.T. SCHWARTZ.

11:00-11:15 am. **The functional significance of canine height reduction in early hominins.** W.L. HYLANDER.

11:15-11:30 am. Paper moved. Spot available to organizers.

11:30-11:45 am. **Metatarsal neutral axis and head torsion in hominoids.** D. MARCHI, M.S.M. DRAPEAU.

11:45-12:00 Relative **lumbosacral transverse process length in extant hominoids and australopithecines.** ROSENMAN AND C.O. LOVEJOY

Session 27. Skeletal biology. Paleopathology. Trauma, interpersonal violence and warfare. Contributed Papers. *Michigan A & B.* Chair: Eric J. Bartelink California State University, Chico

8:00-8:15 am. **A macroscopic and radiological study of porous skull lesions at Norris Farms 36 cemetery.** J.M. BAUDER.

8:15-8:30 am. **Urbanization and Infection: Trends from Medieval Poland.** TRACY K. BETSINGER.

8:30-8:45 am. **Differential diagnosis of brucellosis from vertebral lesions at Butrint, Albania.** L.L. JENNY, J.S. BEATRICE, T.W. FENTON, M.J. MUTOLO, D.R. FORAN

8:45-9:00 am. **Hypocellularity in the mastoid process: differential diagnosis in two early medieval populations from Germany based on Wittmaack's concept of normal and pathological pneumatization.** S. FLOHR U. KIERDORF, M. SCHULTZ.

Friday April 3rd, 2009. Morning sessions.

9:00-9:15 am. **A bioarcheological study of respiratory health in England from fifth century BC to nineteenth century AD.** KAREN BERNOFSKY.

9:15-9:30 am. **Study of orbital lesions in Anglo Saxon England.** J.A. MORGAN.

9:30-9:45 am. **Diachronic and regional patterns of childhood anemia in precontact central California.** ERIC J. BARTELINK,

9:45-10:00 am. **Slow bone turnover rates in prehistoric skeletal samples: supporting evidence for the impact of pellagra on maize-dependent populations.** B. P. BRENTON, R.R. PAINE.

10:00-10:15 am. **The Woodland Ridge site: evidence of conflict in a small late prehistoric Indiana population** C. NEWMAN, A. SERRANO, AND C.W. SCHMIDT.
10:15-10:30 am. **Break**
10:30-10:45 am. **Osteoporosis in a prehistoric Bay Area population.** M.L. ATWOOD.

10:45-11:00 am. **Antemortem fracture patterns in two Florida Archaic skeletal samples: Bay West (8CR200) and Windover (8BR248).** H. WALSH-HANEY, S. JONES, AND A. RANDALL.

11:00-11:15 am. **Fighters, victims and average Joes: fracture patterns at the site of El Brujo, northern coastal Peru.** S.S. PHILLIPS.

11:15-11:30 am. **Bioarchaeological evidence of interpersonal violence in a prehistoric skeletal sample from the Middle Cumberland Region of Tennessee.** H. WORNE, D.W. STEADMAN, G.M. VIDOLI.

11:30-11:45 am **A bad day at Brinkerhoff: protohistoric trauma and violence in northern Nevada.** K.A. HOPKINSON, J.J JANZEN, P. BARKER.
11:45 am.-12:00 pm. **Skeletal indicators of conflict-zone populations: a bioarcheological study in Medieval Britain.** J.D. JENNINGS.

Session 28. Anthropological genetics: Genetic variation, population and phylogenetic studies in non-human primates. Evolutionary and phylogenetic studies in humans. Contributed papers. *Superior A & B*

Chair: Katy Gonder University at Albany State University of New York.

8:00-8:15 am. **Positive natural selection in the MMP9 gene correlates with placental invasion in primates.** A.S. LOBELL.

8:15-8:30 am. **Vasopressin Receptor V1a (*avpr1a*) Gene Variation in the Monogamous Owl Monkey, *Aotus azarai azarai*** P.L. BABB, E. FERNANDEZ-DUQUE, T.G. SCHURR.

8:30-8:45 am. **Directional hybridization of howler monkeys in Mexico.** L. CORTÉS-ORTIZ.

8:45-9:00 am. **Of baboons, gorillas, squirrels and wildebeest: the morphology of hybrid mammals.** R.R. ACKERMANN

9:00-9:15 am. **Mitochondrial population structure of a baboon contact zone.** C.M. BERGEY, C.J. JOLLY, J.E. PHILLIPS-CONROY, A. BURRELL, T.R. DISOTELL.

9:15-9:30 am. **Genetic data suggest the kipunji mangabey (*Rungwecebus kipunji*) is hybrid in origin.** S. BURRELL, C. J. JOLLY, A. J. TOSI, T. R. DISOTELL.

9:30-9:45 am. **Intraspecific phylogeography of the Chacma baboon reveals evidence for behavioural adaptation to local habitats.** R SITHALDEEN, JM BISHOP, RR ACKERMANN.

9:45-10:00 am. **The genetic history of chimpanzees across the Gulf of Guinea region.** M. K. GONDER, S. LOCATELLI, L. GHOBRIAL AND A. D. SHEPPARD.

10:00-10:15 am. **Eye of the beholder: Variable color vision in wild lemur populations.** B.J. BRADLEY, T. MACFIE, R. LAWLER, T.L. MORELLI, A. BADEN, P.M. KAPPELER, E. E. LOUIS, J. PASTORINI, M. SAUTHER, P.C. WRIGHT, N.I. MUNDY

10:15-10:30 am. **Break**

10:30-10:45 am. **Heredity of spinal osteoarthritis in *Macaca* spp.** A.E. DUNCAN, P.A. KRAMER.

10:45-11:00 am. **Coalescent simulations of human louse (*Pediculus humanus*) evolution reveal contact between archaic *Homo* species and modern humans.** AT. MIRO, A. KITCHEN, M. TOUPS, AND D. REED.

11:00-11:15 am. **Studying the genetic basis for differences in gene regulation between human and chimpanzee** A.A. PAI, N. LEWELLEN, R. BLEKHMAN, Y. GILAD

11:15-11:30 am. **Syntenic regions of human and non-human primate chromosomes differ in gene content: implications for human evolution.** MATTHEW KASER.

Friday April 3rd, 2009. Afternoon sessions.

Session 29. Ecology and Evolutionary Biology of Primate Lactation: Recent advances and future directions. Invited papers. ***Chicago 8.*** **Organizers:** Daniel Sellen, Katherine Hinde. **Co-Chairs:** Masako Fujita, Lauren Milligan

Lactation represents one of the most significant components of mammalian maternal reproductive investment but until recently little was known about the physiological aspects of milk synthesis during lactation across the primate order. This symposium will provide a detailed and timely review of recently published and currently ongoing research on the comparative biochemistry, behavioral ecology, and evolutionary biology of primate milk and lactation. Participants in the proposed symposia, drawn from established and emerging specialists, will focus on key findings, knowledge gaps, and recent innovations in theory and methods, integrating proximate mechanisms and ultimate explanations. Understanding lactation is critical for anthropological theory concerning maternal investment and life history, developmental programming, and brain evolution and cognition.

1:00-1:15 pm. **Lactation costs and benefits: contrasting primates with other mammalian taxa.** S.D. TARDIF.

1:15-1:30 pm. **Mother's milk energy shapes infant growth and behavioral development in rhesus macaques (*Macaca mulatta*).** KATHERINE J. HINDE AND JOHN P. CAPITANIO

1:30-1:45 pm. **Does a woman's birth weight predict milk protein composition in adulthood?** E.A. QUINN, C.W. KUZAWA.

1:45-2:00 pm. **Assessing the uniqueness of human milk composition: old assumptions, new hypotheses.** L.A. MILLIGAN.

2:00-2:15 pm. **Recent advances in the neurochemistry of polyunsaturated fatty acids.** R.P. BAZINET

2:15-2:30 pm. **The availability of fatty acids to ancestral human foragers and their infants.** B.A. CARLSON.

2:30-2:45 pm. **Life-history tradeoffs can explain vitamin A levels in human milk: an example of the maternal reproductive strategy from Kenya.** M. FUJITA.

2:45-3:00 pm. **What are the distinctive features of human lactation biology and why should we care?** D.W. SELLEN.

3:00-3:15 pm. **Participant Panel Discussion**

3:15-3:30 pm. **Break**

Session 30. Anthropological genetics. The genetics of craniodental variation and evolution. Contributed papers. ***Chicago 8.***

Chair: Mark Hubbe Universidad Católica del Norte - Chile

3:30-3:45 pm. **Assessing the relationship between craniofacial morphology and genetic variation in a population with admixed ancestry**. F.I. MARTINEZ, D. BUSEL, M. MORAGA, G. MANRÍQUEZ, M. BELLATTI, F. LAHR, M.M. LAHR

3:45-4:00 pm. **A genetic association study of normal variation in facial features.** D.K. LIBERTON, K.A. MATTHES, B. MCEVOY, R. PEREIRA, T. FRUDAKIS, M.D. SHRIVER

4:00-4:15 pm. **Dissimilarity fraction for metrical traits of human skull: comparison with genetic studies.** A.M. STRAUSS, M. HUBBE.

4:15-4:30 pm. **The genetics of normal variation in the mammalian dentition.** S.J. SHOLTIS, K. KAWASAKI, C.S. SHASHIKANT, K.M. WEISS.

4:30-4:45 pm. **Evaluating genes related to non-metric dental variation in European Americans.** L.N. PEARSON, A.L. WEDDLE, M.D. SHRIVER.

4:45-5:00 pm. Paper moved. Spot available to organizers.

Session 31. Infant Carrying in Human Evolution. Invited podium symposium. ***Chicago 9.*** **Organizer Karen R. Rosenberg.**

A commonly noted consequence of bipedalism is that the hands are freed from their locomotor function and available to carry things. What things? Darwin proposed tools, while Isaac, Lovejoy and others focused on food. What has received less attention is that babies seem to be one of the "items" most commonly carried by humans. The successful carrying of babies was almost certainly a consistent selection pressure on all hominids irrespective of other environmental conditions. This symposium addresses the unique ways in which hominids carry their infants and young children and the implications of that behavior for energetics and locomotor biomechanics. Inevitably, changes in energetic cost and biomechanics due to carrying will influence: hominid life histories; duration of infant helplessness; the length of time before weaning and the composition of breast milk; the length of time before it is possible to have another infant; whether crawling occurs as a universal stage in human development; hairlessness; and thermoregulatory strategies for both mother and offspring. A diversity of approaches is taken by the participants including: comparative, energetic, biomechanical, paleontological and ethnographic.

1:00-1:15 pm. **Carrying human babies: evolutionary costs and benefits.** K. R. ROSENBERG AND E. SINGH

1:15-1:30 pm. **Mechanical analysis of infant carrying in hominoids: a confront between safety and costs.** L.Q. AMARAL.

1:30-1:45 pm. **Reproductive costs for everyone: How female frontal loads impact mobility.**
C.M. WALL-SCHEFFLER, M.J. MYERS.

1:45-2:00 pm. **Grandmothers and mothers on the move: How age and frontal loads affect biomechanics and energetics.** M.J. MYERS, A.L. HOKANSON, A.L. MYHRE, M.D. MASCIOLI, J.A. MCCAFFERTY, C.M. WALL-SCHEFFLER.

2:00-2:15 pm. **Mothers and children: Moving in new directions.** P.A. KRAMER.

2:15-2:30 pm. **Carrying and holding: the close physical association between mothers and young children in a hunter gatherer group.** P. DRAPER.

2:30-2:45 pm. **Implications of alternative carrying strategies for infant thermoregulation.** W.R. LEONARD, ML ROBERTSON AND R.B. THOMAS

2:45-3:00 pm. **Infant carrying and prewalking locomotor development: proximate and evolutionary perspectives**. D.P. TRACER.

3:00-3:15 pm. **Infant carrying and contact: it's not just about transportation.** J.J.MCKENNA.

3:15-3:30 pm. **Infant carrying in humans: interaction between morphometric and gait parameters.** L.T. GRUSS, C.M. WALL-SCHEFFLER, N. MALIK.

3:30-3:45 pm. **Tethered and terminal load: female travel at pregnancy's end.** K.K. WHITCOME

3:45-4:00 pm. **Discussion**

Session 32. Chimpanzee behavior. Contributed papers. ***Chicago 9.*** Chair: John Mitani University of Michigan

4:00-4:15 pm. **Aggression, risk sensitivity, and orbitofrontal cortex volume in the genus *Pan*.** S.D. HURST.

4:15-4:30 pm. **The function of coalitionary aggression among wild CHIMPANZEES.** I.C. GILBY, M.W. WILSON, K.A. MOHLENHOFF, A.E. PUSEY.

4:30-4:45 pm. **Male chimpanzees form enduring and equitable social bonds.** J.C. MITANI.

4:45-5:00 pm. **The dynamics of stress in female chimpanzees: interactions of social and ecological factors** M. EMERY THOMPSON, S.M. KAHLENBERG, M.N. MULLER, AND R.W. WRANGHAM.

Session 33. Standing at the Crossroads: The Genetics of Morphology. Symposium co-sponsored by the American Association of Anthropological Genetics (AAAG). Invited podium symposium. ***Michigan A & B.*.**
Organizers: Richard J. Sherwood, Dana L. Duren
The morphological sciences have served as one of the primary cores of biological anthropological research since Blumenbach began examining the relationships between the geographic distribution of populations and the shape of the human cranium in the 18th and 19th centuries. Since that time, biological anthropological research has focused on characterizing the extent and sources of morphological variation. One of the primary sources for this variation is, of course, the underlying genetic architecture for morphological traits. In the past two decades, advances in techniques and technology have expanded our understanding of the genetic control of morphology. This symposium seeks to examine the genetic basis for morphological traits at every level and to document the many approaches researchers are using to explore this important area of research.
Importantly, the applications of findings from the research presented have broad relevance to anthropology, evolutionary biology, and biomedicine.

1:00-1:15 pm. **The genetics of morphology.** R.J. SHERWOOD, D.L. DUREN

1:15-1:30 pm. **The quantitative genetics of frontal curvature: evolutionary implications.**
B.F.B. ALGEE-HEWITT, E.A. CARSON.

1:30-1:45 pm. **The geometry and architecture of craniofacial inheritance.**
K.P. MCNULTY, D.L. DUREN, J. BLANGERO, T. DYER, S.A. COLE, M. LEE, R.M. SIERVOGEL, B. TOWNE, R.J. SHERWOOD

1:45-2:00 pm. **Development of morphological integration of brain and skull: evidence from mouse models for craniosynostosis.** JOAN T. RICHTSMEIER, ETHYLIN WANG JABS, CHRISTOPHER PERCIVAL, CHERYL A. HILL, YING LI WANG, RAN XIAO, KRISTINA ALDRIDGE.

Friday April 3rd, 2009. Afternoon sessions.

2:00-2:15 pm. **The Developmental Determinants of Craniofacial Variation Structure.** BENEDIKT HALLGRÍMSSON

2:15-2:30 pm. **Digit identity is independent of digit position: What gene expression tells us about the individuality of morphological characters?** GUNTER P. WAGNER, VINCEZO CAPUTO, REBECCA YOUNG, AND ALEXANDER VARGAS

2:30-2:45 pm. **Discussion** NEIL SHUBIN

2:45-3:00 pm. **Genetics of tooth morphology: Assessing the diversity of gene expression patterns for early tooth development in mammals.** BROOKE A. ARMFIELD, CHRISTOPHER J. VINYARD, J.G.M. THEWISSEN

3:00-3:15 pm. **The Genetics of Morphology: The Primate Dentition.** L.J. HLUSKO, O.T. RIZK, M.C. MAHANEY.

3:15-3:30 pm. **Break**

3:30-3:45 pm. **How many genes does it take to make mammalian dental diversity?** J. JERNVALL, I. SALAZAR-CIUDAD, S.J. KING, I. CORFE.

3:45-4:00 pm. **The contribution of genes to variation in bone morphology: Considerations of co-adaptation of traits.** H.L. HANSEN, L.M. HAVILL.

4:00-4:15 pm. **Human bipedality and the genetic architecture of a locomotor system.** D.L. DUREN, R.J. SHERWOOD, M. LEE, R.M. SIERVOGEL, B. TOWNE.

4:15-4:30 pm. **Masticatory stress and the functional genomics of the TMJ articular disc in mammals.** M.J. RAVOSA, J. NING, R.A. MENEGAZ, M.S. STACK, G. SCHULTZ

4:30-5:00 pm. **Discussion.** STEVEN C. WARD.

Session 34. Primatology. Primate brain, cognition, growth, learning, and reproductive biology. Contributed papers. *Chicago 10.*. Chair: James P Higham. The University of Chicago

1:00-1:15 pm **Cluster analysis and social network theory applied to the study of socially learned traditions in primates.** L.J. MATTHEWS.

1:15-1:30 pm. **The effects of a long term psychosocial stress on reproductive indicators in the baboon.** K.A. O'CONNOR, E. BRINDLE, J. SHOFER, B.C. TRUMBLE, J.D. ARANDA, K. RICE, K.D. CAREY, M. TATAR.

1:30-1:45 pm. **Causes and consequences of reproductive skew in male primates.** C.L. NUNN, N. KUTSUKAKE, J OSTNER, AND O. SCHÜLKE.

1:45-2:00 pm. **Long-term inter-sexual association patterns among wild chimpanzees**. Z.P. MACHANDA, I.C. GILBY, R.W. WRANGHAM.

2:00-2:15 pm. **Male coercion and female choice in wild chimpanzees.** M.N. MULLER, M. EMERY THOMPSON, S.M. KAHLENBERG & R.W. WRANGHAM.

2:15-2:30 pm. **Rank-dependent Reproductive Energetics in Free-living Female Chimpanzees (*Pan troglodytes schweinfurthii*)** C.M. MURRAY, E.V. LONSDORF, L.E. EBERLY, A.E. PUSEY.

2:30-2:45 pm. **Food sharing among captive chimpanzees and bonobos: Reciprocity and altruism.** A.V. JAEGGI, J.M.G. STEVENS, C.P. VAN SCHAIK.

2:45-3:00 pm. **You got to know how to fold'em: biassed wadge-folding in wild chimpanzees.** W.C. MCGREW, K.D. HUNT

3:00-3:15 pm. **Well-digging by Semliki chimpanzees: new data.** L.F. MARCHANT, W.C. MCGREW, C.L.R. PAYNE, T.H. WEBSTER, K.D. HUNT.

3:15-3:30 pm. **Break**

3:30-3:45 pm. **Geographic variation in orangutan calls: implications for the evolution of language?** S. A. WICH AND C. P. VAN SCHAIK. **Paper originally not scheduled here.**

3:45-4:00 pm. **Orangutan's flexible deployment of techniques in problem solving.** S.R. LEHNER, J.M. BURKART, C.P. VAN SCHAIK.

4:00-4:15 pm. **A longitudinal study of postnatal brain morphology in Rhesus macaques exposed to an environmental insult *in utero*.** K. ALDRIDGE, L. WANG, M. HARMS, A.J. MOFFITT, K. POPE, J.G. CSERNANSKY, L.D. SELEMON.

4:15-4:30 pm. **Monoamine metabolites in the CSF of male anubis (*Papio anubis*) and hamadryas (*P. hamadryas*) baboons parallel their species-specific behavioral ontogeny.** C.J. JOLLY, J.E. PHILLIPS-CONROY, J. KAPLAN, T. BERGMAN, J.J. MANN.

4:30-4:45 pm **Sexual swellings and mate choice in olive baboons.** J.P. HIGHAM, C. ROSS, A.M. MACLARNON, M.HEISTERMANN & S. SEMPLE.

4:45-5:00 pm. **The "bleeding-heart baboon": Does chest patch color signal male quality in geladas?** J.C. BEEHNER, T.J. BERGMAN.

Session 35. Skeletal Biology: Postcranial variation. Functional skeletal biology of locomotion. Contributed papers. ***Superior A & B.*** Chair: DANIEL LIEBERMAN. Harvard University

1:00-1:15 pm. **The acquisition of upright posture: the role of the vertebral bodies and the intervertebral disks in the lumbar curvature.** E. BEEN

1:15-1:30 pm. **Sexual dimorphism in sacral curvature and its relationship to bipedalism and obstetrics.** D.J. COPPETO, S.E. BAILEY, M. SESELJ, W. HARCOURT-SMITH.

1:30-1:45 pm. **Biomechanics of foot strike in habitually barefoot versus shod runners.** DANIEL LIEBERMAN, WILLIAM WERBEL, ADAM DAOUD.

1:45-2:00 pm. **Carpal kinematics in extant non hominoid anthropoids using an X-ray methodology**. G. DAVER, G. BERILLON, D. GRIMAUD-HERVÉ

2:00-2:15 pm. **Locomotor developmental timing in humans and other apes.** CARA OCOBOCK, HERMAN PONTZER, ELIZABETH ROBERT W. SHUMAKER, ANNA BLACKBURN WITTMAN.

2:15-2:30 pm. **Collisional costs of bipedalism in primates.** BAUMGARTNER, R.E., WUNDERLICH, R.E., SCHMITT, D

2:30-2:45 pm **High-resolution analysis of plantar pressure in habitually shod and unshod humans.** K. D'AOÛT, T. PATAKY, P. AERTS.

2:45-3:00 pm. **Were Levantine early modern *Homo sapiens* the marathoners of the Pleistocene?** SHAW, C.N. & STOCK, J.T

3:00-3:15 pm. **Some new aspects of the shoulder architecture within the genus *Homo*.** VOISIN JL.

3:15-3:30 pm. **Break**

3:30-3:45 pm. **Plantigrade foot posture increases locomotor economy in walking but not in running humans.** D. CARRIER, C. CUNNINGHAM, N. SCHILLING, C. ANDERS

3:45-4:00 pm. **Testing the MNI and the MLNI: Which method is most likely to be accurate and when?** M.O. BEARY. Paper originally not here.

4:00-4:15 pm. Paper moved. Spot available to organizers.
4:15-4:30 pm. **An investigation of long bone curvature in modern human populations: femur, ulna and radius.** DE GROOTE.
4:30-4:45 pm. Paper moved. Spot available to organizers.
4:45-5:00 pm. **Just how inefficient is human running?** K.L. STEUDEL-NUMBERS, T.D. WEAVER, C.M. WALL-SCHEFFLER.

Saturday April 4th 2009. Morning sessions.

8:00 am-12:00 pm. **Teaching outreach Program. Fossils, Bones & Primates: Enriching High School Teaching. Parlor C.**

Presenters:
Dr. Andrew Petto, University of Wisconsin-Milwaukee
Dr. Michael Alan Park, Central Connecticut State University
Dr. Barbara O'Connell, Hamline University
K. Lindsay Eaves-Johnson, University of Iowa
Dr. Deborah Cunningham, Florida Atlantic University
Dr. Martin K. Nickels, Illinois State University & Illinois Wesleyan University

Saturday April 4th 2009. Morning sessions.

Session 36. Primatology. Primate feeding, dietary and behavioral Ecology. Contributed posters. *River Exhibition Hall B.*

Chair: A. Derby. Stony Brook University.

8:00-8:30 am: Poster set-up
6:00-6:30 pm: Poster take-down
10:00-10:30 am. and 2:00-2:30 pm: Author of even number posters present for discussion
10:30-11:00 am. and 2:30-3:00 pm: Author of odd number posters present for discussion

1. **Foraging efficiency in wild orangutans (*Pongo pygmaeus wurmbii*) at the Tuanan field station in Central Kalimantan, Indonesia.** K.V. BARITELL, C.P. VAN SCHAIK, E.R. VOGEL.

2. **Ecosystem in decay: Factors influencing primate species extinctions in forest fragments of Tsinjoarivo, Madagascar.** M.T. IRWIN, J.-L. RAHARISON.

3. **Dietary flexibility: Subsistence of the southern gentle lemur *Hapalemur meridionalis* on a low quality diet in the Mandena littoral forest, SE Madagascar.** T.M. EPPLEY, G. DONATI

4. **Temporal variation in diet in three strepsirhine species in southeastern Madagascar.** E.M. ERHART, C. GRASSI

5. **Intraspecific isotopic variability in *Varecia variegata*, Ranomafana National Park.** A.L. BADEN, B.E. CROWLEY.

6. **Ranging behavior flexibility in response to habitat disturbance by Milne-Edwards' sifakas (*Propithecus edwardsi*) in Ranomafana National Park, Madagascar.** D.H. MORRISS, S.J. ARRIGO-NELSON, S.M. KARPANTY, B.D. GERBER , AND P.C. WRIGHT

7. **Seasonal rainfall and male invasion alter fecal glucocorticoids in female Verreaux's sifaka (*Propithecus verreauxi verreauxi*).** B.L. LITTLEFIELD.

8. **Differing strategies to problems of seasonality in *Indri indri* and *Propithecus diadema* in Mantadia National Park, Madagascar.** M.L. BLANCHARD, R.H. CROMPTON.

9. **Gum's the word: applying knowledge from the wild to improve environmental enrichment for captive gummivores.** H.F. HUBER, K.P. LEWIS.

10. **Comparative demography of red howler monkey (*Alouatta seniculus*) populations in relation to habitat ecology in Yasuní N.P., Ecuador.** A.M. DERBY.

11. **Why do capuchin and squirrel monkeys form interspecific associations? A GIS based test using ranging and feeding data.** M.J. MONTAGUE, L.J. MATTHEWS.

12. **Feeding manipulative behavior in free ranging silvery woolly monkeys *(Lagothrix poeppigii).*** N.E. KARANTANIS AND D. YOULATOS.

13. **Chew before you swallow? Ingestive versus digestive folivory among species of *Pygathrix* and *Trachypithecus.*** BABCOCK, M., WRIGHT, B.W., WRIGHT, K.A., O'BRIEN, J, ULIBARRI, L., NADLER, T.

14. **Tana River yellow baboons' (*Papio cynocephalus*) diet and habitat use: potential impact on a sympatric species?** V. BENTLEY-CONDIT

15. **New information on the feeding and grouping behavior of *Cercocebus torquatus*, the red-capped mangabey, from southwestern Gabon.** C. COOKE, R. MOUSSOPO-IBESSA, W.S. MCGRAW.

16. **Daily energy expenditure in orangutans measured using doubly labeled water.** H. PONTZER, C. OCOBOCK, R.W. SHUMAKER, D.A. RAICHLEN.

17. **Variation in primate basal metabolism: explanations and ecological implications.** D.A. RAICHLEN, A.D. GORDON, M. MUCHLINSKI, J.J. SNODGRASS.

18. **Mating system and cost of pregnancy across neotropical primate taxa: a bioenergetic perspective.** N.P. RAO.

19. **Poster available to organizers.**

20. **Social and ecological factors associated with temporary reproductive collapse in cooperatively breeding red variegated lemurs (*Varecia rubra*) on the Masoala Peninsula, Madagascar.** N. VASEY, C. BORGERSON.

21. **The function of sexual swellings during pregnancy in chimpanzees.** ANNE PUSEY

22. **Assessing the distribution and abundance of owl monkeys (*Aotus zonalis*) in Chagres National Park, Panama.** M.S. SVENSSON, S.K. BEARDER.

23. **Mongoose lemur (*Eulemur mongoz*): Ecological requirements and conservation implications.** M.K. SHRUM

24. **Invasion of gallery forests by introduced species (*Rattus rattus*) and possible interactions with endemic small mammals at the Beza Mahafaly Special Reserve, SW Madagascar.** E. RASOAZANABARY, I.A. JACKY YOUSSOUF, L.R. GODFREY

25. **Abundance estimates and species diversity of the enigmatic nocturnal primates in the protected Rhoko forest, Cross River State, Nigeria.** L. H. SCHEIN, K.A.I. NEKARIS, S.K. BEARDER.

26. **Assessment of human installations and activities on vervet body mass indices.** J.D. PAMPUSH, E. A. DREW, J. L. DANZY, J. P. GROBLER, T. R. TURNER.

27. **Effects of habitat disturbance on population density of pileated gibbons (*Hylobates pileatus*) in Southeast Thailand.** R. PHOONJAMPA, W.Y. BROCKELMAN, T. SAVINI, G.A. GALE.

28. **Semliki chimpanzees do eat insects.** T.H.WEBSTER, L.F. MARCHANT, W.C. MCGREW, C.L.R. PAYNE, K.D. HUNT.

29. **Food selection among individuals in a group of brown bearded capuchins (*Cebus libidinosus*) at Boa Vista, Piaui, Brazil.** SPIESS, K, WRIGHT, B.W., WRIGHT, K.A., BIONDI, L, FRAGASZY, D., MATTOS, W, VISALBERGHI, E, IZAR, P., OTTONI, E.B.

30. **Interannual comparison of food toughness in the diets of a wild *Lemur catta* population in Beza Mahafaly special reserve, Madagascar.** N. YAMASHITA, F.P. CUOZZO, M.L. SAUTHER.

31. **Sex Differences in Mantled Howler Monkey (*Alouatta palliata)* Feeding Diversity in Two Dry Tropical Forest Fragments.** K.L. WILBANKS.

32. **Ontogenetic differences in giant bamboo consumption by *Hapalemur* (*Prolemur*) *simus*.** C.L. TAN.

33. **Contribution to New Forest Growth by *A. palliata* in a Fragment of Dry Tropical Forest.** TOOLE, A.

34. **The effects of the white-faced capuchin monkey (*Cebus capucinus)* on seed dispersal within a neotropical forest.** JESSICA REIMER, MICHELLE BEZANSON, SEAN M. WATTS

Session 37. Primatology. Non-human comparative functional anatomy. Contributed Posters.

River Exhibition Hall B. Chair: Richard F Kay Duke University.

8:00-8:30 am: Poster set-up
6:00-6:30 pm: Poster take-down
10:00-10:30 am. and 2:00-2:30 pm: Author of even number posters present for discussion
10:30-11:00 am. and 2:30-3:00 pm: Author of odd number posters present for discussion

35. **Patterns of knee joint shape dimorphism in guenons (*Cercopithecus*) reflect interspecific scaling trends among cercopithecoid monkeys.** M.R. LAGUE.

36. **Ontogenetic change of internal structure in macaque calcaneum.** N. EGI, N. OGIHARA, W. YANO.

37. **A study of 2D landmark data accuracy in representing 3D mouse skull form.** C. PERCIVAL, M. CHIMERA, M. KIM, J. KENNEY-HUNT, A. CONLEY, C. O'CONNOR, C. ROSEMAN, J. CHEVERUD, J. RICHTSMEIER.

38. **The effects of suppressed estradiol on femoral cortical bone structure in growing female rats.** M.E. SAINE V.R YINGLING.

39. **The impact of basicranial growth on craniofacial shape variation.** T.E. PARSONS, C. DOWNEY, F.R. JIRIK AND B. HALLGRÍMSSON.

40. **The effect of variations in muscle positions in a complex biomechanical model of a macaque skull** J.F. SHI, M.J. FAGAN, N. CURTIS, L. FITTON, and P. O'HIGGINS.

41. **Influence of Orbit Size on Aspects of the Tarsier Postorbital Septum.** D. SAVAKOVA.

42. **Fiber type composition in the perivertebral muscles of small, primates - Are primates different from other small mammals?** SCHILLING N.

43. **Brachiation: insights from forelimb anatomy and kinematics.** F. MICHILSENS, K. D'AOÛT, E. VEREECKE AND P. AERTS

Saturday April 4th 2009. Morning sessions.

44. **Empirically derived limb inertial properties of four prosimian primates: Implications for primate locomotor behavior.** J.R. GRAHE AND J. HANNA.

45. **Systematic characterization of locomotor head movements in *Lemur catta*.** M.D. MALINZAK, R.F. KAY.

46. **Osteological correlates of the vomeronasal system in primates.** E.C. GARRETT, T.D. SMITH, A.M. BURROWS, C.J. BONAR.

47. **Ecomorphology of first phalanx reflects differing habitat adaptations among cephalophines.** M.J. STEELE, R.S. SCOTT.

48. **Lever mechanics in the jaws of sympatric West African colobines: skull proportions do not invariably sort taxa by a criterion of dietary consistency.** D.J. DAEGLING, W.S. MCGRAW.

49. **The role of sutures in modulating strain distribution within the skull of *Macaca fascicularis*.** L.C. FITTON, K. KUPCZIK, N. MILNE, M.J. FAGAN, P. O'HIGGINS. This paper was not originally here.

50. **Do more manually dexterous non-human primates have a more human-like arrangement of carpal tunnel structures? Implications for the development of carpal tunnel syndrome.** HAM, N., WRIGHT, K.A., WRIGHT, B.W., SMITH, E.

51. **The ancestor's tail: evolution of taillessness within the Catarrhini.** A.E. MACKENZIE, D.R. BEGUN.

52. **Growth in three environments: developmental canalization and positive allometry in wild, orchard-raiding and pet Sulawesi booted macaques, *Macaca ochreata*.** R.R. STALLMANN.

53. **Functional morphology of metacarpals in digitigrade and palmigrade cercopithecoid monkeys.** B.A. PATEL

54. **The expensive-tissue hypothesis and plant neurotoxins: Comparative analysis of metabolic hepatic enzymes indicates hominin diet shift**. R. J. SULLIVAN, E. H. HAGEN.

55. **Dietary quality and brain size in platyrrhines: support for the "Expensive Tissue Hypothesis".** R. F. Kay, K. L. Allen.

56. **The Expensive Tissue Hypothesis revisited.** A.F. NAVARRETE, K. ISLER, C. P. VAN SCHAIK.

57. **The mysterious genitalia of female strepsirhines: explaining variability in female genital morphology**. K. TREATMAN-CLARK. This paper was not originally here.

Session 38. Skeletal Biology: Descriptive methodology, functional skeletal biology and mechanical stress.

Contributed posters. ***River Exhibition Hall B.*** Chair: Valerie Burke DeLeon. Johns Hopkins University.

8:00-8:30 am: Poster set-up
6:00-6:30 pm: Poster take-down
10:00-10:30 am. and 2:00-2:30 pm: Author of even number posters present for discussion
10:30-11:00 am. and 2:30-3:00 pm: Author of odd number posters present for discussion

58. **The Raymond A. Dart Collection of Human Skeletons: history, inventory and demographic assessment.** M.R. DAYAL, A.D.T. KEGLEY, G. STRKALJ, M.A. BIDMOS, K.L. KUYKENDALL.

59. **Work-related trauma in Washington, DC's, black poor: evidence from the W. Mantague Cobb skeletal collection.** J.L. MULLER.

60. **Assessment of pathological conditions in the Huntington Collection, Smithsonian Institution.** K.E. PEARLSTEIN, D.R. HUNT.

61. **Paper withdrawn.**

62. **Looking for dacryon: a comparison of Martin and Howells.** K. DRISCOLL.

63. **How useful are measurements currently used for sex assessment in archaeological remains?** A.L. CLARK AND J.L. BUCKBERRY.

64. **Application of Portable X-Ray Fluorescence to determine relationships between individuals from an unknown graveyard based on strontium readings.** J.F. BYRNES, P. BUSH, J.E. SIRIANNI.

65. **The effect of bias skeletal recovery on bioarchaeological interpretations: a case study from the Southeast.** A. THOMPSON.

66. **A Comparison of High Detail Analog and Computed Radiography Imaging Systems in Paleoradiographic Studies of Archaeological Bone.** K. FORGEY, D. STURK.

67. **An R program for automating bone cross-section reconstruction.** E.M. GAROFALO, A.D. SYLVESTER, C.B. RUFF.

68. **Fiber architecture underpins *in vivo* length-tension measurements in masseter and digastric muscles.** F. ANAPOL, C. MUELLER, N. SHAHNOOR, C.F. ROSS.

69. **Histomorphology of human parietal bones.** H. CHO, K. HWANG.

70. **Trabecular microarchitecture in thoracic vertebrae of extant hominoids.** M.M. COTTER, S.W. SIMPSON, B.M. LATIMER, C.J. HERNANDEZ.

71. **How and why *do* humans grow thin skulls? A test of the Systemic Robusticity Hypothesis.** LYNN E. COPES.

72. **Cross-sectional geometry: The relationship between bending loads and the neutral axis.** J.H. PLOCHOCKI.

73. **Assessing musculoskeletal markers characteristic of military activities: an analysis of sacrificial victims from Teotihuacan.** M.A. RUBEL

74. **Musculoskeletal stress markers in agriculturalists: Pueblo villages and Spanish subsistence farmers.** L.K. NOLDNER, H.J.H. EDGAR.

75. **Assessment of secular change in osteological aging methods.** W.E. POTTER.

76. **Food material properties and their influence on the growth of cranial sutures.** H. KUNZ, C.D. BYRON, Q. WANG. **Poster not originally here.**

77. **CT-based assessment of relative soft tissue alteration in different types of ancient mummy.** C. SYDLER, T. BÖNI, U. WOITEK, F. RÜHLI.

78. **The pattern of change during human tibial trabecular bone ontogeny and locomotor development: components of intra-tibial heterogeneity.** J.H. GOSMAN, R.A. KETCHAM.

79. **Regional canalization and developmental instability in the human skull.** V.B. DELEON.

80. **Why we sprain our ankles.** J.M. DESILVA.

81. **Injuries in Classical ballerinas related to behavior and biomechanics.** L.A. SKELTON & R.R. PAINE.

82. **An evaluation of the relationship between living stature and vertebral body height and width measurements from CT Scans.** L.A. LAMONT.

83. **A little tail about sexual dimorphism of the human pelvis.** R.G. TAGUE.

84. **Variability of human foramen magnum size.** P. GRUBER, M. HENNEBERG, F. RÜHLI.

85. **Sex and size effect on human neurocranium shape.** Y. HEUZÉ.

86. **Variation in dental tissue distribution in molar crowns of human males and females.** R.N.M. FEENEY, A.J. OLEJNICZAK, D. GUATELLI-STEINBERG, J.-J. HUBLIN.

Session 39. Skeletal Biology: Forensic Anthropology. Contributed posters. *River Exhibition Hall B.*

Chair: Gary P. Aronsen Department of Anthropology Yale University

8:00-8:30 am: Poster set-up

6:00-6:30 pm: Poster take-down

10:00-10:30 am and 2:00-2:30 pm: Author of even number posters present for discussion

10:30-11:00 am and 2:30-3:00 pm: Author of odd number posters present for discussion

87. **A pilot study of sexual dimorphism in human 5th metatarsal bones.** J.N. ESPENSHADE, A.M. BURROWS.

88. **Quantifying sexual dimorphism of the pelvic inlet**. K.M. BROWN, V.B. DELEON.

89. **Sexing of the human innominate using non-metric traits and statistical analysis.** J.M. VOLLNER, A.R. KLALES, S.D. OUSLEY.

90. **How sexually dimorphic is the human sacrum? Assessment of sex from the sacrum in a modern Portuguese population.** M.C. ROSETT, J.L. BUCKBERRY.

91. **Manual digital proportions and sexual dimorphism in a North American skeletal series.** R.F. PASTOR, S.R. FROST, D.T. CASE, J.J. SNODGRASS, L.S. SUGIYAMA, F.J. WHITE.

Saturday April 4th 2009. Morning sessions.

92. **Evaluation of metric methods of sex assessment using ulnae from the Windover site.** PAWN I.

93. **Using the patellae for sex identification of human skeletal remains in a pilot study.** A.M. JACOBS, A.M. BURROWS.

94. **Morphological variation and sexual dimorphism in the skeletal elements of the human elbow.** M.L. CAMPBELL, P.H. MOORE-JANSEN.

95. **The five skull trait sexing method and the benefits of Rasch analysis.** J.C. STEVENSON, P.M. EVERSON, E.R. MAHONEY, P.L. WALKER.

96. **Sex and sample: classification analysis using cervical canine metrics.** B.R. HASSETT, S.W. HILLSON.

97. **A non-invasive alternative to histology: A study using the Alicona 3D Infinite Optical Microscope to investigation human tissue.** M. Clegg, G. Guerra.
98. **Age-at-death assessment in poor preserved juvenile skeletal remains: a new methodological approach.** V. GARCIN, P. VELEMINSKY, J. BRUZEK, P. SELLIER.

99. **A quantitative analysis differentiating human from nonhuman fragmented skeletal remains.** R. BALABUSZKO, D.C. PINTO, S.D. STOUT.

100. ***Emics* and *etics* of postmortem skeletal trauma: An investigation into fracture patterns induced by conflagration, firefighters, and transportation.** J.L. ANDERSON, H.A. WALSH-HANEY, L.E. GIBSON.

101. **Forensic anthropological investigation of historic hate crimes: the Pine Barrens case.** A.J. CURTIN

102. **Increase of anthropology cases in the five last years in the Forensic Service in Santiago of Chile.** C. GARRIDO-VARAS.

103. **Biology and Culture in the modern era: How cultural evidence can help determine forensic significance.** C.R.DICKE, L.C. FULGINITI, M.A. FISCHIONE.

104. **Multivariate estimation of ancestry from the distal femur.** L.C. BAKER.

105. **Variation and secular trends in linear measurements of the mandible.** K.E. SKORPINSKI, A.B. FALSETTI.

106. **An alternative approach to cranial allocation in an historical forensic case study from Spanish Colonial Georgia.** W.N. DUNCAN, C.M. STOJANOWSKI.

107. **Identification of unprovenienced human remains using FORDISC 3.0: biological race revisited.** G. P. ARONSEN, S. C. ELLIS.

108. **Ancestry estimation from metacarpals**. S.E. MCMANUS, M.K. SPRADLEY, J.B. DEVLIN.

109. **FORDISC and the determination of ancestry from craniometric data.** MARINA ELLIOTT AND MARK COLLARD.

110. **Determining the effects of preparatory methods when observing cementum layering: exploration of techniques and microscopy.** M. HUFFMAN, D. ANTOINE, W. BIRCH.

111. **The rings of fire – Tooth cementum annulation for estimation of age at death in cremated remains.** T. GOCHA, H. SCHUTKOWSKI.

112. **Test of intra- and inter-rater agreement of scoring cranial non-metric traits used in the forensic determination of ancestry.** A.N. HEARD, C.A. MALONE.

113. **Sex and ancestry determination using the human orbital aperture.** P.R. HUSMANN, D.R. SAMSON

114. **Animal models in taphonomic experiments: an interspecies comparison or cortical bone properties.** C.M. MARCEAU. THIS PAPER WAS NOT ORIGINALLY HERE.

115. **Craniofacial growth and development in the Arikara.** C.R.F. MEYER, A.D. FOSTER, J.C.M. AHERN, G.W. GILL, K.G. GEROW.

116. **Cranial nonmetric study of archaeological populations from different historical periods of Mongolia** ERDENE MYAGMAR.

Session 40. Skeletal Biology: Postcranial Variation. Functional skeletal biology of locomotion. Contributed posters. *River Exhibition Hall B.*

Chair: Danny Wescott University of Missouri & Florida Atlantic University.

8:00-8:30 am: Poster set-up
6:00-6:30 pm: Poster take-down
10:00-10:30 am and 2:00-2:30 pm: Author of even number posters present for discussion
10:30-11:00 am and 2:30-3:00 pm: Author of odd number posters present for discussion

117. **Evidence of Reduced Mobility in a Missouri Woodland Period Adolescent Male**. DANIEL J. WESCOTT AND STEPHANIE CHILD.

118. **Upper limb asymmetry in the archaic Windover population from Florida.** GEOFFREY THOMAS.

119. **Cross-sectional geometry of a warlike Samnite sample from the Alfedena necropolis (Iron Age, Italy).** V. S. SPARACELLO, O. M. PEARSON, A. COPPA

120. **Breaking symmetry in British archaeological populations.** R.A. STORM

121. **How sexual dimorphism and kinematics interact to impact cost over variable terrain.** L. M. BLOCK, E.S. CHUMANOV, K.L. STEUDEL-NUMBERS, C.M. WALL-SCHEFFLER. THIS PAPER WAS NOT ORIGINALLY HERE.

122. **Sex differences in brachial and crural indices in relation to climate.** R.L. NUGER.

123. **Waddling and toddling: biomechanical effects of an immature gait.**
A BLACKBURN WITTMAN, L.W. COWGILL, H. PONTZER, C. OCOBOCK.

124. **Modularity in the hominoid vertebral column: implications for the evolution of orthogrady.** WILLIAMS, SA.

125. **Scaling patterns of cross-sectional strength of limb bones and the relationship to locomotion.** SARA K. DOYLE.

126. **Internal bone structure in the human hind foot as an indicator of habitual compressive load during locomotion.** A. SU.

127. **Digit ratio (2D:4D) and Ponderal index as predictors of half-marathon performance**. L.M. BARONE.

Session 41. Anthropological genetics: Genetic variation, population and phylogenetic studies in human and non-human primates. Chair: Fabian Crespo. University of Louisville

8:00-8:30 am: Poster set-up
6:00-6:30 pm: Poster take-down
10:00-10:30 am and 2:00-2:30 pm: Author of even number posters present for discussion
10:30-11:00 am. and 2:30-3:00 pm: Author of odd number posters present for discussion

128. **Natural selection for birth weight at high altitude: Is small good or bad?** M.J. WILSON, E. VARGAS, A. BIGHAM, M. SHRIVER, C.G. JULIAN, L.G. MOORE. Poster not originally here.

129. **Molecular evolution of color vision genes in howling monkeys (*Alouatta*).** J.L. JOGANIC, G.H. PERRY, A. CUNNINGHAM, N.J. DOMINY, B.C. VERRELLI.

130. **Genetic variability in three South African vervet monkey (*Chlorocebus aethiops*) populations.** MCAULIFFE DORE, J.P. GROBLER, J.G. LORENZ, T.R. TURNER

131. **The phylogeography of the Angolan Black and White Colobus monkey, *Colobus angolesnsis palliatus*, in Kenya and Tanzania.** M. MCDONALD, H. HAMILTON, R. DREWES.

132. **Influence of androgen receptor variation in primate and carnivore female social dominance.** L.A. PFISTER, L.T. NASH, M.S. ROSENBERG, A.C. STONE.

133. **Molecular clocks in lemuroid primates.** C. TSANTES, M.E. STEIPER

134. **Genetic and Linguistic Coevolution in Native Latin America**. N.J. SCHNEIDER, K.L. HUNLEY,

135. **Characterization of *TAS2R38* (phenylthiocarbamide) Haplotype Diversity in Altaian Populations from South-Central Siberia.** PIPES L, STEFFLOVA K, DULIK MC, OSIPOVA LP, ZHADANOV SI, SCHURR TG.

136. **Geographical Distribution of Surnames in the Aleutian Archipelago: Evidence from Y-Chromosome Markers.** ORION M. GRAF, MARK ZLOJUTRO, ROHINA RUBICZ, MICHAEL H. CRAWFORD.

137. **Analysis of aDNA From Maya Skeletal Remains Using the Mitochondrial Control Region.** ELIZABETH LAVOIE.

138. **Search for founder mitochondrial lineages in Holocene human remains in Patagonia.** M. MORAGA, E. ASPILLAGA, F. MENA.

139. **Genetic diversity in South Amerindian populations.** M.L. PAROLIN, A.S. GOICOECHEA, C.B. DEJEAN, S.A. AVENA, F.R. CARNESE.

140. **Allele distribution at HLA DQA1 and HLA DQB1 among Cayapa Indians and Blacks from Ecuador: an association study with onchocerciasis.** F. DE ANGELIS, A. GARZOLI, G.F. DE STEFANO.

Saturday April 4th 2009. Morning sessions.

141. **Disease susceptibility and genetic ancestry of climatic droplet keratopathy in Mapuche populations**. MC DULIK, TG SCHURR, TA CAFARO, EA URRETS-ZAVALIA, JA URRETS-ZAVALIA , HM SERRA.

142. **Microevolutionary analysis of populations of Amerindian origin from southern Chile.** M. DE SAINT PIERRE, E. LLOP, M. MORAGA.

143. **The Origins of the Taita and Mijikenda ethnic groups of Kenya: A mitochondrial case study.** K. BATAI, K.B. BABROWSKI, S.R. WILLIAMS.

144. **Finding the Scot in the Scottish-American: Examination of ethnic identity through the Y-chromosome.** K.G. BEATY AND M.L. MEALEY.

145. **A New World thalassemia in the 16th century Tipu population in Belize.** M.N. COHEN, N. ELWESS, S. LATOURELLE, N. BHALLA, AND E. LAVOIE.

146. **Mitochondrial DNA origins and affinities of the Kanak of New Caledonia.** E.G. KOUNESKI, D.A. MERRIWETHER

147. **Genetic adaptations to thermal stress in the uncoupling proteins**. A.M. HANCOCK, V.J. CLARK, AND A. DI RIENZO.

148. **What can cytokine polymorphisms tell us about human population history? The case of interleukin-6.** F. A. CRESPO, G. R. FERNANDEZ-BOTRÁN, M.F. CASANOVA, AND C.R. TILLQUIST.

149. **The peopling of Gabon (Africa) seen through its genetic and linguistic diversity.** F. MANNI

150. **A statistical test that two individuals are from the same randomly mating population.** N.M. SCOTT, W.C.L. STEWART AND J.C. LONG.

Session 42. Human Biology. Measuring human variation. The distribution of human diversity. The influence of humans on other species' genomes. Contributed posters.

Chair: Fred L. Bookstein University of Vienna and University of Washington
8:00-8:30 am: Poster set-up
6:00-6:30 pm: Poster take-down
10:00-10:30 am and 2:00-2:30 pm: Author of even number posters present for discussion
10:30-11:00 am and 2:30-3:00 pm: Author of odd number posters present for discussion

151. **The use of computerized tomography in the analysis of sagittal suture fusion.** J.C. REED, J.W. ADAMS, L.K. BURSON, K.M. DEGRANDE, J.J. CRAY, M.P. MOONEY

152. **Physical and cognitive predictors of skills and expertise across the lifespan.** E. SCHNITER.

153. **Comparison of heart rate monitor and accelerometer for measuring energy expenditure under field conditions.** M.W. REICHES, K.SHARROCK, S. MOORE, A.M. PRENTICE, P.T. ELLISON.

154. **Predicting the oxygen consumption of individuals: Are mechanical energy calculations enough?** A. D. SYLVESTER, P.A. KRAMER.

155. **Global human population structuring seen from craniometric data.** D. V. BERNARDO, T. F. ALMEIDA, W. A. NEVES, T. HANIHARA

156. **The effect of *Kitlg* on human skin pigmentation**. E.E. QUILLEN, S. BELEZA, D.M. KINGSLEY, R.A. KITTLES, AND M.D. SHRIVER.

157. **A Population Genomic Analysis of the Peopling of the New World. Geographic patterns of anthropometric and linguistic data in Native Americans from California: Using Monmonier's algorithm to detect barriers.** P.C. DILLINGHAM

158. **A Population Genomic Analysis of the Peopling of the New World.** KITCHEN A, F. QIU, M.M. MIYAMOTO, C.J. MULLIGAN.

159. **Dating selection pressures in recent human evolution.** J.L. KELLEY, M. PRZEWORSKI

160. **Landmark selection and statistical significance for a cranial vault thickness study in an eco-geographically diverse recent human sample.** H.E. MARSH.

161. **Human mediated dispersal of the *Anopheles punctulatus* group in the Pacific.** D.M. REIFF, C. STELLFOX, M. WELLS, C. BRUNSON, S. SUGURI, F. HOMBHANJE, A. KANEKO, G. TALEO, M. AMOS, J.K. LUM.

162. **The role of the Melanocortin 1 receptor in domestication induced changes in alpaca coat color.** J.G. LUEDTKE, D.A. MERRIWETHER.

163. **Camelid domestication in the Americas.** DAVID A. MERRIWETHER

164. **Automated conversion and haplotyping of human mitochondrial DNA sequences**. R.L. RAAUM.

165. **A metric for covariance matrices in the context of evo-devo studies.** F.L. BOOKSTEIN, PHILIPP MITTEROECKER.

Session 43. Paleoanthropology: Primate Evolution. Morphology and function in fossil and living human and non-human primates. Teaching efforts. Contributed posters. Chair: Jason Organ. Saint Louis University.

8:00-8:30 am: Poster set-up
6:00-6:30 pm: Poster take-down
10:00-10:30 am. and 2:00-2:30 pm: Authors of even number posters present for discussion
10:30-11:00 am. and 2:30-3:00 pm: Authors of odd number posters present for discussion

166. **Cranial shape variation in extant and giant subfossil lemurs from Madagascar.** K.L. BAAB, W.L. JUNGERS.

167. **Caudal vertebral structure of *Cebupithecia sarmientoi*.** J.M. ORGAN, P. LEMELIN.

168. **Tail length and the sacral index in living and subfossil Malagasy prosimians.** E. HUQ, W.L. JUNGERS.

169. **Dietary implications of relative infraorbital foramen size in the subfossil lemurs of Madagascar.** L.R. GODFREY, M.N. MUCHLINSKI, K.M. MULDOON, LYDIA TONGASOA.

170. **The mandible of *Protopithecus brasiliensis*: implications for fossil hyoid reconstruction in alouattins.** L.B. HALENAR

171. **The internal basicranial morphology of *Victoriapithecus macinnesi*.** L.A. GONZALES, F. SPOOR, P. MORRIS, B. BENEFIT

172. **Low Magnification Microwear Analysis of Early Pliocene Cercopithecids from Gona, Ethiopia.** E.H. GUTHRIE, S.R. FROST, S.W. SIMPSON, J. QUADE, S. SEMAW, N. LEVIN.

173. **Adaptations of *Microcolobus* discovered from Nakali, Kenya.** M. NAKATSUKASA, T. IKARASHI, D. SHIMIZU, M.F. TEAFORD, P.S. UNGAR, Y. KUNIMATSU.

174. **An atlas of modern human cranial morphology constructed via non-rigid deformation analysis of high-resolution CT images.** P.T. SCHOENEMANN, J. MONGE, B.B. AVANTS, J.C. GEE.

175. **Measuring human remains in the field: grid technique, total station, or MicroScirbe?** V. SLADEK, P. GALETA, D. SOSNA.

176. **Presenting human evolution at the Smithsonian: 'What does it mean to be human?'** POTTS R., POBINER, BRIANA, GORDON, KATHLEEN

177. **God and the *Stegosaurus*: presentations of creationism and evolution in American museums.** K.E. SCHROER

178. **Evaluating the race concept in the classroom and community: insight from student research**. D.L. OSBORNE, M.S. WILLIS, S.G. BEYENE.

179. **Teaching genetic drift the (W)right way.** S.J. CARNAHAN, M.I. JENSEN-SEAMAN.

180. **The ontogenetic trajectory of the phenotypic covariance matrix and its effect on human cranial evolution.** P. MITTEROECKER, F. L. BOOKSTEIN.

181. **Phylogeographic variation of ASPM is determined by IL-10?** C.R. TILLQUIST, G. R. FERNANDEZ-BOTRÁN, M.F. CASANOVA, AND F. A. CRESPO.

182. **Poster moved. Spot available to organizers.**

183. **Social stratification of height in postfamine Ireland (1860-1910).** K. Young, J. Relethford, M.H. Crawford.

Session 44. Skeletal Biology: dental anthropology. Contributed Papers. ***Superior A & B.***

Chair: Daniel Antoine. Institute of Archaeology. University College London

8:00-8:15 am **The Caries-Attrition Relationship: A View from Precontact Central California.** M.C. GRIFFIN, J.A. SNYDER, D. GRANT.

8:15-8:30 am. **Among the enemy: Dental affinities of the C-Group Nubians at Hierakonpolis, Egypt.** J.D. IRISH.

8:30-8:45 am. Human occlusion in past and present. Edge-to-Edge as physiologically adapted bite. A. ROSSBACH AND KW ALT.

Saturday April 4th 2009. Morning sessions.

8:45-9:00 am. **Health status and lifestyle in early Neolithic and later Iron Age Taiwan: dental indicators.** M. PIETRUSEWSKY, A.J. LAUER , C.H. TSANG.

9:00-9:15 am. **Resolving the mystery of the Kylindra cemetery: deciduous tooth development in ancient Greece.** C. FITZGERALD, S. HILLSON.

9:15-9:30 am. **Incisor microwear textures of five bioarcheological groups.** KRISTIN L. KRUEGER AND PETER S. UNGAR

9:30-9:45 am. **Assessment of the dietary transition in the Southern Lower Mississippi Valley through the analysis of dental paleopathologies.** G.A. LISTI.

9:45-10:00 am. **Comparative morphology of modern Malay and fossil deciduous teeth from central Java (Indonesia).** J.R. LUKACS, S. KUSWANDARI, J ARIF .

10:00-10:15 am. **A study of human growth in London over the past 1000 years using tooth histology to determine a precise age-at-death.** D.M. ANTOINE, S.W. HILLSON, D. KEENE, G. MILNE, A. WALDRON AND W. WHITE.

10:15-10:30 am. **Break**

Session 45. Human Biology. Assessing and understanding maturational processes. *Superior A & B.* Chair: Patrick F. Clarkin. U. Mass Boston

10:30-10:45 am. **Paleoepidemiology of periodontal disease and dental calculus in the Windover population.** MT FASHING .

10:45-11:00 am. **Energy source, caloric intake, and bone acquisition during growth: implications for human skeletal phenotype.** M. J. DEVLIN, D. PANUS, N. THOMAS, C. J. ROSEN, M. L. BOUXSEIN.

11:00-11:15 am. **Shape analysis of the dimorphism in modern human mandible throughout postnatal development.** M. COQUERELLE, J. BRAGA, S. KATINA, F.L. BOOKSTEIN, D.J. HALAZONETIS, G.W. WEBER.

11:15-11:30 am. **Testosterone, aging, and seasonality among Toba men of northern Argentina.** C.R. VALEGGIA, C.L. LEWARCH, P.T. ELLISON.

11:30-11:45 am. **Correlations between refugee experiences and physical stature in Hmong and Lao adults.** P.F. CLARKIN

11:45-12:00 am. **Magnitude of change in energy balance and duration of lactational amenorrhea among Toba women of northern Argentina.** K.M. BURKE, C.R. VALEGGIA, P.T. ELLISON.

Session 46. Human biology. Human reproductive ecology. Contributed papers. *Michigan A & B.* Chair: Peter B Gray UNLV.

8:00-8:15 am. **MHC and mate choice in humans.** RAPHAËLLE CHAIX, CHEN CAO, PETER DONNELLY.

8:15-8:30 am. **Age at sexual maturity in humans: implications for life history analysis.** A. PARRISH, S.L. ROBSON.

8:30-8:45 am. **Social behavior and genetic diversity in human populations.** E HEYER, R CHAIX, L SEGUREL, F AUSTERLITZ, R VITALIS, T HEGAY, M BLUM.

8:45-9:00 am. **A semi-free ranging chimpanzee (Pan troglodytes) gives birth at 65 years of age: Implications for delayed reproductive senescence.** CT. CLOUTIER DC. BROADFIELD, T WOLF, AR. HALLORAN.

9:00-9:15 am. **Reproduction and lifespan: trade-offs, overall energy budgets, intergenerational costs and costs neglected by research.** G. JASIENSKA.

9:15-9:30 am. **Changes in women's fertility can be tied to their population's demographic processes.** MADRIGAL L, MELENDEZ-OBANDO M. AND R. VILLEGAS-PALMA.

9:30-9:45 am. **Testing the hormonal correlates of grandmothering in Jamaica.** P.B. GRAY, M.E. SAMMS-VAUGHAN.

9:45-10:00 am. **The operational sex ratio (OSR) among hunter-gatherers: cause or effect of male-male competition?** MARLOW, FW AND BERBESQUE, JC

10:00-10:15 am. **Women's coalition aggression: The influence of allies and competition on gossiping.** N. HESS, E.H. HAGEN.

10:15-10:30 am. **Break**

Session 47: Anthropological genetics: Human population studies. Contributed papers. ***Michigan A & B.***
Chair: Francesc Calafell Unitat de Biologia Evolutiva Universitat Pompeu Fabra Barcelona

10:30-10:45 am. Mitochondrial DNA diversity of Yemenite and Ethiopian Jewish populations. NON, AMY L, RYAN RAAUM AND CONNIE MULLIGAN.

10:45-11:00 am. **Recent demographic changes account for the genealogical discontinuity between Etruscan, Medieval and modern Tuscans**. GUIDO BARBUJANI, SILVIA GUIMARAES, ANDREA BENAZZO, LUCIO MILANI , DAVID CARAMELLI.

11:00-11:15 am. **Genetic structure of the Spanish populations: the end of the Basque singularity?** F. CALAFELL, H. LAAYOUNI, P. GARAGNANI, A. GONZÁLEZ-NEIRA, J. BERTRANPETIT.

11:15-11:30 am. **Inferring human gene flow over Mediterranean space towards Iberian Peninsula based on Y-chromosomal haplogroups E and J in a coastal Andalusian population (Southern Spain).** R. CALDERÓN, B. AMBROSIO, J.M. DUGOUJON, C. HERNÁNDEZ, D. DE LA FUENTE, A. GONZÁLEZ-MARTÍN, J.N. RODRÍGUEZ, A. NOVELLETTO.

11:30-11:45 am. **Evidence supporting two centers of population differentiation in East Asia: Siberia and SE Asia.** M.S. SCHANFIELD, S. MILLER, R. SHYU,M. MOUNT, H.F. POLESKY, R. CASTRO, H. EHRLICH, U. EKE, S. MACK, R.J. MITCHELL, M. COBLE, K. MELVIN, M. H. CRAWFORD.

11:45-12:00 **Genetic discontinuity in indigenous populations of the Aleutian Archipelago.** MH CRAWFORD, R RUBICZ, AND M ZLOJUTRO.

Session 48. Paleoanthropology: Hominin craniofacial morphology and neural evolution. Homo evolution. Contributed Papers. ***Chicago 8.*** Chair: Sheela Athreya. Texas A&M University

8:00-8:15 am. **Plant neurotoxins and brain development: Implications for encephalization in *Homo*.** E.H. HAGEN, R.J. SULLIVAN

8:15-8:30 am. **A comparative study of frontal bone morphology among Pleistocene hominin fossil groups.** S. ATHREYA.

8:30-8:45 am. **Neglected aspects of evolution: temporal and causal sequence of cranial base change.** A. BARASH, P. GUNZ.

8:45-9:00 am. **Opposing extremes of jaw mechanics: *Australopithecus boisei* vs. *Homo neanderthalensis*.** Y. RAK, W. HYLANDER.

9:00-9:15 am. **Basicranial flexion in the evolution of *Homo*: new analyses of an old model.** M. BASTIR, A. ROSAS, C. STRINGER, J.M. DE LA CUÉTARA, R. KRUSZYNSKI, C.F. ROSS, M.J. RAVOSA.

9:15-9:30 am. **Artificial cranial deformation in Pleistocene Australian crania from Kow Swamp and Cohuna.** A.C. DURBAND.

9:30-9:45 am. **Growth in African Pygmies tested from cranial morphology.** F.V. RAMIREZ ROZZI, M. SARDI.

9:45-10:00 am. **Comparing endocranial ontogenetic trajectories between humans and chimpanzees.** S. NEUBAUER, P. GUNZ, J.-J. HUBLIN.

10:00-10:15 am. **Interpreting Hominin Variability: A Test of the Template Method.** NEIL THOMAS ROACH, RACHEL CARMODY, MEREDITH REICHES, ELLEN MCRAE & ALEXANDER GEORGIEV.

10:15-10:30 am. Break

10:30-10:45 am. **A new and simple method for sharing paleoanthropological data using Google Earth and GIS.** G.C. CONROY, R.L. ANEMONE, J. VAN REGENMORTER, A. ADDISON.

10:45-11:00 am. **Rediscovery of the *Homo erectus* bed at Ngandong: Site Formation of a late Pleistocene hominin site in Asia.** R.L. CIOCHON, F. HUFFMAN, E.A. BETTIS III, Y. ZAIM, Y. RIZAL, ASWAN.

11:00-11:15 am. **A female *Homo erectus* pelvis from Gona, Ethiopia.** S.W. SIMPSON, J. QUADE, N.E. LEVIN, BUTLER, G. DUPONT-NIVET, M.A. EVERETT, S. SEMAW.

11:15-11:30 am. **Divergence in hominin upper limb anatomy in the early Pleistocene.** RICHMOND, B.G. , J.W.K. HARRIS , E. MBUA , D.R. BRAUN , M. BAMFORD , R. BOBE , D.J. GREEN , N.L. GRIFFIN , J.T. MCCOY , S. MERRITT , M. PANTE , B. POBINER , H. CARTER-MENN , H. CHIRCHIR , P. KIURA , M. KIBUNJIA .

11:30-11:45 am. **Bite force scaling and food mechanical properties**. C.M. ENG, M.A. PETERS, K.D. ZINK, D.E. LIEBERMAN.

11:45am-12:00 pm. **Inhibitory interneurons and the evolution of human frontal cortex.** C.C. SHERWOOD, M.A. RAGHANTI, C.D. STIMPSON, M.A. SPOCTER, C.J. BONAR, K.A. PHILLIPS, J.M. ALLMAN, J.M. ERWIN, P.R. HOF.

Saturday April 4th 2009. Morning sessions.

Session 49. Skeletal Biology: Craniometric and Nonmetric Variation. Postcranial variation. Contributed Papers. *Chicago 9.* Chair: Sarah Elton Hull York Medical School

8:00-8:15 am. **Masticatory loading, function and plasticity of the mammalian circumorbital region.** E. JAŠAREVIĆ, J. NING, R.A. MENEGAZ, J.J. JOHNSON, M.S. STACK, M.J. RAVOSA.

8:15-8:30 am. **Mandibular shape changes in modern humans and *chimpanzees* during fetal and early postnatal development.** G.W. WEBER, M. COQUERELLE, J. BRAGA, S. KATINA, F.L. BOOKSTEIN, D.J. HALAZONETIS.

8:30-8:45 am. **Climate and Craniofacial shape variation among major human populations: a geometric morphometric approach**. M. FRIESS.

8:45-9:00 am. **Eskimo-Aleut craniofacial morphology: a test of the hard chewing hypothesis.** C.M. JOHNSON, G.R. SCOTT.

9:00-9:15 am. **The ectocranial suture synostosis pattern of Paleo-Aleut and Aleutian inhabitants: A test of cranial shape.** JAMES J. CRAY JR. MARK P. MOONEY, AND MICHAEL I. SIEGEL

9:15-9:30 am. **The use of elliptical Fourier analysis on human orbit shape.** T.M. GORE.

9:30-9:45 am. **Cranial muscle markers: A preliminary examination of size, sex, and age effects.** ELIZABETH WEISS.

9:45-10:00 am. **Cross-sectional Variation at the Femoral Mid Diaphysis: Evidence for Sex Bias in Contour Categories.** I.S. MAGGIANO, V. TIESLER BLOS, H. KIERDORF, M. SCHULTZ.

10:00-10:15 am. **Wrist and upper limb kinematics of amateur knappers during stone tool production.** E.M. WILLIAMS, A.D. GORDON, B.G. RICHMOND.

10:15-10:30 am. **Break**

10:30-10:45 am. **Evidence for the influence of diet on cranial form and robusticity**. R.A. MENEGAZ, S.V. SUBLETT, S.D. FIGUEROA, T.J. HOFFMAN, M.J. RAVOSA, AND K. ALDRIDGE. Paper not originally here.

10:45-11:00 am. **Developmental and Ecogeographic Limb Variation Among the Subadults of Three Native American Populations.** E.B. WAXENBAUM, A. B. FALSETTI.

11:00-11:15 am. **The development of humeral strength asymmetry during growth: play, practice, and childhood activity patterns.** LW COWGILL.

11:15-11:30 am. **Tibial shape analysis – a quantitative approach for the whole bone.** M.A. FRELAT, F.L. BOOKSTEIN, G.W. WEBER.

11:30-11:45 am. **Identifying skeletal upper limb bilateral asymmetry in great apes**. L.A. CASHMORE & S.R. ZAKRZEWSKI.

11:45-12:00 S. **Monkey macroecology: spatial, environmental and taxonomic influences on cranial morphology in *Piliocolobus* and *Chlorocebus.*** S. ELTON, A. CARDINI

Session 50. Primatology. Primate feeding, dietary and behavioral Ecology, and evolution. Contributed papers. Chair: Mary Glenn. Humboldt State University Arcata, California.

8:00-8:15 am. **Comparative ecology of exudate feeding by Asian lorises (*Loris, Nycticebus*).** K.A.I. NEKARIS.

8:15-8:30 am. **A facultative mutualism? Interspecific associations between a small raptor (*Harpagus bidentatus*) and two species of capuchin monkey (*Cebus capucinus, C. apella*) in Costa Rica and Suriname.** K.C. MACKINNON

8:30-8:45 am. **The role of food supply in the recovery of a black howler monkey (*Alouatta pigra*) population in response to a major hurricane.** ALISON M. BEHIE, MARY S.M. PAVELKA, COLIN A. CHAPMAN.

8:45-9:00 am. **Diet and habitat use of mona monkeys (*Cercopithecus mona*) on the island of Grenada, West Indies.** M.E. GLENN, M. RAMSIER, G. HYLTON, K.J. BENSEN.

9:00-9:15 am. **Seeds as a fallback resource for East African *Cercocebus*.** J. WIECZKOWSKI, C.L. EHARDT.

9:15-9:30 am. **The importance of protein and fiber in Delacour's langur food choice.** CATHERINE WORKMAN

9:30-9:45 am. **Spatial correlates of capuchin-dispersed seed and seedling survival, germination and growth.** K. VALENTA AND L.M. FEDIGAN.

9:45-10:00 am. **Masticatory-system configuration and canine height in New and Old World monkeys.** J.E. SCOTT.

10:00-10:15 am. **Intraspecific variability in the nutritional contents of primate foods: implications for primate feeding ecology and ways forward.** JESSICA M. ROTHMAN AND COLIN A. CHAPMAN.

10:15-10:30 am. **Break**

10:30-10:45 am. **Parties in the rainforest: Subgroup size and composition of black-handed spider monkeys at a wet site in Costa Rica.** M.A. RODRIGUES, S.M. LINDSHIELD, J.T. WALZ, M. PALMER, T.L. LARSEN.

10:45-11:00 am. **Asian primate species richness correlates with rainfall using GIS modeling.** M. SHEKELLE, A. SRIVATHSAN, AND A. SALIM.

11:00-11:15 am. **Comprehension of tool properties by orangutans (*Pongo* spp.): rigidity and flexibility.** K.R. WALKUP, R.W. SHUMAKER, J.D. PRUETZ.

11:15-11:30 am. **Digestive efficiency and its effects on primate biomass across continents.** E.R. VOGEL, C.H. JANSON, AND C.P. VAN SCHAIK.

11:30-11:45 am. **Travel route analysis of fissioning Japanese macaque troops in Yakushima, Japan.** D.S. SPRAGUE, N. IWASAKI.

11:45-12:00 **Population estimates of Mentawai primates on the Pagai Islands, Mentawai, West Sumatra, Indonesia.** L.M. PACIULLI, J.P. VIOLA .

Saturday April 4th 2009. Afternoon sessions.

Session 51. What makes us human? Views from the genome. Invited symposium *Chicago 8.*

Organizers: Anne C. Stone and Brian Verrelli

Since the sequencing of the human genome, research has focused on elucidating the function of genes and non-coding elements and on the selective pressures that have influenced and characterized human evolution. This research seeks to discover answers to questions such as how and why are we different from other primates, why do we have language, art, and complex culture, and how have humans adapted to the environments in which we live? The addition of the chimpanzee, macaque, and other and primate genomes currently in progress add to growing picture of what makes us human.

1:00-1:15 pm. **Introduction: Using comparative genomics to understand human evolution.** A. C. STONE

1:15-1:30 pm. **Sign, sign, everywhere a sign: high density haplotype maps of the dog, human, and cow genomes reveal extensive human reorganization of domesticated genomes.** CARLOS D. BUSTAMANTE, ELAINE A. OSTRANDER, MAGNUS NORDBORG, MATTHEW R. NELSON, MICHELE CARGILL, RICHARD A. GIBBS, AND ROBERT K. WAYNE

1:30-1:45 pm. **Using comparative genomics to improve understanding of hominid craniofacial evolution.** HEATHER A. LAWSON, KATHERINE E. WILLMORE, LAURA COX, MICHAEL MAHANEY, JEFFREY ROGERS.

1:45-2:00 pm. Paper withdrawn. Spot available for organizers.

2:00-2:15 pm. **Gene regulation in primates evolves under tissue-specific selection pressures** YOAV GILAD.

2:15-2:30 pm. **Gene gain, gene loss, and primate evolutionary ecology.** G.H. PERRY.

2:30-2:45 pm. **Hominoid gene duplications in hominin evolution.** M.I. JENSEN-SEAMAN.

2:45-3:00 pm. **Using comparative primate population genetics in understanding infectious disease resistance.** B.C. VERRELLI, E.E. TASSONE, D.M. ANDERSON, A.C. STONE, J.A. RAWLS.

3:00-3:15 pm. **Null mutations in human and mouse orthologs frequently result in different phenotypes: Implications for human evolution.** JIANZHI ZHANG.

3:15-3:30 pm. **Break**

3:30-3:45 pm. **Insights from sequencing the Neandertal genome.** J. KRAUSE, R. E. GREEN, A.W. BRIGGS, U. STENZEL, K. PRUEFER, T. MARICIC, M. KICHNER, J. KELSO, D. REICH, J. C. MULLIKIN, M. EGHOLM & S. PÄÄBO

3:45-4:00 pm. **Layers of history within humanity's genomes.** J.L. MOUNTAIN.

4:00-4:15 pm. **The genetic basis of phenotypic variation in Africa: Evidence for local adaptation.** S. A. TISHKOFF, M. CAMPBELL, A. FROMENT, J. HIRBO, M. IBRAHIM, S. OMAR, A. RANCIARO.

4:15-4:30 pm. **The impact of local selection on recent human evolution.** M. STONEKING.

4:30-4:45 pm. **Genetic adaptations to spatially-varying selective pressures and the susceptibility to common diseases.** DI RIENZO, A. M. HANCOCK, D. WITONSKY, G. ALKORTA-ARANBURU, J. K. PRITCHARD, G. COOP

4:45-5:00 pm. **Round table.**

Session 52. Paleoanthropology. Early hominin evolution. Non—hominin primate evolution. Contributed Papers. *Chicago 9.* Chair: Kathleen M. Muldoon, Dartmouth Medical School & Dartmouth College.

1:00-1:15 pm. **Biomechanical changes in the ankle and foot during flexed hip and knee walking and its implications for interpreting the hominin fossil record.** M. P. WILSON, E. L. SIMS, D. SCHMITT.

1:15-1:30 pm. **New evidence on the evolution of human foot function based on optical laser scanning of early hominin foot prints.** MATTHEW R. BENNETT, JOHN W.K. HARRIS, BRIAN G. RICHMOND, DAVID R. BRAUN, EMMA MBUA, PURITY KIURA, DANIEL OLAGO, MZALENDO KIBUNJIA.

1:30-1:45 pm. **Laetoli hominin footprints site G: the changing views of sustainable conservation of Tanzania's ichnofossil record.** CHARLES M. MUSIBA, CASSIAN C. MAGORI, PAUL MSEMWA, BETHANY WILLIAMS, JAMIE CARPIO, AND AUDAX Z.P. MABULLA .

1:45-2:00 pm. **A new computational method for simulation and optimization of hominin gait.** T. EREZ, W.D. SMART, H. PONTZER.

2:00-2:15 pm. **Muscle force production during bent-knee, bent-hip walking in humans.** A.D. FOSTER, D.A. RAICHLEN, H. PONTZER, M.D. SOCKOL
.

2:15-2:30 pm. **Troubling the waters of anthropology: Is wading the missing factor in the evolution of hominid bipedalism**? A.V. KULIUKAS, DR N. MILNE, DR P. FOURNIER.

2:30-2:45 pm. **Calcar femorale visualized in computed tomographic images of the fossilized hominid femora, BAR 1002'00 and BAR 1003'00.** A.J. KUPERAVAGE, R.B. ECKHARDT.

2:45-3:00 pm. **Systematic and functional significance of the KNM-ER 3228 os coxa.** E. E. SARMIENTO

3:00-3:15 pm. **Phylogenetic relationships of late Uintan primates from the Devil's Graveyard Formation, Texas.** E.C. KIRK, B.A. WILLIAMS.

3:15-3:30 pm. **Break**

3:30-3:45 pm. **Phylogenetic history of the African papionins: a cladistic analysis of extant and fossil taxa using craniodental data.** C.C. GILBERT.

3:45-4:00 pm. **A new pliopithecid from the late early Miocene of Fanchang, Anhui Province, China.** T. HARRISON, C. JIN.

4:00-4:15 pm. **Dental roots morphology and phylogeny of hominoids.** E.-G. EMONET, P. TAFFOREAU, Y. CHAIMANEE, L. DE BONIS, G. KOUFOS, J.-J. JAEGER.

4:15-4:30 pm. **Coping with taxonomic ambiguity and inter-observer variation in paleontological and paleoanthropological analyses.** W.A. BARR, D.N. REED.

4:30-4:45 pm. **Geographic patterning in subfossil primate community dynamics in Madagascar.** K.M. MULDOON, L.R. GODFREY, W.L. JUNGERS, J.W. CHIPMAN.

4:45-5:00 pm. **Primate paleontology across the Paleocene-Eocene boundary in the Great Divide Basin, SW Wyoming.** R. ANEMONE, W. DIRKS, B. NACHMAN, W. MOORE, J. VAN REGENMORTER.

Session 53. Human Biology. Population biological variation and disease. Measuring body composition. Socio-cultural contexts of malnutrition. Contributed papers. *Superior A & B.* Chair: Craig Hadley Emory University

1:00-1:15 pm. **Effects of malaria control and modernization on health across the lifespan: the health transition in Vanuatu.** KD NEEDHAM, M VILAR, C CHAN, LE SOLOWAY, C DEHUFF, M WILSON, L TARIVONDA, A KANEKO, RM GARRUTO, JK LUM.

1:15-1:30 pm. **Finger and Palmer Dermatoglyphics on β Thalassemia Patients visiting two Hospitals in Siliguri, West Bengal, India.** SUBIR BISWAS & ROSHNI ROY.

1:30-1:45 pm. **Patterns of genetic variation at the GYPA locus in human populations.** BIGHAM AW.

1:45-2:00 pm. **Genetic evidence of a prehistoric Athapaskan migration.** R.S MALHI.

2:00-2:15 pm. **Foraging strategies and diet composition of Hadza children**. A.N. CRITTENDEN, N.L. CONKLIN-BRITTAIN, F.W.MARLOWE, M.J. SCHOENINGER, R.W. WRANGHAM.

2:15-2:30 pm. **Adiposity in 7-11 year old British children: comparison of British Pakistanis and white Britons, and 2nd and 3rd generation British Pakistanis.** E. J. HENDERSON, C. H. D. JONES, Y.C. HORNBY, H.C. ATHERTON, T.M. POLLARD.

2:30-2:45 pm. **The impact of the global food crisis on the health and wellbeing of Ethiopian youth.** CRAIG HADLEY.

2:45-3:00 pm. **Body frame dimensions can predict obesity: Body mass index, body frame and fatness.** M. HENNEBERG, S.J. ULIJASZEK.

3:00-3:15 pm. **Specific metabolic correlates of obesity as indicated in a cross-sectional population study.** U.WOITEK, F. RÜHLI, P. GRUBER, M. HENNEBERG.
3:15-3:30 pm. Break
3:30-3:45 pm. **Novel non-invasive alternatives for the measurement of autonomic stress responses in children and adults**. J.A. DECARO

3:45-4:00 pm. **Assessing the human stress response in paradise.** D. VELDHUIS.

4:00-4:15 pm. **Principles of growth perception: does the human face processing pathway generalize to cars?** S. WINDHAGER, F.L. BOOKSTEIN, K. GRAMMER, T. THORSTENSEN, K. SCHAEFER.

4:15-4:30 pm. **Psychomorphometry: Towards a novel assessment of human facial form and function.** K. SCHAEFER, F.L. BOOKSTEIN, B. FINK, P. MITTEROECKER.

4:30-4:45 pm. **Shape analysis of human midfacial morphology.** W.R TRASK, J.T HEFNER.

4:45-5:00 pm. **A flexible new program for computer-aided footprint analysis: demonstration, discussion and application**. D. WEBB

Session 54. Skeletal Biology: Bio-archaeology. Contributed Papers. ***Michigan A & B.***
Chair: Heather C. Gill-Robinson North Dakota State University

1:00-1:15 pm. **Friend or foe: Heads as memorials and status symbols in the Torres Strait Islands.** H. BONNEY, M. CLEGG,

1:15-1:30 pm. **Subsistence strategies of the early inhabitants of southernmost California**. M.J. SCHOENINGER, P.M. MASTERS, C.M. KELLNER, J.L BADA, JOSHUA J. PECK, A.N. CRITTENDEN.

1:30-1:45 pm. **A reanalysis of the human cranium from the Scharbauer site (41MD1), a paleoindian locality near Midland, Texas.** TAYLOR MS

1:45-2:00 pm. **Estrogens in human remains.** P. HELD, K.W. ALT.

2:00-2:15 pm. **Gender and paleopathology: a 19th and 20th century Portuguese perspective.** F. ALVES CARDOSO.

2:15-2:30 pm. **Qualitative and quantitative assessment of diagnostic MR and CT imaging in ancient mummies.** F. RÜHLI, H. VON WALDBURG, M. BOCK, S. NIELLES-VALLESPIN, P. SPEIER.

2:30-2:45 pm. **Piercing the body: Labret use and identity in prehistoric Chile.** C. TORRES-ROUFF.

2:45-3:00 pm. **As we were in life, we are not in death: evidence of possible mummification in prehistoric Britain.** C.C. COX, M. PARKER PEARSON.

3:00-3:15 pm. **Identification of infanticide in the Greco-Roman world: a contrary view from the Agora of Athens.** M.A. LISTON.
3:15-3:30 pm. **Break**
3:30-3:45 pm. **New findings on life and death of the Tyrolean Iceman.** A.R. ZINK, M. JANKO, O. PESCHEL, P. GOSTNER, E. EGARTER-VIGL.

3:45-4:00 pm. **An 18th century lithopedion from Heidelberg, Germany.** H.C. GILL-ROBINSON, H.P. SCHMITT, W. ROSENDAHL.

4:00-4:15 pm. **Who's herding the sheep? Exploring the origins of pastoralism in southernmost South Africa.** J. K. GINTER.

4:15-4:30 pm. **Quadruplegic paralysis and bone remodeling: A case study.** D.C. PINTO, S.H. SCHLECHT, S. D. STOUT.

4:30-4:45 pm. **Unlocking the Clavicle: Musculoskeletal Stress Markers (MSM) from Tell Abraq, United Arab Emirates (2300 B.C.).** D. RUZICKA, A. N. PETERSON, D. L. MARTIN, D. T. POTTS.

4:45-5:00 pm. **Sub-Adult sex estimation with dental cervicometrics.** A. LOPINTO, S. HILLSON.

Session 55. Primatology. Primate Locomotion and Ranging. Non-human comparative functional anatomy. Contributed papers. *Chicago 10.* Chair: Matt Cartmill. Boston University.

1:00-1:15 pm. **The effect of ground substrate on the travel paths of captive rhesus macaques (*Macaca mulatta*).** B.A. BEISNER, L.A. ISBELL.

1:15-1:30 pm. **Fore/hind limb interference and primate locomotion.** M. CARTMILL,

1:30-1:45 pm. **A field study of kinematics during quadrupedal walking in *Cebus capucinus*.** M. BEZANSON, D. A. RAICHLEN.

1:45-2:00 pm. **Biomechanics of climbing in *Macaca fascicularis*: a comparison between species that exhibit varying degrees of arboreality.** J.B. HANNA, M. PRUETTE, AND D. SCHMITT.

2:00-2:15 pm. **Forelimb motion during quadrupedalism in ateline primates with different locomotor modes.** L.E. JOHNSON, D. SCHMITT, J.E. TURNQUIST, AND M.D. ROSE.

2:15-2:30 pm. **Quadrupedalism of *Cebus apella* on terrestrial and arboreal substrates – external forces and kinematics.** K.J. CARLSON, B. DEMES

2:30-2:45 pm. **The relevance of over-striding and bipedal stepping in an arboreal context: A comparative analysis of wild ateline primates.** D.M. GUILLOT

2:45-3:00 pm. **Capuchin monkey bipedalism.** B. DEMES, M. O'NEILL.

3:00-3:15 pm. **Aye-aye hand and foot postures and loading during quadrupedal locomotion**. T.L. KIVELL, R.E. WUNDERLICH, E.M. KRAMER.

3:15-3:30 pm. Break

3:30-3:45 pm. **Three-dimensional midcarpal kinematics during wrist extension in five anthropoid species.** C.M. ORR, E.L. LEVENTHAL, F.S. CHIVERS, S.L. MENZIES, S. LARSON, J.J. CRISCO.

3:45-4:00 pm. **Environment influences bone elongation during a critical period of postnatal growth.** M.A. SERRAT, C.E. FARNUM, R.M. WILLIAMS, AND C.O. LOVEJOY.

4:00-4:15 pm. **Musculoskeletal design predicts the cost of locomotion: a test of the force production model across speed and gait in a nonhuman primate.** M. C. O'NEILL.

4:15-4:30 pm. **Seasonality and Brain Size: What's the Link?** J.T. VAN WOERDEN, K. ISLER, C.P. VAN SCHAIK.

4:30-4:45 pm. ***In vivo* bone strain and finite-element modeling of the craniofacial haft in catarrhine primates.** C.F. ROSS, D.S. STRAIT, P.C. DECHOW, B.G. RICHMOND, M.A. SPENCER, C. SCHREIN, G. WEBER, D.E. SLICE.

4:45-5:00 pm. **Comparative analysis of 3-D measures of postcranial dimorphism in primates.** J.M. PLAVCAN, A. GORDON, M. LAGUE.

5:00-5:15 pm. **Locomotor mechanics of the kinkajou (*Potos flavus*): another case of convergence with primates.** P. LEMELIN, M.A. NAGY, L. WANG. Paper not originally here.

Author/Session Index

Decimal numbers represent poster numbers within a poster session (e.g., "13.14" is poster number 14 within Poster Session 13). Brackets represent time on a 24-hour clock within a podium session (e.g., "32[16:45]" is a paper at 4:45 pm within Podium Session 32). A number followed by a "C" indicates a chair for a session, while a number followed by a "D" indicates a discussant for a session.

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Abstracts of AAPA Poster and Podium Presentations

Tuberculosis transmission and maintenance in small, low-density populations.

J.T. Achterberg. Department of Anthropology, University of Washington.

The transition to agriculture entailed a simultaneous worsening in human health, leading to the emergence of communicable disease as a major source of morbidity and mortality in human populations—or so has been long assumed. Implicit in this assumption is that communicable diseases did not represent an important source of pre-agricultural mortality. The most compelling evidence for a lack of pre-agricultural communicable diseases is that population sizes would have been too small to maintain communicable diseases without burning out.

Because of its long latency and symptomatic periods, as well as the possibility of endogenous reactivation, pulmonary tuberculosis (TB) uses a strategy that could be maintained in a small population. Using a stochastic social network model built in R, I overlay TB epidemiology onto a small population exhibiting realistic human contact patterns and structure. Using a population of 10 persons, each with defined age, sex, household and disease attributes, I model contact structure and attendant TB exposures. Attributes, and therefore contact structure, can be customized to specific historic populations.

The results of the model demonstrate that a population of 10 persons is of sufficient size to maintain communicable TB for 500 years. These results are robust over multiple trials of the stochastic model, though the percentage of persons infected with TB varies within and among model runs. This model demonstrates that small population sizes in pre-agricultural settings were not a limit to the presence of communicable diseases.

Of baboons, gorillas, squirrels and wildebeest: the morphology of hybrid mammals.

R.R. Ackermann. Department of Archaeology, University of Cape Town, South Africa.

There is a long-standing tendency within paleoanthropology to look for functional/adaptationist explanations for morphological variation. In contrast, there has been little attention given to how variation would look if other evolutionary forces – especially genetic drift and gene flow – were acting. For the latter, our understanding of how gene flow affects magnitudes and patterns of skeletal variation when it occurs between diverging populations is minimal, despite the fact that admixture among primate species that have been separated for millions of years is common, and despite myriad long-term studies of primate hybrid zones. Here I discuss ongoing research into patterns of primate (and other mammalian) craniofacial variation in the presence of admixture. Quantitative genetic expectations of heterosis/dysgenesis are often met in primate hybrids, though they can be difficult to test in the absence of pedigree data. Unusual non-metric trait variation is a sensitive indicator of hybridization and can be used to identify admixture in wild populations. Such traits have been identified in a number of mammalian lineages, including baboons, squirrels, and wildebeest. Hybrid morphologies also exist in gorillas (N=582), and indicate that admixture among genetically divergent gorilla taxa has continued until the very recent past. Combined with molecular data, these results confirm a complex relationship between lineage divergence and the true cessation of gene flow. More studies of hybridization are needed to further clarify the link between evolutionary process and extant biodiversity, and to lay the groundwork for a more nuanced interpretation of fossil diversity in all primates, including our hominin ancestors.

Differential response to predators in the Gray's Bald-faced saki monkey (*Pithecia irrorata*): A playback experiment.

D.B. Adams, E.M. Erhart. Department of Anthropology, Texas State University.

Primates use various strategies to respond to different predation pressures. Alarm calls are often used to alert conspecifics to the presence of predators and may contain information regarding predator class and/or level of threat. For example, functionally referential calls vary acoustically to elicit specific escape responses from conspecifics while urgency based calls are graded to indicate the level of threat present. I report findings of a study to determine whether the Gray's Bald-faced saki monkey (*Pithecia irrorata*) utilizes vocal communication to elicit predator-specific escape responses from conspecifics.

Data were collected on three groups of *P. irrorata* at the Los Amigos Biological Station in Southeastern Peru. A total of 48 playback experiments were conducted, including 15 harpy eagle calls, 17 jaguar growls (6 of these accompanied by a visual stimulus), and 16 control sounds. The harpy eagle playbacks elicited a consistent response from the sakis; they gave an immediate upward gaze (80% of playbacks) and descended into the lower canopy (93% of playbacks). In contrast, the jaguar playbacks only elicited a consistent response when a visual stimulus was combined with an auditory one. Under these conditions, the sakis responded by mobbing the visual stimulus for an average of 22 minutes. Mobbing behavior included alarm calls of increased intensity and duration, as well as aggressive displays directed toward the visual stimulus. My results indicate that the Gray's Bald-faced saki may utilize a referentially based alarm call system for aerial predators and an urgency based alarm call system for terrestrial predators.

Patterns of violent and non-violent trauma in a medieval population from Giecz, Poland.

A.M. Agnew, H.M. Justus. Department of Anthropology, The Ohio State University.

One-hundred eighty mature skeletons from the medieval population in Giecz, Poland (XI-XII c) were examined for evidence of skeletal trauma to determine the effects of intentional violence and lifestyle factors. The stronghold in Giecz is considered one of the strongest military fortifications of its time, playing a major role in the unification of the Polish state and royal administration. The following hypotheses were tested in this study: 1) more males (i.e. soldiers) will be affected by trauma than females and 2) a high frequency of trauma will be the result of intentional violence.

The prevalence of trauma in the adult population is significant at 46.6 % (84/180) with males exhibiting trauma more often than females at 66.6 % (56/84) and 28.5 % (24/84), respectively. More individuals exhibit trauma in the trunk region at 83.3% (70/84), than the upper limb at 13% (11/84), lower limb at 5.9% (5/84), or cranium at 5.9% (5/84). Only 3.5 % (3/84) of the adults exhibiting trauma are considered victims of intentional violence. Of the individuals with fractures in the trunk region, 84.2 % (59/70) have fractures of the vertebrae, specifically. These data suggest that a physically demanding workload and lifestyle played a large role in the incidence of trauma and either 1) the population at Giecz was not involved in as extensive a military effort as previously thought or 2) the sample of excavated skeletons is not representative of the entire population and does not include soldiers.

Issues in Detecting Natural Selection in Humans.

J.M. Akey. Department of Genome Sciences, University of Washington.

Identifying regions of the genome that have been substrates of adaptive evolution will provide important insights into recent human evolutionary history, mechanisms of evolutionary change, and patterns of phenotypic variation within and among populations. Genomics has profoundly changed the field of evolutionary genetics by providing the necessary resources to systematically interrogate the human genome for signatures of natural selection. However, unambiguous inferences of natural selection are often difficult. We have recently performed an extensive reanalysis of all genome-wide scans of selection performed in humans to date, which highlights both the promises and pitfalls of identifying genomic signatures of adaptive evolution. I will discuss how we can begin to traverse the path from where we are (low-resolution, incomplete, and error prone maps of selection) to where we want to be (a detailed molecular, mechanistic, phenotypic, and population genetics characterization of adaptive alleles).

A longitudinal study of postnatal brain morphology in Rhesus macaques exposed to an environmental insult *in utero*.

K. Aldridge[1,2], L. Wang[2,3],M. Harms[3], A.J. Moffitt[1], K. Pope[1], J.G. Csernansky[2,3], L.D. Selemon[2,4]. [1]Department of Pathology & Anatomical Sciences, University of Missouri School of Medicine, [2] Department of Psychiatry, Northwestern University School of Medicine, [3] Department of Psychiatry, Washington University School of Medicine, [4]Department of Neurobiology, Yale University School of Medicine.

Studies have shown alteration of neuronal populations in early fetal development leads to deficits in connectivity, and ultimately to functional differences in adulthood. Low-dose x-irradiation has been shown to disrupt neurogenesis in neurons undergoing the final stage of mitosis while sparing neurons at other mitotic stages. Here we examine the temporal emergence of neuroanatomical changes in macaques exposed prenatally to low-dose irradiation during early gestation.

Magnetic resonance scans were collected at 6 months, 12 months, 3 years, and 5 years of age in Rhesus macaques exposed to x-irradiation (N=5) and in sham-irradiated control animals (N=5) during early gestation (E30-41). Volumes of the whole brain, cortical gray matter, striatum (caudate, putamen, nucleus accumbens), and the thalamus were compared between cohorts at each of the four ages.

Irradiated monkeys showed reduced volume in all structures examined at all four ages. The magnitude of reduction of whole brain volume remained relatively constant (10-15%) with increasing age. In contrast, volumetric deficits of cortical gray matter, thalamus, and striatal structures became disproportionately larger with age in irradiated individuals, with thalamus (10-20%) and putamen (12-25%) showing the most pronounced reductions at older ages.

These results indicate that disruption of neurogenesis during early gestation results in progressive volume loss in multiple brain structures during postnatal ontogeny. These findings provide biologic support for the concept that small prenatal changes may produce larger effects in adulthood. This has important implications for the processes involved in primate brain development and evolution.

Work supported in part by MH071616, T32MH17104, and University of Missouri Department of Pathology & Anatomical Sciences.

Stops and starts: growth, nutrition, and Harris lines.

MP. Alfonso-Durruty. Indiana University-Purdue University of Indianapolis, State University of New York Binghamton.

Traditionally associated with stressors that halt/decelerate growth, Harris lines (HL) status as stress markers is indeed questionable. Their association with illness and deficient growth is low and they form in the absence of stress, most commonly at times of normal accelerated growth. Given that new studies demonstrate that growth is saltatory, and that its occasional, but repetitive absence is normal, HL must be reevaluated, since they may result from normal growth stasis.

To identify their value as stress markers, this study examines HL's association to nutritional status and bone growth velocity. Forty-five New Zealand white rabbits were divided into: Control (C), Experimental-1 (E-1; moderately undernourished), and Experimental-2 (E-2; periodically fasted) groups. Variables analyzed included weight, bone length, and bone growth velocity of the right humerus, as well as *Total number of Harris lines*, and *New Harris lines*. A lower number of *Total HL* was observed among E-1 rabbits by the end of the study ($p<.05$). No linear relation was identified between *Total* or *New* HL and bone growth velocity ($p>.05$). More HL formed during periods of rapid growth ($p<.05$), most likely as the result of an increased frequency in saltatory growth events at those times.

Neither nutritional status, nor bone length are associated with HL. Harris lines are a poor stress marker, likely to appear in the absence of stress. Intrinsic limitations to paleopathological studies can be overcome, but even the most careful attentiveness to multiple stress markers and cultural contexts will go amiss if the markers used are unreliable.

Wenner-Gren (Gr-7431), American Women in Science, and Sigma-Xi

The quantitative genetics of frontal curvature: evolutionary implications.

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In studies of both fossil and modern crania, frontal curvature has received regular attention for discrimination among groups, across space and through time. Although this phenotype has long been employed to distinguish archaic from modern *Homo* species and has been variably used as an indicator of population affinity in forensic contexts, its genetic significance remains unknown. It is necessary, therefore, to determine whether the observed variation in frontal curvature has a genetic basis, thus, corroborating its use in population differentiation.

We performed a Procrustes transformation and principal components analysis on 20 semi-landmarks between glabella and bregma, collected on 625 modern crania from central Austria. The resulting principal components scores were subjected to variance components analysis to obtain estimates of additive genetic variation in the sample. Our results indicate that the principal components of frontal curvature show heritabilities not significantly different from a model of $h^2 = 0$ (no additive genetic component to the phenotypic variation). Sex was not a significant covariate in the models tested. These results confirm previously published research using CT scans (Bookstein et al.1999), which identified large differences in curvature on the exterior surface of the frontal bone but failed to demonstrate a significant change in the internal surface over time in *Homo* specimens. While heritabilities from one sample cannot be directly applied to another because of environmental differences, our results suggest that the external frontal curvature, when used to distinguish modern populations, more accurately describes dissimilar environmental conditions than heritable genetic diversity.

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Buccal dental microwear pattern as an indicator of dietary behaviour in a human Neolithic tooth sample from Abu Hureyra.

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The dietary adaptations and subsistence economy of the Neolithic people from the archaeological site of Abu Hureyra (Syria) were reconstructed by using buccal microwear analyses. Casts of post-canine teeth belonging to twelve individuals were sufficiently preserved to be examined under the Scanning Electron Microscope. General preservation of enamel surfaces was poor and the sample could not be increased. The output SEM micrographs were analyzed using SigmaScan Pro 5 by SPSS. Buccal microwaer was characterized on a 0.56 mm^2 enamel patch on the buccal side of teeth, between the cemento-enamel junction and the occlusal crown rim. A total of 15 microwear variables were derived and analyzed using SPSS v. 15. The results show that the samples dating to the Pre-Potery Neolithuc (PPN) 2B have the highest densities of striations, though less variable, suggestive of the consumption of highly abrasive particles derived from food processing techniques. In contrast, the samples dating to the earlier transitional PPN-2A/2B period show fewer and widely dispersed striations densities. This abrupt change toward an increase in the abrasivity of the diet from PPN-2A/2B to PPN-2B might be related to the collapse of the Neolithic populations in the Near East around the 8.2 event, characterized by an increase of aridity conditions that could bave affected food availability in the region. The results also indicated that the analysis of buccal microwear is a sensitive tool in reconstructing dietary patterns and subsistence

strategies in past human populations.

Gender and paleopathology: a 19th and 20th century Portuguese perspective.

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This research aimed to portray gender differences in 19th and 20th century Portugal through a paleopathological perspective. The underlying assumptions were that Markers of Occupational Stress (*MOS)* could be used to infer patterns of activity, and that activity could be use as gender proxy. *MOS* were analyzed and compared with historical and biographical data of 603 individuals from the Coimbra and Lisbon identified skeletal collections. Hypothesis tested if activity-related osseous changes reflected the sexual division of society, and if the social construct of gender could be inferred through the analysis of *MOS*.
The results showed that occupational categories, historically documented, lacked detail with regard to descriptions of female occupations, and were ambiguous with some male activities. Furthermore, individuals' biographical data did not document their entire "life history". With regard to the *MOS* observed, age at death was found to be a major confounding variable throughout the analyses performed, and occupations which were historically associated with strenuous activity did not necessarily correlate with high values of *MOS*.
The major conclusions drawn were that the identified skeletal collections lacked in-depth information about the individuals' biological and social history, and that *MOS* assumptions and methods need an urgent re-evaluation if they are to be employed in the behavior reconstruction of past human societies. Consequently, a paleopathological perspective proved not to be capable of portraying gender in the 19th and 20th Portuguese century.

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Mechanical analysis of infant carrying in hominoids : a confront between safety and costs.

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Recent results on the mechanical conditions for safety in the usual primate pattern of infant carrying (Amaral, 2008) are confronted with arguments of efficiency in locomotion. In the ventral-ventral position of carrying newborns there are clear limits imposed by the infant weight, infant clinging capacity and by the characteristics of hairs and skin of the mother. For older infants carried in mounting position there are extra limits, given by the angle of inclination of the base plane where the infant lies and the hair-hair friction coefficient that prevents slippage. Tensile strength of hairs of gibbon, orangutan and gorilla were measured and shown to be species dependent, indicating evolutionary meaning related to safe infant carrying. The friction coefficient was also measured. The body angle in the knuckle-walking position must be less than 30º in order to avoid slippage of the infant. This might explain the persistence of knuckle-walking among the great African apes and evidences the necessity to focus on females carrying infants in the evolution of bipedalism. In this paper it is further shown that the usual infant carrying of great Apes, both in the tripedal walk, in which African apes carry their newborns with one arm, and in the lateral carrying of orangutan, the load is carried asymmetrically. Therefore arguments of efficiency in symmetrical carrying of loads by humans do not deny the importance of infant carrying in the evolution of bipedalism. The form of infant carrying is determined by safety criteria, not only energetic efficiency.

Fiber architecture underpins *in vivo* length-tension measurements in masseter and digastric muscles.

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In this study of muscle morphology and function, fiber architecture was quantified in *m. masseter* and *m. digastric* of miniature pigs (*Sus scrofa*), which are typically studied as human surrogates in these kinds of studies. Muscle weights, fasciculus lengths and pinnation angles, and proximal/distal lengths of tendon attaching fasciculi per muscle to bone were quantified in pigs 2.0-20.0 kg. Resting fasciculus lengths and pinnation angles were reestablished using microscopic examination of sarcomere lengths. From the direct measurements, physiologic cross-sectional area, maximum excursion length, and the relative percentage of tendon/fasciculus were computed. These physiologically related, morphological variables are associated with estimates of maximum muscle force, velocity of contraction, and energy cost of transmitting force to bone and whether a muscle might be used isometrically or isotonically. Least squares and reduced major axis estimates of slope and intercept were employed to test allometric relationships of measured and calculated variables on both body and muscle weights.
For every variable, the slope for masseter was steeper than for digastric. This implies that, as altricial functional complexes of infants grow and develop, more masticatory function is assumed by the masseter. This coincides with the behavioral transition from infant suckling to mastication of adult, solid foods. The results also were correlated to *in vivo* recordings of

length-tension relationships published by Anapol and Herring (1989) from the contralateral muscles of the same animals examined here.
This work was supported by HHS (NIDR) DE05427, HHS (NIDR) DE10648, and HHS (NIMH) MH53641.

Emics and _etics_ of postmortem skeletal trauma: An investigation into fracture patterns induced by conflagration, firefighters, and transportation.

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For decades, forensic anthropologists have studied skeletal conflagration. Initial research was based upon observations of the cremation patterns of prehistoric societies and modern funerary practices. It is from this previous research that a baseline (i.e., color changes, fracture patterns, bone splintering) was developed for analyzing burned human remains. As such, forensic anthropologists' knowledge of fire induced damage has become an invaluable asset within medicolegal contexts. However, activities at a burn site can hamper skeletal analyses such as extraction and search methods, high water pressure, and falling debris.
For this study, we macroscopically examined burning patterns on human skeletal remains from a Florida Industrial sample (N = 10). Variables such as the anatomical location of the burning, fracture pattern, scene description, and actions of responders were noted. *Ad hoc* interviews with first responders were also conducted. Of particular interest in this project was the number of times a forensic anthropologist was utilized at the scene and the incongruence between the *emic* and *etic* perspectives of the first responders and skeletal analysts, respectively.
The results of this study indicated that an emphasis should be placed on proper search, collection, and transportation of burned remains by first and second responders at the scene. This would include an archaeological-style method of searching the scene; proper collection of burned bone fragments; and transportation of remains to the medical examiner offices. All of these actions could decrease the chances of lost information thereby increasing the likelihood of identifying a victim and recognizing perimortem versus postmortem fracturing.

Cranial modularity: patterns of stability of the facial module in _Homo_ and non-_Homo_ representatives as tested by the Flury hierarchy.

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Current modular theory predicts the skull is organized in a hierarchy of modules, areas of localized integration exhibiting an essential conservancy of form through time and space. These integrated regions are described as resultant from function, emerging and changing as function changes through time. Modules, as functional units, can thus be expected to have two key aspects: a degree of invariance within a given taxa, coupled with a degree of difference from antecedent taxa where functional requirements are different. This research tests the prediction that modules of the skull remain invariant within taxa and are distinguishable across taxa.
The Flury hierarchy provides a methodology to test these predictions in the facial module of modern humans. Here, the hierarchy is used to test structural differences in covariance matrices of the facial module in modern humans and in different taxa. The hypothesis tested is that true modules of the skull, such as the facial, should represent "areas of invariance" in which variability of form is not present in the axes of population or sex. The Flury hierarchy thus tests the degree to which the facial module corresponds to predictions of structural similarities within populations of present humans (or invariance) and differences across other taxonomic levels. Results presented here demonstrate the facial module in modern humans shares the structural homogeneity expected in conspecifics, and, at the same time, exhibits the structural dissimilarity expected when compared to other, antecedent species.

Bioarchaeological evidence for a regional pattern of trophy-taking in prehistoric central California.

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We reconstruct the history of human trophy-taking as a warfare practice among Native Americans of central California through a synthesis of osteological, archaeological, and ethnographic data. Following the initial discovery of forearm trophy-taking at the prehistoric site of CA-SCl-674 in San Jose, California in 1999, we initiated a study of previous excavation reports to determine the prevalence of forearm trophy-taking as well as of other forms of trophy-taking in central California. We documented several types of trophy-taking between the Early Period (3450–2450 BP) and the Historic Period (AD 1770–1880) using a bioarchaeological database of nearly 13,500 burials. These trophy-taking cases ranged from forearm trophy-taking—identical to those burials from CA-SCl-674—to cases of decapitation, scalping, and lower-limb trophy-taking. Several human bone artifacts that appear related to trophy-taking were also discovered. These bioarchaeological data, in conjunction with ethnographic and ethnohistoric evidence, suggest that

trophy-taking functioned for status acquisition and revenge for war-related killings. Finally, in comparing these results against a region in California without trophy-taking, we believe that social geography strongly influenced the prevalence of trophy-taking in prehistoric central California.

Primate paleontology across the Paleocene-Eocene boundary in the Great Divide Basin, SW Wyoming.

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The results of twelve field seasons of paleontological work in the Great Divide Basin (GDB) are summarized with respect to the taxonomic and biostratigraphic nature of its sedimentary deposits and their included primate fossils. The GDB was first explored during the 1950s and '60s in a limited fashion by US Geological Survey geologists and Smithsonian Institution paleontologists. Our fieldwork began in 1994 and has focused on determining the extent of late Paleocene and early Eocene primate-bearing deposits in previously unexplored areas, as well as finding and re-collecting at the few fossil localities identified by previous workers. We currently have collected and catalogued nearly 8000 mammalian specimens from more than 75 localities, including nearly 1000 fossil primates. We have been utilizing innovative approaches from the Geographical Sciences (including GIS, GPS, and remote sensing) in our fieldwork and laboratory analysis of fossil distribution throughout the basin. Results indicate the presence of rich primate-bearing deposits in both late Paleocene and early Eocene deposits of the Fort Union and Wasatch Formations, respectively. Plesiadapiforms first appear in the GDB as part of an "anachronistic" mammalian faunal assemblage from the late Paleocene. A rich concentration of early Eocene fossil mammals, including several taxa of both adapid and omomyid primates, are known from the Freighter Gap-Pinnacles area, Salt Sage Draw, and Tipton Buttes. These fossil primate assemblages provide new information concerning the adaptive radiation of Euprimates in North America after the worldwide global warming event at the Paleocene-Eocene boundary.

Changes in urinary dehydroepiandrosterone sulfate (DHEA-S) levels with age in juvenile captive chimpanzees (*Pan troglodytes*).

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Dehydroepiandrosterone sulfate (DHEA-S) is one of the most abundant hormones in humans and is a precursor to other steroids, including testosterone. Nevertheless, its roles in development and behavior are largely unexplored and its evolutionary origins unknown. Adrenarche, or the sharp pre-pubertal rise in DHEA-S occurring in humans, does not exist in many non-human primates. It has been suggested that adrenarche occurs in great apes including chimpanzees, but little data exist to support this assertion. Our goals in this study were to 1) develop a way to assess DHEA-S levels non-invasively in chimp urine, and 2) assess whether adrenarche occurs in captive chimpanzees. We used dilution and spiking experiments to validate a commercially available enzyme immunoassay kit for use with chimpanzee urine. We measured DHEA-S levels in urine samples obtained over a four-year period from 11 juvenile chimpanzees (eight males, three females) living at the New Iberia Research Center, Louisiana. We found that when ages were summed across individuals, no significant age-related rise in DHEA-S was observable. However, when each individual's DHEA-S levels were considered separately, we found a distinct age-related increase in this hormone in some, but not all, individuals, beginning between ages five and seven. We did not find differences in DHEA-S based on time of day or sex. Our results suggest that DHEA-S levels do increase in chimpanzees before the onset of puberty, but that the timing of this event is variable. These findings may have implications for brain development and its social correlates in the juvenile period.

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A study of human growth in London over the past 1000 years using tooth histology to determine a precise age-at-death.

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The aim of this project is to investigate secular change in the rate and pattern of dental and skeletal growth in 11th-19th century London children, using the Museum of London's unique bioarchaeological collection of 17,000 skeletons. Long bone and skull measurements have been recorded for 250 children from the sites of St Nicholas Shambles (11-12th century), St Mary Graces (14th century catastrophic Black Death assemblage), St Mary Spital (Phase 17, 15th-16th), Broadgate (16th-18th century) and Old Church Street (17th-19th century). 75 children have been chosen for detailed examination using a total of 130 thin sections of their teeth (still developing at time of death) to provide an independent age-at-death estimate based on counts of circadian developmental structures in their enamel and dentine. These counts are not affected by changes in growth rate and so provide an independent estimate of the number of days of growth which had taken

place between birth and death. This has been used to calculate growth rates for each individual, for both skeletal and dental development. Data are presented for growth in size and shape of long bones, skull bones and tooth development stages, showing contrasts between different periods of London's history.
Research supported by the Leverhulme Trust.

Integrative measurement protocol for morphological and behavioral research in human and nonhuman primates.

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Human biologists, primatologists, and evolutionary morphologists seek to understand the evolution of primate adaptation. Yet, despite the interdependence at an organismal level of physiology, behavior, and skeletal biology, each group of biological anthropologists works in relative isolation. Although we each might address similar 'umbrella questions', such as adaptation to marginal environments or ontogeny, we generally do so without integration of protocols across subareas. This inherently weakens the applicability of results, making it likely that proximate rather than ultimate questions will be answerable with the data retrieved. To begin fostering a greater synthesis across biological anthropology, a small group with expertise in each of the target subareas met to generate a set of protocols for linking behavioral, biological, and skeletal databases. We culled a set of core measures from across the subdisciplines that address issues of universal concern and that could be made maximally comparable. These are organized around 'nonskeletal' measures such as body weight and overall size (stature, circumferences) and 'proxies for key skeletal measures' with definitions that can be approximated on both living and skeletal samples. We present the protocol, provide sample videos of precise collection methods, and examples of how these have been used in cross-disciplinary research. To date the protocol has been implemented in studies of NWM, OWM, and humans. Protocols will be available at the poster and at www.nyu.edu/gsas/dept/anthro/programs/csho/research.html, and are designed to provide a small core of standard measures that are easily added to the lengthier and more specific protocols of targeted research questions.
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Dental Morphological Traits in Pre-Incaic Populations of the Andes: Interpreting the Biocultural Evolution in the Osmore Valley.

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The focus of the present investigation is to infer the biological relations among prehistoric populations that inhabited the Osmore Valley, South Central Andes, from the Archaic Period (8.000 B.C. – 1.000 B.C.) to the Late Intermediate Period (A.D.1.100 – A.D.1.450) in the wide framework of the diversity of others contemporary Andean populations.
Dental morphological traits (ASUDAS) were employed in this study as direct indicators of biological affinities among 11 samples/ populations representative of 10.000 years of prehistory of the Central and the South Central Andes. Dental non-metric traits of the permanent dentition were assessed in 1.388 individuals as 46 tooth trait combination.

The results, obtained performing a set of multivariate statistical analyses (PCA, MDS and cluster analysis) on the dental trait frequencies, are concordant one another showing that there isn't a general model to interpret the biological and cultural dynamics of the ancient populations of the Osmore Valley. In light of the currently available genetic, anthropological and archaeological data regarding the prehistory of the Andean Area our results suggests :i) ancestor descendant relations with little genetic microevolution in the Osmore Coastal Valley from the Archaic to the Late Intermediate Period, ii) genetic homogeneity among the Chiribaya, in the Late Intermediate Period, regardless of the significant geographic distances separating the different communities, iii) biological affinity between the contemporary Tiwanaku and Wari, substantiating the scenario of a pacific relation, and possible gene flow, between the Middle Osmore Valley colonists of these two Empires that ruled the Andes during the Middle Horizon Time Period.

The Paleolithic Disease-scape, the Hygiene Hypothesis, and the Second Epidemiological Transition.

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The hygiene hypothesis argues that in developed nations the lack of childhood exposure to infectious pathogens, parasites, and symbiotic microorganisms increases susceptibility to allergy and other chronic inflammatory. A modified hygiene hypothesis, the "old friends" hypothesis proposed by G. A. Rook, excludes childhood diseases as a requisite factor and focuses on organisms such as lactobacilli, a variety of saprophytic mycobacteria, and helminthic parasites that are tolerated by the immune system and are absent from the pathogen load of developed nations. The exposure to these ubiquitous agents is postulated to help in the development of the T regulatory response. When exposure is largely absent, as in industrialized nations, allergies and an array inflammatory or autoimmune diseases such as inflammatory bowel disease, multiple sclerosis, and type 1 diabetes increase. Within the last century, some populations have undergone the second epidemiological transition in which public health measures, improved nutrition and medicine resulted in declines in infectious disease and a rise in non-infectious, chronic and degenerative diseases. This phase, characterized by the control of infectious disease and the development of a sanitized water supply and sewer system, has played a role in the modified hygiene or "old friends" hypothesis. It is a period in which "cleanliness" removes us from contact with "dirt," resulting in a bevy of new diseases.

Genetics of tooth morphology: Assessing the diversity of gene expression patterns for early tooth development in mammals.

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Our understanding of genetic mechanisms that establish the intricate morphology found in mammalian teeth stems primarily from studies of a single model organism, the house mouse. However, mammals exhibit a wide range of morphological diversity in tooth form and number beyond the derived dentition of mice. To build on this work in mice and further explore the genetic mechanisms that correlate with mammalian dental variation, we are describing gene expression patterns during early dental development in pigs and dolphins. These two mammals have dental morphologies that differ from each other and from mice. The dentition of domestic pigs (*Sus scrofa*) maintains several features representative of many mammals, especially primates. They have two generations of bunodont teeth and a dental formula (3-1-4-3) primitive for eutherians. The pan-tropical spotted dolphin (*Stenella attenuata*), an odontocete cetacean, has a highly derived, homodont dentition, a single tooth generation and an increased number of teeth. Based on proteins and genes affecting tooth determination in mice (BMP4, FGF8, SHH, MSX1), we used immunohistochemistry in dolphin embryos and in situ hybridization in pig embryos to determine timing and location of these proteins and genes. Initial results suggest each species demonstrates a unique expression pattern. For example, dolphins exhibit a posterior expression of BMP4 (relative to mice) that might relate to the single, unicuspid tooth type found throughout their dentition. This potential diversity in expression patterns highlights the promise of developmental studies for establishing new insights into the genetic mechanisms underlying the diversity seen in mammalian teeth. Supported by NSF (BCS-0725951).

Sex differences in vocalization patterns in the northern muriqui monkey *(Brachyteles hypoxanthus).*

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Within-group social dynamics are known to correlate with individual rates of vocalizations in many species of primates. In northern muriquis (*Brachyteles hypoxanthus*), males and females vary in their association patterns, with philopatric males spending a higher proportion of time in proximity with one another than females. We investigated whether sex differences in association patterns correlate with the rates of vocalizations in three groups of northern muriquis at the RPPN/FMA, Minas Gerais, Brazil. A total of 1,393 staccato and 719 neigh vocalizations were recorded during 2,727 10-minute focal samples on 32 adult females and 31 adult males from April 2006 to March 2007. Females gave staccato vocalizations at significantly higher rates than males while feeding, moving and resting, whereas males gave significantly more neigh vocalizations than females during the same activities. Both females and males gave significantly more staccatos when they were feeding than when they were engaged in other activities, but their respective rates of neighs were similar across activities. The higher rate of staccatos emitted by females compared to males, and by both sexes when they were feeding, may be related to the function that these short distance calls serve in inter-individual spacing. By contrast, the higher rate of long distance neighs by males compared to females may be a way for males to advertise their location when group members are out of view. These sex differences in the types and rates of northern muriqui vocalizations are consistent with other sex differences in their socioecology.

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Identification of unprovenienced human remains using FORDISC 3.0: biological race revisited.

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The biological concept of race has been debated within anthropology for decades. Multiple attempts to quantify variation in human skulls and postcrania have provided some support for discriminant classification of populations. However, issues of sample size, overlap in population centroids and difficulties in assigning specimens to populations continue to plague objective assessment of biological race.

We used the program Fordisc 3.0 to assess thirteen human crania, for the purpose of identifying unprovenienced human remains from the Yale Peabody Museum of Natural History. Nine crania were of unknown origin, and four had detailed provenience data. We followed the osteometric and classification methods described in the Fordisc manual. Of the four provenienced specimens, two were correctly assigned to South African and Japanese provenience, while the remaining two (Australian and Indian) were both identified as Japanese. Within the total sample, 70% of crania received concordant geographic assessment by the Forensic and Howells' databases.

While this sample is small, it highlights the pitfalls of applying morphometric software without careful review of applicable sample choices, sex and age assessment, and evaluation of nonmetric traits. In the end, these difficulties highlight the complex nature of biological race, which can be defined as either as a typological ideal or as a spectrum of variation. While this debate continues, applications such as Fordisc have value in discriminating human remains into more restricted racial or geographic ranges. This must be followed by further analysis to determine affiliation to the limits of our ability for criminal or research-based needs.

A comparative study of frontal bone morphology among Pleistocene hominin fossil groups.

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Frontal bone traits that are conventionally used to distinguish among hominin groups were quantitatively examined using 55 fossil crania dating from the Early to Late Pleistocene. A modified pantograph was used to take three outlines of the frontal along the midsagittal and two parasagittal planes. The profiles were quantified using Elliptical Fourier Function Analysis (EFFA). Three sets of measurements were taken: overall morphology as expressed in the Fourier harmonic amplitudes; maximum projection of the supraorbital torus at three points along the browridge (glabella, and the middle and lateral aspects of the torus above the orbit); and maximum distance of the frontal squama from the nasion-bregma chord (capturing forehead curvature). The results indicate that in overall morphology, the midsagittal profile is significantly different among all Pleistocene groups in analyses that include size and shape; AMHS are significantly different from all groups for each outline in both size-shape and shape-only analyses; and the parasagittal aspects of the frontal are diagnostic for Middle Pleistocene *Homo*. An assessment of localized morphology reveals that *Homo erectus* is significantly different from Neandertals and anatomically modern *H. sapiens* in glabellar projection; and forehead curvature is distinctive for AMHS. However, for the majority of analyses there was no significant difference among the archaic Pleistocene hominin groups, suggesting that with the exception of midsagittal profiles, most aspects of this bone are not sufficiently diagnostic to allocate unknown specimens or characterize non-modern groups as distinctive from each other in frontal morphology.

Comparing reproductive aging in wild and captive apes.

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Human menopause, the complete termination of cycling and fertility typically followed by an appreciable post-reproductive period, seems to result from a conflict between the stored follicular supply and our enhanced longevity. Although the exceptional length of the post-reproductive period in humans seems unique, other primates may have the potential to experience an analogous menopausal pattern. To this effect, evidence of contrasting differences in female fertility patterns between captive and wild populations as they age will be presented, focusing on data from common chimpanzees. Reproductive and other life history parameters typical of captive females, such as early menarche, shorter lactational periods, nursery rearing, accelerated growth and maturation of offspring and early weaning reducing the years that ape mothers spend nursing, can lead to an increased number of ovulatory years experienced by each female. Ultimately this can result in early follicular depletion with respect to the enhanced longevity characteristic of captivity. Thus, despite increased longevity in captivity, reproductive lifespan may be shortened compared to wild chimpanzee females. The result is that a post-reproductive lifespan is likely to occur in captive chimpanzees and perhaps in other species that have the potential to live longer than what is foreseen by their initial follicular store.

Osteoporosis in a prehistoric Bay Area population.

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Osteoporosis is an age-related disease characterized by decreased bone mass that leads to bone fragility and fracture susceptibility. To study the factors that influence osteoporosis onset and severity, such as sex, age, diet, activity, or genetics, second metacarpal radiogrammetry is used to measure cortical bone mass in a prehistoric San Francisco Bay Area, semi-sedentary, hunter-gatherer population, CA-ALA-329 (n=62). The results are then compared with measurements taken from Wharram Percy, a medieval English, agriculture-based population (n=126). Two- and three-way ANOVA tests are performed with graphs of significant interactions. Two-way ANOVA results for each site individually show age and sex are not statistically significant in the expression of bone loss in both populations, but CA-ALA-329, has a significant age and sex interaction ($F=4.33$; $P < 0.05$). The three-way ANOVA results display significant differences between sites ($F=123.56$; $P < 0.01$), as well as in the interactions of age and sex ($F=6.97$; $P < 0.05$), and sex and site ($F=3.74$; $P < 0.05$).

In summary, results from the CA-ALA-329 population mirror those of other archaeological and modern studies: females have more cortical bone in youth, and then lose bone earlier and eventually more over time than males. When compared with Wharram Percy, bone mass is higher in CA-ALA-329, regardless of sex and age. The causes for the differences seen may be dietary insufficiencies at Wharram Percy and the use of cultural resource reciprocity systems by prehistoric Bay Area populations.

The substance of subsistence: body mass and nutrition in Pre-Columbian North America.

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Extensive studies of past populations associate diachronic changes in adult stature with the adoption of new subsistence technologies and resources. Many of these analyses, especially among North American samples, indicate an overall decrease in stature with agricultural intensification. However, some research has demonstrated that this relationship is not universal. Moreover, stature is only one potential morphological indicator of nutritional deprivation experienced throughout primary growth. Estimated body mass may be another, but has not been compared across subsistence strategies through time or with changes in stature among samples.

This study examines estimated stature and body mass in a sample of 2224 pre-contact North American skeletons (1188 males, 1036 females), which represent five broad subsistence categories, including hunter-gatherers, horticulturalists, and agriculturalists. Body mass was estimated using the Grine et al. (1995) femoral head equation, and stature was estimated using new equations developed by Auerbach and Ruff based on the revised Fully technique. A subset of the sample (n=530) from the Southeastern United States was analyzed for diachronic changes within a restricted geographic range.

Changes in stature and body mass with the adoption of new subsistence methods do not follow a common pattern across North America. Both stature and body mass increase with the adoption of agriculture in the Southeast, contrary to previously published patterns. Body mass and stature covary within the sexes, though females exhibit less change across time than males. Confounding factors (e.g., sampling, gene flow and environmental variables) and the interpretation of estimated body mass versus stature are discussed.

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Cranial shape variation in extant and giant subfossil lemurs from Madagascar.

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The extant Malagasy lemurs exhibit considerable morphological variation in the cranium. Here we present preliminary results of a Procrustes-based geometric morphometric exploration of 3D cranial shape in extant lemurs (n=117). We then expand our consideration of cranial shape space by adding specimens of giant extinct lemurs (n=23) to our sample and assess (1) the degree to which similarities and differences in skull shape parallel lemur phylogeny, (2) the impact of large differences in overall skull size, and (3) the influence of diet (particularly seed predation) on cranial shape.

The greatest contrasts in cranial morphology (PC1) among lemurs relate to the relative length of the rostrum and the height and breadth of the neurocranium, a relationship that remains after inclusion of the larger subfossil taxa. Species with long faces, such as *Varecia* and *Megaladapis*, accomplish this through an anteroposterior expansion of the palate rostral to the molars. While shape variation is greater among the largest individuals, taxonomic distinctions are apparent at all sizes (e.g., *Avahi* vs. *Lepilemur*). The second PC is strongly influenced by overall size of the specimens, and is more clearly affected by the addition of the large extinct specimens. Larger crania have relatively smaller orbits that are more medially positioned, as well as straighter rostrums, and a more anterior position of prosthion relative to rhinion. Subsequent PCs serve to emphasize the autapomorphic cranial morphology of particular taxa, including *Megaladapis* and *Daubentonia*. Results indicate that phylogeny, size, and diet (particularly seed predation) have all impacted shape variation within Lemuriformes.

Vasopressin Receptor V1a (*avpr1a*) Gene Variation in the Monogamous Owl Monkey, *Aotus azarai azarai.*

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A growing number of molecular studies continue to report significant associations between the variable expression of the Vasopressin V1a Receptor gene (*avpr1a)* and differential levels of partner preference across mammalian taxa. Although the transcribed protein of *avpr1a* is highly conserved across species, microsatellite repeats located in the 5' regulatory region correlate with the neuroanatomical distribution of V1a receptors in the brains of different taxa and influencing sexual fidelity and pair-bonding behaviors. However, there has been little focus on *avpr1a* sequence variation within the Platyrrhini, where social monogamy is particularly prevalent. In this study, we present our initial results from the analysis of *avpr1a* sequence variation in a population of wild *Aotus azarai azarai* individuals living in the Argentinean Gran Chaco. Our focal population exhibits strict social monogamy and, thus, provides a unique model for the investigation of this particular locus. We have sequenced the 5' region of the *avpr1a* gene in *Aotus* and other platyrrhines homologous to the "dinucleotide" repeat region described in catarrhine primates. This putative regulatory promoter region encompasses both the –3956 bp and –3625 bp repeat segments that have notably associated with *avpr1a* expression variation. These data allow us to compare the phylogenetic and functional variation at this locus with the behavioral phenotypes of these New World monkey species, which display varying degrees of partner preference and patterns of social behavior. This analysis will be further enhanced through the comparison of *avpr1a* sequence information with our collection of behavioral, demographic and genetic data from *A. azarai azarai*.

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Chew before you swallow? Ingestive versus digestive folivory among species of *Pygathrix* and *Trachypithecus.*

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In contrasting leaf monkeys of Vietnam, Wright *et al*. (2008) argued that *Trachypithecus* species rely more on ingestive behavior for the processing of leaves, as evidenced by faster chewing rates, larger molar area, and more robust jaws, whereas *Pygathrix* species, with slower chewing rates, smaller molars, more gracile jaws, and the presence of a "gastric mill" (i.e. presaccus of the stomach) rely more on their digestive tract for the processing of leaves. This study builds on the findings of Wright *et al*. (2008) by conducting a detailed comparison of the ingestive behavior of *Pygathrix* and *Trachypithecus*. Detailed data on ingestive behavior were collected on over 40 hours of video tape (5735 bouts) recorded on *T. hatinhensis*, *T. delacouri*, *P. cinerea*, and *P nemaeus* at the Endangered Primate Center, Cuc Phuong, Vietnam. We found that the frequency of incisive behavior was 27% greater for the *Pygathrix* species (77%) than for the *Trachypithecus* species (50%). Among the species *P. nemaeus* (80%) used its incisor most frequently, whereas *Trachypithecus delacouri* exhibited the lowest frequency of incisor use (48%) and most frequently began immediate mastication of leaves with its cheek teeth with no initial incisor processing (50%). These findings augment the previous findings of Wright et al. (2008) by further emphasizing molar food processing in *Trachypithecus*, revealing the possible importance of incisor processing to the *Pygathrix* species, and by clarifying particular patterns of leaf ingestion for each of the four studied species.

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Intraspecific isotopic variability in *Varecia variegata*, Ranomafana National Park.

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Stable isotope analysis is a unique way to study an animal's ecology and physiology. This technique, combined with observational, biomedical and morphometrics research, can be used to augment our understanding of an animal's ecological requirements. Due to slight variations in feeding preferences and habitat characteristics, isotopes can detect inter-individual physiological or dietary differences, both within and between populations. Yet, despite their utility, isotopic studies have only recently been applied to wild lemur populations.

Here we present data from 49 *Varecia variegata* individuals, a critically endangered primate relegated to southeastern Madagascar's low-to-mid altitude rainforests. Samples were collected over a three-year period (2006-2008) from two behaviorally and genetically distinct populations, and were supplemented with samples from > 30 preferred food items. Furthermore, study sites (Mangevo & Vatoharanana, Ranomafana National Park) vary in both their altitude and disturbance levels, factors thought to significantly

influence *Varecia* densities and their behavioral repertoire.
We analyzed stable carbon and nitrogen isotopes in both *Varecia* fur and in fruits sampled from their primary food trees. Preliminary results suggest that carbon and nitrogen isotopes are significantly different between sexes and between localities. Continued analyses will help us further define the isotopic differences 1) between individuals, 2) seasonal shifts within individuals, and 3) between lemurs and their food sources. The recognition of species-specific fractionation patterns and isotopic niches will be critical for the preservation of remaining lemurs and their vanishing habitats, particularly in ecologically sensitive species such as *V. variegata*.
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Multivariate estimation of ancestry from the distal femur.

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This study investigates morphometric differences on the distal femora of European and African Americans that may assist in determining ancestry. Seven linear measurements are used to evaluate potential shape differences between these populations. Results of discriminant analyses indicate that medial and lateral condyle lengths are relatively larger in African Americans, while biepicondylar breadths are relatively larger in European Americans.
Further analyses reveal notable differences between the two skeletal collections utilized in this study (University of Chicago Collection and William M. Bass Donated Skeletal Collection)(n=276). There are two hypotheses for these unexpected results. First, if the majority of individuals in the University of Chicago (UC) Collection are of European American ancestry, the sample may appear morphologically different from the Bass Collection, from which a sample of equal numbers of African and European Americans was obtained. A second hypothesis relates to secular change in the morphology of the distal femur that may have occurred during the approximate 70 years that separate the two collections. If significant secular change has taken place, it calls into question how physical and forensic anthropologists develop accurate standards for estimating aspects of ancestry. Therefore, the widely-used Terry and Hamann-Todd collections, both roughly contemporaneous with the UC Collection, may not be appropriate resources on which to develop and test these standards. Results from the present analyses suggest that more contemporary collections, such as the Bass Collection, may be more representative of modern American skeletal morphology.

A quantitative analysis differentiating human from nonhuman fragmented skeletal remains.

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The goal of this study was to develop a histomorphometric method of analysis which differentiated human from nonhuman fragmented skeletal remains. Comparisons were made between various species including antelope, baboon, badger, deer, black bear, dog, mountain lion, pig, and human. Histological sections from these species were obtained from ribs in addition to various long bones. The variables of interest included osteon area (On.Ar) and circularity (On.C) and haversian canal area (H.Ar). Discriminant function analysis was performed to generate an equation for predicting whether a bone sample was of human or nonhuman origin. Our model had a success rate of over 75%, suggesting that On.Ar, On.C, and H.Ar are useful variables for differentiating humans from nonhumans. Our high success rate with a limited number of variables provides a powerful and novel method of differentiating human from nonhuman fragmented skeletal remains.

Endocranial shape asymmetries in extant hominids assessed via skull based landmark analysis of 3D reconstructions from CT images.

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Brain shape asymmetries or petalias consist in the extension of one cerebral hemisphere beyond the other. A larger frontal or caudal projection is usually coupled with a larger lateral extent of the more projecting hemisphere relative to the other. The concurrence of these petalial components is characteristic of the human genus. Studies aimed at quantifying petalial asymmetries in human and pongid endocasts rely on the definition of the endocranial surface midline. Studies of brain material however show that, at least in humans, most of the mesial surface of the left occipital lobe distorts the midline and protrudes into the right side, making the midline identification and the corresponding left and right reference points definition problematic. In order to accurately quantify and compare brain shape asymmetries in extant hominid species, we here propose a new protocol based on unbiased skull landmarks definition. This protocol is performed on 3D reconstructions from CT images. Our current sample is represented by >15 specimens of each sex of

Pan paniscus, *Pan troglodytes*, *Gorilla gorilla* and *Pongo pygmaeus*. We describe and quantify for the first time the positions in 3D of frontal and occipital projections. Our analysis complements previous results and allows the grouping of extant hominid species based on the quantification of the degree of asymmetry of these projections. Although different from humans, the degrees of asymmetry of these petalial components in pongids show considerable variations.

Neglected aspects of evolution: temporal and causal sequence of cranial base change.

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The causes for the evolutionary changes of the cranial base in hominids have been subject to contentious debates. Because many authors contrast the unique shape of the modern human cranial base with pongids, uniquely modern human traits as diverse as large brain-volume, bipedality, facial retraction and language have been suggested to explain the modern human morphology. Looking at the two extremes of a process, however, makes it impossible to tease apart the temporal (and causal) sequence of events. We argue that to fully understand the process one needs to incorporate the early hominids.
Furthermore, up until recently, the discussion has focused mainly on the midline aspect, in particular the amount of cranial base flexion. Here we present a landmark-based (N=28) three-dimensional geometric morphometric study that quantifies the overall morphology of the cranial base in a sample of adult chimpanzees, modern humans and australopithecines. Landmarks on the external and internal surface were taken on CT scans of the original specimens and converted to shape coordinates using Procrustes superimposition.
Because we find marked shape differences, especially in the posterior cranial fossa, between chimpanzees and *A. afarensis* specimen A.L. 444-2 without a marked increase in brain volume, we suggest that these structural changes are related to bipedality. We therefore argue that the cranial base was shaped by at least two distinct, temporal disjunct processes: (1) bipedality, which changes the posterior cranial fossa and the position of the foramen magnum and, later, (2) encephalization in the human lineage.
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Recent demographic changes account for the genealogical discontinuity between Etruscan, Medieval and modern Tuscans.

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The available mitochondrial DNA data appear incompatible with the view that modern Tuscans are descended from the Etruscans who inhabited the same region 2,500 years ago. To understand how and when such a genetic discontinuity may have arisen, we extracted and typed the mtDNAs of 27 medieval Tuscans from an initial sample of 61, spanning a time period between the 10th and 15th centuries A.D.. Etruscans and medieval Tuscans share four mitochondrial haplotypes, and serial coalescent simulations show a clear genealogical continuity between them. By contrast, it was impossible to fit into the same mtDNA genealogy modern inhabitants of the same area, including those (Murlo, Volterra, Casentino) who were recently claimed to be of Etruscan descent. These data strongly suggest that the Etruscans did not get extinct when their culture disappeared with the Roman assimilation. However, they contributed little to the modern mitochondrial gene pool, probably because of extensive immigration after 1500 A.D.. No evidence of excess mutation was found in the ancient DNA by a Bayesian test, and so there is no reason to suspect that these results be biased by laboratory artefacts in the ancient sequences. Genealogical continuity between ancient and modern populations of the same area does not seem a safe general assumption, but rather a hypothesis that should and can be tested using ancient DNA analysis.

Foraging efficiency in wild orangutans (*Pongo pygmaeus wurmbii*) at the Tuanan field station in Central Kalimantan, Indonesia.

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MacArthur and Pianka's (1966) optimal diet model and subsequent elaborations of it (Stephens & Krebs 1986 and references within) have become the default hypothesis for any and all spatial variation in a species' diet. Classical models of optimal foraging assume that animals attempt to maximize their average long-term energy gain rate on prey items or in food patches (Stephens & Krebs 1986). The standard prey model predicts which prey items an animal should include in its diet to maximize long-term gain. We measured foraging efficiency in wild orangutans by examining the time spent moving between major food patches, defined as feeding bouts >10 minutes, and energy intake rates within these patches. Given that orangutans commonly consume low-quality food items including leaves and inner-cambium while traveling to fruit patches, we also examined the number of short foraging bouts on these fallback items between major fruit trees and

how they differ during periods of varying habitat-wide fruit availability. We used *e/t* for our profitability criteria, where *e* is measured as the total energy gained per patch, $t = h$ (handling time) + t_r (travel time), and ranked food patches for each day. Preliminary results indicate that orangutans are efficient foragers, visiting several profitable patches per day. The profitability of these patches correlates with species preference, measured as Vauderploeg Scavia's selection coefficient. Finally, we found that when habitat fruit abundance is low, the orangutans have a greater number of short feeding bouts on low-quality food items.

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Comparing social cognitive, non-social cognitive, and resting brain activity in chimpanzees.

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Human functional neuroimaging studies have identified brain areas that are active at rest, deactivate during most cognitive tasks, and activate above resting levels during social cognition. Chimpanzees activate similar brain areas at rest as do humans; however, the neural substrates of chimpanzee social cognition are unknown. We used ^{18}F-[FDG] Positron Emission Tomography (PET) imaging to compare regional cerebral glucose metabolism in chimpanzees (*Pan troglodytes*) during three conditions: rest, social processing, and non-social object matching.

Chimpanzees (N=4) received an oral dose of 15 mCi ^{18}F-[FDG] in their home cage. In the rest condition, the subjects then rested quietly in the home cage for a 75-minute uptake period. During the social processing condition, the subjects performed a match-to-sample task with videos and still photos of conspecific social behaviors for 45-60 minutes. In the object condition, subjects performed a similar task involving non-social objects. After uptake, subjects were sedated with 5 mg/kg Telazol, transported to the PET Center's Siemens HRRT scanner, and scanned under propofol anesthesia.

PET scans were normalized to mean whole brain activity (controlling for dosage differences), coregistered to T1-weighted anatomical MRI scans, and spatially normalized to a T1 template. Paired t-tests revealed distinct patterns of activation in each task condition relative to rest. Unlike humans, chimpanzees did not display higher activity in the cortical areas active at rest while processing social stimuli. Both social and object tasks activated ventral temporal cortex. In addition, the social task relative to rest showed significant amygdala activation, suggestive of greater emotional arousal.

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Digit ratio (2D:4D) and Ponderal index as predictors of half-marathon performance.

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Recent work on the relationship between second-to-fourth digit ratio (2D:4D) and athletic performance suggests a connection between 2D:4D, a measure of prenatal androgen exposure, and physical aptitude in a number of sports, including soccer, rugby, and running (Manning et al., 2007, Manning, 2002, Honekopp et al., 2006). However, little investigation has been done on the ability of 2D:4D to predict variance in endurance running, which has been argued to be an evolutionary salient activity. This study tests the utility of 2D:4D in predicting variance in half-marathon time among a sample of 37 self-identified half-marathon runners. Data was collected regarding training habits, half-marathon personal record (PR), most recent half-marathon time, age, height, weight, and digit ratio and analyzed in a multivariate regression model. To test the comparative strength of 2D:4D, the Ponderal index (PI), a known predictor of running performance, was also included as a predictor. Multivariate regression indicated that neither digit ratio nor PI had any predictive effect on half-marathon times. Instead, sex and miles run per week had the strongest predictive effect, together explaining approximately 40% of variance in half-marathon times. These results suggest that androgen exposure and anatomical features may become less predictive at longer distances, while increased importance is placed on the amount of training an individual does. These findings may have important implications for the evolution of endurance running in *Homo*.

Coping with taxonomic ambiguity and inter-observer variation in paleontological and paleoanthropological analyses.

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Accurate, reproducible taxonomic identification of bony remains is critical for paleontology and paleoanthropology. This statement holds true for alpha taxonomy of primates/hominins themselves, and for paleoecologically relevant faunal analyses of their sites. However, primate/hominin alpha taxonomies and faunal taxonomic lists may be susceptible to error introduced by invalid taxonomic identifications. The only published study testing the reproducibility of faunal identifications demonstrates significant inconsistency among faunal experts analyzing the same

osteological remains (Gobalet, *J. Arch. Sci.*, 2001, 28:377-386). The present study (1) demonstrates that osteological identifications performed by a single worker may be ambiguous, and (2) introduces a database tool to address the known problem of inter-observer variation. Extant East African murine rodents were chosen as a study group because they are common, speciose, and ecologically informative in paleoanthropological contexts. Using 26 commonly reported craniodental traits in sample of 46 species (24 genera), results indicate that some genera can not be unambiguously identified. Furthermore, we discovered evidence for a taphonomic effect on diagnosability. Maxillary characters perform best in diagnosing genera, while mandibular characters perform less well in our taxonomic sample. This finding suggests that taxonomic lists should not be compared across sites exhibiting differential preservation without accounting for this taphonomic effect. To counteract inter-observer error, we present a web-available database complete with character state matrices and an electronic identification tool. This tool provides a public repository for comparative taxonomic information that we hope to expand to include other taxonomic groups, including primates and hominins. This work was supported by a National Science Foundation Graduate Research Fellowship to WAB.

Comparison of fluctuating dental asymmetry in Neandertals and Inuit.

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Some researchers have concluded that Neandertals were less able to accommodate environmental stressors than either their modern human contemporaries or their modern human successors. We test whether fluctuating dental asymmetry (FDA), a sensitive indicator of developmental stress, was significantly higher among Neandertals than in a recent archaeological population of Inuit, which, like Neandertals, inhabited a marginal environment.

Buccolingual crown dimensions of antimeric adult teeth were taken for 46 Inuit from Point Hope, Alaska, and for 21 Neandertals from sites in Europe and the Middle East. FDA was estimated using a two-way mixed model ANOVA (sides=fixed, individuals=random) with three replications per measurement. Measurements were size-corrected prior to analysis. Low numbers of antimeres among the Neandertal sample ($n<5$) prevented direct estimation of FDA. Instead, R-L differences for Neandertals were converted to z-scores and compared to the Inuit mean and sd to determine how many of these estimates differed significantly at a 0.05 level.

Estimates of FDA for the Inuit were higher than previous estimates for Prehistoric and modern populations from the Ohio River Valley Area. Of the 111 R-L Neandertal measurements examined, only 15 differed significantly (13.5%) from the Inuit sample. In addition, 8 Krapina Dental Persons were compared separately to the Inuit; of the 27 comparisons made, only 4 differed significantly (14.8%). These results show that the majority (>85%) of Neandertals experienced levels of developmental stress indistinguishable from the Inuit and suggests a comparable ability to accommodate stress during the period of dental development.

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Natural knock-out: changes in female social networks as a consequence of mortality in female chacma baboons.

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Previous work on captive pig-tail macaques illustrated the importance of particular individuals to the stability of social networks within a group by using 'knock-out' experiments, where key individuals were removed from the group and the social consequences monitored. Here, we use data from 'natural knock-out' experiments, caused by the sudden (over-night) death of particular individuals in a wild troop of South African chacma baboons, to investigate the consequences for social network structure. We compared network structure before and after the death of a high-ranking female, a middle-ranking female, and to a control period (a period of 6 months either side of a non-death event). The results showed that individuals became significantly more cliquish in a nearest neighbour context, but not in a grooming context, after the death of the high-ranking individual. There was no such pattern after the death of the mid-ranking female, nor during the control period. In addition, the effect size seen in the case of the high-ranking death was very large compared to the other two conditions. These results suggest that the loss of a high-ranking female disrupts the network substantially more than losses lower in the hierarchy, or during non-catastrophic social events, and that high-ranking individuals may play a large role in preserving network integrity.

Diachronic and regional patterns of childhood anemia in precontact central California.

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The role of food production on human health has played a central role in bioarchaeological research since the 1980s. In prehistoric California, forager societies intensified plant staples (e.g., acorns and small seeds) and marine resources instead of agriculture but maintained some of the highest population numbers in North America. Previous research in coastal southern California indicates that vault porosities suggestive of anemic response are relatively common, despite a maritime adaptation for these populations. Lesions have been attributed to parasitism or infection from contaminated water sources.
This study examines anemic response in 511 crania from late Holocene (4500-200 B.P.) central California. Human remains from four sites along San Francisco Bay and six sites in the Sacramento Valley comprise the study sample. Both vault porotic hyperostosis and cribra orbitalia were evaluated for crania that had at least 50% of the external surface intact. Due to the prevalence of generalized vault porosity, only moderate to severe expression is considered. Regional comparisons indicate that 25.9% of crania from the Bay and 11.0% of crania from the Valley exhibit cribra orbitalia ($p<0.05$). A similar pattern is observed for porotic hyperostosis (47.3% SFB vs. 18.4% SV; $p<0.05$). Temporal comparisons indicate a significant increase in both vault and orbital lesions through time in the Valley ($p<0.05$), which conforms to archaeological evidence for increased population density and vegetal food storage economies. However, data from Bay sites failed to show temporal variation in vault porosities. The results are interpreted in light of archaeological resource intensification models.
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Basicranial flexion in the evolution of *Homo*: new analyses of an old model.

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Understanding variation in the basicranium is of central importance to paleoanthropology because of its fundamental structural role in skull development and evolution. At the beginning of the 20th century it was suggested that encephalisation plays a role in producing flexion between midline basicranial elements. It has been proposed that basicranial flexion is also influenced by the size or shape of the face. This hypothesis was further refined during the 1950s by the Swiss anatomist Biegert, who suggested that brain size and facial size act as antagonists on basicranial flexion. Biegert's model is particularly relevant for understanding aspects of Neanderthal skull evolution because one important and unresolved problem is that these large-brained hominins have slightly less flexed basicrania than equally large-brained modern humans. We addressed this hypothesis by applying geometric morphometrics to a large comparative dataset of radiographic and/or CT images of adult non-human primates, hominin fossils and humans (29 species, 142 individuals). Multiple, multivariate regression and thin plate splines analyses suggest that basicranial evolution is highly significantly influenced by both brain size and face size. Our data show that in addition to brain size, the prime factor of basicranial evolution in *Homo*, facial size importantly influences basicranial morphology and orientation. These interactions can explain why, despite their similar brain sizes, Neanderthals as well as some Mid-Pleistocene humans have less flexed cranial bases than modern humans. To gain a detailed understanding of the multifactorial inputs into basicranial flexion, future studies should also focus on the underlying factors of facial size evolution.
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The Origins of the Taita and Mijikenda ethnic groups of Kenya: A mitochondrial case study.

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The mtDNA HVRI variation of 349 individuals from three Taita groups (Dawida, Kasigau, and Sagalla) and five Mijikenda groups (Chonyi, Digo, Duruma, Giriama, and Rabai) were analyzed to address questions of origin, admixture and culture history in southeastern Kenya. The Taita and Mijikenda are Bantu speaking agropastoralists whose ancestors probably migrated into the area from Northeast Kenya or Southern Somalia, or from Tanzania, as part of Bantu migrations that began around 3,000 BC. Their oral histories, however, suggest greater complexity with some groups' histories describing heterogeneous origins, while members of other groups recount conflicting histories that suggest a lack of consensus concerning their origins. The Taita groups in particular may have absorbed some of the foraging groups who were already living in the Taita Hills when they arrived.

Our analyses indicate that, although the two ethnic groups share many sequences, they show some distinctive differences that reflect their unique culture histories. For example, the Taita are genetically more diverse than the Mijikenda groups with larger values of all the measurements of

genetic diversity. Furthermore, the Taita cluster with other East African groups, having high frequencies of haplogroups from that region while the Mijikenda have high frequencies of Central African haplogroups and cluster most tightly with Central African Bantu speaking groups. These results suggest that the forager populations who lived in the southeastern Kenya before the Bantu expansion were at least partially incorporated into the Taita groups, while gene flow from pre-Bantu populations into the Mijikenda was limited.

Paleodemography of a Predynastic Egyptian skeletal sample: exploring different age indicators and analytical approaches.

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This study compares demographic characteristics derived using two osteological age indicators and separate analytical approaches to age estimation—a "traditional" approach and one advocated for in the Rostock Manifesto (Hoppa and Vaupel, 2002). From a Predynastic cemetery at Hierakonpolis, the two samples consist of individuals with observations for either the pubic symphysis (N = 139) or auricular surface (N = 176), scored following Todd (1920) and Lovejoy and colleagues (1985), respectively. Reference sample information comes from the Terry Anatomical Skeletal Collection. In the traditional approach, individuals in the target sample are grouped into age categories based upon the 50% (median) percentile of age within stage from the reference sample. The second approach uses what Boldsen and colleagues (2002) have referred to as "transition analysis." Differences between these approaches are analyzed by comparing resultant parameters for a Gompertz model of mortality.
With a proportional odds probit regression model, the transition analysis approach yields Gompertz parameters α_3 = 0.1571 and β_3 = -0.0222 (pubic symphysis) and α_3 = 0.0627 and β_3 = 0.0074 (auricular surface). The Gompertz mortality model with the proportional odds probit model does not perform well in producing the observed counts for the pubic symphysis (X^2 = 31.98, p < 0.0001), although it performs better for the auricular surface (X^2 = 4.60, p < 0.05). Gompertz model parameters for the traditional age estimation approach are not similar to those estimated by transition analysis, particularly for the auricular surface (α_3 = 0.0149 and β_3 = 0.0641).
Funding support was provided by NSF grant BCS-0119754, and acknowledgement goes to Dr. Lyle Konigsberg for providing reference sample data.

A macroscopic and radiological study of porous skull lesions at Norris Farms 36 cemetery.

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The Norris Farms 36 cemetery sample is remarkable for the large frequencies of antemortem pathologies as well as antemortem and perimortem traumas reported by Milner and Smith. These authors concluded that this Oneota population was severely biologically and socially stressed. The current study reexamines the presence of the pathology, porotic hyperostosis (here termed porous skull lesions), in the Norris Farms sample for the purpose of differential diagnosis. All cranial material was visually examined for the presence of porous skull lesions. Next, a selected sample of 12 affected skulls was examined radiologically utilizing both x-ray and CT scans. Upon review of the radiographs it was found that x-rays did not significantly add to etiological identification. However, CT scans did reveal diagnostically important features on some individuals. Specifically they showed an expanded diploe and hair-on-end trabeculation in several individuals indicating the presence of anemia. Several other individuals were diagnosed by the anatomical patterning of lesions which match Ortner's descriptions of infantile and childhood scurvy. If correct, this would be the first reporting of scurvy at Norris Farms and supports the earlier finding by this author of scorbutic lesions at the nearby site of Orendorf. Taken together this locates a previously unrecognized nutritional deficiency in the prehistoric Central Illinois River Valley. Although the majority of porous skull lesion in the sample remains undiagnosed a combination of macroscopic and radiographic analyses has resulted in a revised understanding of health of this community.
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Collisional costs of bipedalism in primates.

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Bipedalism has evolved numerous times within primates, however the selective advantages of different styles of bipedalism are poorly understood. We consider the energetic tradeoffs involved in sifaka bipedal galloping *versus* human walking and running by examining the work limb muscles must do to redirect the center of mass (COM) from generally downward to generally upward during a single stride. Ruina et al (2005) detailed a model in which redirection of the COM is described as a "collision." The energetic costs of redirecting the COM can be reduced by minimizing the number of collisions, sequencing multiple limb contacts during a collision, or simulating an elastic collision (incoming energy and outgoing energy are equal). During walking and running collisional costs are high because humans have two collisions per stride with only one impact per collision, and absorbing running collisions. Humans can reduce these costs by optimizing step length and timing of toe-off

and heel-strike during walking and by using elastic energy storage during running. We videotaped (250 Hz) two adult sifaka during bipedal locomotion across a long force platform and documented number of collisions per stride, limb contacts per collision, and elasticity of collisions. Sifaka minimize collisional energy loss by (a) reducing the number of collisions per stride to one; (b) sequencing two limb impacts per collision, theoretically reducing energy loss by half; and (c) exhibiting pseudo-elastic collisions. These data suggest that the unusual galloping gaits of sifaka may be selectively advantageous for a leaping primate moving on the ground.
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High Infant Mortality in Ancient Arabia: Endemic Infections and Marriage Patterns at Tell Abraq (c. 2300 BC).

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Excavations of the Umm an-Nar tomb at the Bronze Age site of Tell Abraq (2300 B.C.) provided the comingled human skeletal remains of 280 adults (MNI based on right talus) and 82 subadults (MNI based on right femur). Age distribution of subadult femora revealed the following distribution: 29%, 8 lunar months to neonate; 41%, neonate to 2 years; 18%, 2 years to 5 years; and 11%, 5+ years of age. Age distribution based on the tibiae (MNI=71 left tibiae) revealed a higher prevalence of neonates and a lower prevalence of infants: 45%, 8 lunar months to neonate; 25%, neonate to 2 years; 17%, 2 to 5 years; and 17%, 5+ years. Of the premature and newborn femora, 74% exhibit active periosteal reactions along the midshaft, suggesting newborn mortality was at least in part due to nonspecific systemic infections. Because the subsistence base was resource-rich, dietary factors were likely not a factor. Moreover, 47% of the infants through 2 year-olds exhibit periosteal reactions. For children aged 2 to 5, and older, the frequencies decrease to 10% and 12% respectively. The local environment likely represented a number of health challenges to both mothers and infants including a variety of endemic diseases (sandfly fever, leishmaniasis, acute diarrheal disease, upper respiratory disease and brucellosis) and high fluoride levels. Additionally, cultural factors such as the long tradition of child marriages and marriage to 1st cousins (which both act to increase infant mortality) may have contributed significantly to infant mortality and maternal morbidity.

Loud calls as a tool in identifying the purple-faced langur (*Trachypithecus vetulus*) subspecies of Sri Lanka.

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Trachypithecus vetulus is an Asian colobine endemic to Sri Lanka of which four subspecies are currently recognized (*T. v. philbricki, T. v. monticola, T. v. nestor* and *T. v. vetulus*). Additionally a fifth variant is postulated in the north-west of Sri Lanka. Vocalization analysis is increasingly used as a form of distinguishing primate species, subspecies and individuals. Opportunistic sound recordings of the four recognized subspecies were carried out periodically over the last 3 years and collated. The parameters of 111 calls were analyzed for distinguishing characteristics between the subspecies (*T. v. philbricki* = 30, *T. v. monticola* = 24, *T. v. nestor* = 47, *T. v. vetulus* = 9). Parameters included call duration, number of phrases and residuals, number of units, phrase lengths and maximum, formant and fundamental frequencies.
More than 60 parameters, including formant frequency and phrase one length, showed significant differences between subspecies. Those parameters extractable from the first call phrase were included in discriminant function analysis. Absence of frequency data for *T. v. vetulus* prevents differentiation analysis of this subspecies. Discriminant function analysis correctly classified the three subspecies containing frequency data to 97.4% but this dropped to 83.3% when frequency variables were omitted, indicating its importance in subspecies differentiation. This indicates the loud calls of *T. vetulus* may be used to distinguish subspecies, and thus determine the existence of the fifth postulated subspecies. As all members of this taxon are currently listed as Endangered or Critically Endangered, vocalizations can provide a non-invasive mechanism for clarifying taxonomic relationships.
This research was funded by The People's Trust for Endangered Species and logistically supported by JetWing Ecotours.

Dental tissue proportions in the deciduous dentition of the immature individuals from Roc de Marsal (Neanderthal) and La Madeleine (late Upper Paleolithic), Dordogne, France. Implications for dental developmental patterns.

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Recent advances in the application of high-resolution microtomographic (μCT) analytical tools to the study of the human fossil record allow the noninvasive quantitative characterization of the inner dental structure. Compared to the extant human condition, Neanderthal permanent molars show comparable relative enamel volumes, but distributed over a greater dentine surface. However, dental tissue proportions of the deciduous Neanderthal dentition are

still poorly known, notably for the anterior arch, and the structural condition characteristic of the anatomically modern fossil human teeth is unreported yet.
By using techniques of (SR)μCT-based 3D virtual reconstruction-modeling and quantitative structural analysis, we reconstructed and assessed comparatively the deciduous "virtual dentition" of two fossil children: the Neanderthal from Roc de Marsal and the late Upper Paleolithic from La Madeleine, both from Dordogne, Western France. More specifically, we assessed the subtle linear, surface, and volumetric proportions of their crown and root components (enamel, dentine, pulp), and compared, element by element, their relative enamel thickness global and topographic variation to the tooth-related enamel/dentine ratio.
Results show that, since the early developmental stages, Neanderthal teeth are characterized by a unique tissue organization, while the late Upper Paleolithic specimen shows a pattern similar to the extant condition. We suggest that some maturational characteristics observed for the Neanderthal deciduous dentition (notably, a relative developmental delay of the incisors associated to a relative advancement of the first molars) may result from the direct influence on dental developmental patterning of absolute and relative differences in tissue proportions with respect to the modern human condition.

Recent advances in the neurochemistry of polyunsaturated fatty acids.

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The unique polyunsaturated fatty acid (PUFA) composition of the brain has been recognized for nearly half a century. The brain is particularly enriched in the n-6 PUFA arachidonic acid and the n-3 PUFA docosahexaenoic acid, while virtually devoid of other n-3 PUFA such as alpha-linolenic acid and eicosapentaenoic acid.
Recent radiotracer studies in rodents suggest that PUFA enter the brain via non-selective passive diffusion and upon their entry into the brain, they can be rapidly (<100 sec) subjected to beta-oxidation to maintain their desired concentration level. While earlier theories emphasized the structural role of PUFA within brain phospholipids, new observations suggest that PUFA act as secondary messengers to multiple neuroreceptor mediated pathways via coupling with phospholipase A_2. Recent molecular targets of docosahexaenoic acid released via phospholipase A_2 include neuroinflammation and cell survival, while phospholipase A_2-mediated release of arachidonic acid may be a key target of the mood stabilizers. Furthermore, it is now recognized that PUFA turnover rapidly within brain phospholipids, with the turnover of docosahexaenoic acid accounting for ~0.1% of the brain's basal ATP consumption. Current controversies include both the amount and form of n-3 PUFA that must be consumed in the diet to maintain brain turnover rates and at what level do the consequences of inadequate n-3 PUFA intake impair brain physiology or behavior.

Health and lifestyle of ancient pastoralists from Mongolia.

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Here the results are presented of a multi-dimensional study concerned with the general health, nutrition, and trauma in ancient pastoralist populations from Mongolia. This research is based on skeletal material excavated from Baga Gazaryn Chuluu, in the Dundgovi Aimag of Mongolia. Since 2003, Baga Gazaryn Chuluu has been extensively surveyed to document and record archaeological features present in the area. To date, an assortment of analyses have yielded a variety of information concerning past health, human behavior, and lifeways of these populations.
The purpose of this study is to present the findings of research aimed at understanding the impact of a pastoralist lifestyle on people as exhibited through their skeletal remains. The skeletal materials analyzed during this study were excavated from a variety of different mortuary structures dating from the Mongolian Bronze Age, Iron Age, and Mongol Period. Attention here is focussed on the examination of trauma, infectious disease, congenital defects, dental health and degenerative joint disease. A number of instances of trauma such as broken ribs, mid-shaft femoral fractures, broken clavicles and craniofacial trauma have been documented within this assemblage. Degenerative joint disease has revealed a differential expression of the condition based on age and sex. Examination of the dental pathology of these individuals has yielded low incidence of dental caries, large quantities of calculus, and enamel hypoplasias. These results display the importance of multi-dimensional analyses in reconstructing the health status of past populations and creating a more detailed picture of their lifeways.

Pulmonary artery hemodynamics of high and low altitude native Ethiopian Amhara.

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Hypoxic pulmonary vasoconstriction in response to lowered oxygen tension in the airway is more pronounced among Andean than Tibetan high-altitude

natives. This report presents the results of a study of pulmonary artery hemodynamics in a little-studied population with thousands of years of residence at altitude, the Amhara of Ethiopia. 76 healthy adult Amhara non-smokers, lifelong residents around 3700m, 54 similarly screened Amhara at 1200m, and 46 U.S. residents at 282m provided Doppler echocardiography measurements. The Amhara sample at 3700m, as compared with that at 1200m, had ~ 25% higher average tricuspid regurgitant gradient (indicator of pulmonary artery systolic pressure), did not differ in average right ventricular outflow velocity time integral (indicator of pulmonary artery blood flow) or pulmonary vascular resistance, and had ~ 33% larger right ventricles. The Amhara sample at 1200m, as compared to the U.S. sample, had higher pulmonary artery pressure and blood flow, and lower pulmonary vascular resistance yet the same size right ventricle. The conventional model of pulmonary hemodynamic response to high-altitude residence considers pulmonary vascular resistance and right ventricular hypertrophy as co-dependent responses. This study discovered that these traits respond to high altitude independently, and that a graded response to increasing altitude may account for the population contrasts found among highlanders. Financial support was provided by NSF0452326, HL60917, RR)24989, and NSEC.

Testing the MNI and the MLNI: Which method is most likely to be accurate and when?

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The problem of estimating the number of individuals represented by a commingled assemblage of human remains is one that affects physical anthropologists, bioarchaeologists and forensic anthropologists alike. The traditional quantification technique applied to this problem has been the minimum number of individuals (MNI). Recently, Adams and Konigsberg ([2004] Am J Phys Anthropol 125:138-151) suggested a new method, the most likely number of individuals (MLNI), be used in place of the MNI to estimate the *original*, versus the *recovered*, number of individuals in an assemblage.

The MLNI is based on the Lincoln index (LI), a population estimation technique originally developed by biologists. In living populations, a capture-mark-recapture approach is used to calculate population estimates. In the osteological analogy, one side of an antimeric pair (e.g. humeri) serves as the "capture" and the other side serves as the "recapture." Thus, accurate pair-matching of bilateral elements is a necessary requirement. Adams and Konigsberg (2004) did test for pair-matching accuracy; however, their sample size did not establish the pair-matching limits of the analyst and, concomitantly, the quantification limit of the technique. Utilizing skeletal remains from the Campbell Site (23PM5), the results of the present study indicate that pair-matching abilities suffer at higher sample sizes and can produce increased Type I (false pair) and Type II (missed pair) errors. Furthermore, the MLNI, like the MNI, is prone to errors resulting from taphonmic degradation and loss. Ultimately, in these situations, the MLNI fails to provide estimates that are of more value than traditional quantification techniques.

Evaluating diagenetic alterations affecting stable isotopes in bone using C/P and CI values: a comparison of four sample preparation methods for FTIR analysis.

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Since the 1980s, researchers have used carbon stable isotope values from bone apatite to reconstruct ancient diets. Initially, the suitability of bone apatite analysis was debated because of the possible diagenetic alterations affecting the bone mineral properties due to the burial environment. However, several studies have indicated that, through appropriate sample preparation treatments, bone apatite can yield reliable stable isotope signatures. Nonetheless, it is still necessary to evaluate diagenetic alterations that might not have been addressed by such treatments. One standard method of evaluating diagenesis in bone apatite is to use FTIR (Fourier transform infrared) spectroscopy to measure carbonate content (C/P ratios) and apatite crystallinity (CI). FTIR spectroscopy is viewed as a semi-quantitative method for analyzing chemical components within a material. In recent years, evolving technology has enabled new preparation methods for FTIR samples. In this study, we examined the differences between four different preparation methods for spectroscopy analysis of 25 prehistoric bone apatite samples. The methods that were compared (ATR, DRIFT, hydraulic press pelleting and mechanical pelleting) use varying optic properties to analyze a sample. According to chemists, each spectra produced by each method is equivalent. And in fact, each method does identify the same chemical components for a sample. However, it was found that each spectra yielded statistically significant different values for C/P ratios and CI, as well as different correlations between the values. It is therefore concluded that the sample preparation method used for spectral analysis does affect the resulting calculations that evaluate diagenesis in bone apatite.

Life and death at Butrint, Albania: paleopathology and mortuary behavior in Late Antiquity.

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Combining molecular analytical techniques with more traditional bioarchaeological approaches elucidates specific aspects of ancient mortuary practice and health status within a sample of Late Roman human skeletons (N=41) recovered from the Triconch Palace at Butrint, Albania. This grandiose 3-4th century AD private residence fell into disrepair in Late Antiquity and was used as a cemetery by the late 6th century. The skeletal sample includes an overwhelming proportion of subadults (82%), suggesting high infant mortality. High frequencies of cribra orbitalia, porotic hyperostosis, and periosteal reactions also indicate that poor living conditions at Butrint during Late Antiquity placed a particularly heavy burden on young children. Observed spatial clustering of graves within certain rooms of the palace suggests that those rooms were used by family units as private burial areas. This demographic hypothesis was tested with mitochondrial DNA analysis of bone samples taken from 31 of the Triconch skeletons. Both shared and unique mtDNA haplotypes were identified from these remains. In some cases, individuals sharing mtDNA haplotypes were located close to one another and exhibited similar grave orientations. In contrast, individuals with unique haplotypes were exclusively subadults and were often buried in a more isolated manner. These results suggest that the Triconch Palace was the site of a combination of Late Roman mortuary practices that included family burial areas and isolated inhumations.

Finding the Scot in the Scottish-American: Examination of ethnic identity through the Y-chromosome.

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It is estimated that over 12 million Americans claim Scottish ancestry. To determine whether individuals self-identifed as Scottish carry Scottish genetics markers in their genes, samples were collected from 50 males at the 2006 Kansas City Highland Games. All individuals in the sample identified themselves as "Scottish.". To determine possible contribution from a paternal line, surnames where analyzed. All but 6% of the individuals have surnames that are currently found in Scotland, with most surnames having been present in the historical records the since the mid 1500's. Analysis of 9 short-tandem repeats on the Y-chromosome (YSTRs) identified probable Y haplogroup assignment. Individuals in this sample represented the following haplogroups: R1b, R1a (3%), I (11%), J2 (12%), G (6%) and E3b (4%). Haplogroup R1b dominates the sample at 64%, as would be suspected of a population with origins in Western Europe. Haplogroup frequencies are found at those similar to the current Scottish population, as well as in similar frequencies to the rest of the British Isles. All but six Y-STR haplotypes matched individuals in the current Scottish population. This research was funded by Clan Donald, USA Academic Scholarship.

The "bleeding-heart baboon": Does chest patch color signal male quality in geladas?

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Sexually-selected signals that honestly advertise condition, can facilitate the assessment of a rival or mate. One of the most striking features of geladas (*Theropithecus gelada*) is a red patch of skin on the chest and neck. It has been hypothesized that chest color in male geladas might broadcast reliable information about fighting ability to rivals or mate quality to females. To determine whether chest color in gelada males is a sexually-selected signal, we collected two years of data on male social status, reproductive tenure, chest patch color (using digital photography), and fecal hormones from a population of wild geladas living in the Simien Mountains National Park, Ethiopia. First, because a critical requirement for the evolution of honest signals is that they carry some fitness cost, we examined chest color in relation to testosterone – a metabolically costly steroid hormone. Our results indicate that males with redder chests have higher testosterone. Second, we examined the prediction that the highest quality males would maintain the reddest chest patches. In geladas, only leader males have direct reproductive access and, as predicted, we found that leaders had redder chests than bachelor (pre-reproductive) or follower (post-reproductive) males. Furthermore, leader males with more females in their harem had redder chests than those with fewer females. Thus, chest patch color does, indeed, vary with status among gelada males. Although these data are consistent with the hypothesis that chest patch color is a sexually-selected signal, it is still unclear whether it functions to deter challengers, attract females, or both.
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The acquisition of upright posture: the role of the vertebral bodies and the intervertebral disks in the lumbar curvature.

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The degree of the lordosis angle exhibited by primates is influenced by their mode of locomotion; Plantigrade primates show little lordosis angles, or no lordosis at all, while orthograde primates (humans) show high lordosis angles. The lumbar lordosis is formed by the wedging of the lumbar vertebral bodies and the wedging of the intervertebral disks. While it is well established that humans exhibit a greater lordosis angle than plantigrade primates, it is not clear if the difference stems from changes in the wedging of the vertebral bodies, or in the angulations of the intervertebral disks.

The aim of this study is to establish whether the increase in lordosis results from an increase in vertebral body wedging, intervertebral disk wedging, or both. Lateral radiographs of the lumbar spine of 100 orthograde primates (Modern humans) and 56 plantigrade primates (Macaque) were examined.

As was expected the lordosis angle of Macaques was found to be significantly smaller then the lordosis angle of Modern humans. Out of the 36° of difference in lordosis angle between Macaques and Humans, thirty degrees come from the differences in the wedging of the vertebral bodies and only six degrees come from the differences in the wedging of the intervertebral disks. Hence, this might indicate that in the transition from plantigrade to orthograde posture, most of the change in lordosis angle comes from the change in the wedging of the vertebral bodies.

New *Anapithecus* jaws from the late Miocene of Rudabánya, Hungary.

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Excavations in 2008 yielded the most complete maxilla (RUD 215) and mandible (RUD 222) of the primitive catarrhine *Anapithecus*. The male maxilla is elongated with nearly parallel sides. The premaxilla is missing, but the incisor morphology suggests a short premaxilla. The zygomatic root is low and broad, above M1-M2, and the infraorbital surface is antero-inferiorly orieinted. The incisors are broad and low crowned. The canine is moderately high crowned and buccolingually compressed. The premolars and molars are typical for *Anapithecus*, the former being large and rectangular, and the latter broad with prominent lingual cingula and buccal styles. The molars are approximately the same size. The female mandibular corpus preserves only portions of the postcanine alveolar processes, but the nearly complete dentition gives a good indication of mandibular shape. The mandible is long and the corpora diverge posteriorly. The incisors are large, and they and the canines are tall, though the canine is clearly female in morphology. The postcanine dentition is typical for *Anapithecus*, with large premolars, m1 and m2 of nearly equal size, and an elongated and tapered m3. The maxilla and associated orbital fragments provide critical data for the reconstruction of the face of *Anapithecus*, known from one other specimen (RUD 83), and will aid in the re-evaluation of the status of the taxon *Ataxopithecus* (RUD 71). *Anapithecus* is clearly a stem catarrhine, despite its relatively young geologic age. These more complete fossils will help address the enigma of the origin and evolution of the Pliopithecoidea.

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The role of food supply in the recovery of a black howler monkey (*Alouatta pigra*) population in response to a major hurricane.

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In 2001, Hurricane Iris hit Southern Belize, devastating the forest that is home to a black howler monkey population. Immediately following the hurricane the population density fell from 102 individuals/km^2 to 60 individuals/km^2. Due to the disappearance of adults and low infant production and survival, the population continued to decline for 3 years reaching a low of 20 individuals/km^2. The population then stabilized for two years before beginning to recover. This study uses demographic, behavioral, phenological, and nutritional data to determine the role of the food supply in the stabilization and recovery of the population. Howler monkeys are folivores, so it is predicted that their biomass is dependant on the protein to fibre (P:F) ratio of leaves. By collecting mature leaves from the 20 most abundant trees in the area and analyzing them for nutritional content we tested the P:F model and found that in 2001 the P:F was 0.42 and the biomass was 800 kg/km^2. In 2004, the P:F increased to 0.58, but the biomass declined to 250 kg/km^2, suggesting leaf quality was not limiting population growth. Rather, we found that population size and infant survival were tied to the availability and consumption of fruit, which was severely limited after the storm. Infant survival and population density increased following the return of fruit consumption to pre-hurricane values of 40% of the annual diet. This suggests that although howlers are able to survive on leaves, it is fruit and not leaf quality that is crucial to population recovery and growth.

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The effect of ground substrate on the travel paths of captive rhesus macaques (*Macaca mulatta*).

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Optimal foraging theory argues that animals are adapted to travel the route of least effort between resources because time and energy are limited. Path tortuosity provides an estimate of how efficient animals are in their search of a goal or whether or not animals are traveling toward a known goal. The structure of food resources, such as food size, density, distribution, and heterogeneity, has been shown to influence the degree of tortuosity of animal paths. This study investigated the influence of the type of ground substrate on the travel paths of groups of captive rhesus macaques (*Macaca mulatta*). Grass substrate provides supplementary food resources (e.g., insects, blades of grass) having more random and unpredictable distribution and higher density relative to gravel substrate, which is depauperate in supplemental foods. Animals in four grass enclosures (n = 95 individuals) traveled along more tortuous paths, as measured by greater number of changes in direction, greater number of stops, and lower straightness index (straight-line distance/total distance) compared to animals in two gravel enclosures (n = 52 individuals). Additionally, animals in grass showed shorter and slower bouts of locomotion immediately prior to foraging behavior (n = 85 individuals) compared to locomotion bouts that approached the feeding pad (n = 46 individuals). Captive macaques, like wild animals, move along more tortuous paths and at slower speeds when their food resources are small, randomly distributed, and high in density.

New fossil papionins from the Late Miocene of As Sahabi, Libya.

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Renewed field work at the 6-7 million year old site of Sahabi in eastern Libya during 2007 and 2008 led to the discovery of two new mandibles with well preserved teeth, and a left distal humerus of one of the oldest known cercopithecines. Together with previously collected specimens, they appear to belong to a new species.
The Sahabi monkey's low molar cusp relief indicates it is cercopithecine, and its thin incisor lingual enamel that it is papionin. Its size is similar to late Miocene monkeys *Parapapio lothagamensis* (Kenya) and *Macaca libyca* (Egypt), but smaller than *Macaca* sp. from Menacer (Algeria). It shares with *P. lothagamensis,* and differs from late *Macaca* sp. from Menacer, a P_3 lingual metaconid. This feature occurs at very low frequency among extant cercopithecoids, but on nearly all *Victoriapithecus* P_3s. M_2s of both males and females from Sahabi are distinctive in being only slightly longer than they are wide (L/MW=104%), with exaggerated buccal flare (MCP/MW=48% on the unworn M_2), a condition observed in *V. macinnesi, Cercocebus, Lophocebus* and *Allenopithecus*. Individual M_2s of *P. lothagamensis* and *M. libyca* are as square and almost as flared buccally, but the central tendency of these species is to have more elongated second molars. In contrast *Macaca* sp. (Menacer) M_2s are relatively elongated with less buccal flare. The Sahabi species differs from *P. lothagamensis* and one specimen of *M. libyca* in having a less elongated and more steeply oriented mandibular symphysis. The distal humerus exhibits clearly cercopithecine and terrestrial features.
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New evidence on the evolution of human foot function based on optical laser scanning of early hominin foot prints.

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Footprints, although rare, offer unique evidence about gait and foot shape, and have figured prominently in debates about the evolution of human bipedalism. Here we develop new approaches to the analysis and conservation of human footprints preserved within the geological record to quantitatively examine the functional morphology of Pliocene footprints from Laetoli (Tanzania), Pleistocene footprints from the Koobi Fora region, (Kenya), and modern human footprints in order to test hypotheses about the evolution of foot function.
Using an optical laser scanner, we recorded footprint morphology and produced detailed digital elevation models composed typically of 300,000 data points (xyz

coordinates) per 0.5 m^2 scan which are accurate at a sub-millimetre scale. We digitized 3D footprint landmarks (e.g., tip of hallucal imprint, deepest metatarsal imprint) and applied a range Geometric Morphometric techniques. Our analyses show that the Laetoli footprints are distinct from modern human footprint populations in important respects (e.g., hallucal abduction, location of deepest impression), but that Pleistocene examples from Kobi Fora are very similar to modern human footprints. We argue therefore that our methodology provides an important approach to the preservation and long-term conservation of fragile field evidence of this sort, and that by the early Pleistocene, footprints show evidence of modern foot function, adding to anatomical and archeological evidence for hominins with a greater emphasis on long-distance bipedalism in a variety of ecological settings at this time.

Changing environments, developmental plasticity and life history traits.

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Developmental environments affect growth, maintenance and reproductive function. Human ovarian function is influenced by the quality of childhood environments as measured by comparative reproductive steroid levels in adults. For example, migrant Bangladeshi women, aged 18-35, who grew up in the UK have significantly higher salivary progesterone and ovulation rates compared to women who developed in Bangladesh with higher immune costs. However, we know little about ovarian function *over the life course* in relation to changing environments.

We are now examining hormones reflecting ovarian reserve (follicle-stimulating hormone, inhibin B, and anti-müllerian hormone (AMH)) to assess the effects of developmental environments on women aged 35-59. Using preliminary data, we find significantly higher inhibin B in migrants aged 35-39 who grew up in Bangladesh (96.2 pg/ml; <0.05, unpaired t-test) compared to sedentees (52 pg/ml). Levels of inhibin B are undetectable (<10 pg/ml, days 4-6 of the cycle) at significantly earlier ages (45-49) among sedentees compared to migrants (23 pg/ml) and Europeans (40 pg/ml). Europeans aged 45-49 have 50% higher AMH compared to sedentees, but only 43% higher levels compared to migrants. Sedentees aged 45-49 also have 61% higher FSH ($p<0.05$, unpaired t-test) compared to migrants.

Migrant Bangladeshi women deplete their follicular pool later than sedentees, suggesting that reproductive ageing and ovarian reserve is influenced by exposure to different environments during adulthood. While childhood conditions appear to influence the quality and, thereby, potential fecundity of individual cycles (as measured by reproductive steroids), an improved environment during adulthood appears to lengthen the reproductive lifespan.

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Tana River yellow baboons' (*Papio cynocephalus*) diet and habitat use: potential impact on a sympatric species?.

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Baboons inhabit a mosaic-savanna environment similar to that of early hominins and knowledge of their habitat use may facilitate understanding our past. However, relatively little has been reported on Kenya's Tana River Primate National Reserve yellow baboons' long-term habitat usage and food preferences – particularly with respect to the critically endangered Tana crested mangabeys also found there. I present preliminary analyses of Jan88-Oct92 data (875 observation days, 4893 hourly scans) on the Mchelelo baboon troop (n=75). I predicted more observations should be recorded on the proportionately larger savanna than in the riverine forests and the baboons should show both seasonal and rainfall-influenced dietary preferences for fruits/seeds. While more observations are on the savanna ($t(105) = -4.86$, $p<0.001$), 42.43% are inside the forests. Fruit/seed consumption is high throughout the year and a significantly higher proportion of each months' observations reflect fruit/seed rather than grass/herb/corm consumption ($t(86)=-2.02$, $p=0.047$). The fruit/seed of two forest species' (*Phoenix reclinata*, *Hyphaene coriacea*) are particularly important, accounting for more than 24% of the food consumption observations. There is no statistical difference in fruit/seed ($t(42)=-0.77$, $p=0.448$) or grass/herb/corm ($t(41)=-1.05$, $p=0.299$) consumption in rainy vs. dry seasons. An important implication of the baboons' forest use and fruit/seed consumption is their potential impact upon the mangabeys which rely upon *Phoenix reclinata* and *Hyphaene coriacea* for >30% of their annual diet. Seven of the baboons' top 15 forest foods (representing >30% of observations) are also among the mangabeys' top 15 foods. Further investigations of Tana baboon nutritional ecology and interspecies competition are underway.

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Mitochondrial population structure of a baboon contact zone.

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Kinda baboons (*Papio cynocephalus kindae*) differ from "typical" yellow baboons (*P. c. cynocephalus*) in size, morphology, and infant coat color, and they carry mitochondrial haplotypes of a distinct major clade. The baboons in and immediately around South Luangwa National Park, Zambia, are intermediate physically, and in the incidence of kinda-like infant coat color. The present study reports the distribution of mitochondrial variation in the area's baboons, based on an analysis of hypervariable region I of the mitochondrial d-loop in 36 fecal samples, all from different individuals, belonging to N different social groups. In general, troop members shared identical or closely-related haplotypes. Groups from the left (eastern) bank of the Luangwa River carried haplotypes of the yellow clade, while those from the right (western) side had kinda haplotypes. There were, however, two groups with both kinda and yellow haplotypes. One lived on and immediately east of a bridge recently built across the Luangwa, the other lived around an abandoned meander immediately west of the river. These findings suggest that historically this stretch of the Luangwa Valley was occupied by baboon populations that expanded to the river from both highland regions that flank the valley. They also suggest natural and anthropogenic routes to subsequent, cross-river gene-flow between the populations.
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Variation over time in grooming kin bias among female rhesus macaques on Cayo Santiago supports the time constraints hypothesis.

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The time constraints hypothesis posits that nonhuman primate social networks are shaped by the fact that group members have limited amounts of time to devote to social relationships. As groups expand, grooming networks should focus progressively more on a subset of potential partners, particularly close kin. We test several predictions of the time constraints hypothesis by examining variation in grooming kin bias intensity (KBI) among free-ranging rhesus females on Cayo Santiago, 1983-1986. We analyze grooming in both the main study group (I) as it grew and fissioned and in its fission products. Grooming KBI was positively related to group size (r_s=.83, n=8 group-years, p<.01). Females groomed similar numbers of partners and amounts of time regardless of group size, but groomed smaller percentages of available partners in larger groups (r_s=-.86, n=8, p=.001), suggesting that they were unable to maintain grooming relationships with all females as their groups expanded. Low ranking females displayed higher KBI than others (r=-.35, n=80 female-years, p<.01), as expected if they had less time to spare. Females with relatively more close kin showed less KBI than those with fewer (r=-.34, n=80, p=.002), as expected if they had limited time to distribute grooming among kin. We conclude that kin-focused grooming networks in rhesus females are shaped at least in part by time constraints. We found similar results for wild Tibetan macaques living in smaller groups and displaying less extreme kin bias, suggesting that differences in group size may be partly responsible for differences in kin bias between species.

Global human population structuring seen from craniometric data.

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Studies in molecular biology have suggested two different scenarios emerging for the geographic distribution of human diversity. One suggests a linear relationship between genetic distance (or diversity) and geographic distance, pointing to a cline pattern. Another one, indicates the occurrence of genetic discontinuities between different continents. In this case, human diversity does not obey a linearly increment of geographic distance, suggesting a pattern of discrete grouping. This study try to identify which pattern is observed when human cranial morphology is considered. A sample containing craniometric information of 6,770 males, distributed in nineteen large areas of the planet, was explored by us. Through single and pair wise comparasions over geographic and morphological (obtained from calculation of coefficient of variation and Fst) distance matrix, two patterns of association were explored: one for populations coming from one same geographic area (intra) and another for populations between the continents (inter). The results indicate that the diversity of the human population's structure seen from the craniometric data can be best explained by a pattern marked by discontinuities revealing a suggested identity within each great geographic regions.
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A bioarcheological study of respiratory health in England from fifth century BC to nineteenth century AD.

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Respiratory disease has affected human populations throughout our history and remains a significant cause of morbidity and mortality today. In spite of this, there is a dearth of bioarchaeological research on this important subject. Previous research has suggested a relationship between poor air quality and the prevalence of chronic maxillary sinusitis and rib periostitis. These conditions have many causes (e.g. congenital disorders, allergies, poor air quality, climate, infectious disease). Chronic maxillary sinusitis and rib periostitis are recognised as bone formation and/or destruction, indicating long-term inflammation of the soft tissues of the sinuses and ribs in some upper and lower respiratory tract conditions. If air quality is a significant contributor to respiratory disease, the highest prevalence rates would be expected in populations exposed to high concentrations of indoor and outdoor pollutants. This study examines 11 skeletal samples from cemeteries located in southern England, ranging in date from the Iron Age to the Post-Medieval period. The samples were chosen to examine both synchronic and diachronic trends in respiratory disease, contrasting contemporaneous populations living in rural and urban contexts, as well as populations from high and low social status groups. Frequency ranged from 31.5% (Roman) to 67% (Late Medieval) for sinusitis and 1.3% (Iron Age) to 29.7% (Post Medieval) for rib periostitis, but, when combining the skeletal and archaeological/historical data, the hypothesis posed is not consistently supported. These results suggest that the causes of respiratory disease are more complex than this current hypothesis presumes.

Hormonal correlates of growth in mandrills (*Mandrillus sphinx*).

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The marked sexual size dimorphism between male and female mandrills, among the highest of living primates, is due mainly to a prolonged growth period in males which includes a pronounced spurt in mass. This study quantifies levels of insulin-like growth factor-I (IGF-I) and free testosterone (free T) in order to assess whether differences in hormone level or pattern are associated with variation in growth pattern. Samples from animals between 0.5 and 12 years (N=275; 85 individuals), with associated mass and crown-rump length (CRL), are analyzed. The mixed longitudinal nature of some samples allows for comparison of individual growth patterns with hormone levels. We use lowess regression to generate distance curves for mass and CRL, and for patterns of IGF-I (male and female) and free T (males only). Pseudovelocity curves are constructed for mass and CRL for each sex, and velocities in these measures are also calculated for individual animals.
Our results show that males have higher average IGF-I levels than females during growth, and while female levels decline after 48 months of age, males sustain high IGF-I levels between 36 and 84 months. Comparison of pseudovelocity and hormone curves suggests that IGF-I levels approximate body mass growth in both sexes, while showing a weaker relationship with growth in CRL. Individual mass velocities show a close correspondence with IGF-I patterns. Levels of free T show a clear and marked increase beginning at nine years of age, coinciding with the attainment of adult body size and testicular volume in males.
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Biological variation resulting from Inka imperialism.

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Prior to European contact, the Inka empire was unarguably the largest civilization ever to emerge in the New World. A tremendous corpus of ethnohistorical and archaeological literature has been published, in addition to a fluorescence of contributions from biological anthropology. Until recently, relatively few Inka burials have been recovered, however, newly documented cemeteries are changing what we know about those who administered and lived under imperial Inka rule. Scholars have answered questions regarding Inka paleodemography, health and disease, diet and subsistence, residential mobility, and biological distance. This research hopes to contribute to the latter avenue of inquiry by investigating the intra/inter-phenotypic variability of several Inka sites.
3D coordinate data were captured with a Microscribe digitizer from two spatially distinct coastal Inka sites near Lima (Huaquerones and 57AS03) and two highland sites located near Cuzo (Machu Picchu and Choquequirau). Due to the small sample size from the latter highland site, these data were pooled.
Coordinate data were employed to calculate traditional inter-landmark distances, which were standardized and used to calculate F_{ST} from a

relationship (R) matrix. Genetic differentiation ranged 0.0437(h^2 = 1) to 0.075 (h^2 = 0.55). Analyses of the residuals from the R matrix indicate that individuals from 57AS03 and Machu Picchu were influenced by greater than average levels of external gene flow while negative residuals generated from Huaquerones indicate that this population was subjected to less than average gene flow. These findings are then discussed in context with the Inka's socio-political organization as an empire.

Urbanization and Infection: Trends from Medieval Poland

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By various measures, urbanization has been shown to affect negatively the health of populations in both historical and contemporary settings. However, the continued trend of urbanization and population aggregation in urban centers has rarely been addressed. In some cases, these outcomes may be seen as a necessary cost for the benefits of living in urban environments. This study tests the hypothesis that urbanization affected the health of a medieval Polish population and that the consequences of urbanization occurred gradually and were not severe; thus, reducing the likelihood that negative health effects factored into the ongoing process of urbanization for this population.
Evidence of infectious disease (periostitis, leprosy, tuberculosis, treponematosis) was assessed in three medieval Polish skeletal samples (Śródka, n= 140; Wodna, n=10, Garbary, n=14), representing three temporal periods: pre-urbanization (A.D. 950-1025), early urbanization (A.D. 1025-1100), and late urbanization (A.D. 1100-1250). The prevalence rates of periostitis and the specific diseases were compared among the temporal samples to determine whether exposure to pathogens and infection increased with urbanization. Statistical analysis (chi-square, Fisher's exact; $p<0.05$) revealed no significant difference among the three periods. These results indicate there was no change in the level of pathogen exposure and infection, which contradicts previous urbanization studies. However, it is possible that health did decline later than what is represented by this skeletal series as urbanization intensified. This would support the notion that changes in health did not occur rapidly and, therefore, were not a consideration in the trend of urbanization.
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Female behavior and the one-male unit social structure among the Gola baboons.

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Anubis (*Papio hamadryas anubis*) and hamadryas baboons (*Papio h. hamadryas*) are so distinct in their morphology, behavior, social systems and ecology that many consider them to be different species. However, they interbreed where their ranges overlap to form expanding hybrid zones in Ethiopia. Among the derived features of the hamadryas social system is its four-level social organization. The most stable structure in this multi-level hamadryas society is the one-male unit (OMU), whose stability is often attributed to male herding behavior. However, results of this study, based on focal female sampling technique, suggest that female behavior also contributes to the temporal and spatial stability of OMUs. This long-term study, based on two different baboon groups; a predominantly anubis group with hamadryas and hybrid males, and a second group with anubis, hamadryas and hybrid baboons of both sexes, demostrates that hamadryas males form OMUs in both groups. However, these OMUs are less stable than typical OMUs in hamadryas societies. The formation of 'loose' OMUs between hamadryas males and anubis females has been documented within several baboon groups in the Awash hybrid zone. The results presented herein are novel in that similar 'loose' OMUs emerge even when females members of the OMUs are hamadryas. Demographic and social factors such as the adult sex ratio, the nature of female-female relationships, and group history are proposed among possible explanations for this finding. Some of these factors, in turn, are the result of recent human induced ecological changes in the region.
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A field study of kinematics during quadrupedal walking in *Cebus capucinus*.

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Laboratory studies have revealed that most primates are unique in sharing a preference for diagonal sequence/ diagonal couplet gait sequences (DSDC), where the hindlimb foot touches down followed by the contralateral hand (DS) and movement of these contralateral limbs are related (DC). Recent researchers have suggested that DSDC gait evolved to increase stability on arboreal supports by positioning a grasping foot underneath the body when a hand touches down on an untested support. In this research, we tested this hypothesis in a natural setting by examining footfall sequences in a group of free-ranging white-faced capuchins (*Cebus capucinus*) in Costa Rica. We filmed 32 arboreal strides of adult males, adult females, adult females carrying

infants, juveniles, and infants while crossing a two-meter horizontal support (4-4.9 cm diameter). These data are compared to footfall sequences of individuals on branches within their arboreal habitat to assess the effects of varying branch inclination, diameter, and flexibility on gait selection. Subjects were filmed using a JY-HD10U high definition digital camcorder (60 fps) and data were analyzed using Hildebrand's method. Preliminary analysis revealed that wild capuchins of varying ages used both lateral and diagonal sequence gaits, suggesting DSDC is not always necessary on arboreal supports. Infants and juvenile capuchins fell within the range of their adult counterparts and did not differ in gait selection on the experimental substrate. Additional relationships among limb morphology, limb length, ontogeny, and branch use are discussed.

Preliminary determination of a possible â-Thalassemia causing genetic mutation in the Tipu Maya Skeletal Collection through DNA sequencing.

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This study involves the sequencing and analysis of the β-hemoglobin gene exon-2 in ancient DNA (aDNA) isolated from Maya skeletons, which were excavated at a Maya Cemetery in Tipu, Belize. The study of aDNA is challenging due to extensive fragmentation, deterioration and contamination concerns. To prevent contamination and ensure delicate manipulation, the study was conducted in a separate sterile laboratory, on canine and molar teeth using an established protocol modified by our laboratory. Anatomical studies, including skeletal and bone perforation measurements, previously indicated the possible presence of the blood disorder β-Thalassemia in several skeletons. To test for the genetic basis of the disease, the second exon of the β-Hemoglobin gene was amplified and sequenced. Preliminary sequencing results have revealed a mutation (Cytosine deletion at bp 43) within this exon in several skeletons. This mutation is known to cause β-Thalassemia in contemporary human individuals. This finding is significant because, to the authors' knowledge, there have been no reports of a β-Thalassemia causing mutation present in any ancient New World populations. Further skeletal sequencing of this exon would confirm the presence of this mutation, the extent of its prevalence, and support the possible presence of β-Thalassemia in the skeletal population. This would help resolve the status of β-Thalassemia as an Old World or a New World disease. Further research would extend this study over the entire gene and involve contemporary Maya sequences obtained from living Maya individuals. Lastly, this study would increase the current knowledge base for both aDNA and modern genetic studies.

A moving target: How do primates estimate predation risk in space and time?

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It is unlikely that primates have perfect information about predator activity in their environment. Given this, the antipredator behaviors that are exhibited by primates must be based on an estimation of risk. Monitoring both primates and their predators simultaneously can indicate how closely this estimation of risk matches predator activity, and can also reveal what other cues primates use to estimate risk in space and time.
The data presented here were collected simultaneously on one troop of chacma baboons and two radio-collared, female leopards from August 2007 through March 2008 at Loskop Dam Nature Reserve, South Africa. The proximity of the troop both to collared leopards and to core areas of leopard activity was determined for all baboon locations and associated behaviors using ArcGIS 9.1 and Home Range Extension. Results show that while some changes in habitat use and antipredator behavior were observed when the troop was proximate to collared leopards, this pattern was not consistent. Many antipredator strategies that did not change based on proximity to collared leopards did change with proximity to leopard core areas regardless of leopard presence. These results indicate that the baboons (A) indeed did not have perfect information about leopard activity in their environment, and (B) likely used past experience from leopard encounters to estimate areas of higher risk (e.g. leopard core areas) when employing antipredator behaviors.
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Patterns of variation at the *GYPA* locus in human populations.

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GYPA encodes a cell surface protein called glycophorin A that is expressed solely on the surface of erythroid cells. Isoforms of glycophorin A encode the MN blood group antigens that have been widely studied in human populations. The primary function of glycophorin A is yet to be discovered, but it is known that it serves as the major binding site for the 175-kD erythrocyte-binding antigen (EB-175) of the malarial parasite, *Plasmodium falciparum*. *P. falciparum* has been a major selective pressure in recent human

history . Accordingly there has been interest in understanding what impact, if any, it has had on the distribution of variation in *GYPA*. However, population genetic studies of *GYPA* have been limited by the small sample size and restricted geographical distribution of the populations studied. To gain a better understanding of the recent evolution of *GYPA*, we resequenced its coding and putative regulatory regions in a panel of sub-Saharan Africans, Europeans, East Asian, and Asian Indians. Patterns of variation differed substantially among groups, particularly in the region of *GYPA* that encodes the domain that interacts with EB-175 of *P. falciparum*. Variation in this region revealed an excess of intermediate frequency polymorphisms in only sub-Saharan Africans. Efforts are now underway to determine to what extent population-specific forces have shaped *GYPA* variation and to distinguish between the effects of natural selection and demographic history.

A unique commingled burial at the Norris Farms 36 cemetery: questioning the "revered ancestor" hypothesis.

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The A.D. 1300 Oneota skeletal series from the Norris Farms 36 cemetery in the Central Illinois River Valley has been documented extensively with regard to biological attributes and trauma. Two isolated adult hands were discovered lain over a subadult burial at the site, a finding that previous authors hypothesized was related to "revered ancestor worship."
The goal of this presentation is to estimate biological parameters of this single associated pair of hands from the Norris Farms 36 cemetery in order to investigate possible intra- versus inter-group origins. This study quantified metacarpal physiological length of the two isolated adult hands, as well as that of 25 males and 25 females from the cemetery, in order to evaluate the sex and stature of the isolated hands and their relationship to the reference population. Our results indicated that both of the isolated hands were those of a male with minimal bilateral asymmetry.
Given the unique nature of this burial, we argue an alternative hypothesis for these commingled remains that takes into account the high degree of traumatic injury present throughout the rest of the skeletal population. Although caution must be exercised when interpreting metacarpal length, we believe these data provide valuable biological information regarding isolated appendages associated with prehistoric interpersonal violence in the bioarchaeological record in the Central Illinois River Valley.

Strong deviations from the priority-of-access model in Barbary macaques (*Macaca sylvanus*): the influence of female behavior and male-male coalitions.

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The priority-of -access model (Altmann 1962) posits that when only one female is attractive only the alpha male will mate with her; when two females are attractive the alpha and the beta males will mate, and so on. We used mating data (1) to provide the first formal test of the priority-of-access model in Barbary macaques and (2) to investigate the factors influencing male mating success. The study was conducted during the mating season 2006/07 at Affenberg Salem (Germany) and focused on one large group of semi-free ranging animals. Focal follows of males and attractive females were performed by two observers, and detailed behavioral data on agonistic and sexual behaviors were collected. The quantitative fit of the priority-of-access model to the observed data was poor. The alpha male obtained only 20% of the matings, while the expected value was around 50%. Low-ranking males obtained some proportion of the matings, while the model predicted no mating access for these males. We tentatively suggest that the low mating skew was mainly brought about by an interaction between male and female mating strategies. On the one hand, older, subdominant males used coalitions as an effective way to marginalize younger, higher-ranking competitors during the mating season. On the other hand, females actively sought younger males and were more likely to initiate consorts with them, thus counter-balancing the effect of coalitions. The contributions of this study to a better understanding of the mating system of Barbary macaques are explained.

Finger and Palmer Dermatoglyphics on β Thalassemia Patients visiting two Hospitals in Siliguri, West Bengal, India.

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Objectives: Association of some dermatoglyphic pattern with β Thalassemia found to be significant by scholars. The present paper intends to identify finger and palmer dermatoglyphics of β Thalassemia patient compared to control.
Methods: Data were collected from 30 patients (16 male, 14 female) visiting two hospitals of Siliguri, West Bengal, India, by Ink method and using roll print. Controls were 30 people of same sex, region and community.
Results and Discussion: The patients of β Thalassemia had more often prevalence of 11, 9, 7- and 9, 7, 5, - main line formula than others, thenar area is characterized by more pattern. Frequency of whorls and loops are higher than control, though statistically not significant. Regarding other characters the differences are too

little for any statistical consideration.

Great ape and human phylogeny.

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The evolutionary relationships of extant great apes and humans have been largely resolved by molecular studies, yet morphology-based phylogenetic analyses continue to provide conflicting results. Measuring phylogenetic accuracy as bootstrap clade support for accepted molecular relationships we analyzed two quantitative datasets, one consisting of linear measurements of the whole skull from five hominoid genera and the second consisting of 3D landmark data from the temporal bone of four great ape and human genera including nine sub-species. Using similar protocols for both datasets we were able to 1) compare distance-based phylogenetic methods to cladistic parsimony of quantitative data converted into discrete character states, 2) vary outgroup choice to observe its effect on phylogenetic inference, and 3) analyze male and female data separately to observe the effect of sexual dimorphism on phylogenies. Our results were varied, with some being congruent and others incongruent with molecular clades. Phylogenetic analysis was particularly sensitive to outgroup selection, where designation of *Pongo* as outgroup and removal of *Hylobates* resulted in greater phylogenetic accuracy. In addition, the performance of distance-based methods justifies their use in phylogenetic analysis of morphological data. It is clear from our analyses that hominoid phylogenetics ought not to be used as an example of conflict between morphological and molecular data, but as an example of how outgroup and methodological choices can affect the outcome of phylogenetic analyses.

Qualitative and quantitative analyses of the Holocene Khoesan dentition.

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Dental analyses of the Holocene Khoesan populations of Southern Africa provide insight into the biological evolution of an anthropologically important people. Here, we present results on qualitative and quantitative dental analyses of this Sub-Saharan African group, including an intensive focus on Early Holocene material. Metric and non-metric data were collected from >650 adult Khoesan individuals. To place Khoesan dental morphology in context, data were also collected from a comparative Holocene African collection. Depending on preservation and wear, both standard and cervical dental measurements were taken on all teeth. Qualitative traits were also assessed for the permanent dentition using scoring procedures for key morphological traits, as outlined in the Arizona State University dental anthropology system. Metric data analyses indicate that tooth size fluctuations generally conform to the mid- to late Holocene size variations observed in other studies of cranial and post-cranial material. However, apparent tooth size fluctuations during the Early Holocene are also observed, and while these may coincide with notable climatic changes during this period, sample size constraints make firm conclusions difficult. In contrast, qualitative trait variation remains fairly constant throughout the last 12,000 years. Although differences in trait frequencies among Southern African populations do exist, there is no evidence for unique trait variation in any population, suggesting that population differences result from intrinsic factors affecting the populations, such as environmental and geographic variation, rather than gene flow from outlying areas. Taken together, these results support recent hypotheses of morphological and genetic continuity in Southern African populations during the Holocene.

Waddling and toddling: biomechanical effects of an immature gait.

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Cowgill (2008) has recently reported a distinct difference between young children and adults in the orientation of maximum bending strength of the femoral shaft. In adults, maximum bending strength is oriented anteroposteriorly while in children under the age of six, it is mediolateraly oriented. Immaturity in bipedal gait related to the lack of development of a valgus angle and a relatively abducted leg may provide an explanation for the observed differences in cross-sectional shape. We hypothesize that the observed shape pattern in children results from higher mediolateral ground reaction forces experienced during locomotion, increasing bending moments about the femoral diaphysis. To test this hypothesis, force plate data was collected on nine children between 19 months and 8 years of age, and six adults between 18 and 35. A ratio of maximum mediolateral to maximum vertical forces (ML/V) was calculated for each subject, and mediolateral force trace patterns were observed. The mean ML/V ratio for children in this sample is 0.10 (standard deviation = 0.026), while the mean ratio for adults is 0.055 (standard deviation = 0.017). This difference is statistically significant (p-value = 0.003). Force traces indicate a consistent double peaked pattern of mediolateral ground reaction forces in the adults, but the children are much more variable. These results suggest that the observed pattern of femoral

cross-sectional geometry in young children may be the result of differential biomechanical loading as gait patterns develop towards maturity.

Differing strategies to problems of seasonality in *Indri indri* and *Propithecus diadema* in Mantadia National Park, Madagascar.

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Seasonality has long been known to affect the activity patterns of primates and this effect has been shown to be especially distinct in the highly seasonal environment of Madagascar. Seasonal behaviour is linked to day length, ambient temperature, humidity, precipitation and food abundance. Primate species often exhibit an 'energy minimising' strategy, resting more during cold weather when food resources are scarce, allowing considerable energy to be saved.
A field study was conducted at Mantadia National Park, Madagascar from November 2004 to October 2005. One group each of *Indri indri* and *Propithecus diadema* were habituated and followed; over 170 hours of activity-pattern data was collected for each species using focal animal sampling. *I. indri* and *P. diadema* were found to be diurnal, their active period lying between sunrise and sunset. Duration of feeding did not alter between seasons in *I. indri*, but duration of rest and travel was lower in the austral winter. Rest and travel duration in *P. diadema* was lower in winter but feeding duration greater. Thus, *I. indri* and *P. diadema* appear to have very different activity strategies. *I. indri* maintain a lower quality diet all year, and survive the colder winter months by decreasing their overall period of activity, and thus travelling less. *P. diadema* maintain a higher quality diet, so that during colder winter months they have to spend longer feeding and more time resting; equally serving to aid digestion of lower quality foods and to save energy.

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Growing as cheirogaleids: life history and age-related differences between eastern mouse and dwarf lemurs.

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The Cheirogaleidae is comprised of small-bodied nocturnal lemurs, including some of the smallest primates (*Microcebus* spp.) and the only primates to undergo hibernation (*Cheirogaleus* spp.). On the basis of research conducted in captivity, researchers have described mouse and dwarf lemurs as having comparable ages at first reproduction, gestation lengths and sexual behaviors. In contrast, studies of wild populations suggest remarkable differences in their growth and reproductive parameters. Much remains to be learned about ontogenetic correlates of life history variation in cheirogaleids. We present field data from two eastern cheirogaleid populations, mouse lemurs from Ranomafana National Park and dwarf lemurs from Tsinjoarivo forest, and we compare their growth, developmental and reproductive profiles. Mouse lemurs achieve adult body size during their first year (although first-year cohort females may have lower body masses at the beginning of the reproductive season) and they can reproduce during their first reproductive season (although first-year cohort females may be more prone to abortions or perinatal death of offspring). Females older than 5 years (and perhaps as old as 8 or 9) still display evidence of normal estrus, pregnancy and lactation. Wild dwarf lemurs begin reproducing at a later age (~3 for females). Immature individuals experience retarded growth and development (including dental development) during hibernation, and adult body size is not attained until the second year. This very slow pace of life more closely resembles that of much larger-bodied lemurs than that of their small-bodied but closer relatives.
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Evolution and human behavior: perspectives from human behavioral ecology.

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Human behavioral ecologists tend to rely on two fundamental assumptions about the nature of the relationship between natural selection and behavior: 1) that selection acts at the level of the individual, and 2) that behavioral variability is the product not of environmentally correlated genetic variation, but of extreme phenotypic plasticity. Under these two assumptions, culture exists not as an independent entity, but as one that emerges from the historical process of individual agents responding flexibly to tradeoffs, opportunities, and constraints encountered within social and natural environments. This suggests that the effect of evolutionary forces on culture is likely to be remote at best. Instead of acting directly on "culture", evolutionary forces shape the capacity for behavioral plasticity. This behavioral plasticity allows for adaptive learning and decision-making by individuals facing particular social and environmental opportunities and tradeoffs. Similarities in constraints and tradeoffs within particular environmental contexts ultimately produce consistencies in behavior that converge to form large-scale patterns that we recognize as "culture". These patterns in turn provide new opportunities and constraints to future decision-making strategies. To illustrate this notion, I draw the analogy between

culture and anthropogenic fire mosaics in the Western Desert of Australia. The resulting mosaic increases the long-term productivity of key resources, but the mosaic itself is not the product of selection. Rather, the mosaic is an emergent phenomenon, formed by the cumulative process of individual agents attempting to increase their hunting returns while pursuing small game.

How sexual dimorphism and kinematics interact to impact cost over variable terrain.

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The terrain on which humans walk is key to understanding human locomotory strategies, as is the possibility of differential mobility strategies based on sexual dimorphism. While level walking has been extensively studied, and variable terrain and sex differences have been investigated to some degree, the interactions between kinematics and anthropometrics have not yet been greatly considered. Thus, this study aims to investigate the interactive effects of posture, morphology and terrain on the energetics of walking. Metabolic and whole body kinematic data were collected on subjects (N=10, 5 males and 5 females) walking on the level, as well as on two inclines (5º and 8º). All participants repeated the protocol with different randomized orders on 4 different days.
Females show a different pattern of increased cost in relation to increased incline. On the level surface, body mass, sex and the interaction between body mass and sex are all significant ($p<0.01$); however, as incline increases, sex and the sex*body mass interaction get less significant (sex, $p=0.098$ and sex*body mass, $p=0.068$ at 8°). This means that the significant differences between cost versus body mass curves of males and females on the level become non-significant as incline increases, despite most size differences illustrating smaller female measures ($p \approx 0.05$-0.07). The data indicate that females are working harder than males (increased forward body tilt, increased vertical excursion of the center of mass, and increased stride length) so females' smaller mass becomes less advantageous in terms of total energy expended when walking up even slight inclines.

Female age of first reproduction at Cayo Santiago: heritability and shared environments.

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Sexual maturation is a major transition in mammalian life histories including relatively long-lived, late-maturing primates. Age of first reproduction (AFR) in female primates is widely documented to vary among population members and to correlate with population density and social dominance. Research with Cayo Santiago macaques was among the first to identify these patterns.
While explanations for variation in female AFR have centered around priority of access to limited resources and avoidance of stress, less attention has been drawn to potential genetic variation for AFR. Furthermore, the "dual inheritance" of genes and dominance rank in nepotistic female macaques implies these effects may be confounded. Several approaches to estimating the heritability of AFR indicate it is small (0.2) but significantly greater than zero. Systematic variation in heritability estimates among these methods and the analysis of predicted breeding values (PBVs) also implicate modest shared environmental effects that contribute to resemblance among relatives. However, unexplained residual variance still accounts for the majority of phenotypic variation. Lack of any rank-related trend in PBVs for AFR implicates common or residual environmental effects as the primary causes of rank-related variation in AFR.
These results emphasize the importance of the environment shared and provided by relatives (kin or maternal effects) in affecting female maturation, their potential role in the evolution of plasticity in primate behavior and life history traits, and the value of quantitative genetic information in describing those effects.
Research supported by University of Illinois Graduate College and University of Missouri. Cayo Santiago and the Caribbean Primate Research Center (CPRC) are supported by the University of Puerto Rico and National Institutes of Health (NIH). The genetic database of paternities was used in this research under agreement with its creators who were funded by National Science Foundation, Guggenheim Foundation, University of Berlin, Deutsche Forschungmeinschaft, Medisinzische Hochscule Hannover, NIH and CPRC.

An estimated demographic profile of fisherman-foragers (Cabeçuda, Lagoa do Imaruí, Laguna, Santa Catarina, Brazil, 2670+- 300 calBP), using TCA technique for aging and paleodemographic estimators.

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An estimate of the age-at-death distribution of a sample of 64 Skeletons of a shell-midden of fisherman-gatherers (Cabeçuda, levels 2-3 meters, dated 2670±300 calBP), has been obtained, using the TCA technique for the individual age estimates of adults (≥20 years). Among the adults, there are two mortality modes, at 20-29 years (lowest) and 40-49 years (highest). The growth rate obtained by the paleodemographic estimators, from the proportion of the individuals aged 5-19 years, relative to 5 years+ ($15p5$) is $r=0.01243 \pm 0.01068$ (CI95%). If the TCA technique is true, this one

of the first demographic sample from a distribution of a fisherman-gatherers population in South America.

Childhood health in Anglo-Saxon Britain: evidence from the Christian cemetery population of Church End, Cherry Hinton, Cambridgeshire.

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Church End, Cherry Hinton is a Saxon Christian cemetery dated to approximately the 8th-10th centuries. Located southeast of the outskirts of present day Cambridge the cemetery yielded nearly 700 remains. My analysis focuses on health and growth parameters in 201 juveniles (newborn-15 yrs.) from the site. Individuals in the study were inventoried and aged using standard osteological methods. Additionally, all remains were assessed for markers of stress, pathologies, and/or trauma. Although a number of conditions and diseases were evidenced in the studied remains, the most salient feature encountered was the high incidence of cribra orbitalia in children aged 1-15 yrs. (70%), followed by that of linear enamel hypoplasia in individuals over the age of 6 yrs.(44 %). Active cases of cribra were most commonly encountered in juveniles aged 4-7 yrs., while hypoplasia was only present in permanent teeth. Nonspecific infections were comparatively rare. The data suggest that juveniles from Cherry Hinton were particularly stressed during their early childhood years (2-7 yrs.) and that dietary insufficiencies are the most likely culprit. Growth, as indicated by discrepancies between dental and skeletal age, was also affected. Although not necessarily the immediate cause of death, it is hypothesized that death during childhood at this particular Saxon site was in all probability linked to dietary stress.

Size and scaling in the hominin brow.

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Adult supraorbital morphology is very distinctive in certain species of *Homo*, with aspects of supraorbital form often used as distinguishing criteria in definitions of hominin species. For example, variation in *H. erectus* supraorbital torus development has resulted in the placement of some specimens traditionally assigned to *H. erectus* into another species, *H. ergaster*. In addition, browridge development and frontal bone curvature are major morphological traits that are used to differentiate Neandertals from anatomically modern humans. However, such differences in hominin supraorbital form, often used to distinguish between different taxa, may actually be the result of small changes in size and shape during ontogeny.
Three-dimensional ontogenetic supraorbital data were collected from a sample of three hominin species (*H. erectus s.l.*, Neandertals, *H. sapiens*) and a comparative outgroup of chimpanzees (*P. troglodytes*). These data were then subjected to Generalized Procrustes Analysis (GPA) and Principal Components Analysis (PCA). Patterns of size and size-associated shape variation exposed by GPA and PCA were then further investigated through the use of standard bivariate allometry.
All three species of *Homo* follow a general hominin growth pattern not shared with the chimpanzee sample. Neandertals display much larger shape changes over a limited size range, in the form of anterior-posterior (A-P) browridge length and the degree of browridge projection at the region of glabella. This may suggest that Neandertals experience higher rates of growth in this region of the skull, with possible functional consequences for the selection of such rapid shape changes. In contrast, results indicate a juvenile *H. erectus* browridge morphology that is more adult-like in form, with a higher degree of browridge projection at glabella, longer A-P browridge lengths, and a greater degree of post-orbital constriction than either Neandertals or *H. sapiens* at a similar size.
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Savanna chimpanzee (*Pan troglodytes verus*) feeding ecology at Fongoli, Senegal.

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We examined the feeding ecology and behavior of Fongoli chimpanzees in southeastern Senegal from August 2006 to August 2007. Ecological variables include habitat composition, food resource availability, and the underlying ecological context of tool use behavior in particular. Approximately 900 hours of behavioral data were collected in conjunction with 15 hours of video data. The chimpanzees' 65 km² home range is a mosaic environment, composed of open (tall grass [47%] and short grass [21%] grassland, woodland [16%], bamboo thicket [10%], and fields [4%]) and closed habitats (forest ecotone [1%] and gallery forest [<1%]). Rainfall was 674mm during this study. Availability of fruits, insects, and animal prey varied with season and habitat type. Diet composition varied by month and season, but insects were eaten in all months. Termites are consumed all year by the chimpanzees, while ants were only consumed from June through August. Fongoli chimpanzees exploit two genera of ants (*Oecophylla* and *Dorylus*) and one species of termites (*Macrotermes subhyalinus*). Although fecal analyses indicates the diet composition as 74% seeds, 23.7% leaves and fiber, 1% termites, 1% flowers, and less than 1% ants and bees, behavioral data indicate a significant amount of time devoted to insect feeding (30% of time in

some months). Ecological data from this unique environment, along with behavioral observations, provides a more thorough understanding of the impact of a savanna habitat on the chimpanzees at Fongoli.
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Childhood, adolescence, grandmotherhood and the non-symmetrical, variant nature of human life history.

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Human life history evolution is characterized by the addition of childhood, adolescence, and grandmotherhood as biologically, behaviorally, and mathematically definable stages of the life cycle (Bogin and Smith 1996; Hawkes et al. 1998, 2003; Bogin 1999). Attempts have been made to accommodate human life history into a universal model. Currently, the most influential is Charnov's "Life History Invariant-Symmetry" Model (1991, 1993, 2001). It is the purpose of this paper to consider the impact of human childhood and adolescence on the application of the Charnov Model to the Grandmother Hypothesis (GH) of Hawkes et al. (1998). GH is based on a presumed invariant-symmetry that lower adult mortality results in a longer period of pre-adult growth and development. In contrast, the new analysis presented here indicates that the evolution of human childhood and adolescence, along with cooperative breeding, are responsible for a longer and slower phase of pre-reproductive growth. Specifically, it is found that the addition of childhood and adolescence changes the value for a key variable in the GH model, $\boldsymbol{\alpha M}$ (the period of independent growth x the adult instantaneous mortality rate). The new value is lower than that for the apes and indicates that it is not lower adult mortality that prolongs the period of growth and development. Rather, it is the building of a better body and the developing of greater biological, behavioral, and cultural resilience prior to sexual maturity that leads to greater adult health, fitness, and longevity compared with any other primate species.

The fertility/mortality discussion in paleodemography revisited.

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Recent development in age estimation has shown that it is possible to reach unbiased estimates of paleodemographic profiles based on Calibrated Expert Inference (CEI). These profiles can be characterized as mortality profiles – i.e. distributions of age at death in given skeletal samples. All kinds of demographic processes in the once living population can influence the distribution of age among those who died out of the community. Many paleodemographic samples consist of people who died out of specially selected communities like monasteries, poorhouse inmates, or armed forces. Other paleodemographic samples came out of communities with highly structured migrational imbalance like early urban communities that got lot of late adolescent and young adult immigrants.
No ancient community could maintain a high level of natural population growth or decline for a prolonged period of time and remain the same. This means that fertility differences leading to measurable changes in paleodemographic profiles can only be seen in skeletal samples accumulated over a short period of time and that most deviations from the stationary population assumption comes from other reasons than fertility. In paleodemographic analysis there is no way of escaping the hard work of understanding the community that ones skeletal sample died out of.

Mitochondrial DNA variation among ancient Adena populations from Kentucky.

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Anthropologists often assume that archaeological sites with similar cultural remains represent a single biological population, but cultural exchange can occur independently of gene flow. In this study, we evaluate how well this assumption applies to Adena sites (2500-1750 ybp) in the Ohio Valley. These sites are characterized by accretional burial mounds, circular ceremonial earthworks, and distinctive artifacts, but the biological composition of the populations who created them is unknown. Some anthropologists hypothesize a single widespread population connected via gene flow, whereas others suggest that Adena communities were more independent, with each burial mound being used by a single, genetically isolated population.
To test these hypotheses, we extracted DNA from the skeletal remains of 193 individuals, representing 17 Adena burial mounds in Kentucky. Mitochondrial DNA (mtDNA) haplogroups were assigned based on restriction fragment length polymorphisms and a 9-bp deletion. The first hypervariable segment (HVS I) was also sequenced in a subset of samples to determine mtDNA haplotypes and confirm haplogroup assignments. When considered altogether, Adena haplogroup frequencies were similar to those observed in other ancient and extant Native Americans from eastern North America. However, both haplogroup frequency distributions and haplotype networks indicated substantial variation among Adena burial mounds. These data provide some evidence of gene flow between sites, but genetic drift also played an important role in structuring the pattern of Adena mtDNA variation.

Regularities of growth patterns in wild catarrhines.

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Catarrhine primates represent a diverse group of monkeys and apes with a range of diets (folivore, frugivore, omnivore), and a variety of locomotor patterns (quadrupedalism, semi-to-full brachiation, quadrumanous climbing, fist and knuckle walking). Life history traits also vary from "fast" growing colobines to the "slow" maturing apes. This study tests the hypothesis that catarrhine species share a pattern of physical development despite differences in diet, locomotion and timing of growth. This sample consists of juvenile and adult females (to control for sex differences) from six species. All individuals were wild-collected from the same temporal-geographic population: 26 *Cercopithecus aethiops* (11 juvenile and 15 adults) from Uganda; 8 *Papio hamadryas* (6 juveniles and 2 adults) from Ethiopia; 15 *Nasalis larvatus* (7 juveniles and 8 adults) from Borneo; 49 *Hylobates lar* (21 juveniles and 28 adults) from Thailand; 7 *Pongo pygmaeus* (4 juveniles and 3 adults) from Borneo; and 20 *Pan troglodytes* (9 juveniles and 11 adults) from Ivory Coast. Measurements were taken of the cranium (bizygomatic breadth, length, capacity), limbs (humerus, femur, hand, foot lengths), trunk (height, chest circumference, chest breadth, clavicular length, scapular length), pelvic girdle (innominate length, iliac breadth), and overall body mass (except for *Pan troglodytes*). Juvenile values were compared to the adults. Results indicate that catarrhines follow a broadly similar order of growth in body regions, with cranial dimensions maturing first, followed by the limbs, trunk, pelvis then body mass. Subtle variations within each region may offer insight into each species' particular locomotor adaptation.

Friend or foe: Heads as memorials and status symbols in the Torres Strait Islands.

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The Torres Strait Islands are one of few regions where both head-hunting and the removal of heads as part of normal funerary ritual co-incide. Basic treatment of the heads after removal is similar (including decoration with red ochre and the modelling of facial features), so it is difficult to distinguish between trophy heads and those of tribal ancestors within museum collections.
The method of head removal is dependent on a number of factors. Tribes of the Western islands left bodies of relatives to decompose on platforms until the head could readily be removed without the use of any tools. The bodies of higher status individuals from tribes of the Eastern islands underwent a process of mummification before being put on public display in the villages. When these mummies began to disintegrate, the head was cut off. On head hunting raids, tribes of islands in both areas would remove the heads of victims by cutting through the mouth toward the back of the neck. Parts of the face including the eyes and cheeks were sometimes eaten, in the belief that this would impart bravery on the warrior.
This study aims to determine if the cut marks from these practices can be observed, and if they can differentiate between trophy heads and those of ancestors.
Cut marks and peri-mortem damage were observed predominantly on the mandible and facial bones of the well-provenanced trophy heads and these cuts followed similar patterns. No evidence of peri-mortem decapitation damage was observed on the cranial base.

A metric for covariance matrices in the context of evo-devo studies.

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To help bring the modern evo-devo spirit into quantitative human paleobiology we need to be able to study growth and evolution in a conjoint biometric context. Because evolution is visualized in general by trends, such as trends in neurocranial shape or form, we need a method for visualizing the corresponding changes in developmental covariance, the raw material of selection. When data come in the form of arbitrarily many Procrustes shape coordinates, this requires a method for the ordination of multiple covariance matrices of a large size. Current approaches by way of principal components or factor analysis do not supply adequate visualizations. We propose a new approach to this biometric problem that adapts one classic mathematical approach, the Riemannian geometry of the positive-definite symmetric matrices. The construction, which is mathematically unique, is at root a matrix generalization of the familiar slide rule, the machine that converts multiplication into addition. We explain this metric and the ordinations it generates, and then apply it to two much-published classic data sets of interest to anthropologists and human biologists: the Vilmann rat neurocranial data and the Denver Growth Study of human children. The relation between covariance structures takes the form of a different factor model between each pair of changes of growth stage. That phenotypic variance fluctuates in this systematic way bears implications for the heritable component of age-specific selection and thereby for actual quantification of evo-devo theories of human evolution.
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Separating interventions during agonistic and affliative dyadic encounters by captive male and female bonobos.

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In some species of primates, individuals exhibit coalition-building behaviors that may function in dominance rank acquisition. For example, it has been suggested that adult female bonobos employ this behavior as a strategy to dominate males. Conversely, in species such as chimpanzees and capuchins, males employ 'separating interventions' to prevent the formation of coalitions among rivals. In bonobos, few studies have explored whether males or females intervene in either aggressive conflicts or affiliative dyadic encounters to prevent coalition formation. Using 50 hours of observation on 12 bonobos at the Columbus Zoo, we examined the context and relative frequency of intra- and intersexual separating interventions. Preliminary analysis suggests that females frequently intervene during male-male conflict and their behavior, typically affiliative toward one of the males, temporarily halts conflict. Because interventions are most commonly conducted by juvenile females who have not established their rank positions, these behaviors might function in intersexual dominance maintenance. Conversely, adult males rarely intervene during male-male aggression, but frequently perform separating interventions during male-female affiliative encounters. Such disruptions frequently result in mild aggression between the males. Based on the social status of the targets and the rank position changes that have resulted, we hypothesize that these interventions function to restrict social bond formation by other males. Despite female dominance of males and the peaceful reputation of bonobos, results like ours are beginning to suggest that males are not passive. Rather, they probably use subtle social-striving strategies to acquire rank status.

Growth and development in a Peruvian archaeological sample.

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The Andean, Late Intermediate Period (AD 1000-1300), Chiribaya polity located in the Osmore Drainage of Southern Peru consisted of economically specialized groups. Sites including San Gerónimo, Chiribaya Alta, Algodonal and El Yaral, are distributed to maximize use of available resources from marine to agricultural and include domestic and mortuary components. A significant number of the mortuary remains include subadults assigned to broad age categories (under ten or ten to twenty-five years) using macroscopic methods. Histological aging methods based on osteon density (#/mm^2) are suitable for adults but in the bones of subadults there is a poor correlation between osteon density and age. The Streeter method, developed on a modern population, describes four distinct developmental phases characterizing subadult rib micromorphology. The goals of this study were two fold, first a more precise age estimation of the Chiribaya subadults and secondly to verify that the Chiribaya subadults experienced the same sequence of developmental stages as recorded in the modern sample.

Eye of the beholder: Variable color vision in wild lemur populations.

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Despite the general acceptance that natural selection has shaped animal morphology and behavior via alterations in the genotype, there are surprisingly few cases where specific genetic changes are known to modify phenotypes in a way that demonstrably increases fitness. Primate color vision presents a superb system to investigate the relationship between genetic variation and adaptation in the wild because variation in color vision status is largely determined by a few variable sites in a single gene, the X-linked opsin. In general, all Old World monkeys, apes and humans have full, trichromatic color vision. In New World monkeys, however, color vision in polymorphic: males and some females are red-green color blind, but other females have full trichromatic color vision. Less is known about the color vision of lemurs, although studies of a few captive individuals have shown that at least some species are polymorphic. We have conducted the first broad survey of color vision in wild lemurs by sequencing the X-linked opsin gene from over 350 individuals at 15 study sites. This includes 18 lemur (sub)species representing 7 genera sampled throughout Madagascar. We found that many, but not all, diurnal lemur populations have polymorphic color vision similar to that of New World monkeys. However, our results also indicate that color vision status is variable across lemur populations and this variability likely reflects extensive local adaptation.

Important variations in dental trait expression at the EDJ throughout an *Australopithecus*

***africanus* entire postcanine dentition.**

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Advances in micro-computed tomography (micro-ct) and computer-aided tools for three-dimensional (3D) analyses recently allowed studies of morphological variations of the 3D enamel-dentine junction (3D-EDJ) in primate lower molars. However, the elucidation of the taxonomic value of the 3D-EDJ in early hominids is still bristled with difficulties because inter-specific differences among early hominids are investigated in specimens which do not preserve diagnostic craniofacial features or in isolated teeth which position along the molar row is questionable.
In order to contribute to the identification of taxonomically relevant 3D-EDJ data in early hominid, we examine through micro-CT, the postcanine morphological features of the 3D-EDJ throughout all four quadrants of one of the most complete *Australopithecus africanus* specimen ever found (Sts 52, Sterkfontein, South Africa). We investigate (i) the differences in expression of traits between teeth of the same type (molars or premolars) and within each postcanine row (intra-individual metameric variations); (ii) the differences between antimeres (iii) the intra-individual inter-trait associations. When necessary, differences are quantified by using rigid registration methods.
Results show important intra-individual metameric variations within each four quadrants, for both premolars and molars. Stability in trait expression is higher in the upper dental arcade. Moreover, the morphology of an EDJ on one side of a postcanine row is not necessarily matched by its equivalent on the other side. We discuss the genetic or functional basis of these observed variations and the potential implications of our results for the identification of inter-specific differences among early hominids.
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Slow bone turnover rates in prehistoric skeletal samples: supporting evidence for the impact of pellagra on maize-dependent populations.

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In previous reports we discussed our findings related to rib microanatomy and age-at-death of individuals known to have died from pellagra. This was based on South African skeletal samples taken from the Raymond Dart Autopsy Collection. We detailed the fact that 100% of this sample showed extremely slow bone turnover rates associated with pellagra, represented by low Osteon Population Density (OPD) for known age-at-death. With this established relationship we offer alternative explanations that connect dietary deficiencies to low OPD rates in past populations.
Compelling data to support our position is derived from two archaeological collections from the lower Illinois Valley region; the Middle Woodland Gibson Site and the terminal Late Woodland Ledders Site. There is considerable evidence for slow bone turnover rates in these archaeological samples that can reasonably be linked to dietary stress. Eighty-six percent of the individuals from the Gibson site sample exhibited less OPD than expected for their osteological age [mean OPD = 19.94, n = 22], while 66.7% of the individuals from the Ledders site sample exhibited less OPD than expected for their osteological age [mean OPD =20.28, n = 15].
This paper will also address critiques made recently by Stout (2008) concerning the need for having a comparative sample of healthy individuals from the Dart Collection to support our findings. Overall, we argue against long-held interpretations for various metabolic disorders (secondary hyperparathyroidism, porotic hyperostosis, etc.) and suggest that the overall synthesis of our findings offers new insights into skeletal-based interpretations linking pellagra to maize-dependent populations.
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Socio-culturally mediated disease: rickets and scurvy.

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Scurvy (caused by vitamin-C deficiency) and rickets (caused by vitamin-D deficiency) are strongly linked to social and cultural variables within a society. Vitamin C is obtained from the diet, and synthesis of vitamin D is dependent on exposure of skin to ultraviolet rays, or less frequently dietary intake - linking deficiency to factors such as clothing, housing type, outdoor activity and diet. Although many of the osseous changes seen in scurvy superficially resemble those of rickets, scurvy typically results in hemorrhage producing porosity, and new bone formation once vitamin C is obtained. Rickets, in contrast, results in the cupping of the growth plate and bowing of lower and occasionally upper limb bones in children, with possible new bone formation on the cranial bones.

The large size and broad spatial-temporal coverage of the Global History of Health Project European skeletal sample provides an unprecedented opportunity to study the history of these conditions in Europe. Lesions suggestive of scurvy were identified in 1.37% of the individuals analyzed (n=10,724) and signs of rickets (active and healed) in 1.40% of these burials. Twenty-nine individuals show signs of both conditions.

There is significant temporal variation in the presence of signs of these conditions. For both scurvy and rickets the frequency of suggestive lesions steadily increases from Classical Antiquity to the High Middle Ages and then declines significantly ($p<0.0001$) during the Late Middle Ages. An interesting finding is that the prevalence of both conditions is lower in environments with low primary productivity indices.

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Divergence of human and chimpanzee chemokine receptor structure: 3Dimensional (3D) modeling of HIV-1 co-receptors.

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Chimpanzee and human immune responses to immunodeficiency viruses (IV) strongly differ in late stages of infection, with chimpanzees typically not advancing to AIDS as humans typically do. Chemokine receptors CC-motif receptor 3 (CCR3) and CX3C motif receptor 1 (CXC3CR1) are know to interact with IVs and receptor variants of CX3CR1 are linked to delayed and rapid AIDS progression in humans. Given the divergence in disease progression in these species, this study examined CCR3 and CXC3R1 for 3D structural variations in these species. Comparisons of published CCR3 and CX3CR1 isoforms revealed divergent amino acids in these species. Chimpanzee sequences did not contain the residues presumed to effect human AIDS progression. As previously reported, five interspecies residue differences in CX3CR1 were found in the domains likely to interact with the virus (extracellular) and initiate cell signaling (cytoplasmic). These were assessed to lead to major protein 3D structural changes. Newly refined models of these receptors are presented here. Receptors were modeled in 3D using threading and homology-based programs (Fugue, 123D+, Modeller v. 9.3 and i-TASSER) with Beta-2 adrenergic G-coupled protein receptor as the primary template. Models were verified with 3D verify and energy profiles (Anolea). Functional studies of receptor/virus interaction are to completed. This study concludes that chimpanzee and human CX3CR1 have evolved significantly different cytoplasmic and extracellular structure. These results raise further questions about the role of CX3CR1 in divergence of chimpanzee and human immune response to immunodeficiency viruses.

Noninvasive assessment of dioxin exposure in *Pygathrix* at the Endangered Primate Rescue Center, Cuc Phuong National Park, Vietnam.

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Humans residing in "dioxin hotspots" of Vietnam have markedly elevated serum dioxin (TCDD) levels but no comparable data exist on mammals residing in those areas, including primates. The long-term goal of this research is to assess the potential role of TCDD in the health of endangered primates inhabiting "dioxin hotspots," in southern Vietnam. This study examined the utility of fecal dioxin (fTCDD) enzyme immunoassays for quantifying dioxin in douc langurs (*Pygathrix)* housed at the Endangered Primate Rescue Center, Cuc Phuong National Park, Vietnam. Analyses were based on a total of 22 fecal samples collected from 4 and 18 *Pygathrix* primates from known capture locations north and south of the demilitarized zone, respectively. An fTCDD enzyme immunoassay was previously validated and found to reliably detect 2,3,7,8,-TCDD in *Pygathrix* feces. Fecal TCDD associations with geographic location, species, residence time, sex, and age were tested. FTCDD enzyme immunoassay procedures yielded variable levels of dioxin, ranging from non-detectable to 21.0 pg/g. Results of linear regression analysis showed that fTCDD levels were unrelated to geographic location, species, residence time or sex. FTCDD levels were, however, linked to age, juveniles exhibiting significantly elevated mean fTCDD levels over those observed in adults from central and southern Vietnam. Age-related patterns of TCDD excretion are interpreted in the context of possible developmental biomarkers of dioxin toxicity in some adult members of this population. The importance of this research resides in identifying TCDD-exposed primate populations for immediate protection and possible remediation through the establishment of "Species Conservation Areas." Financial support was provided by the Conservation International Primate Action Fund (DKB).

Mimosa: a new Middle Stone Age fossil locality in the Free State of South Africa.

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The Middle Stone Age (MSA) of South Africa has become an increasingly important focus of research into the origins of modern humans. However, our understanding of the environments occupied by MSA humans in South Africa is presently hampered by a lack of non-coastal sites dating to this time frame, in particular sites with good faunal preservation. Mimosa is a recently discovered locality in the Free State of South Africa, situated within a donga system that drains into the modern Vet River. Initial surface collections in 2007 and 2008 revealed a relatively diverse fauna indicating a predominantly grassland environment that was moister and more wooded than at present. Of particular interest is the discovery of the earliest extant giraffe remains in the fossil record of the Free State. Taphonomic indicators point to carnivores, perhaps hyaenas, as the principal bone accumulating agents. Although no human fossils have been recovered to date, the presence of MSA tools in the immediate vicinity of this locality demonstrates a human presence in the area during the MSA. Preliminary dating of the site using associated ostrich eggshell thickness indicates an age in excess of 60-80 Ka. In South Africa, the transition from Cornelian (ESA) to Florisian (MSA) to modern mammalian faunas reflects a trend of increasing aridification, with a concomitant disruption of ancient ecosystems. Mimosa allows us to investigate not only the paleoenvironment of the Free State during this important period, but also the impact that environmental change might have had on large mammal (including human) populations over time.

Energy expenditure and body composition in a multiethnic sample of school children in Hawaii.

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Data are being collected to describe rates of obesity in school children in Hawaii and examine some related factors. A multiethnic sample of children (N = 105) in Kindergarten and third grade underwent an anthropometric battery and air displacement plethysmography; performed a graded treadmill exercise test while pulse, VO_2 and VCO_2 were measured; and provided blood for glucose and lipid analysis. Children wore a Polarus telemetry unit for two days: one school day and one non-school day, during which pulse was recorded each minute between 8 AM and 8 PM. Energy expenditure (EE) was computed from the linear relation between pulse and VO_2, and the percentage of time the child was inactive (PTI) was derived from time when their pulse was $\leq$ their Flex heart rate, defined as the midpoint between pulse while standing and while doing the lowest level of treadmill activity. Mean EE was not significantly related to BMI, percentage body fat as computed from the plethymography measurements, blood lipids, glucose, nor with the sum of six skinfolds. PTI was significantly correlated with total cholesterol ($r=0.27$, $p < 0.05$), LDL ($r=0.32$, $p < 0.05$), glucose ($r=0.34$, $p < 0.01$) and to sum of six skinfolds ($r=0.25$, $p < 0.05$) but not to BMI or percentage body fat. Native Hawaiian ethnicity was significantly related to elevated EE but not significantly related to PTI. While these results are preliminary, they demonstrate the importance of examining patterns of physical activity in relation to health risks in an ethnically diverse community.
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Quantifying sexual dimorphism of the pelvic inlet.

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Sexual dimorphism of the modern human pelvis has been attributed to obstetrical adaptations in females. Specifically, the size of the pelvic inlet has to accommodate the passage of a fetal head. Previous research on pelvic shape has relied primarily on linear measurements and univariate measures (e.g., pelvic inlet index). However, these methods are not always sufficient to distinguish different samples. This study quantifies shape of the pelvic inlet using a new approach based on 3D geometric morphometrics.
Pelves of age-matched American black males and females from the Terry Collection at the Smithsonian Institution were assembled for digitization (N=20,20). The entire pelvic inlet was landmarked in multiple trials with an autoscan interval of 2 mm using a MicroScribe G2 digitizer. Landmarks at articulations were fixed, the remaining curves were re-sampled, and multiple trials were averaged. Sexual dimorphism was quantified using Procrustes superimposition followed by PCA.
The pelvic inlet index was unable to distinguish the sexes ($p=0.64$). However, the morphometric approach clearly distinguished between males and females ($p<0.001$). While medio-lateral widening contributed most to the observed variation among all individuals, it failed to discriminate the sexes well, suggesting that both sexes are relatively narrow in pelvic breadth. The projection of the sacral promontory and the height of the promontory relative to the linea terminalis distinguished the sexes the most. These results suggest that because both black males and females have relatively narrow pelvic inlets, the females may exhibit compensatory morphological measures to maintain adequate obstetric dimensions.

Craniofacial evolution in Polynesia: A geometric morphometric study of population diversity.

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The settlement of Polynesia was one of the most recent major migration events by humans, occurring within the last 3,000 years. Previous research suggested that morphologically, the present day inhabitants of Polynesia are a relatively homogenous group when compared with other Oceanic populations. A likely explanation for the high degree of biological homogeneity is that the parental population from which all Polynesian groups derive went through a series of 'bottlenecks' during Oceanic settlement. After initial settlement, Polynesian islands were also geographically isolated and some islands remained free from outside interaction until European contact centuries later. This study uses geometric morphometric techniques to examine morphological diversity within Polynesian samples in order to discern aspects of craniofacial evolution. Patterns of diversity within Polynesian samples are compared with those from proposed founding populations of Southeast Asia and Melanesia. The morphological data confirms a homogenous Polynesian grouping in relation to possible founding populations. Although overall distinct from these populations, however, the Polynesian samples are not homogenous as a group. Diversification between the Polynesian samples is likely caused by a series of founder effects followed by isolation. A significant correlation between morphological and geographical distances illustrates that isolation by distance is important in creating the patterns of morphological diversity found in these samples. It is demonstrated that even when only a short period of separation has occurred, founder effect, followed by isolation and genetic drift can significantly influence the craniofacial morphology of differing populations.

Magnitude of change in energy balance and duration of lactational amenorrhea among Toba women of northern Argentina.

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Ovarian function is not an all or nothing event triggered by a threshold value of energy availability, but rather falls along a continuum that reflects the optimum allocation of energy to the processes of growth, maintenance, and reproduction. The metabolic load hypothesis views individual variation in the length of postpartum subfecundity as a difference in the relative cost of lactation for women with different energy balances. Under this framework, we predicted that women with different lengths of lactational amenorrhea would show different patterns of changes in body mass index (BMI) during the postpartum period. Monthly BMI data was collected from 70 lactating Toba women, and monthly urine samples were assayed for c-peptide and estrogen and progesterone metabolites. Women who resumed meses early (3-6 month), intermediate (7-11 months), and late (12-18 months) were grouped separately and the percent changes in BMI from month to month were calculated for each group. Results indicate that women with a short duration of lactational amenhorrea tend to show a steeper increase in BMI one month prior to the resumption of menstruation (a change of 2.6% in one month) than women with long periods of lactational amenorrhea, who show a slow rate of increase for several months before the return to menses (an average of 0.88% during the 5 months prior to resumption). Thus, the return to postpartum fecundity

seems to respond not only to a change in energy balance but also to the magnitude of that change over time.

Genetic data suggest the kipunji mangabey (*Rungwecebus kipunji*) is hybrid in origin.

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Common baboons (*Papio*) and baboon-mangabeys (*Lophocebus*) are closely related papionin primates more terrestrial or arboreal, respectively, in their habits and adaptations. In 2005, the species *Lophocebus kipunji* was described from relict montane and submontane forests in Tanzania based upon a single specimen and observations of living animals. Its initial assignment to *Lophocebus* was based on its overall morphology, but subsequent genetic studies suggesting that it was sister taxon to common baboons (*Papio*) led to its generic separation, as *Rungwecebus*. Here we present mitochondrial and nuclear genetic phylogenies from African papionins including *Papio* baboons from populations geographically close to the kipunji. Rather than supporting sister-taxon status, the mitochondrial phylogeny not only situates the kipunji's mtDNA among *Papio* haplotypes, it clearly assigns it to a mitochondrial clade including geographically adjacent yellow baboons (*Papio cynocephalus*). The nuclear data are more ambiguous, but tend to associate the kipunji with *Papio* rather than *Lophocebus*. This relationship suggests either that the kipunji is descended from a yellow baboon and has converged on a mangabey-like morphology, or, more likely, that it originated by hybridization between *Papio* cf. *cynocephalus* females and *Lophocebus* sp. males, about 0.65 Ma. This may be the first case among mammals in which a natural occurrence of inter-generic hybridization can be shown to have resulted in a new, distinct, long-surviving taxon.

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Galago exudate-acquisition: it's not about the toothcomb.

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Consumption of exudates is dependent upon acquiring exudates. Attaining this food depends upon wounding the tree bark or opening/licking an exudate drop to stimulate flow. It is clear that exudativorous marmosets gouge the bark with their anterior dentition but the acquisition method in galagos is not clearly understood. While it has been thought that galagos use the toothcomb to acquire exudates, this has been called into question. This study assesses dental morphometrics of galago species to understand morphological correlates of how they acquire exudates, typically gums from *Acacia*, and to more clearly understand use of the toothcomb. Cleaned and dried skulls from 152 galagos representing ten species were selected with varying percentages of exudates in their diets and included *Euoticus elegantulus, Otolemur crassicaudatus, O. garnettii, Galago senegalensis, G. braccatus* (= *G. s. braccatus*), *G. demidoff, G. moholi, G. gallarum, G. alleni*, and *G. zanzibaricus*. Two-dimensional measurements were taken from mandibular incisors, maxillary and mandibular canines, mandibular and maxillary premolars, and the last mandibular molar. One-way ANOVA's revealed few significant ($p<0.05$) differences in toothcomb morphometrics among species but significant differences were seen in the premolars and canines between exudativorous and non-exudativorous species. Additionally, the last mandibular molar was significantly smallest in exudativorous species. These results suggest that the toothcomb may not be the most important dental tool for exudate-acquisition among galagos and that the premolars and canines have a more important role than previously thought. Moreover, increased size of the last mandibular molar may have been selected against in exudativorous galagos.

Sign, Sign, Everywhere a Sign: High density haplotype maps of the dog, human, and cow genomes reveal extensive human reorganization of domesticated genomes.

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We have developed high-density SNP and Haplotype maps of the bovine, human, and domestic dog genomes. These maps came about through three separate efforts: (1) The CanMap Project which genotyped 1,000 dogs and wolves spanning 85 AKC registered breeds using the Affy 2.0 canine array (~127K SNPs), (2) The Bovine HapMap project which genotyped 25K SNPs on ~500 animals from two dozens breeds belonging to the two main subspecies of cattle (*Bos taurus* and *Bos indicus*), and (3) the GSK-POPRES project which documented SNP and haplotype variation across ~7,000 humans of diverse ethnic and geographic origin using Affy 500K human arrays.Comparing patterns across species we find several striking features: First, the domesticated species show genetic clustering of individuals within breeds before clustering between breeds. This clustering results in levels of relatedness on the order of (at least) first cousins for the most

"unrelated" animals from a breed. Secondly, while humans show a very high correlation at the megabase scale in estimated population recombination rates across subpopulations, cows and domestic dogs show a striking lack of correlation across breeds. Lastly, both dogs and cattle show pervasive signatures of recent selection using SNP and haplotype-based statistics. We also find that all breeds examined demonstrate high degrees of cryptic relatedness, even when close relatives are avoided at the time of sampling. This implies that great care must be taken in interpreting nominal and genome-wide corrected p-values in whole genome association mapping within domesticated species.

Oxygen isotope analysis of tooth enamel carbonate from the New Kingdom site of Tombos.

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The ancient site of Tombos, located in northern Sudan, was the location of an Egyptian colonial cemetery in Nubia used during the New Kingdom period. Originally thought to be only occupied by colonists, recent research using mortuary and craniometric data suggest, instead, that the population buried at this site was composed of both Egyptians and Nubians. Strontium isotope analyses of tooth enamel support the idea that both local and immigrant individuals were present. This study uses oxygen isotope analysis in order to further examine residential mobility of individuals buried at Tombos. A total of 33 tooth enamel carbonate samples were analyzed using standard procedures. Samples were prepared and analyzed at the Purdue Stable Isotope Facility.
The $\delta^{18}O_c$ values range from 29.2‰ to 35.3‰ relative to the V-SMOW standard, with an average value of 31.4‰. Although the range of values is not significantly larger than that reported for other ancient populations in the region, the distribution of values is highly skewed. The average value is similar to the samples from Gebelein, located near Thebes, the likely place of origin for Egyptian immigrants in Nubia during this time period, whereas three samples with particularly high $\delta^{18}O$ values (>33‰) are more similar to average values found further south in Nubia at Kulubnarti. Although both oxygen and strontium isotope data suggest the presence of local and non-local individuals, the values are non-concordant.
This research was funded by the College of Liberal Arts Research Incentive Grant from Purdue University (MRB).

Application of Portable X-Ray Fluorescence to determine relationships between individuals from an unknown graveyard based on strontium readings.

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The Jackson Street Burials were excavated in 1997 after being discovered during work on a construction site in Youngstown, NY. The eleven burials under investigation have no known history of which could either be deduced from the physical evidence or found in past burial records. The cemetery was used sometime between the late 18th century and before 1840, based on the artifact assemblage and the history of Fort Niagara, with which the individuals were most likely associated. The purpose of this study is gain insight into the identity of these unknown individuals, by using X-ray Fluorescence technology.
Bone chemistry can reveal much about an individual's life history. Certain trace elements give specific and pertinent information about environmental exposure, diet and geographical location of residence. X-Ray Fluorescence (XRF) is a nondestructive method for analysis of trace elements. Portable XRF instruments now available allow trace element analysis of samples in the field or in collections. The remains of the eleven individuals were analyzed by portable XRF. The results suggest they can be divided into four groupings based on similar strontium readings from their bones and teeth, where the individuals may be related to one another based on geographical location. Based on differences in bone versus tooth strontium levels, six of these individuals show they had migrated away from the location where they spent their childhood. These findings tell us more about these individuals, so we can have a better understanding of who they were and their relationship with one another.

Genetic structure of the Spanish populations: the end of the Basque singularity?

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The genetic structure of a population can be used to infer its demographic past, but it is also to the design and interpretation of genetic association studies. We set out to investigate the genetic structure of the Spanish populations, with two specific goals: assess the contribution of North Africans, and provide a genowide perspective on the Basque singularity.
We carried out two different studies to describe and interprete the genetic structure of the Spanish populations. First, we genotyped

123 SNPs in a gene-free 1-Mb region in chromosome 22 in Basque samples from France and Spain, as well as in samples from northern and southern Spain, and in three Moroccan samples. Both Basque samples showed similar levels of heterozygosity to the other populations, and the decay of linkage disequilibrium with physical distance was not different between Basques and non-Basques. We also found that genetic differentiation in our sample set was low, and that the most important source of differentation was Iberians (Basques included) against N Africans.
We followed the first study with a more thorough survey of the Spanish populations. We have genotyped 317,500 SNPs, in samples collected by the Spanish DNA bank. We have estimated allele frequencies by genotyping 16 pools of samples rather than individuals. In a preliminary analysis, less than 5% of the SNPs have Fst values above 0.05, and, with the possible exception of the Canary Islands, Spanish populations are genetically homogenous.

Evolution, culture, and the role of biological anthropology.

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The scientific study of evolution and culture often makes biological anthropologists squirm within their home departments, fearing savage and barbaric responses regarding a return to unilinear evolutionism. Meanwhile, much of the research that is conducted on the evolution of human behavior is often greeted by similar levels of distrust from biological anthropology, especially as evolutionary psychologists became a dominant source in the discussion. Unfortunately, although biological anthropologists have championed biocultural research perspectives, no central role is played regarding ideas of cultural evolution, despite being an inherently interesting subject for holistic anthropology to investigate. However, it is a great time to jump into the fray, as evolutionary concepts change rapidly and in ways that, if understood properly and with an open mind, should be welcomed by all subfields. In addition, despite differences among behavioral ecology, evolutionary psychology, sociobiology, gene-culture evolutionary theory, memetics, and other perspectives, there are clear connections and agreements to be found. Hopefully, more scholars working on the issues will find the AAPA meetings as a receptive and valuable venue to present their research, as biological anthropologists are well-positioned to shape and advance theoretical discussions and useful applications of a better understanding of humans past and present, our primate heritage, and the evolutionary natures of cultures. Although many of us who have been around awhile might see this subject as a troubling venture, new students increasingly find it interesting and important, and will further investigate, with or without the help of anthropologists.

Inferring human gene flow over Mediterranean space towards Iberian Peninsula based on Y-chromosomal haplogroups E and J in a coastal Andalusian population (Southern Spain).

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The Iberian Peninsula, located on the fringes of Europe and at the westernmost edge of the Mediterranean basin, is separated by a short stretch of water from Africa. To understand the Mediterranean peopling process the Andalusia region, the southernmost region of Spain, densely occupied since ancient times and with a rich history of contacts with many different Mediterranean populations, must be considered. The present study aims to perform an analysis of the Y chromosomal lineages E and J in a sample of 167 autochthonous males from Huelva, Andalusia's most western province, bordering Portugal, and close to the Strait of Gibraltar. These two haplogroups emerged as the second and third most frequent lineages, with high frequencies of Hg E (E3b) (12%) and Hg J (7.2%) when compared to other Spanish populations. Within the clade E3b the E-M78 and E-M81 mutations account for 80% of the chromosomes E. In Europe the E-M78 is the most common lineage whereas the E-M81 is considered a signature of northwestern African populations (Berbers). Internal to the Y-chromosome haplogroup J, its two major clades J-M267 and J-M172 appear with very different frequencies, 33% and 67%, respectively. The J-M172 is more prevalent in Europe whereas the J-M267 is mainly confined to the Mediterranean coastal areas. Most of the genetic features identified seem to be the result of recent processes ranging from the protohistoric Tartessian civilization, followed by the rise and fall of the Roman Empire, and continuing into the Middle Ages, with the movements associated with the expansion and decline of Islam in the Iberian Peninsula.
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Immunoepidemiology of schistosomiasis in ancient Nubia.

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Schistosomiasis is an ancient parasite which continues to plague humanity causing significant

morbidity and mortality. Archaeological and ethnohistorical data support the presence of schistosomiasis in the Nile Valley throughout the last 5000 years. This study presents the results of immunological testing conducted on naturally mummified tissue samples from 235 individuals excavated from the area near Wadi Halfa and Kulubnarti. Enzyme-linked immunosorbent assays (ELISAs) were used to detect circulating schistosome antigens as well as antibodies to examine the extent of individual exposure to schistosomiasis and infection intensity in the populations. The rates of exposure and infection found are within the ranges seen in modern populations in the area and have been stratified by age and sex to develop a nuanced epidemiology of schistosomiasis in these ancient Nubian populations. Infection prevalences increased with age while intensity of infection reached a peak in early adulthood and then declined following a pattern similar to that seen in modern populations. While the general epidemiological pattern within these populations is consistent, variations between populations provide insights into the relationship between the epidemiology of schistosomiasis, the local ecology and the cultural, social, and political contexts of infection and transmission. Future analyses will utilize a range of previously obtained data on more general measures of health within these populations to examine the impact of schistosomal infection on the health of these populations.

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Male Reproductive Aging in Comparative Primate Perspective.

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Evolutionary models of the human life span has tended to focused on females. However, recent findings suggest relatively little difference in the timing of the female reproductive life span between humans and our hominoid relatives. Such results implicate selection on males as the driver of the extended human life span and underscore the need for a better comparative understanding of male aging and reproductive senescence. In this paper we compare indices of male aging between humans and the great apes. Though there is very little data on the hormonal correlates of male reproductive aging among the great apes, there is reason to believe that among males, age patterns of reproductive function are directly tied to somatic senescence. Age profiles of mortality, kidney function, and testosterone all suggest the onset of male senescence in captive chimps at around 25 years of age, compared to approximately 55 years among humans, despite similar timing in the onset of reproductive function between the two species. Thus selection appears to have acted to greatly extend the male reproductive span during the course of human evolution, along with increased somatic survival. We suggest that selection for increased reproductive span among humans is associated with increased paternal investment and a reduction in direct male-male reproductive competition relative to the other great apes. More detailed age profiles of reproductive hormones, including gonadotropins, are needed to clarify the timing of reproductive senescence among the great apes.

Morphological variation and sexual dimorphism in the skeletal elements of the human elbow.

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Previous research of the arm has demonstrated sexual dimorphism in the humerus, ulna, and radius. This study affords attention components of all three bones that comprise the elbow and identifies one, two, and three variable models for the quantitative assessment of sexual dimorphism in bones of the elbow. Thirty-one measurements were recorded from a sample of 80 white individuals from the Hamann-Todd Comparative Osteological Collection. Summary statistics are generated for the purpose of univariate assessments of size and shape. A stepwise discriminant procedure with a MAXR option is used to generate a multivariate assessment of the sex discriminating ability of protocol variables. Classification parameters derived from the calibration sample of left arm bones are tested on two samples (one consisting of right bones from the calibration sample, and an additional independent sample of white individuals from the WSU-BAL Anatomical Collection). Individuals in the two test samples are correctly classified over 80% of the time using only the circumference of the radius head. Classification rates improve to 90% and above when coupled with the minimum circumference of the humerus. Classification rates again improve with the addition of the maximum diameter of the radius head and range from 90 to 100% correct classification. The further improvement of sex estimation in both test samples lends support to our initial suggestion that a composite of measurements from at least two of the bones comprising the elbow, namely the humerus and radius, successfully improves sex estimation in white individuals generally from 80% to 100%.

The utility of rodent assemblages in testing niche specialization in hominins.

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Differences in faunal assemblages are generally an integral component of paleoenvironmental

reconstruction for most fossil localities. Small animal faunas are especially useful in rebuilding terrestrial environments as they often have niche specializations allowing for estimates of environmental parameters such as vegetation cover, substrate, mean annual precipitation and temperature range. It has been suggested that Plio-Pleistocene hominins from southern Africa likewise demonstrate niche specializations. Hypothesized niche specializations would be supported if distinct suites of rodents were associated with specific hominin taxa. Our analysis, therefore, compares rodent taxa identified from a series of Plio-Pleistocene hominin-bearing localities distributed throughout southern Africa. Due to ambiguities in the diagnosis of fossil rodent species, we limited this analysis to the level to genus. Our findings indicate that several genera are commonly reported at most hominin localities, including *Cryptomys*, *Steatomys*, *Otomys*, *Tatera*, *Rhabdomys*, *Mastomys*, *Mus*, *Thallomys* and *Dendromus*. Alternatively, other taxa such as *Desmodillus*, *Georychus*, *Grammomys*, *Graphiurus*, *Thryonomys* and *Zelotomys* are reported relatively rarely at hominin localities. While our analysis indicates substantial overlap in the rodent faunas, there is a distinct difference in rodent genera from australopithecine-bearing localities relative to localities containing *Homo*. As most rodent genera from the Plio-Pleistocene are extant, variation in rodent faunas should reflect habitat variation rather than adaptation or extinction in various lineages. This preliminary analysis suggests that particular suites of rodent taxa may be predictive for the presence of habitats suitable for various hominin taxa throughout the Plio-Pleistocene.

The availability of fatty acids to ancestral human foragers and their infants.

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Access to essential fatty acids during gestation and early infancy is critical for normal development of the nervous and immune systems, and may have a significant impact on child morbidity (e.g. cognitive function, visual acuity), mortality, and maternal fecundity. Whether these essential dietary nutrients would have proven limiting in the diet of ancestral human foragers remains speculative, and has not yet been systematically explored.

The two essential fatty acids, the omega-6 *linoleic acid* (LA, 18:2n6) and the omega-3 *alpha-linolenic acid* (LNA, 18:3n3), are differentially distributed within the environment in ways that may have fundamentally affected which landscapes could have supported the maintenance and expansion of human populations. This paper reviews that differential distribution and discusses how these patterns may inform our understanding of ancestral human ecology and modern nutritional requirements. While today's supermarket landscape is characterized by an overabundance of omega-6 fatty acids, the ancestral human foraging niche may ironically have been more constrained by the availability of these now ubiquitous lipids. Early evidence is suggestive, however, that a mixed diet of wild terrestrial resources could have adequately provided the currently recommended intake of both *linoleic acid* and *alpha-linolenic acid*. Questions surrounding food, or nutrition, and human evolution are fruitful areas for future research. Many questions remain, and the study of essential fatty acids and human evolution may provide one of the few opportunities available to physical anthropologists to test and potentially falsify hypotheses as large as the mechanisms behind human encephalization.

Quadrupedalism of *Cebus apella* on terrestrial and arboreal substrates – external forces and kinematics.

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Primates are distinguished from many mammals by emphasizing arborealism. Primate arboreal adaptations include specializations for enhancing mobility, balance, and manipulative skills. Compliant gait is one proposed behavioral adjustment of primates for attenuating limb stresses during locomotion. Primates presumably prefer diagonal to lateral sequence gaits as a means of improving balance on arboreal supports. Capuchins (*Cebus apella*) are an arboreally-adapted primate quadruped that also uses diagonal and lateral sequence gaits, making them well-suited for exploring arboreal gait adaptations. Moreover, as tool-users, capuchins face selection for manipulative capabilities, which seemingly is at odds with sustaining large locomotion-induced forelimb stresses.

We evaluate kinetic and kinematic data from 250 limb contacts of two capuchins moving on simulated terrestrial and arboreal supports. Does *C. apella* exhibit compliant gait on arboreal supports? How kinematically similar are diagonal and lateral sequence gaits on different supports? Lower peak forces during arboreal locomotion support the notion that capuchins adopt a compliant gait on branch-like substrates, but mixed kinematic results (e.g., joint flexion angles, limb protraction/retraction, and fluctuations in trunk height) largely obscure how they accomplish the reduction. Interestingly, forearm/leg adduction angles are the most prominent kinematic differences between simulated terrestrial and arboreal locomotion, suggesting frontal plane movements could be relevant to achieving a compliant gait on branch-like supports. Diagonal and lateral sequence gaits are kinematically more similar on simulated arboreal than terrestrial substrates. This result is not consistent with the notion these gait choices are linked to substrate preferences.

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Teaching genetic drift the (W)right way.

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The concept of random genetic drift was developed by Sewell Wright in the early 1930s. Genetic drift was central to the development of population genetic theory, is essential for Kimura's Neutral Theory, and forms the basis of many common neutrality tests. In Physical Anthropology textbooks, genetic drift is typically taught as either a process of random sampling of gametes each generation, with allele frequency fluctuations arising from sampling error; or alternatively, resulting largely from random events such as traffic accidents, drownings, or hurricanes.
We surveyed 21 introductory Physical Anthropology textbooks published over the last 25 years. Four texts (19%) describe the mechanism of genetic drift mostly or exclusively deriving from accidents. Twelve (57%) provide a coherent description of drift as resulting from random sampling of alleles. Four texts describe genetic drift as simply equivalent to the founder effect. Several laboratory guides and online resources show similar patterns.

We argue here that the most appropriate way to teach genetic drift is the way Wright originally described—as fluctuations due to random sampling of alleles in a finite population. We believe teaching drift using accidents as examples is misleading and should be abandoned for several reasons, including: a) it easily conflates selection with drift, b) it is not, nor can ever be, formulated quantitatively, c) it obscures the relationship between drift and population size, and d) it makes little sense when taken to more advanced levels such as understanding the neutral theory or in null hypotheses in tests for selection.

Analysis of dental pathologies in a medieval Scandinavian sample, with a comparison to prevalence of cribra orbitalia.

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Dental pathologies (caries, abscesses and linear enamel hypoplasias [LEH]) of 116 male and 104 female adult crania from three medieval churchyards from Oslo, Norway are analyzed to answer key questions. 1) Do the dental pathology patterns differ significantly between sites? 2) Are there sex differences in the occurrence of these dental pathologies? 3) Do these dental pathologies occur independently of other cranial pathology such as cribra orbitalia? 4) Do these sites reflect previously established patterns from other medieval sites?
Chi square analyses indicate that the prevalence of dental pathology is dependent upon site, but occurs independently of sex. The authors conclude the dental pathology patterns are highly dependent upon the site, perhaps due to differences in social status since the churchyards served different social classes.
The co-occurrence of LEH and cribra orbitalia is expected because of the presumed similar etiology of both conditions. Fisher's exact test indicates a significant co-occurrence of LEH and cribra orbitalia for all three sites. This compliments conclusions made from previous work comparing the interrelationship between LEH and cribra orbitalia from a medieval population in Slovakia (Obertova, Thurzo 2008). These analyses are the first of a larger, ongoing project on ancient human health in this geopolitical region.

Plantigrade foot posture increases locomotor economy in walking but not in running humans.

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Plantigrade foot posture, in which the heel (i.e., calcaneus) contacts the substrate during a step, is a derived character of great apes (i.e., Hominidae). We used human subjects (N=11) to test the hypothesis that the energetic cost of transport (COT, oxygen consumed to travel a given distance) is lower during walking and running with plantigrade than with digitigrade foot posture. When the subjects walked with their heels slightly elevated, COT increased by 63 $\pm$ 8% (mean $\pm$ SEM) above that of plantigrade walking. In contrast, there was no difference in COT when subjects ran with digitigrade versus plantigrade foot posture. Subsequent observations and experiments suggest that the greater economy of plantigrade walking results from a suite of factors. First, stride length decreased when the subjects walked with digitigrade posture, resulting in higher stride frequencies (9.0 $\pm$ 1.0%) and accounting for a 15% increase in metabolism in a control experiment. Second, electromyography indicates that recruitment of the main extensor muscles of the ankle, knee, hip, and back is higher during walking with digitigrade posture. Third, preliminary analysis of the mechanical work done on the center of mass suggests (1) that the positive external work is approximately 11% greater during digitigrade walking, and (2) the potential to save energy via a transfer of gravitational potential and forward kinetic energy is reduced during digitigrade walking. Relative to other species, humans are exceptionally economical walkers, but not economical runners. The structure and posture of the human foot may help explain how humans walk economically.

Australian craniofacial evolution: drift, selection, or all of the above?

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By virtue of their extreme size variation over time, the Australian fossil cranial data occupy an important position in the debate of the origins and migrations of modern humans. Multiple hypotheses have been forwarded to explain this diversity, including waves of migrations into Australia, population replacement, genetic drift, and natural selection. This study tests whether natural selection has been the driving evolutionary mechanism in the evolution of craniometric variation in Australia. Via and Lande's (1985) model of soft selection is tested against a model of genetic drift (Ackermann and Cheverud, 2004) using southeastern Australian crania from three distinct time periods. Additionally, the soft selection model is modified to include an environmental component that incorporates the acute changes in climate that occurred in this region during the Pleistocene and Holocene, and the results compared to those from the original selection and drift models.
Results indicate that selection is not the only evolutionary process influencing Australians over the past 40,000 years; random genetic drift can explain most or all of the craniometric variation observed. While the model of soft selection that incorporated environmental variables yielded univariate and some multivariate predicted differences in trait means that were equivalent to the observed values, suggesting that selection had occurred, the overriding effects of drift would likely overwhelm any selective process. The results refute the hypothesis of selection-driven evolution of Australians, but suggest that the addition of population-level environmental variables may improve the selection model's predictive abilities in populations not affected by drift.

Trait independence in Eocene primate dental evolution

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Eocene primate radiations contained many parallel developments of dental features including the addition of a hypocone to the upper molars and the loss of a paraconid on the lower molars. The latter development is unusual given ontogenetic restraints on the paraconid. Although earlier studies have examined one of these phenomena, they are rarely viewed together as a process. Many cladistic studies treat the presence or absence of these cusps as discrete and independent traits. The objectives of this study were to examine between-teeth trait independence and to identify metric traits of use in situations where high levels of parallelism is suspected. Occlusal photographs of upper M1s and M2s and lower M2s across a wide sampling of adapiform and omomyid primates were measured using unit-standardized coordinates centered on cusp base triangles. The resulting metrics were analyzed using a combination of multivariate multiple regression and pairwise contrasts. This represents a novel way of analyzing data that takes into account trait independence as well as occlusal and developmental constraints. Results indicate high variability in the position of the protocone, with the cusp incurring a mediolingual shift in many species with a hypocone. Loss of a paraconid did not significantly alter lower cusp positions. Metric combinations of coordinate data showed little or no phylogenetic signal. Together, this indicates that selection acted strongly on the independent development of a hypocone, so much so that it most likely led to the parallel loss of a paraconid throughout primates. This project was funded by a Collegiate Research Scholar grant through New York University.

Maternal influence on orangutan gestural and behavioral development.

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Maternal behavior has been shown to affect the development of foraging and other skills in several primate species. For great apes in particular, social learning is thought to influence the acquisition of behavior during ontogeny. It is notable, then, that although all species of great apes have been shown to use gesture as a frequent communicative medium, there is no evidence that natural gestures are learned through observation of or interaction with conspecifics. Orangutans have an extended inter-birth interval and long period of dependency, making them an ideal model to investigate vertical transmission of information or behavior. We studied the gestural repertoires and social interactions of seven orangutan mother-infant dyads (*Pongo pygmaeus* and *P. abelii*) housed in three European zoos to determine to what extent maternal behavior influenced infants' social and communicative behavior. Infants actively synchronized with their mothers' object-directed behavior, and their gestural repertoires were more similar to those of their mothers than to those of other adult females in the same population. These immediate and lasting effects of maternal influence in orangutans shed light on the evolution of the vertical transmission of learned behavior.

Fore/hind limb interference and primate locomotion.

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Most quadrupedal mammals have diagonal-couplets gaits, in which the movements of diagonally opposite limbs are approximately in phase. Animals with such gaits risk stepping on or striking a front foot

with the descending hind foot on the same side — a gait fault known as overreaching or "forging" in horses. Quadrupeds can avoid forging by adjusting several variables: by reducing step length relative to trunk length, by decreasing forelimb retraction at liftoff and/or hindlimb protraction at touchdown, or by altering the phase relationship between the forelimb and hindlimb cycles. In walking gaits, the probability of forging is maximal when hindlimb touchdown is synchronized with ipsilateral forelimb liftoff. This occurs when diagonality (D = the percentage of the duration of the gait cycle by which hind footfall precedes ipsilateral fore footfall) plus forelimb duty factor (Sf = forelimb stance phase as percentage of cycle duration) equals 100. Gaits plotting significantly below this line (D =100 - Sf) on a graph of D against Sf avoid forging; but so do gaits plotting significantly above it. These facts appear to help explain the distribution of gait types and the patterning of limb movements in primates and some other arboreal mammals.

Identifying skeletal upper limb bilateral asymmetry in great apes.

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A desire to understand the evolution of handedness has led researchers to focus on bilateral asymmetries in the upper limbs of both modern human and hominin skeletal material. Non-human primate models have been incorporated into handedness research to help pinpoint the timing of its emergence. Despite considerable work focusing on skeletal asymmetries, the same approach has, for the most part, been lacking in non-human primate species. Considering the controversial nature of hand preferences in primates, study of anatomical bilateral asymmetry has the potential to shed light on these questions.

To this end, data were collected on the metric properties of the humeri, metacarpals and phalanges in a sample of 21 *Pan troglodytes* and 21 *Gorilla gorilla*. Musculoskeletal stress marker development was also scored in both groups. These analyses indicate that both samples show reduced levels of asymmetry relative to modern human samples, plus similarities in terms of the magnitude and direction of asymmetry. The trend towards left-side dominant asymmetry identified in the humeri and phalanges, and right-side dominance in the metacarpals lends support to the proposed notion of the left arm providing postural and locomotor support while the right hand engages in manipulatory actions.

These results suggest that the great ape upper limb presents a unique and identifiable asymmetry profile, possibly reflect lateralisation in the use of the arms and hands in these samples. While further investigation into the functional causes of these asymmetries is required, it highlights the potential usefulness of anatomical study of behavioural lateralisation in non-human primates.

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Assessing age at death in adult dentitions: a new approach using three-dimensional microcomputed tomography and its application to fossil samples.

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Changes in the age structure of populations across the Middle/Upper Paleolithic transition have important implications for understanding the origin and success of modern humans. Previous work using large dental samples has suggested increases in older adult survivorship associated with this transition, but the details of these changes (how old individuals live to be) are unclear because of the low resolution of dental age estimates for older adults.

We have found that micro computed tomography (μCT) provides a new, more accurate and non-destructive approach for assessing age at death in fossil hominids using several aspects of the internal structure of dental roots. Here, we focus on secondary dentin deposition and the relationship between this variable and Miles method ages in the Krapina Neandertals. The methodology used to quantify secondary dentin deposition is developed and its relationship to age is assessed. We find that regressions predicting age from μCT measures of secondary dentin deposition may be of use in samples which include individual teeth that are too worn for accurate Miles method assessments. While the age at death distribution at Krapina includes a large number of younger individuals, at least two individuals may be considered older adults, with attrition comparable to that of older Neandertals from other sites. Even these older individuals are aged under 35 years based on secondary dentin deposition. This supports hypotheses that the Neandertal life history pattern was characterized by higher adult mortality and lower adult life expectancy than that of modern humans.

A radiographic comparison of root growth during eruption in modern human mandibular M2s.

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The rate of root elongation has been used as a proxy for estimating the timing of gingival eruption. Recent radiographic and histological analyses of human mandibular M1s found that peak rates of eruption and peak root extension rates (RERs) do not coincide. This study expands on that research by focusing on root growth in mandibular M2s and asks this question: Do M2s share the same pattern of dissociation between eruption and root growth rates as M1s? Developing roots of M2s (n=90) were measured from orthopantomograms of known-age humans throughout four eruptive phases (i.e., alveolar, early, late, and complete). Root growth rates were derived from three regions of developing teeth (i.e., the root cleft, mesial and distal root lengths) and were compared to previously published M2 RER data. Unlike the case for M1s, peak rates of eruption in M2s correspond with peak RERs. Peak mesial and distal root growth rates occur during early eruption for M2s. Parametric and nonparametric tests revealed significant differences between mandibular M1 and M2 root growth throughout the eruptive process. The lengths of mesial and distal root present between M1s and M2s are significantly different during the early, late, and complete eruptive phases (i.e., $p \leq 0.02$) but not for the alveolar eruptive phase (i.e., $p=0.76$ and $p=0.37$ for mesial and distal roots, respectively). These data highlight important differences in how M1 and M2 roots develop during the eruptive process.

MHC and mate choice in humans.

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In several species including rodents and fish, it has been shown that the Major Histocompatibility Complex (MHC) influences mating preferences and in some cases that this may be mediated by preferences based on body odour. In humans, the picture has been less clear. Several studies have reported a tendency for humans to prefer MHC-dissimilar mates, a sexual selection that would favour the production of MHC-heterozygous offspring, which would be more resistant to pathogens, but these results are unsupported by other studies.
Using genome-wide genotype data (HapMap II) and HLA types in African and European American couples, we test whether humans tend to choose MHC-dissimilar mates. This approach allows us to distinguish MHC-specific effects from genome-wide effects. In the African sample, the patterns at MHC loci is confounded by genome-wide effects, possibly resulting from demographic processes relating to the social organization of this population, and no tendency to choose MHC-dissimilar mates is detected. On the other hand, the sampled European Americans appear to have favoured MHC-dissimilar mates, supporting the hypothesis that MHC influences mate choice in some human populations.
Thus, this study suggests that in some cases, humans may rely on biological factors, in addition to social factors, when choosing a mate.

Bioarchaeology and demography of 17th century mass graves at the Barbican Site, York, England.

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In 2007 a commercial redevelopment in the city of York, England, revealed the location of the abandoned medieval church of All Saints Fishergate and resulted in the excavation of approximately 660 human skeletons. This study reports osteoarchaeological findings from a series of post-medieval mass graves that had been inserted into the medieval churchyard after the church had become disused. There is no documentary record for these mass graves, which contained more than 110 individuals, but the available archaeological evidence together with close parallels to other post-medieval military graves indicates that they date to the period of the English Civil Wars, more specifically to the siege of York in 1644 when a large army of parliamentary forces was encamped for several months outside the city walls. Palaeodemographic analysis of the individuals buried in the mass graves has confirmed that they are almost all males aged between 15 and 45 years with a predominance of young adults, a demographic structure which is typical of a military cohort. Mass graves provide an unrivalled opportunity to ascertain the demographic composition, health status and cause of death of military personnel. Although there are passing references to burials of the bodies of combatants in mass graves during the English Civil Wars, very few details are actually known about how the dead were interred after the battles, sieges and skirmishes of this period of conflict, and only one other example exists of an archaeologically excavated mass grave from this time period in Britain.
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The Gibbon Hind Limb: What is it specialised for?

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Although gibbons primarily excel in their brachiating skills, they also regularly engage in hind limb powered locomotion, such as

leaping, climbing and bipedalism. It is likely that these different locomotor modes impose differing mechanical constraints on the hind limb. To better understand the evolutionary pressures acting on the gibbon hind limb we have investigated its functional anatomy. These results are then integrated with kinematics of gibbon jumping.
We collected quantitative anatomical data of the gibbon hind limb by detailed dissection of 11 unfixed cadavers including four species (*Hylobates lar* n=3, *H. pileatus* n=2, *H. moloch* n=2 and *Symphalangus syndactylus* n=4). In addition, muscle moment arm data was collected with an electro-goniometer and a linear displacement transducer using the tendon-travel technique. High-speed videos (250Hz) of jumping gibbons were digitised and joint angles calculated to estimate the extent to which the hind limb is specialised for this form of locomotion.
The data shows that gibbons possess short-fascicled, high PCSA knee and hip extensors with small moment arms which may facilitate powerful movements such as jumping. A simple fascicle-length-change model predicts that, for angular excursions used in jumping, the extensor muscles are required to shorten relatively little because of their small moment arms. In contrast, the long-fascicled knee and hip flexors may be better suited to positioning the limb in a wide range of postures, useful for activities such as climbing and clambering.

Parallel evolution of papionin craniofacial morphology.

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The craniofacial variation present in the Old World monkey tribe Papionini, composed of macaques, mandrills, baboons, geladas and mangabeys, is examined using multivariate morphometric techniques to reconstruct the differences in selection responsible for cranial diversification in the clade. These methods were used in conjunction with phylogenetic structure to assess when, in the history of the tribe, specific differences in craniofacial morphology arose and whether similar differences in selection occurred repeatedly during the clade's evolution. Facial prognathism, a characteristic of the tribe, best discriminates baboons and mandrills from other members of the tribe. The results show the pronounced facial elongation seen in these two species is primarily the result of differentiation occurring in their immediate ancestors. Parallel evolution of facial prognathism in baboons and mandrills occurred by similar patterns of morphological differentiation from their respective sister species.
We acknowledge support from NSF grant BCS-0725068 and the Genomics of Cranial Morphology Project.

Effects of habitual activity patterns on modern human elbow morphology: a comparison of elbow joint size among four modern human populations and *Homo neanderthalensis*.

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Size related measurements were made on distal humeri and proximal ulnae of 145 modern human individuals from four populations of pastoralists, farmers, foragers and urban-dwellers to determine the effects of activity patterns on elbow joint morphology. The first hypothesis was that, neanderthals have larger elbows than modern human populations and that this feature can aid in partially understanding the divergence between *Homo sapiens* and *Homo neanderthalensis*. Secondly, I hypothesized that populations engaging their arm muscles intensely have large elbow joints whereas populations loading their elbow joints to a lesser extent bear smaller joint size. Measurements were done on both articular and epiarticular surfaces of the joint to quantify length, breadth and depth of the joint. Data was collected on both forensic and historical samples from Africa, North America, and Australia. I performed linear regression analysis to determine the relatedness of adjusted size measures and their geometric means among all human groups and neanderthals. It revealed presence of strong correlations between capitular depth and biepicondylar breadth while, all ulnae measurements did not show a strong correlation. I used principal component analysis to define the relationship between the categories of activities these populations engage in. There was a stronger genetic signal amongst sub-Saharan Africans than between groups performing similar activities. The lack of clear correlations of measurements indicating effects of strain corresponding to muscular motion may imply strains acquired in adulthood are not marked. Also, genetic signals and ontogenetic strains are rather useful in interpreting strain patterns.

Relationship between body morphology and lipid levels among the Mennonites of Henderson, Nebraska.

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Anthropometric measurements have been informative in biomedical research to categorize body morphology and to assess the risks of acquiring certain chronic diseases. Complex phenotypes such as height, weight, body mass, skinfold thickness, circumference of upper arm, lipid levels, and degrees of obesity have both genetic and environmental

components and can be used to ascertain the impact of environmental factors on underlying biological variables. GOALS: 1) To determine the relationship of body morphology and fat distribution to lipid levels; 2) To determine which body measurements are significant predictors of lipid levels for this Mennonite community. METHODS: To understand the dynamics of morphology and lipid levels, we conducted multivariate analysis of the data. Each anthropometric variable was regressed on age to remove age effects and residuals were used for analysis of males and females and standardized residuals were used for pooled sexes. Stepwise regression was performed to select best predictors for lipid levels, and then predictors were entered into a linear regression model. RESULTS: HDL-C and weight were not correlated with age for both the sexes. The total body size (R-Sq: 99.84%), along with body mass index, and body fat (R-Sq: 99.31%) significantly predicts HDL-C levels in this population. Whereas, only height, weight and chest measurements seems to significantly predict TC, TG and LDL-C, along with triceps skinfold thickness. Therefore, it seems that overall morphology and especially total body size are important factors in predicting HDL-C, but the relationship between other lipid levels and body morphology is much more complicated.
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Histomorphology of human parietal bones.

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Parietal bones are a preferred grafting site for maxillofacial reconstructive surgeries. There is concern that calvarial bones become too thin and brittle for older patients to safely undergo the grafting process of splitting the outer and inner cortical tables. To address this concern and the conflicting reports regarding age-related changes in the calvarium, we investigated evidence for age-associated bone loss and bone remodeling activity in a preliminary parietal bone sample.
Parietal samples from 14 individuals ranging 14~75 years old (mean 41.64 years) were prepared into thin sections ~10μm thick. Using an image analysis software, cortical and diploë layer thicknesses were measured from scanned thin section images. The mean outer table thickness is 1.38±0.39 mm, inner table thickness is 1.19±0.35 mm, and diploë thickness is 3.43±1.72 mm; age has no significant effect on these variables ($p=0.63$, $p=0.24$, $p=0.26$, respectively). A polarizing research microscope and Integrationsplatte II reticule were used to quantify the histomorphologic structures. The secondary osteons are visible in the parietals indicating bone remodeling activity, but the pattern of primary and secondary osteons and osteon fragments differs from that observed in long bones and thorax. Age has no significant effect on bone remodeling in the outer and inner tables ($p<0.05$) and the number of osteons and fragments per volume does not differ between the outer and inner tables ($p=0.26$, $p=0.80$, respectively). The preliminary data suggests that the parietal bones do not lose significant bone mass with increasing age unlike in other skeletal elements.

Rediscovery of the *Homo erectus* bed at Ngandong: Site Formation of a late Pleistocene hominin site in Asia.

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Between 1931 and 1933, excavations by the Geological Survey of the Netherland Indies at the site of Ngandong in the Solo Valley, Java yielded 14 specimens of *Homo erectus* – one of the largest collections of this species found at a single site. In addition, many thousands of non-hominin fossils were also recovered. Subsequent excavations, however, have confounded researchers with their distinct paucity of fossil discoveries within ostensibly the same area.
In August 2008 we undertook geoarchaeological investigations at Ngandong utilizing information produced by the original Survey geologists, not previously used in re-evaluating the site. Total Data Station surveying was employed to superimpose the Survey's map of the excavation onto current topography, enabling construction of a 3D model of the Ngandong site. This model allowed for precise placement of the original *Homo erectus* specimens within the basal fossiliferous horizon.
The identification of fluvial facies with volcaniclastic sand and abundant mud mixed with gravel invokes the following scenario: hominins and other fauna aggregated within the Solo River drainage, possibly due to drought, where localized volcanic eruptions killed them. Later floods or lahars swept the bones into the river where they became concentrated and fossilized in the 20m terrace.
Knowledge of the geological processes that likely caused the positioning of these bones prior to their fossilization has important implications for future research. We can now more accurately predict the location of fossiliferous outcroppings in the terrace, while our recovery of *in situ* elements allows meaningful radioisotopic dating in the fossils' original context.

How useful are measurements currently used for sex assessment in archaeological remains?

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It has long been recognised that skeletal growth and body size vary significantly within, and between, archaeological and modern human populations (Eveleth & Tanner, 1990). This variation is influenced by genetic, geographical and biocultural factors. Bone lengths and stature have been the primary source of data relating to secular change in skeletal populations. If the causative factors which result in secular change in stature are reflected in other bone dimensions, the diachronic changes in male and female morphology may render modern metric sexing techniques inadequate for sex assessment in archaeological individuals.

This research investigated six commonly used metrical sexing landmarks in British skeletal populations dating from the Roman, Anglo-Saxon, medieval, and post-medieval periods. Sex was first assessed by morphological features of the *os coxae* and *os pubis*. Intra- and inter-observer error demonstrated that all metric sexing measurements could be accurately replicated at the 95 per cent level. More pronounced secular trends were demonstrated in metric sexing measurements for males than females, reflecting the general consensus that females are genetically buffered against adverse environmental conditions. Upper limb measurements varied less between periods than lower limb measurements, however measurements of the proximal femur were most accurate for sex assessment.

Overall, the present investigation demonstrated that the morphology of the long bones are affected by variations in the bio-cultural environment. It is strongly suggested that period-specific metric sexing boundaries are employed in order to achieve greater accuracy in correctly assigning sex to archaeological skeletal individuals.

This research was supported by NERC.

Ontogeny and behavior of *Propithecus edwardsi* (Milne-Edwards' sifaka).

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Propithecus edwardsi (Milne Edwards' sifaka), a southeastern rainforest lemur species has been the focus of a longitudinal study in Ranomafana National Park (RNP), Madagascar for almost 20 years. Valuable information has been obtained concerning this endangered species however; one area of research that has been underrepresented is infant development and behavior. Due to the immense knowledge that has been gained so far, it is crucial to gain further insight into the ontogeny and behavioral repertoire of this sifaka in order to attain a more complete picture of its life history. The purpose of this study is to conduct an initial investigation concerning early infant development and behavior over a two and a half month period during the austral winter (birthing and lactation season). The methods employed consisted of a combination of focal animal sampling and *ad libitum* data collection, resulting in a total of 221 sampling hours for all sampled mother/infant pairs (n=4) over a period of 10 weeks. Infant sex is known for 3 out of 4 of individuals, and the appearance of each infant was noted within five days of birth. Results suggest that *P.edwardsi* infants are quite precocious; climbing and manipulating behaviors were found to appear early in their development. Yet, although preliminary analyses suggest that while these infants can be described as precocious, they spend the majority of their time resting and in close proximity to their mothers during the first 12 weeks of life.

Correlations between refugee experiences and physical stature in Hmong and Lao adults.

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In the last century, high-intensity armed conflict has been linked with reductions in childhood stature in various countries, including France, the former Soviet Union, the Netherlands, Norway, China, and Japan. Few studies have examined whether disruptions to economic and ecological conditions caused by the Second Indochina War (1958-75) led to insults to childhood growth, or whether the effect of those insults was permanent.

Using retrospective life histories collected from interviews, the current research tested whether there was a significant correlation between adult stature and the number of refugee experiences a person had in a sample of 378 ethnic Lao and Hmong adults residing in the United States and French Guiana (aged 20- 60 years). These two groups originate in Laos, where war disrupted food production for much of the rural population. Results reveal that, consistent with historical documentation, many individuals were forced to leave their homes multiple times due to the conflict. For both sexes, the number of times a person was displaced by military conflict, either within Laos or across an international border, was inversely correlated with final stature (males, $r = -0.171$; $P = 0.015$; females, $r = -0.391$; $P < 0.001$). Similar correlations were found for sitting height and leg length. Thus, it appears that armed conflict has had a permanent effect on the physical growth of Hmong and Lao refugees.

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A non-invasive alternative to histology: A study using the Alicona 3D Infinite Optical

Microscope to investigation human tissue.

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The application of histological methods to different kind of human tissues has been very successful, and implemented in a variety of scientific fields. Human tissue histology has a wide range of applications, in the fields of clinical and forensic pathology, as well as that of identification sciences. Microscopic examination of biologic tissues requires that they are infiltrated and embedded in a solid medium to retain the proper shape of the tissue and its cellular anatomy during sectioning. In some cases however, such as when working with archaeological human remains, destructive methods may need to be avoided.
The use of Alicona 3D Infinite optical microscope with the Infinite Focus Alicona Software (Infinite Focus 2.0, IFM 2.0) produces a three dimensional image of the scanned tissue. Each visible point of view of the surface is measured and its coordinates stored for subsequent analyses. This study aims to analyse human tissues using Alicona 3D imaging compared to traditional light microscope histology.
The initial results of a comparison of Alicona images with histological sections of the same types of human tissue suggest that both the structures within the tissue can be identified clearly in the Alicona image and that accurate measurements of cell size can be produced.

Tooth use in Aboriginal Australia.

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Like most other groups of hunter-gatherers, both ancient and recent, Australian Aborigines have been noted for their high rates of tooth wear. The cultural use of their teeth has frequently been reported, with one of the most extreme examples being their use to chip stone tools. This paper presents the results of a study examining tooth wear patterns in three groups of Australian Aborigines, two from the Northern Territories (Yuendumu and Haast's Bluff) and one from the Western Territories (Kalumburu). Permanent tooth wear was measured from high resolution casts using image analysis software and a graphics tablet. The area of the occlusal surface and the area of exposed dentine were both measured, and a dentine proportion calculated by dividing the area of dentine by the area of the occlusal surface. Wear patterns were compared independent of age, which was achieved by dividing the dentine proportions of each tooth by that of the first molar. The results showed that all three groups possessed patterns of heavy anterior wear, but those from the Northern Territories (Yuendumu & Haast's Bluff) showed significantly higher wear ratios for their anterior teeth, than individuals from Kalumburu. Differences between males and females were also found.
Research funded by the Leverhulme Trust.

A semi-free ranging chimpanzee (Pan troglodytes) gives birth at 65 years of age: Implications for delayed reproductive senescence.

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A female chimpanzee (*Pan troglodytes*) housed at a semi-free ranging facility in Florida (The Elgin Center at Lion Country Safari), was documented to give birth to a live offspring at age sixty-five. Interestingly, this was the female's second offspring in two years. Both infants (1.1) survived less than four months. This suggests an absence of menopause in the chimpanzee species; or, at the very least, this finding indicates a substantially delayed period of reproductive senescence, relative to the life history traits of the species. Follow up studies are currently being conducted, including testing cortisol levels, estrogen levels, progesterone levels, and luteinizing hormone (LH) levels, along with monitoring anogenital swelling (which has always been minimal in this individual).

Integrated variation in facial orientation and the craniomandibular skeleton in the extant great apes.

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A major difference between the Asian and African extant great apes is the orientation of the facial skeleton relative to the neurocranium (airorhynchy, klinorhynchy). It has been hypothesized that a number of craniomandibular differences between groups, such as supraorbital torus morphology, midfacial profile, premaxilla length and symphyseal orientation, are related to this basic structural difference. This proposed non-independence of craniomandibular features among the great apes has important implications for phylogenetic analyses and our understanding of the evolution of the hominoid cranium. This study aims to use patterns of intraspecific variation in the extant great apes to test the hypothesis that these characteristic craniomandibular features are related to differences in facial orientation. 2D landmark coordinates were obtained from the lateral radiographs of 46 *Gorilla gorilla*, 79 *Pan troglodytes* and 37 *Pongo pygmaeus* complete juvenile and adult skulls. Landmark data was corrected for growth allometry, establishing facial orientation to be independent of ontogeny. Geometric morphometric techniques of Procrustes superimposition and principal

component analysis were used to ascertain patterns of facial orientation. Partial least squares analysis was used to find correlated pairs of singular warps between morphological regions in each species. A similar pattern of craniomandibular variation was found associated with facial orientation and height within each of the species. The results generally support the hypothesis that these craniomandibular features are related to differences in facial orientation variation, the patterns of covariation between facial orientation and the characteristic craniomandibular features are not all consistent with those previously proposed.

Bones in the beach: Preliminary results from Isla San Lucas.

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Isla San Lucas, an island off the west coast of Costa Rica in the Gulf of Nicoya, has been inhabited since pre-Columbian times. Historic occupation includes a penal colony, closed in 1991. In January, 2008, we were part of multidisciplinary research to understand and preserve the site. Scant documentation suggested that there were at least two cemeteries on the island; no grave markers or plot maps survive. We surveyed likely cemetery sites and then excavated three test pits, one of which contained a skeleton. We report on that single, fragile skeleton which was exposed to the transverse line. We examined it *in situ* to preserve the integrity of the entire skeleton for subsequent recovery. Data were recorded for 1) skull bone inventory and 2) evidence of trauma. Eight bones were analyzed. The splanchnocranium and all teeth were missing. Trauma was noted in four bullet entrance wounds and one exit wound. The sizes of the entry wounds (5-6 mm) are consistent with a .22-.25 caliber weapon, available in Costa Rica at the time the prison operated. The two findings suggest this individual may have been struck in the face, perhaps with a gun butt, resulting in a LeFort 3 facture after being shot in the head. Such traumas were not unexpected in a penal colony cemetery. However, uniform jacket buttons, were found in immediate association with the skeleton. These buttons were on guard uniforms manufactured between 1848-1906. So, the remains were likely those of a guard, not a prisoner.

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A New World thalassemia in the 16th century Tipu population in Belize.

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aDNA analysis of skeletons from the 16th century Colonial Maya site of Tipu, Belize, has revealed the presence of a highly unusual hemoglobin irregularity at a locus associated with β-thalassemia. The mutation, found in four of eleven individuals in our preliminary analysis, is a c-deletion in the second exon of the hemoglobin gene, creating a frameshift mutation in codon 44, producing a termination at codon 60. Our analysis of our DNA sequences, including the presence of a mutation for β-thalassemia and identification of New World C and D haplotypes (but not A, B, X, or H) have been replicated by independent DNA laboratories. We believe that the mutation is indigenous to the New World, for various reasons including the haplotype evidence. The possibility that the mutation was introduced by the Spanish is very remote, primarily because the particular form of the mutation does not occur among the modern Spanish or any other Old World population with one exception. A fraction of a small population of Kurdish Jews displays the same mutation and might possibly represent its historic source, since Jews were expelled from Spain in 1492. We are plotting the distribution of the allele in the Tipu population and ultimately its wider New World distribution, and searching for possible selective factors resulting in balanced polymorphism, while simultaneously attempting to trace a plausible means by which the gene might have come from the Old World.

A preliminary report on the interaction between ambient acoustics and primate vocalizations in the Ecuadorian Amazon.

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Research on the ambient acoustics of African forests has demonstrated that many primate species utilize "frequency sound windows", or spectral bands with few other sounds present, which help increase the fidelity and propagation distance their vocalizations. However, in-depth research of this nature has not been conducted on primates living outside of Africa. The aim of this project was to begin conducting acoustic analyses of ambient sounds and primate vocalizations in the Ecuadorian Amazon (Tiputini Biological Research Station). Three primary research questions are being addressed: 1) Do primates living outside of mainland Africa exploit frequency sound windows? 2) Is there evidence of vocal niche separation among primates living in close proximity in order to minimize masking from spectrally similar calls? 3) What is the relationship between the acoustic composition of vocalizations, call

propagation characteristics, and aspects of primate social behavior such as group size, group spread and other activity patterns?
Ambient acoustic data (recordings and sound pressure level measurements) were collected every 15 minutes during all daylight hours (5:30 to 18:00 hours) over a 17 day period in July-August, 2007. Primate vocalizations were also opportunistically recorded. Preliminary results show that a frequency sound window does exist (at least near the ground) and playback experiments with *Callicebus* calls demonstrate the acoustic benefits of vocalizing within this range. These results also suggest a more complex picture than that found in Africa with some smaller species vocalizing primarily in the frequency range of some birds, possibly aiding in the acoustic crypsis of these taxa.

A new and simple method for sharing paleoanthropological data using Google Earth and GIS.

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The ease, efficiency, and speed of data communication and analyses are paramount to, and characteristic of, any mature science. Here we show how paleoanthropological data can easily be displayed and communicated by combining Google Earth and Geographic Information Systems (GIS). Using paleoanthropological field data, we demonstrate several examples that go far beyond the novelty of simply ''find my house'' that many Google Earth users are currently familiar with. Specifically, we show how GIS map layers, including their associated attribute tables (e.g., field catalog data), are freely and easily transmitted to anyone with Internet access and familiarity with Google Earth. GIS layers can be exported as an email attachment to colleagues who may have no knowledge of, or access to, GIS, and then simply ''dragged and dropped'' onto their own desktop Google Earth display. The recipient has access to all graphics and attributes of each map layer exported from GIS as well as to all Google Earth tools. Google Earth, as a powerful and freely downloadable geographic visualization tool, is accessed by millions of users worldwide. This opens up enormous possibilities for the free and easy dissemination of paleoanthropological information in a visually meaningful and stimulating way to students, colleagues, and the interested general public around the world.

Mechanical properties of great ape tooth enamel.

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While there have been numerous examinations of the mechanical properties of modern human tooth enamel, nothing is known of the enamel properties of the other great apes. This is mainly due to the destructive nature of mechanical property tests and the rarity and high value of great ape teeth. Nonetheless, the mechanical properties of great ape teeth are critical for evaluating current models of enamel adaptation and may reveal potential differences in how the teeth of these species resist damage. We use nanoindentation to "nondestructively" test the hardness (*H*) and Young's modulus (*E*) of chimpanzee, gorilla, and orangutan teeth. We also use optical and scanning electron microscopy to compare these property values with patterns of enamel microstructure. Preliminary results on gorillas indicate that they are generally similar in *H* and *E* to humans, but at the same time show significant differences in the gradients of these properties from the occlusal surface to the enamel-dentine junction.
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Voices from the past: An analysis of ancestry of a French colonial cemetery in Biloxi, Mississippi.

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The Moran site (22HR511 in Biloxi, Mississippi, dates from 1719 to 1723 and is the earliest known French Colonial cemetery in the United States. Historical records suggest that those interred likely represent immigrants from Western Europe as well as Africa who were relocated in an effort to colonize the Louisiana Territory. A Native American presence is also noted. Given the variety of cultural backgrounds at the site, an ancestral analysis of the 25 individuals uncovered has been conducted. Traditional markers such as cranial and tooth morphology and metrics as well as enamel composition were evaluated in all individuals, and DNA was analyzed in five. Stable isotope levels were also assessed to reconstruct diet.
The sample consists of one infant and 21 male and 3 female adults aged 18 to 45. Results support that most individuals are of European ancestry with strong consensus among those markers employed. Cranial morphology and osteometrics did suggest the presence of one African male. His placement in a stacked grave and in one of only two caskets recovered indicates status. Two Native American males were identified through the presence of shovel-shaped incisors and carbon isotope results indicative of a maize diet. One of these individuals was found with a rosary, the only grave good recovered. His DNA analysis

revealed European ancestry, but with equivocal reliability. Thus, data gained from osteological observations, more recently developed analytical techniques, and presence of variant mortuary practices suggest that this French Colonial site exhibited a complex composition of ancestral backgrounds.

New information on the feeding and grouping behavior of *Cercocebus torquatus*, the red-capped mangabey, from southwestern Gabon.

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Members of the *Cercocebus-Mandrillus* clade are united by a suite of skeleto-dental characteristics believed to be associated with a reliance on terrestrial, hard-object foraging. Researchers suggest that this foraging regime is also related to the large home ranges and fluid grouping patterns observed among some *Cercocebus* and *Mandrillus* species. This paper presents novel information on the feeding and grouping behavior of *Cercocebus torquatus*, the red-capped mangabey, which significantly widens our knowledge of the behavioral variation found within this little-known species.
Data were collected during 2008 on a *C. torquatus* group in Sette Cama, Gabon. Previous studies at another site found that *C. torquatus* group size averages 25 individuals and that subgrouping occurs infrequently. In contrast to these studies, the *C. torquatus* group in Sette Cama is large (N=60) and routinely subgroups. *C. torquatus* primarily eat fruit pulp (49%) but a portion of their diet includes seeds (26%) and assorted fauna (17%). For example, *C. torquatus* were most commonly observed eating crabs (e.g. *Cardisoma armatum*) and the seeds of *Sacoglottis gabonensis* fruits. Both of these are hard-object items that require processing with the posterior dentition prior to consumption but little incisal preparation. Additionally, during the dry season, the mangabey group shifted its movements to accommodate feeding on *Sacoglottis* seeds despite the presence of this food item year-round. Although the range of behaviors observed at this site is broader than previously reported for *C. torquatus*, it is consistent with the morphological-behavioral complex that characterizes other species of the *Cercocebus-Mandrillus* clade.

Three-dimensional digital morphology of small–bodied platyrrhine molar teeth.

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We examine the relationship between linear and three-dimensional measurements of molar morphology in a sample of small-bodied platyrrhine primates. Linear measurements of dental morphology have been used for many years as metrics of functional significance and as independent variables in estimating body mass in both living and extinct primates. While linear measurements have many practical advantages, it is possible that a significant amount of information is lost when measurements such as molar crown surface area are approximated linearly. It is unknown how closely these approximations correlate with true three-dimensional measurements of the morphology. To examine the relationship between these two types of data, two-dimensional and three-dimensional measurements of the lower molars were collected from laser-scan generated three-dimensional models representing six species. Length Breadth Surface Area (LBSA) was calculated conventionally as maximum mesiodistal x buccolingual diameter. Occlusal Table Surface Area (OTA) was obtained directly from the laser scan surface by outlining its perimeter on-screen. Statistically, there is only a weak correlation between the two-dimensional LBSA and three-dimensional OTA measurements, suggesting they have different functional and/or developmental properties. In most species, linear calculations significantly overestimated the actual surface area, as expected. Additionally, regressions of OTA against body mass indicated a much greater predictive power for the true surface area measurement than for the linearly derived surface area. These results provide further support for the continued use of three-dimensional digital morphology of dentition in functional studies and for predicting of body mass in platyrrhine primates.

Selection, drift, and geography in recent human evolution.

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Various observations argue for a role of adaptation in recent human evolution, including selection signals at candidate genes and genome-wide selection scans. Nonetheless, using genome-wide SNP data from the HapMap, Perlegen, and Human Genome Diversity Panel studies, we find evidence that strong sustained selection has been rare in recent human evolution (the last ~70,000 years). There are few fixed or nearly fixed differences between human populations, and most fixation events have occurred in the populations that show the most drift at neutral loci. Moreover, the geographic distribution of putatively selected alleles almost invariably conforms to population clusters identified using randomly

chosen genetic markers; this indicates that selected alleles have rarely spread across historical barriers to neutral gene flow. In summary, we propose that the geographic distribution of favored alleles is largely determined by population history and migration, and that the geographic distribution of many SNPs with extreme Fst is best described by a model of relatively weak selection with genetic drift. When humans adapt to new environments it may often be via modest allele frequency changes in multiple genes simultaneously.

How and why *do* humans grow thin skulls? A test of the Systemic Robusticity Hypothesis.

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The most widely accepted theory about the influences on osteogenesis is Wolff 's Law, which posits that physical activity provides the mechanical stimulus necessary to induce osteogenesis.. Recently, Lieberman (Am J Phys Anthropol 101: 217-36, 1996) suggested that increased cortical bone thickness is also influenced by the release of growth hormone (GH) during exercise. This hormone would have systemic effects, increasing osteogenesis even in non-weight-bearing bones.
This research provides an indirect test of Lieberman's Systemic Robusticity Hypothesis (SRH). I compared measures of robusticity of the humerus, femur, and cranium in 25 individuals from the Terry Collection, curated at the National Museum of Natural History in Washington, DC. The SRH predicts that measures of robusticity in different skeletal elements from the same individual should be highly correlated. Results provide intriguing, but equivocal support for the SRH. Ordinary least squares regression analyses fail to support a relationship between cranial and postcranial robusticity within the small sample. However, several pair-wise comparisons, calculated by Spearman ρ rank correlation coefficients, support the SRH, as do Kendall's W coefficients of concordance.
A direct test of the SRH would require measuring the pharmacological and physiological effect of growth hormone on osteogenesis. However, the main problem influencing this and other investigations of cranial robusticity is a lack of agreement on how to define and quantify the trait.

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Late Pleistocene/Holocene human populations transition in Old World: the analysis of morphological dental traits.

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The Pleistocene/Holocene transition was marked by a profound shift in nutritional patterns. Such change, alongside with human demic movements, altered the genetic background of the Old World population. The biological relationships among Upper Paleolithic and Neolithic African, European and Asian human groups have been analyzed by means of morphological dental traits that have proved to be highly discriminant in phenetic analyses among populations because of their abundance, strong hereditary component and low environmental influence.
In the present study, we analyzed the frequency of 49 morphological dental traits (26 maxillary and 22 mandibular) in 18,377 teeth from 3,918 specimens divided in 20 groups (9 belonging to the Final Pleistocene from North Africa, Middle East, South East Asia and Europe, and 11 to the Holocene from North and Sub-Saharan Africa, Arabia, South East Asia and Europe).
The relationships between these groups were assessed applying the standard statistical techniques used in the analysis of genetic data (MMD, Multidimensional Scaling, Maximum Likelihood, Principal Components and Cluster analysis), which produced similar outputs.
Preliminary results indicate homogeneity among the Upper Paleolithic and Neolithic samples from Europe, Middle East, North and Sub-Saharan Africa. In contrast, the Iberomaurusians of Afalou and Taforalt form a separate cluster together with the Saharan Neolithics and the Neolithics from Ras al Hamra 5 in the Sultanate of Oman. As regards the south-eastern Asian groups (Cambodia and Vietnam), the Neolithics present similarities with their European and African coevals, while the Paleolithic groups tend to present some degree of divergence.
Our research was supported by "Progetti di Ateneo" Università di Roma "Sapienza".

Sexual dimorphism in sacral curvature and its relationship to bipedalism and obstetrics.

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The human pelvis is strongly sexually dimorphic. Its shape likely reflects a balance between both obstetric and locomotor selective pressures. While obstetric pressures select for an increase in the size of the birth canal to accommodate the uniquely large-brained human fetus, selection for efficient bipedal locomotion would tend to narrow and, thus, decrease pelvis size.
As part of the pelvic girdle, the shape of the sacrum directly affects both the shape and size of the birth canal. This study examined sacral curvature in humans, apes and early

hominins. Two hypotheses were tested. First, it was hypothesized that modern human females would exhibit significantly less sacral curvature than modern human males as a result of selection favoring a large birth canal. Second, since apes do not have to balance selection to accommodate large-brained infants with selection for efficient bipedalism it was predicted that they would lack sexual dimorphism in sacral curvature. In addition, it was hypothesized that small-brained early hominins would exhibit less sexual dimorphism in sacral curvature than modern humans.
3-D Geometric Morphometrics were used to examine sacral curvature and establish the degree of its sexual dimorphism. Principal Components Analysis confirmed both hypotheses. Modern human females showed significantly less curvature than modern human males. Curvature in both male and female fossil hominin sacra fell within the range of modern human females. Surprisingly, chimpanzees showed greater dimorphism than was expected. The implications of these latter findings will be discussed.

Shape analysis of the dimorphism in modern human mandible throughout postnatal development.

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Studies involving ontogenetic stages potentially strengthen the understanding of sexual dimorphism and within-species morphological variation.
A 3D geometric morphometric study is presented regarding dimorphism of the whole mandibular surface by exploring shape-allometry of modern humans throughout ontogeny. Our cross-sectional sample consists of mandibular surfaces from 151 computed tomographies of humans living in France, ages ranging from birth to adulthood. On each specimen we digitized 415 (semi)landmarks and converted these to shape-variables by Procrustes superimposition. Between males and females, allometric shape changes are compared by regressing shape on the logarithm of centroid size in Procrustes-shape-space. Shape differences according to sex were tested for various mandibular regions and within developmental stages. The mandible exhibits two localized dimorphic shapes during infancy, the coronoid process and the chin. During infancy, the coronoid process exhibits a higher tip and a larger corpus in females. At adulthood the coronoid itself is not dimorphic, but, due to longer growth in males, repositioning of ramus subunits results in overall dimorphism.
In the chin, faster growth in females and some degree of convergence between male and female growth trajectories lead to no shape differences by the time of erupted first permanent molar; then male and female trajectories diverge by adolescence. The adult mental dimorphic shape is similar to the infant one, a rounded female chin against a wide, squared male chin that projects steeply downwards.
Human mandibular dimorphism emerges mainly through allometry due to longer male growth. We discuss the unique chin dimorphism along with additional local patterns.
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Directional hybridization of howler monkeys in Mexico.

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Two species of howler monkeys occur in Mexico, *Alouatta palliata* and *A. pigra*. These are sister species that diverged approximately three million years ago. Overall, these species have parapatric distributions, except in a narrow region in southern Mexico, were groups of both species live in sympatry and hybridize. We have confirmed hybridization through the use of bi-parentally inherited microsatellite loci that are unique to each parent species. In this study both maternally and paternally inherited loci (mitochondrial control region and *SRY* gene, respectively) are sequenced to identify patterns of segregation in individuals of hybrid origin. We only find *A. pigra*-type mtDNA in all adult hybrid individuals, and *A. pigra*-type *SRY* gene in all male hybrids. Based on these results we infer that hybridization only occurs in one direction, by the interbreeding of *A. pigra* females and *A. palliata* males. Nonetheless, first generation male hybrids are either inviable or infertile (consistent with Haldane's rule) and thus only F1 females are produced. Multigenerational hybrid males may only be produced by the backcrossing of hybrid females with *A. pigra* males, or with males of hybrid ancestry. Possible mechanisms causing this bias in hybridization are discussed, including chromosomal and behavioral isolation. Overall, this study contributes to the understanding of reproductive isolating mechanisms between closely related species, and provides insight into the speciation process in primates.
This study is part of an ongoing collaborative project with researchers from the Universidad Veracruzana, Mexico, and has been funded by the Universidad Veracruzana, University of Michigan-OVPR grants U014374 and U022986, and NSF grant DEB-0640519.

Trabecular microarchitecture in thoracic vertebrae of extant hominoids.

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Spontaneous vertebral fractures are a common occurrence in modern humans, yet these fractures are not documented in other hominoids. Variation in structure of the thoracic vertebrae between humans and apes may play a role in their differing resistance to fracture. In this study we examine trabecular bone microarchitecture in the T8 vertebra of extant adult hominoids (mixed sex, n=6 per species). Scaled volumes of interest are analyzed using micro-computed tomography (GE eXplore Locus RS at 46 µm, images analyzed with Quant3D and 3DCalculator). Trabecular thickness, trabecular number, degree of anisotropy, structure model index (SMI) and bone volume fraction (BV/TV) are compared among species. Bone volume fraction and body weight are not correlated. *Hylobates* and *Homo* have a significant difference in BV/TV, but no other differences in BV/TV exist among species. All species display similar trends between BV/TV and trabecular thickness, trabecular number and SMI ($p<0.05$ for each). Degree of anisotropy (DA) does not differ among species, nor is it related to BV/TV in the non-human apes. However, in humans, DA is negatively correlated with BV/TV ($r^2= 0.846$, $p=0.001$), suggesting that less dense trabecular bone is more preferentially aligned in the vertical, primary loading direction with fewer horizontal trabeculae. A structure with fewer horizontal trabeculae can make load-bearing trabeculae more prone to large deformation bending and/or buckling, potentially reducing trabecular bone strength. This may contribute to the unique susceptibility of humans to spontaneous vertebral fractures.

The development of humeral strength asymmetry during growth: play, practice, and childhood activity patterns.

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Studies of humeral strength asymmetry have historically played a key role in establishing the functional adaptation of bone to biomechanical loading, and levels of humeral strength asymmetry in archaeological populations have been utilized to draw conclusions about habitual upper limb use. However, the development of humeral asymmetry has never been extensively explored in multiple immature archaeological or paleoanthropological samples. In this study, asymmetry in humeral cross-sectional properties was explored in seven Holocene samples comprised of individuals under the age of 18 (n=485). Subsequently, levels of humeral strength asymmetry in immature Late Pleistocene fossils were compared to those observed in more recent human groups (n=21). Humeral asymmetry develops slowly during growth, with adult patterns becoming fully apparent after the age of twelve. In the comparative sample, individuals from Indian Knoll have high levels of humeral strength asymmetry in most structural properties; the Kulubnarti sample generally shows low levels of humeral strength asymmetry. In the Late Pleistocene fossil sample, early Upper Paleolithic individuals possess highly asymmetrical humeri, which is congruent with what is known about humeral strength asymmetry in early Upper Paleolithic adults. Archaeological evidence from Indian Knoll and the early Upper Paleolithic indicates that both these populations may have been using spear-throwers, and ethnographic accounts suggest that individuals begin practicing with adult weaponry at a very early age. Reliance on unilateral weapon technology may be partially responsible for the patterns of humeral asymmetry detected in this analysis. Support provided by the Leakey Foundation, Wenner-Gren Foundation, and NSF BCS-0549925.

As we were in life, we are not in death: evidence of possible mummification in prehistoric Britain.

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Most evidence for deliberate preservation of the dead has come from hot or arid regions in which climatic conditions are favourable for natural mummification, and examples from temperate maritime regions are uncommon. Recent excavations at the Bronze Age site of Cladh Hallan, South Uist, Scotland, shows that prehistoric Britons were conducting post-mortem manipulation and long-term preservation of their dead. The skeletal remains of two adults [SK2613 and SK2638] were recovered from separate grave cuts sealed by the foundations of a round house. In SK2613 the left knee (distal femur, proximal tibia and patella) and the right distal radius were deposited in a pit outside the house, while the two upper lateral incisors had been extracted from the maxilla and then placed in each hand. In SK2638 the skeleton appeared to be complete but osteological analysis showed that it was a composite of three separate individuals. Further investigations using ancient DNA, stable isotope determinations, radiocarbon dating and microstructural studies have confirmed that the buried remains are composite bodies with a complex post-mortem history, and were buried in a tightly flexed position centuries after death. In this presentation, I will be discussing the possible modes of preservation, curation, post-mortem bodily manipulation, and implications of how the dead were perceive within Bronze Age Europe.

Inferring the health and status from two bioarchaeological populations recovered from Bridgetown, Barbados.

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While the initial analysis of two skeletal populations interred during the 17th and 18th centuries in Bridgetown, Barbados, revealed vital information concerning the demographic profile and general health of these two groups, the osteological evidence had yet to be applied towards more specific questions involving their epidemiological and social contexts. During the 2008 field season, a more detailed analysis of the observable markers for pathological and occupational stress was conducted. Of these, various indicators of metabolic disorders, infectious pathogens, and occupational stress were noted.

While the high levels of prevalence, patterns, and tendencies of such indicators informs us greatly about the livelihoods and health of these populations, it is their association with the specific historical and archaeological evidence of the period, which allows us to answer questions concerning the environmental and societal causations for such forms of stress. Information from such sources concerning labor activities, dietary practices, and socially based spatial differentiation, is used to discern a more accurate picture of their world.

This research, a result of an investigation involving multiple lines of evidence, sheds new light onto the biological and social lives of these people, and clarifies their socially bound status as members of the early enslaved and freedman populations of Bridgetown, Barbados.

Genetic discontinuity in indigenous populations of the Aleutian Archipelago

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The Aleutian Archipelago consists of approximately 200 volcanic islands, distributed over 1,500 kilometers from the Alaska Peninsula to Kamchatka in Siberia. Currently, 11 of these islands are inhabited by Aleut populations. These populations have been sampled for DNA using mouth rinses, blood specimens and analyzed for mt-DNA sequences and NRY SNPs and STRs. A strong statistical relationship was demonstrated using Mantel tests between geographic and genetic distances ($r = 0.72$; $p > 0.00$) for mt-DNA sequences. Due to asymmetric gene flow (Russian and western European males into Aleut gene pool) there was no statistically significant relationship found between geography and genetic distances based on NRY markers. Genetic discontinuity was detected using SAMOVA (Dupanloup et al, 2002), Delaunay triangulation methods (Monmonier, 1973), Barrier computer program ver. 2.2, and residual genetic distance interpolation of mtDNA haplotypes. SAMOVA analysis performed on D_A distances based on HVS-I, with 2-7 population groups selected *a priori*. The highest Φ_{CT} value (0.326; $p = 0.000$) was obtained when K was set to 4 groups. Genetic discontinuity barriers were located between: (1) Chukotkan, Alaskan Yupik groups and Aleut communities; (2) Kamchatkan populations from Chukchi and Bering Island; (3) Athapaskans from eastern Aleuts; (4) Priblof Islands and Nikolski from eastern Aleuts. The genetic discontinuity reflects the high frequency of haplogroup D in Atka and the aggregated Aleuts settlements. This study documents regional genetic micro-differentiation, following the expansion from the eastern regions to the western islands, followed by founder effect and the action of stochastic processes.

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The ectocranial suture synostosis pattern of Paleo-Aleut and Aleutian inhabitants: A test of cranial shape.

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Research on cranial suture biology has suggested there is biological information to be garnered from pattern of suture synostosis, the pattern being heritable (Cray et al., 2008; Wang et al., 2006). Research also suggests a multifactorial explanation for cranial vault phenotype including heritability, diet, biomechanics, etc. (Mooney and Richtsmeier, 2008; Riesenfeld, 1967). This study was designed to test the hypothesis that ectocranial suture synostosis pattern will differ according to cranial vault shape.

Ales Hrdlicka identified two phenotypes in remains excavated from the Aleutian Island, one he termed Paleo-Aleut, exhibiting a dolichocranic phenotype with little prognathism he linked to artifacts distinguished from later inhabitants, Aleutians, who exhibited a brachycranic phenotype with a greater amount of prognathism (1945).

408 skeletal remains (Umnak-98; Shiprock-101; Kagamil-209) of Paleo-Aleuts and Aleutian as defined by Hrdlicka (1944) were investigated for suture synostosis pattern, following standard methodologies (Meindl and Lovejoy, 1985). Comparisons were performed using Guttmann analyses. Materials were culled eliminating those that lacked a cranium, exhibited no suture activity, or damage preventing analysis.

Results revealed the same patterns for the Paleo-Aleut and Aleutian suggesting pattern is independent of cranial shape in *Homo sapiens*. The patterns for lateral-anterior and vault commencement and termination activity were found to differ from that reported in the literature (Meindl and Lovejoy, 1985). This suggests pattern may

be population dependent and standardized methodology using suture fusion to determine age-at-death may not be applicable to all populations. Abstracting suture data to address population relatedness and mechanism of fusion should continue to be explored.

What can cytokine polymorphisms tell us about human population history? The case of interleukin-6.

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Interleukin 6 (IL-6) is a pleiotropic cytokine that can be synthesized by different types of cells and normally is produced in response to different stimuli. In innate immunity, IL-6 stimulates the synthesis of acute-phase proteins, and in adaptive immunity it stimulates the growth of B lymphocytes (antibody producers). In the promoter region of IL-6 there is a single nucleotide polymorphism G/C at position -174 that affects the transcription rate and the systemic expression of this cytokine. Recent reports showed that the -174 polymorphism is highly heterogeneous among some populations. The aim of this study was to analyze the global distribution for the -174 promoter genotypes and understand what type of evolutionary forces could have been responsible for the observed genotype frequencies. Using previously published data and data from our lab, we analyzed the genotype distribution in 35 worldwide populations. The ancestral allele, giving higher expression, is nearly fixed in Africa, east Eurasia, and the America, while Europe is characterized by a cline of increasing frequency of the derived allele giving lower expression. In the context of the distribution of other cytokine alleles, it is less likely that the European pattern is an effect of demography. We consider two scenarios to have determined the observed patterns: Africa and east Eurasian populations are under purifying selection supporting a high frequency of the higher expression allele, and/or European populations have been under positive selection for lower IL-6 expression. These two scenarios are not mutually exclusive.

Foraging strategies and diet composition of Hadza children.

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Among the Hadza hunter-gatherers of Tanzania, children are active foragers and collect various types of wild plant foods and hunt small sized prey animals. The collection effort of Hadza children is reported to have a positive effect on a mother's foraging yield (Blurton-Jones el at. 1994, *Journal of Anthropological Research* 50(3): 217; Hawkes et al. 1995, *Current Anthropology* 36(4): 688), yet few quantitative data are available on the caloric values of children's foods and the ways in which children distribute their own foraging yield. Here, we report on foraging return rates, consumption data, and the compositional values for several of the plant foods collected by children. Due to predator pressure, it is not safe for children to wander far from camp without adult supervision, therefore they typically focus on foods that are close to camp and easy to collect and process. We calculated the caloric content for the following foods: baobab fruit (346 kcal/100g dry matter (DM)), berries (320 kcal/100g DM), legumes (311 kcal/100g DM), drupes (325 kcal/100g DM), and figs (365 kcal/100g DM). Legumes, drupes, and figs have not been previously analyzed; our values for baobab and berries agree with previous analyses (Murray et al. 2001, *Journal of Food Composition and Analysis* 14: 3). In addition, we calculated foraging return rates and daily consumption values for children. Our results suggest that they collect a significant portion of their daily caloric intake and act as allomothers providing caloric contributions to other children.

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What urine can tell us about protein balance in wild orangutans.

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Nutritional studies of primate diets have long stressed the importance of protein. Yet the role of protein balance in wild primates has received relatively little attention. Inadequate protein in an animal's diet can lead to a negative protein balance, resulting in loss of muscle protein, and stunted growth and development. During periods of low fruit availability, frugivorous primates may suffer a negative protein balance if body protein is mobilized to contribute to energetic demands. This negative energy balance and the catabolic states of tissue mobilization can be detected if fatty acids, amino acids, and nitrogen catabolites are recycled back to tissues. To maintain

nitrogen balance, animals are expected to decrease nitrogen loss via shed body tissue and urine. Consequently, chemical analyses of urine provide non-invasive techniques that contribute to our understanding of how primate metabolism is affected by food availability. We analyzed urea, nitrogen concentrations, and stable nitrogen isotopes in Bornean orangutan urine samples to assess protein dynamics during periods of varying fruit abundance.
Preliminary results indicate that urea and %N varied as predicted during periods of high and low fruit abundance. However, there was no significant difference in isotopes. We suspect that this is because orangutans obtained adequate dietary nitrogen to maintain protein balance throughout the study period. During periods of high fruit abundance, orangutans had excess nitrogen in their diet. Conversely, by consuming adequate amounts of protein in supplemental fallback diets during low fruit availability, they did not lose enough protein to recycle their urea nitrogen.
This research was funded by the National Science Foundation, the L.S.B. Leakey Foundation, and the David and Lucile Packard Foundation.

The early European settlers in the New World: Life and death at La Isabela, Santo Domingo, Dominican Republic (1493-1498).

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La Isabela, founded by Colon in AD 1493 in the Dominican Republic, is the first colonial settlement in the Americas. Its graveyard soon started accumulating the mortal remains of those who did not succeed in accommodating to the harsh living and operational conditions. Historical information reports that deaths occurred for interpersonal violence or infectious diseases, among others. The present study analyzes the remains of 49 individuals, unearthed from that graveyard, currently stored at the Museo del Hombre Dominicano in Santo Domingo. They were sexed and aged using morphologic methods, and scrutinized for pathological skeletal and dental conditions in order to shed light on the potential causes of morbidity and mortality. Preliminary results indicate an average young adult age at death as well as the presence of at least five subadults, one showing artificial head shaping, and four women, one Caucasoid and another Taino. Oral pathologies were fairly common (13.7% of teeth and 63% of the adults affected) as well as evidence of physical stress like periostitis (50% of the individuals) and entesopathies. In contrast, no convincing evidence points to chronic infectious diseases or traumas. In conclusion, the preliminary analysis reports the presence of women and infants that was not included in the historical reports. Lack of chronic infectious diseases indicates that death occurred as a consequence of acute pathological manifestations, which is consistent with the exposure to unknown pathogens. The lack of evidence of interpersonal violence instead suggests that this form of death was not as common as other ones
The analysis was funded by the Universidad Autonoma de Yucatan, Merida, Mexico.

Variability selection and *Kolpochoerus heseloni* (Artiodactyla, Suidae): a model for the dichotomous morphologies of *Australopithecus afarensis*.

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At East African fossil bearing localities members of the family Suidae (pigs) are an abundant and ubiquitous group commonly associated with Plio-Pleistocene Hominidae. Previous research has shown that suids are: (1) important paleoecological indicators, (2) useful for dating hominin bearing sediments, and (3) a useful proxy to model hominin paleoecology. During the Plio-Pleistocene, the genus *Kolpochoerus* is geographically wide spread throughout Africa and is known at localities in northern, eastern, and southern Africa. Here we present the Suidae as a model for the variability selection hypothesis. We used a modern suid sample (n=155) comprised of four genera (*Sus*, *Phacochoerus*, *Hylochoerus*, and *Potamochoerus*) to assess morphological variation in the mandibles and dentitions of *K. heseloni* from the Koobi Fora Formation (n=24). We assessed shape in the following four areas: third molar, symphysis, corpus, and ascending ramus. Linear measurements were transformed into index variables. We conducted discriminant function analyses using indices and computed bivariate plots of linear measurements (e.g. length v. width) to assess variability in *K. heseloni*. Our results indicate that the mandible of *K. heseloni* exhibits a suite of morphological characters which, together, are not found exclusively in any one modern African suid genus. In other words, the mandibles of *K. heseloni* display a combination of features associated with more than one modern suid group. We consider these results to reflect a "versatile" plan necessary for organisms living in variable environments. We suggest that the dichotomous body plan of hominins such as *Australopithecus afarensis* may be explained by variability selection.

Forensic anthropological investigation of historic hate crimes: the Pine Barrens case.

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In 1908 Lillie Brewton Davis, a young wife and mother, was raped and murdered near Pensacola Florida by an itinerant black turpentine worker, Leander Shaw. Before dying she identified her assailant, who was arrested and imprisoned; later that evening an enraged mob broke into the jail and lynched Shaw in a downtown plaza. The violence did not end with Shaw's hanging, however. According to Lillie's great-nephew, an eye-witness to these events, for decades afterward, the victim's family continued to exact revenge on any solitary black men who happened past their property, murdering them and burying their bodies under a walnut tree in the "Sandy Hollow" near the highway. Since 2004, the Department of Anthropology at UWF has participated in a multi-disciplinary, collaborative effort to locate the graves and recover the bodies of these murdered men. This paper describes the methods and techniques used to date (systematic foot survey, cadaver dogs, metal detectors, ground penetrating radar, aerial photography analysis, systematic trenching, test excavation, etc.), and evaluates the potential for a successful outcome based on current results.

Nutrition and epidemiology in the prehistoric population of San Pedro de Atacama, northern Chile, under the influence of Tiwanaku Empire.

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The oasis at the Atacama Desert presents its prehistory marked by the influence of foreign cultures, due to its importance as a checkpoint in the trade routes that connected the Southern Andes to neighbor coastal and Argentinean regions. Of special relevance was the influence of the Tiwanaku State between 400-900 AD. This period is associated with a general enrichment of the material culture and burial offerings and also with a significant increase of human stature, suggesting an improvement in some aspects of health and lifestyle. This study hypothesizes that there was a significant improvement in health in Atacama oasis inhabitants during the Tiwanaku influence. To test that hypothesis, prevalence of nonspecific infections (periostitis and osteomyelitis) and dental caries between four periods of the prehistory of Atacama: pre-, peak, final and post-Tiwanaku's influence were compared. The sample is composed by 161 adults and 88 sub-adults skeletons from three cemeteries: Solcor-3, Coyo-3 and Quitor-6, dating between 250-1240 AD. The prevalence of caries shows a significant decline during the peak Tiwanaku period, suggesting an improvement in oral health. Conversely, nonspecific infections show a significant increase in juveniles and adults during the peak of the Tiwanaku influence. These results suggest that the influence of Tiwanaku had two distinct and opposite effects on population health. Nutritionally, less carbohydrates and more animal protein intake decreased the prevalence of caries while, epidemiologically, changes in population aggregation caused an increase in the prevalence of infections.
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Health status of the Ipiutak at pre-historic Point Hope, Alaska.

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The occupation of the Point Hope peninsula began approximately 500BC and has continued into modern times. Located 125 miles north of the Arctic Circle, the peninsula has hosted various cultures during its occupation. The Ipiutak (0-500AD) and Tigara (1400AD to contact) are the best represented in the skeletal assemblage excavated by Larsen and Rainey in 1940-41. This paper focuses on the health status of the Ipiutak, a migratory band of caribou hunters who returned to the peninsula annually to hunt seal and walrus during the summer months. The sample utilized for this paper represents the 75 Ipiutak individuals (27 females, 33 males, 15 subadults) housed at the American Museum of Natural History whose skeletal remains permitted both age and sex assessment. Analysis of the seven health indicators outlined in *The Backbone of History* (anemia, degenerative joint disease, dental health, hypoplasia, infection, stature, and trauma) allows for the calculation of an overall health score using the Mark I health index. High levels of trauma and DJD and extremely short statures have the greatest negative effect on the health index score for the Ipiutak of Point Hope. At 66.2 the Ipiutak are ranked with American slaves and soldiers and Basin of Mexico inhabitants in the bottom third in health status for the entire Western Hemisphere. These results suggest that despite their hunting and gathering economy, the Ipiutak lived a stressful life, and that environment has a much greater effect on health status than does social organization, economic system or other ecological factors.
This project was supported in part by a Collections Research Grant from the American Museum of Natural History.

Lever mechanics in the jaws of sympatric West African colobines: skull proportions do not invariably sort taxa by a criterion of dietary consistency.

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The inference of dietary adaptation from lever analysis of the mammalian skull has a long and successful history. DuBrul's (1977, *AJPA* 47:305-320) classic analogy of australopith and ursid skulls suggested that inference of muscle size as well as masticatory lever and load arms could distinguish dietary generalists and specialists, with specialists implied to be processing stronger and tougher foods.

The similar-sized and sympatric *Procolobus badius* and *Colobus polykomos* from Tai Forest, Ivory Coast differ in feeding behavior primarily in terms of frequent exploitation of tough and hard foods in the latter. Following DuBrul's rationale, in *Colobus* we should observe (relative to *Procolobus*) larger temporal fossae, larger and taller rami, more favorable lever: load arm ratios (i.e., shorter faces), and a temporomandibular joint elevated above the tooth row. These predictions comprise a test of the lever model for subtle yet significant dietary contrasts.

Our comparison of the skulls of *Procolobus badius* and *Colobus polykomos* from the Tai populations reveals no interspecific difference in temporal fossa size. In addition, *Colobus* displays lever to load arm ratios that are either indistinguishable from or less than those of *Procolobus*. Only in terms of elevation of the temporomandibular joint relative to the occlusal plane and size measures of the ramus does *Colobus* conform to DuBrul's model of dietary specialists. Elevation of the jaw joint serves to maximize leverage of the masseter/medial pterygoid complex, while the enlarged ramus provides anchorage for expanded insertions of these muscles. Facial retraction is not associated with dietary specialization in this case.

The phylogenetic affinities of the Pondaung tali.

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The phylogenetic affinities of the primates from the late middle Eocene Pondaung Formation of Myanmar are currently the subject of much contention. The number of large-bodied primate taxa present in the fauna and the related question of whether the amphipithecids have anthropoid or adapid affinities are both matters of continuing debate. The discovery of NMMP 20, a primate with postcranial attributes most similar to notharctine adapids (Ciochon et al, 2001), gave a clear indication that at least one large-bodied Pondaung primate is closely related to adapids or lemuriforms. On the other hand, the NMMP 39 talus (Marivaux, et al. 2003) and another recently discovered talus (Marivaux, et al. in press) are morphologically most similar to anthropoids and support the notion that large-bodied anthropoids are also represented in the Pondaung Formation.

Based on a morphometric analysis Gunnell and Ciochon (2008) cast doubt on the anthropoid status of the NMMP 39 talus, claiming that this tarsal bone "is more closely related to adapiform primates than any other known group" (Gunnell and Ciochon, 2008: 226). In contrast we are able to produce both principal components and discriminant functions that yield a rather clear separation of extant haplorhine and strepsirhine tali. The discriminant function classifies fossil adapids as strepsirhines and most omomyids and fossil anthropoids as haplorhines. Both Pondaung tali are unambiguously classified as haplorhines.

In addition, the non-metric characters cited by Gunnell and Ciochon to support the adapiform status of NMMP 39 can be easily rejected.

Body mass revisited: a new method to improve the accuracy of individual estimates.

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Most currently implemented methods for determining body mass were created from measurements of living subjects and applied to skeletal remains. Furthermore, population means were utilized in order to determine the regression equation. This study seeks to find the true error associated with estimating body mass from skeletal remains on an individual basis. Skeletal remains (n=671) were analyzed from the Maxwell Museum, Hamann-Todd, Robert J. Terry, and William M. Bass documented collections. The samples were divided into four subgroups based on sex and biological affinity.

This research broadens the scope of a previous pilot study that sought to determine body mass from multiple skeletal elements using stepwise regression equations from documented skeletal data. Stepwise regression on multiple variables consistently produced higher R^2 values than estimates based on single dimensions. In the current research, the new method is compared to current methods to evaluate its effectiveness on skeletal remains. When compared to methods using bi-iliac breadth and femoral length, the range of R^2 dramatically increases (from R^2=0.056 -0.12 to R^2=0.29-0.91). The error is also higher than expected (SEE=19.46-39.7 kg). This suggests that current methods of estimating body mass may not be sufficiently precise on an individual basis and that previous methods based on living subjects may

underestimate the prediction error when applied to skeletal remains.

Ontogenetic differences in scrotal coloration among South African vervet monkeys.

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Scrotal coloration plays an important role in male competition and socio-sexual communication. The blue scrotal coloration of the vervet monkey (*Cercopithecus/Chlorocebus aethiops*) is not under androgen control, but is related to serotonin and hydration levels. Observed differences in male color affects male dyadic relationships. In addition, as males age, aspects of color may change in response to developmental changes in physiology. Age and hormone production have potential developmental effects on testes volume and scrotal color development. To examine potential ontogenetic effects of age and hormone production on body weight, testes volume and scrotal color development, we conducted a preliminary study to examine the relationship between color variability and relative testes size in three groups of free-ranging vervet monkeys. We trapped 19 males, including three yearlings, three juveniles, two sub-adults, and 11 adults. Color was measured objectively using digital photography. Testes volume was determined by using an orchidometer.
Our results indicate that testes volume and body weight are positively correlated ($p<.001$) in sub-adult and adult males. We used a testes volume: body weight ratio to examine the relationship between relative testes size and male coloration. Using a statistical ANOVA, we found a significant positive relationship between scrotal brightness and relative testes size across age groups ($p<.01$). Relative testes size is related to scrotal color saturation ($p=.06$); but not scrotal hue ($p>.05$). Combining future color, behavioral, and biological samples will allow a more in-depth examination of the development of coloration and its role in socio-sexual communication.
This research was supported in part by NSF award BCS0629321.

High-resolution analysis of plantar pressure in habitually shod and unshod humans.

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The distribution of plantar pressure during roll-off can provide crucial information about foot function and gait. Here, we compare plantar pressure data of barefoot walking in habitually barefoot and shod populations, in an attempt to evaluate the potential influence of footwear of foot function. We will use a novel, high-resolution method of analysis (Pataky & Goulermas, J. Biomech 41(2008): 2136-2143) and compare the outcome to conventional methods that subdivide the plantar aspect of the foot in a relatively small number of discrete zones of interest. Additionally, we evaluate kinematic data in order to assess functional stiffness of the foot in the two populations.
Habitually barefoot walkers had significantly wider feet and lower peak pressures than habitually shod walkers. The latter might be due to a more even spatial distribution of pressure over the foot sole, as well as more evenly applied vertical impulse over the duration of stance. The two main factors influencing foot arch stiffness, i.e. lowering of the arch under load and the windlass effect at the first metatarso-phalangeal joint, are similar between the two populations.
We conclude that foot function is grossly similar in habitually shod and unshod populations, but differs quantitatively in specific respects. The high-resolution (pixel level) analysis was found to be more sensitive and spatially unbiased than the conventional method.
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Carpal kinematics in extant non hominoid anthropoids using an X-ray methodology

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Among Miocene anthropoids, potential ancestors of extant hominoid, the use of various quadrupedal hand postures (i.e., palmigrady, digitigrady, knuckle-walking) is supported by functional interpretations of their carpal bones. These conclusions are based on an anatomofunctional knowledge of the wrist of extant anthropoids, neglecting their carpal kinematics that, excepted hominoids, remains largely misunderstood. Here we present a quantitative and qualitative analysis of the carpal kinematics of seven non hominoid anthropoids in order to determine whether their carpal kinematics is homogeneous.

The wrists of seven fresh cadavers of non hominoid anthropoids including cercopithecoids (n = 4) and ceboids (n = 3) were radiographed in the two positions of maximal radioulnar deviation and flexion-extension. The carpal kinematics of each specimen was characterized by angular measurements (ratio between antebrachiocarpal mobility and midcarpal mobility) and qualitative observations (characterizations of osteoarticular columns).
Our quantitative results show that the carpal kinematics of non hominoid anthropoids is homogeneous for the two movements, which is illustrated by a midcarpal mobility higher than the antebrachiocarpal mobility. Qualitatively, osteoarticular columns specific to ceboids and cercopithecoids are highlighted. When compared to data from the literature, these results show that, in flexion-extension, a predominant midcarpal mobility is highlighted in all anthropoid. In radioulnar deviation, the midcarpal mobility is more variable. Thus, a better knowledge of the carpal kinematics of non hominoid anthropoids allows to clarify the relationship between the function and the morphology of carpal bones, and should precise functional interpretations of fossil carpal bones recently attributed to Miocene hominoids.

Preliminary analyses of dental health in Middle Horizon (AD 500-1000) San Pedro de Atacama, northern Chile.

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Bioarchaeological analyses of dental health in prehistoric skeletal remains can reveal facets of diet and lifestyle. We examined the presence of caries, abscesses, and antemortem tooth loss (AMTL) in a sample (N=273) from the cemeteries of Solcor 3, Solcor Plaza, and Solor 3, in San Pedro de Atacama. Atacameños were an agro-pastoral society that experienced a period of great prosperity during the Middle Horizon. We hypothesize that their diet, rich in carbohydrates and grit from processing, contributed to poor dental health, as seen in contemporary cemeteries. Moreover, females likely consumed higher amounts of starches and grains probably resulting in elevated rates of these indicators among females.
As expected, our investigation revealed extreme frequencies of caries (124/160; 77.5%) and AMTL (186/215; 86.5%), while abscesses were less common (110/214; 49.1%). Similarly elevated frequencies have been documented elsewhere in the oases, suggesting that local diet played a strong role in dental health. Intrasite differences are slight, with only the presence of caries reaching statistical significance (p=0.001) because of the lower rates at Solor 3 (42.4%). There were no statistically significant differences between males and females, which nullifies our hypothesis and demonstrates that differential access to resources was minimal. However, when sites were considered individually, females at Solcor 3 had higher rates of AMTL (p=0.015), suggesting that these women may have had a limited diet.
Therefore, our data support our hypothesis that Atacameños suffered from poor dental health in the Middle Horizon, however, there were few differences between the sexes.
This project was supported by NSF BCS-0721229 and the Colorado College Venture and Jones Funds.

The Raymond A. Dart Collection of Human Skeletons: history, inventory and demographic assessment.

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The Raymond A. Dart Collection of Human Skeletons (Dart Collection) is housed in the School of Anatomical Sciences at the University of the Witwatersrand, Johannesburg, South Africa, and comprises one of the largest documented cadaver-derived human skeletal assemblages in the world. This collection originated in the early 1920's as a result of the efforts of Raymond Dart, and continues to grow. The skeletons included represent varied indigenous and immigrant populations from southern Africa, Europe and Asia. This contribution documents the history of the collection and provides an updated inventory and demographic assessment of this valuable research collection.
According to a recent inventory the Dart Collection currently comprises 2605 skeletons representing individuals from regional South African Black (76%), White (15%), Coloured (4%), and Indian (0.3%) populations. A large proportion of the skeletons (71%) represent males. The recorded ages at death range from the first year to over 100 years of age, but the majority of individuals died between the ages of 20 and 70.
The Dart Collection has been affected by collection procedures based on availability. All of the cadavers collected prior to 1958, and a large proportion subsequently, were derived from unclaimed bodies in regional South African hospitals. Some details of documentation (age at death, population group) are estimates and some aspects of the collection demographics (sex ratios) do not closely reflect any living South

African population. Our inventory and analysis of the Dart Collection is aimed to assist researchers planning to study the materials from this collection.

Allele distribution at HLA DQA1 and HLA DQB1 among Cayapa Indians and Blacks from Ecuador: an association study with onchocerciasis.

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As consequence to long exposure to infectious diseases, natural selection had a major effect on human genome. There are many genetic studies on susceptibility to infections, principally on human leukocyte antigen (HLA) in human populations. DNA of 100 unrelated individuals of two South American communities (Cayapa Indians and Ecuadorian Blacks) have been analyzed to typing the locus HLA DQB1 and HLA DQA1. HLA typing was performed by two different protocols: Sequence Specific Oligonucleotides hybridizations (SSO) and Sequence Specific Primer amplification (SSP). Direct sequencing (Sequence Based Typing, SBT) was carried out on samples that have not been successfully typed with SSO/SSP.
As previous studies showed the existence of linkeage disequilibrium between some SNPs and HLA alleles, SNP rs1056315 was typed in order to confirm a predictive correlation between rs1056315-T allele and HLA DQB1*0301 allele in Blacks, as reported in literature.
Among the Ecuadorian Blacks, a connection is pointed out between the HLA-DQB1*0301 and the protection towards the infection of *O. volvulus*. These results confirm the only ones previously reported for African populations. On the contrary, among the Cayapa Indians this correlation is lacking. Otherwise among the Cayapas another putative protective allele seems to be present: the HLA DQB1*0402, which is statistically more frequent in the healthy individuals. No potential protective allele of HLA-DQA1 seem to be in both populations. The correlation between HLA DQB1*0301 and the T allele of SNP rs1056315 has been confirmed in the Blacks, while this correlation among the Cayapas seems not present.

An investigation of long bone curvature in modern human populations: femur, ulna and radius.

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Research from forensic anthropology demonstrated the diagnostic value of femoral curvature in distinguishing between human populations but no relationship was found between femoral curvature, habitual behavioral patterns and latitudinal position and different studies showed a lack of concordance. The current study analyzed patterns of curvature of the femur, ulna and radius using anthropometric measurements and 3D morphometrics of modern humans and their relationship to population-specific information such as body size, activity level, time period and climate.
The results suggest patterns within long bone curvature but that these are different for the upper and lower limb. Femoral curvature is related to habitual activity patterns. The highest levels of curvature for the femur were found in populations with the highest activity levels. Femoral curvature follows different trends from robusticity and is not necessarily a response to the same loading regime. For the femur, which is loaded proximodistally, curvature lowers bending stress by translating it to axial compression, and curvature may be a compromise between bone strength and predictability of bending strains and material failure. In contrast, variation in curvature of the radius and ulna is a consequence of long-term exposure to cold climate conditions rather than a result of habitual behavior. This curvature is arguably not an adaptation in itself, but a consequence of reduced relative forearm length in cold-adapted populations. In order to optimize strength of the lower arm despite its shorter length, curvature may serve to maintain full muscle function, preserve interosseous surface area and facilitate muscle packing.
This project was supported by the Graduate School, UCL; The Leakey Fund; The Ruggles-Gates Fund for Biological Anthropological Research; The Wenner-Gren Foundation for Anthropological Research; Synthesys; and the UCL Alumni.

Microevolutionary analysis of populations of Amerindian origin from southern Chile.

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Above 42 degrees south latitude in Chile there is an important discontinuity in the archeological register. The first human settlements date from the end of the Pleistocene (Monte Verde, 14,500 years BP); then for almost 9,000 years there is no evidence of human occupation, which reappears in the middle of the Holocene, about 5,000 years BP. By contrast, central and southern Patagonia has numerous archeological sites that demonstrate that it has been populated more or less continuously for about 12,000 years. This evidence cannot be explained by a linear model of north-south population of South America, and suggests more complex movements of the populations of this region during the Holocene.
In order to evaluate a possible Patagonian origin of the present-day aboriginal populations of southern Chile, we determined the sequences of mitochondrial DNA D-loop of 246 individuals belonging to five ethnic groups: Huilliches, Pehuenches, Mapuches, Yamanas and Kaweskar. The

detailed analysis of the C and D haplogroups showed a high frequency of D (16187T) haplotypes, exclusive to these populations and in high frequency in Huilliches, Mapuches and Pehuenches, in which there are private polymorphisms that suggest a recent population expansion. In Yamanas and Kaweskar 16187T was infrequent; the majority were of the lineage D4h3 (16241G, 16342C), which is extremely scarce in America and described from a skeleton of 10,300 years BP in North America. Demographic analysis suggests that the Yamanas and Kaweskar are relict populations, possibly related to the center of origin of a south-north migration.

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Hominoid brain organization: Histometric analyses of striate and extrastriate areas.

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The visual system is the largest sensory modality in humans and closely related species, and the size and organization of human visual brain structures have played a central role in discussions of brain evolution. It has been argued that changes in the relative sizes of visual system structures prior to encephalization provide evidence of reorganization in the human lineage. Yet very little is known about the organization of the visual brain structures in the taxa phylogenetically closest to humans – the apes – thus making it difficult to evaluate hypotheses about recent evolutionary changes. The primate visual cortex is comprised of numerous cytoarchitectonically distinct areas, each of which has a specific role in the processing of visual stimuli. The histological organization of striate (V1) and three extrastriate (V2, VP and V5) cortical areas were compared. Quantitative data about the cell volume densities and laminar patterns of these areas were used to compare the cytoarchitectural patterns of visual areas in humans, five ape species, and a macaque. Also investigated were potential scaling relationships between cell volume density and several brain, body and visual system variables. The results suggest that interspecific variability in visual system structures can arise independently of global brain and body size scaling relationships. In particular, species-specific differences in cell volume density seem to be related to gross-level visual structure variables. Also, it is noted that chimpanzees and bonobos differ from each other in the size and histological organization of visual areas.

Are there really any hominoid sclerocarp foragers in the middle Miocene? A closer look at the anterior dental evidence .

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The hominoid fossil record from the middle Miocene of East Africa has historically been characterized by low taxonomic diversity. Prior to 1999, most large-bodied hominoids were included in a single genus (*Kenyapithecus*), although that sample is now thought to represent as many as three separate genera (*Kenyapithecus*, *Equatorius*, *Nacholapithecus*). This increased taxonomic diversity has prompted a renewed interest in the paleobiology of middle Miocene hominoids. While it is generally accepted that this group is a continuation of a radiation of thickly enameled, hard-object frugivores beginning with *Afropithecus*, an early Miocene sclerocarp-forager, relatively little is known about dietary variability among middle Miocene taxa. McCrossin and Benefit (1997) have argued that overlapping anterior dental morphology demonstrates that their hypodigm for *Kenyapithecus* (*Equatorius* + *Kenyapithecus*) represents a sclerocarp foraging adaptation similar to *Afropithecus*, however this hypothesis has yet to be tested by any detailed morphometric analysis of the anterior dentition. This study attempts such an analysis in an effort to better understand the relative importance of sclerocarp-foraging behavior to middle Miocene hominoid diets. High-resolution polynomial curve fitting (HR-PCF) was used to quantify incisor and canine crown curvature for middle Miocene hominoids and a comparative sample of extant pitheciines (n=46). Results suggest that while hard-object resources were an integral component of middle Miocene hominoid diets, these taxa lack the anterior dental specializations for sclerocarp-foraging shared by *Afropithecus* and extant pitheciines (i.e. prominent anterior canine curvature). Therefore, while sclerocarp-foraging was a key dietary component for *Afropithecus*, it is significantly less important in the middle Miocene.

Novel non-invasive alternatives for the measurement of autonomic stress responses in children and adults.

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The autonomic nervous system is an evolutionarily ancient mechanism that coordinates responses before, during and after acute stress. Advances in measurement technology present new alternatives for assessing autonomic stress responses, illustrated here using recent studies. In one study (DeCaro and Worthman, 2008), children (N=30) underwent continuous EKG recording during a standardized interview. An index of respiratory sinus arrhythmia (RSA), a marker for parasympathetic activity, was extracted using a method borrowed from psychophysiology based on heart period oscillations within the respiratory frequency range. In another study (DeCaro, 2008), saliva samples from adults (N=20) were analyzed for α-amylase activity, a general autonomic biomarker, after simulation of various collection and handling conditions. Both methods are consistent with research designs that evaluate the physiological impact of daily experience. However, single measurements are unlikely to be meaningful given sensitivity of both RSA and amylase to current psychosocial context. Both are field-portable, and can be used non-invasively to measure responses in real time in children and adults. RSA is specific to parasympathetic activity, which lacks a non-invasive hormonal proxy. However, controlling effectively for movement can be difficult, especially in children. Hence, RSA may be most useful to biological anthropologists for the assessment of parasympathetic activity at rest. Samples for salivary α-amylase are easy to collect and inexpensive to process; however, two common field collection techniques (azide preservation and absorbent cotton rolls) can interfere with analysis. These methods provide added value for measuring stress effects in field research, if researchers are cognizant of interpretive and methodological limitations.

Age determination by magnetic resonance imaging of the knee: a preliminary study.

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The goal of this presentation is to demonstrate the possibilities of aging using magnetic resonance imaging (MRI) explorations of the knee. The authors developed a MRI grading system for physeal fusion of the knee and evaluated the reliability and validity of this grading system. 189 MRI explorations of the knees were reviewed retrospectively on patients aged from 9 to 25 years old (94 males, 95 females). The evaluation was performed on coronal fast spin-echo proton density-weighted images. Five stages were defined to asses the degree of maturation of the distal femoral and proximal tibial physis. Three different observers classified the explorations (two radiologists, one anthropologist). For both gender the changes in physeal pattern were highly associated with age for both tibial and femoral physis ($p<0.001$). For males, stage 1 of the femoral physis agreed with an age under 16 years old; stages 1 and 2 of the tibial physis agreed with an age under 18 years old. For females, stages 1 and 2 of the femoral physis agreed with an age under 16 years old; stage 4 of the femoral physis agreed with an age over 16 and stage 5 with an age over 22 years old. Inter and intra observer variabilities were excellent, proofing the reliability and the validity of this grading system. Further studies with larger groups are needed to support those results. However MRI exploration of the knee seems to be an efficient non-invasive and non x-ray exposing method for age assessment.

Regional canalization and developmental instability in the human skull.

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Functionally important characters within the mammalian skull are predicted to be less variable than other characters. Determining the developmental pathways that maintain these phenotypes is vital to understanding cranial functional anatomy and evolution. Canalization and developmental stability are two processes thought to maintain phenotypes, although their independence is debated. Canalization is often estimated by between-individual variation, and developmental stability is estimated by within-individual variation, or fluctuating asymmetry (FA). The goal of this analysis was to parse out the roles of canalization and developmental instability in different regions of the human cranium: face, base, and vault. Three-dimensional coordinate data were collected from landmarks on all parts of the cranium in samples from medieval Kulubnarti (30 males, 30 females) and the Terry Collection (29 males, 29 females). Data were partitioned into regions, Procrustes superimposed, and symmetric and asymmetric components of variation were calculated using MorphoJ. ANOVA partitioned the effects of individual, side, and FA. Results from this study suggest that canalization and developmental stability are distinct mechanisms. Within each sample, the vault was the most highly variable region of the cranium, as predicted. However, the cranial base showed relatively low amounts of between-individual variation, but higher levels of asymmetric variation. In contrast, the face varied significantly between individuals, but showed low levels of asymmetry. These results indicate that canalization plays a role in maintaining shape of the cranial base, but that developmental stability may be more important in the face, possibly due to the functional importance of symmetry in this region.

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Capuchin monkey bipedalism.

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Capuchin monkeys habitually walk bipedally. We studied the mechanics of capuchin bipedalism and compared it with the bipedal gait of humans. We collected ground reaction forces (GRF) and 3D kinematics from two capuchin monkeys (*Cebus apella)* trained to move bipedally down an instrumented runway. GRFs were measured from two force platforms and used to calculate center of mass (COM) mechanics. Capuchins prefer to use a fast bipedal gait with short double-limb support periods. Their trunk is positioned upright, but hip and knee joints are significantly flexed during stance. Knee angles at touchdown are about 140^{o} and drop to 100^{o} at midsupport. The ankle also yields early in the support phase. As a consequence, the COM falls in height by about 2cm from touchdown to midsupport. This is different from human bipedal walking where the COM rises as the body vaults over an extended lower limb, but similar to human running where the COM falls to its lowest point at midstance as the limb compresses. Like in human running, the GRF traces lack dual peaks and the kinetic and potential energy of the COM fluctuate in phase. During swing phase, the hip drops and requires knee flexion to allow the foot to clear the ground. Taken as a whole, capuchins prefer a bipedal gait that is not governed by pendulum mechanics, but rather compliant mass-spring mechanics. An effective balancing mechanism to keep the hip level is lacking.
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Taphonomy and paleoenvironment of Laetoli: the micromammal evidence.

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Recent field work conducted between 1998-2005 have more than doubled the available sample of rodent specimens from Laetoli, the type site of *Australopithecus afarensis* and this allowed to name several new species. This paper discusses the taphonomy of Laetoli micromammals and presents an analysis of the paleoenvironment based on the micromammal collections to date. The taphonomic analysis of the new material looks at element representation, breakage patterns and bone surface modification for evidences of owls and/or carnivore activity and weathering. The results indicate that fossil rodents from Laetoli have a complex taphonomic history that in some instances involves predators while other, extremely well preserved specimens result from animals entombed in their burrows by ash from the eruption of nearby volcanos.
The paleoenvironmental analysis unites new and fossil collections and the biogeographic patterns of species representation indicate an affinity to South African Pliocene faunas. The assemblage has a very low abundance of Murine rodents, which come to dominate East African rodent faunas by the start of the Pleistocene. The Pliocene rodent communities at Laetoli include one predominantly arboreal taxon (*Thallomys*) along side fossorial and burrowing taxa which we interpret to indicate the presence of Acacia trees growing on loose, well drained sediments. The community composition of the Laetoli micromammals are compared to modern East African communities and possible analogues discussed.

A biomechanical approach to the identification of activity-related change in the upper limb in the Late Woodland period.

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This study investigates humeral cross-sectional geometric properties in males and females from the Amerindian Late Woodland period Shannon site (Virginia). The bow and arrow was introduced to this area in the Woodland period and it is hypothesized that a pattern of crossed asymmetry may be found in males relating to bow and arrow use. It is presumed that the Shannon population had a sexual division of labor based around the desire and pursuit for war and this will be identifiable in the upper limb. A comparative sample of males from the English Battle of Towton (1461 AD) was included to examine crossed asymmetry in the humerus related to weapon use. CT images were taken of the humerus at the 20%, 35%, 50%, 65%, and 80% slice locations. These images were analyzed to identify differences in diaphyseal robusticity (CA, TA and J) and shape (Ix/Iy) both between sexes and between Shannon and Towton males. Bilateral asymmetry was calculated as [abs(R-L)/((R+L)/2)]*100.
Results show significant differences in diaphyseal robusticity, shape and bilateral asymmetry between males and females of the Shannon site. Females demonstrate increased TA, CA and J when compared with males (significant at multiple slice locations) and decreased bilateral asymmetry. Shannon males did not demonstrate the hypothesized pattern of crossed asymmetry as identified in conjunction with longbow use in the Towton sample, and indeed, significant differences were identified between the two

male samples in diaphyseal robusticity and shape.
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Comparative demography of red howler monkey (*Alouatta seniculus*) populations in relation to habitat ecology in Yasuní N.P., Ecuador.

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Due to the effects of anthropogenic disturbance activities threatening many wild primate populations, it has become increasingly important for researchers to design studies investigating the determinants of primate density and demography capable of yielding more immediate and informative results. With this goal in mind, this study employed a multivariate approach that examined the role forest ecology plays in influencing population density and demography of *Alouatta seniculus* at two Western Amazonian sites in Ecuador where primates currently face many facets of human disturbance.
Study sites were located close in proximity but differed in habitat type and howler monkey density and demography. The site with lower howler monkey density (PPRA) is a non-flooded *terra firme* habitat with resources higher in phenolic content and lower in protein compared to the seasonally flooded site with higher howler monkey density (TBS) (Derby 2008). Results from this study found that within the similar sized study sites there were three groups at PPRA and ten groups at TBS. Average group size was slightly larger at PPRA, reflected mainly in a higher number of females. However, neither the average group size nor any aspect of group composition differed significantly between the two sites (Mann-Whitney U Test, $P > 0.05$). These results differ from previous work suggesting higher howler monkey density is associated with larger group size and more males and females per group. Results are discussed in relation to the possible roles of hunting, infanticide, and biological theories of demographic change in relation to habitat quality.

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Why we sprain our ankles.

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The anterior talofibular ligament (ATaFL) is one of the most often injured ligaments in the human body. This study used x-rays, biomechanical testing of non-human primate ligaments, skeletal specimens, and fossil hominin tali to test why humans are so susceptible to ankle sprains. Though always present in humans, the ATaFL is rare, or absent, in non-human primates. X-rays taken during foot inversion in baboons (n=10) and a gorilla demonstrate that the ankle of non-human primates is stabilized by a valgus ankle and the presence of a strong median keel and corresponding groove in the tibiotalar articulation. Because the ATaFL anchors to a palpable tubercle on the talar body, the evolution of this ligament can be tracked through the hominin fossil record. An examination of 15 hominin tali from 3.18-1.53 mya suggests that early hominin ankles did not possess an ATaFL and instead were stabilized with a strongly keeled tibiotalar joint and perhaps via strong peroneal musculature. The presence of a tubercle for the ATaFL definitively appears in the 4 largest hominin tali (Omo, ER 1464, ER 1813, ER 5428). I hypothesize that the evolution of large body size and increased activity in *H. erectus* may have selected for a flatter tibiotalar joint, and ligamentous, rather than bony stabilization of the hominin ankle. The evolution of an ankle morphology better equipped to distribute forces through the joint at the expense of joint stability may have occurred with *H. erectus* and renders the modern human ankle susceptible to ligament injury.

Energy source, caloric intake, and bone acquisition during growth: implications for human skeletal phenotype.

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Overall energy availability (caloric intake) and energy source (e.g. carbohydrate vs. fat) vary considerably in humans, and we hypothesize that such dietary differences affect skeletal phenotype. To test this prediction, we fed male C57Bl/6J mice (N=4/group, 3 wks old) normal (N, 10% calories/fat), 30% caloric restriction (CR, 10% calories/fat), or high fat diet (HF, 45% calories/fat). At 6 wks of age, we measured body weight, femoral length, serum IGF-1, total body BMD (TBBMD, g/cm2) using PIXImus, and trabecular bone architecture at the distal femur and cortical bone morphology at the femoral midshaft using μCT. CR mice were 54% lighter than N ($p<0.0001$), had 12% shorter femurs and 18% lower TBBMD ($p<0.0001$), but HF and N did not differ. Both CR and HF diets were associated with lower distal femur trabecular bone volume (BV/TV) and thickness (Tb.Th) vs. N: BV/TV and Tb.Th were 14% lower in CR ($p<0.03$ and $p<0.0001$), and 11-12% lower in HF ($p=0.057$ and $p=0.0006$). Consistent with their smaller size, CR mice had absolutely lower femoral cross-sectional area, cortical bone area, cortical thickness, and area moments of inertia, but interestingly, HF mice had lower mass-adjusted cortical properties vs. N. Serum IGF-1 was 14% lower in CR and 26% higher in HF vs. N ($p<0.01$ for both). These results support our hypothesis and suggest that caloric deficit and high fat diet are detrimental to growing

bones. Both trabecular and cortical bone are sensitive to metabolic disturbances, which may be an important consideration in morphological analyses.

The effect of adult age estimates on inferences about sex patterns of mortality.

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The problems associated with the estimation of adult age continue to stimulate important debate and have required innovation within the field of paleodemography. This current analysis attempts to further our understanding of the effect that the choice of age estimation method has on inferences about past human mortality patterns. In particular, this is a comparison of traditional methods with newer estimation methods, consistent with the Rostock Protocol, in the context of an analysis of sex-patterns of Black Death mortality. The question addressed here is: how much of a difference does the age estimation method make? That is, if age estimation methods yield significantly different age estimates for a given group of individuals, do the mortality patterns estimated using those ages also differ? This analysis is done using a sample of individuals from the East Smithfield Black Death cemetery in London.

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Agent-based simulation modeling of primate sociality.

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Despite their growing popularity in social science research, agent-based simulation modeling has not often been used for exploring primate grouping behavior and social dynamics, with a few notable exceptions. This is somewhat surprising, given that agent-based simulation provides a powerful tool for developing null models in primatology and for addressing at least some of the limitations inherent in trying to test existing socioecological models in the wild. Using the software NetLogo, I developed a spatially-explicit agent-based simulation model ("Sim-Primate") to explore the influence of a variety of ranging, foraging, and social behavioral "rules" on the grouping patterns and spatial dynamics of simulated agents and to test, *in silico*, various aspects of current socioecological models of primate societies. The basic model allows for different classes of agents (e.g., males versus females, dominant versus subordinate animals) to be placed into "forest" habitats characterized by different resource distributions and "predator" risks. Using simple rules specifying how the agents move and interact with one another and with their environment, the model then tracks the spatial relationships and behavioral interactions of those agents as underlying ecological conditions (e.g., resource availability, predation risk) are varied systematically. Early simulation results indicate that some very simple social and foraging rules can yield a range of grouping patterns and social dynamics similar to those seen in different nonhuman primates, from solitary animals to stable social groups to groups characterized by highly flexible fission-fusion dynamics.

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Biology and Culture in the modern era: How cultural evidence can help determine forensic significance.

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One of the responsibilities of a forensic anthropologist is to determine the forensic significance of unidentified human remains that are presented to the Office of the Medical Examiner. When determining significance oftentimes the biological conditions alone are not sufficient or can be misleading. The analysis of evidence, circumstance of burial and burial artifacts must be done in both biological and cultural contexts and is required to understand whether a forensic case falls into the purview of the medical examiner.

Here we report a case involving the remains of a Native American individual with a severe case of Ankylosing Spondylitis. The manner and location of the burial prompted the FBI to treat the case as a homicide. Based on the artifacts and certain biological evidence, the forensic anthropologist prematurely deemed the case as historic. When investigating a case involving a Native American individual, it is imperative to consider that Native Americans lived in "historic" conditions well into the modern age. Further investigation revealed that the case was not historic and did fall into the purview of the medical examiner. It is the forensic anthropologist's agenda to consider all evidence in an appropriate manner in order to determine forensic significance. The authors will present literature and photographs of the decedent and the artifacts recovered from the grave to illustrate the conflicting interpretations of evidence and the extent of the disease in this individual.

Geographic patterns of anthropometric and linguistic data in Native Americans from

California: Using Monmonier's algorithm to detect barriers.

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An important objective within anthropological genetics is to determine how various factors operating within geographic space affect the variation within and among human populations. One method, advocated by Manni and colleagues (2004), involves the use of Monmonier's maximum difference algorithm to uncover areas of rapid genetic change, otherwise known as boundaries, in various sets of biological, linguistic, and surname data. This method requires only one or more distance matrices and the geographical coordinates of sampling locations to perform the analysis.
In this study, Monmonier's maximum difference algorithm was applied to anthropometric and linguistic data from 21 tribes from California collected in the late 19th and early 20th centuries. The anthropometric data consists of 12 measurements collected from the head, face, and body. These data were converted to D^2 matrices for the head and body. In addition, a linguistic distance matrix was constructed based on *The Ethnologue* website (Gordon 2005). Separate analyses were carried out for the head, body, and linguistic matrices.
Three boundaries were detected in both the head and body data and only one in the linguistic data. Boundaries in the head and body data coincide with variation in elevation, and are probably related to adaptation to high and low altitude environments. The linguistic boundary separates the Northern Paiute from the other Californian tribes, indicating that linguistic differences might have prevented gene flow only between the Northern Paiute and other tribes. Therefore, impediments to gene flow would have been caused more by topography then linguistic differences.

Comparative anatomy and evolution of the pectoral and forelimb musculature of primates: a new insight

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The anatomy of primates has been the subject of numerous comparative studies. However, the vast majority of these studies deal with skeletal structures. The lack of detailed comparative works on the pectoral and forelimb musculature of primates and their closest living relatives, i.e. tree-shrews and colugos, creates difficulties in the discussion of subjects such as the evolution of primate locomotion. In this work, we briefly describe the pectoral and forelimb muscles of various specimens of primates. The configuration found in the dissected specimens is compared to that found in colugos, tree-shrews and other mammals, in order to discuss how these muscles have evolved during the transitions leading to the origin of primates and to the emergence of higher primates and modern humans. Our observations and comparisons indicate that, contrary to what is often stated, there is no clear increase in the number of pectoral and forelimb muscles within the evolutionary transitions that lead to the origin of higher primates and modern humans. The functional and evolutionary implications of some interesting differences regarding the musculature of modern humans and other primates are analyzed and discussed in a phylogenetic framework.

Genetic adaptations to spatially-varying selective pressures and the susceptibility to common diseases.

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Selective pressures due to environmental variation influence a range of phenotypes in humans, including body mass and skin pigmentation. We previously showed that allele frequencies in genes involved in energy metabolism, which are likely to be central to heat and cold tolerance, are strongly correlated with latitude and climate variables. To test the hypothesis that climate and other aspects of the environment shaped variation in the human genome, we analyzed a genome-wide data set of more than 650,000 SNPs genotyped in the 52 worldwide populations in the Human Genome Diversity Project panel with regard to the correlation between allele frequencies and a broad set of environmental variables including climate, diet, subsistence and ecology. Consistent with the notion that these aspects of the environment reflect selective pressures that acted during human evolution, we find a significant excess of strong correlations among SNPs in genic regions and among non-synonymous SNPs compared to non-genic regions. We also find that many susceptibility SNPs for common diseases are strongly correlated with environmental variables; in particular, some disease phenotypes related to immune response appear to have an excess of risk SNPs associated with signals of spatially-varying selection. We are now using this population genetics approach to detecting genetic variants that influence inter-individual variation in stress response.

Accentuated lines in baboon tooth enamel reflect weaning stress.

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Accentuated lines visible microscopically in histological

sections of teeth are indicators of stress during the period of enamel formation. They are hypothesized to form in baboon teeth during the weaning process. In this study, we tested this hypothesis in five mandibular tooth sections from two Ugandan baboons (*Papio hamadryas anubis*), one male and one female.
Dietary transitions during the weaning process were reconstructed by analyzing the changes in calcium normalised strontium intensities (Sr/Ca) in enamel with laser ablation inductively coupled plasma mass spectrometry. Sections were ablated along prism trajectories from the enamel dentine junction to the enamel surface. Ages for the onset of enamel formation at each ablation point and for the formation of accentuated lines were determined using counts of both long period and daily growth increments, beginning at the neonatal line, formed at birth. Accentuated lines were cross-matched between teeth from the same animal and the ages at each stress line were plotted by month against changes in Sr/Ca.
Both male and female baboons experienced stresses during each month of the weaning process. In the female baboon, the highest frequency of stress was experienced at around six months, coinciding with an inferred reduction in suckling frequency and the mother's first postpartum estrus. In the male baboon, the highest frequency of stress was experienced at around 11 months coinciding with the inferred cessation of suckling. Accentuated lines do, therefore, appear to indicate weaning stress, but show variation in their timing and number between individuals.
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The facial display repertoire of geladas.

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Facial expressions are a fundamental part of primate social communication. In particular, geladas (*Theropithecus gelada*) are well known for their use of facial displays, such as the so-called "lip-flip." However, no systematic descriptions or contextual analyses of gelada facial signals have ever been published. A preliminary description of the variety of facial expressions used by wild geladas will be presented. This is the first step in a larger project investigating the form and function of gelada facial displays in the wild.
Field work was carried out over a five-week period (Spring 2008) in Simien Mountains National Park, Ethiopia. High-definition video recordings (25 h) of adult social interactions were collected on an ad-libitum basis during peak hours of social activity. The video recordings were analyzed using Final Cut Pro. Slow-motion playback was used to determine the probable muscle actions involved in each expression, with a focus on the most salient and distinguishing features. Descriptions were made with reference to the Facial Action Coding System (FACS) to enhance comparability with studies of other species.
The size of the repertoire is comparable to other socially-complex anthropoids. The following six expressions were observed: bared teeth, lip smack, teeth chatter, brow raise, yawning, and canine honing. Three of these displays (bared teeth, lip smack, and teeth chatter) have structural variants that may reflect the motivational intensity of the sender. Eversion of the upper lip was observed in multiple display types. As such, the term "lip-flip display" is misleading and should be abandoned.
This research was supported by the Claire Garber Goodman Fund (Dartmouth College) and the University of Michigan.

Investigating the use of Bromine as a Palaeodietary Indicator.

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Bromine is a halogen that is widely available in the environment, with particularly high levels found in sea waters. As such, the bromine content of foods is high for marine fish, and somewhat lower for fresh water fish. The few studies aimed at documenting the distribution of bromine in human tissues have suggested that variation between individuals may best be explained in terms of the relative proportion of marine foods consumed. With this present study, tooth and rib samples from archaeological sites with known high or low marine components were submitted for blind analyses of their bromine content via synchrotron x-ray fluorescence (sXRF). These samples include tooth and/or rib samples from Mayan, Nubian and Peruvian sites where there is good dietary contextual information. The sXRF data correctly identified those samples which were derived from coastal versus inland regions (Maya and Nubian), and time periods when the marine components of the diet were higher or lower (Peru). These preliminary results suggest that the concentrations of bromine in archaeological hard tissues can provide a useful supplement to other stable isotope techniques aimed at reconstructing the marine component of paleodiets.

Sex differences in western gorilla arboreality.

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Western gorillas (*Gorilla gorilla*) have been hypothesized to be more arboreal than mountain gorillas (*Gorilla beringei*) due to differences in habitat, and western gorilla females have been hypothesized to be more arboreal than males due to their greater fruit consumption and smaller body size. Here we examine the role of diet and activity on male and female western gorilla arboreality,

compared to results from earlier studies of mountain gorillas. Focal animal one-minute instantaneous sampling of adult male and female western gorillas was conducted at the Mondika Research Center. Results indicate that: 1) western gorillas were more arboreal than mountain gorillas and 2) western gorilla females were more arboreal than the male, although this was not a result of sex differences in frugivory, since the sexes did not differ in time spent feeding on fruit. Female, but not male, arboreality was correlated positively with monthly time spent feeding on fruit. The male appeared to achieve equivalent amounts of fruit in the diet without climbing because he was dominant to all females and could monopolize the fallen fruit on the ground. The male spent more time feeding on leaves than females and male leaf consumption and arboreality were significantly correlated. Females rested in trees more than males. We conclude that: 1) more frequent arboreality in western versus mountain male gorillas demonstrates that large body size does not preclude arboreality and 2) sex differences in arboreality may result from social factors as well as more commonly assumed differences in diet.

Scaling patterns of cross-sectional strength of limb bones and the relationship to locomotion.

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By documenting scaling patterns of cross-sectional strength of postcranial bones it is possible to explore the effects of body mass, locomotion and habitual activity on bone mechanical properties in both extant and extinct mammals. Although there has been a great deal of research on the scaling of limb bones of primates, our understanding of these patterns can be enhanced by similar data from other mammalian groups in order to establish patterns of scaling that are universally attributable to locomotion or activity and not simply effects of phylogeny. To this end, data was collected on the postcrania on coyotes and wolves (*Canis*) and bears (*Ursus*) and compared to published data on different primate groups. The results of RMA regressions show that cross-sectional dimensions of limb bones scale with positive allometry on measures of bone length in both genera, with the *Canis* showing a greater amount of positive allometry. When the same variables are regressed on joint surfaces, there is a pattern of isometry in *Canis* (0.902-1.109; $p<0.05$) and slight negative allometry in *Ursus* (0.75--.956; $p<0.05$). The *Canis* sample scales in a manner very similar to that of quadrupedal monkeys, whereas the *Ursus* group is different from quadrupeds in nearly all the scaling relationships tested. The latter results may reflect an emphasis on hindlimb use during bipedal walking or prey capture.

Metacarpal head torsion in apes, humans, and *Australopithecus afarensis*.

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Humans and apes are usually characterized by different types of powerful grips, with apes usually holding oblong objects perpendicular across the palm and humans holding objects more obliquely in the palm. The particular power grip of humans is facilitated by modifications of the metacarpal (MC) bases and heads that allow for rotation of digits 2 and 5. Previous studies have shown that human MCs are also characterized by torsion of the head relative to their base. *Australopithecus afarensis* shares with humans some of the traits associated with the rotation of the digits, particularly for the MC2, but MC head torsion has not been measured.
This study compares MC head torsion among humans, chimpanzees, gorillas, orangutans, and *A. afarensis*. Using a digitizer, palmodorsal axes of the base and head of left MCs one through five were recorded to measure head torsion. The MC1 head of humans is more medially oriented (opposing the other fingers) than that of most apes. The human MC2 to MC5 have more torsion than that of apes, but the differences are significant only for the MC3 and MC4. In *A. afarensis*, the MC1 is more similar to chimpanzees; the MC3 is, on average, intermediate between humans and orangutans; and the MC4 is most similar to humans. These results suggest that *A. afarensis* had a hand that allowed for similar digit rotation to that of humans, but the reduced torsion of the MC1 suggest that adaptations to manipulation had not reached the fully modern form.
This research is supported by the Fond Québécois de la Recherche sur la Société et la Culture (2006 - NP-108312).

Carrying and holding: the close physical association between mothers and young children in a hunter gatherer group.

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Ju/'hoansi (also known as !Kung or San Bushmen) of the Kalahari are known for aspects of infant care such as frequent nursing of infants and high levels of physical constant contact between infants and toddlers and their mothers or another person. In this paper, behavioral observation and interview data from several decades ago when Ju/'hoansi depended largely on foraged food are reassessed for information regarding the proximity of mothers and infants, when the mothers were at rest and when they were in transit. A finding is that allo-parenting (including by grandmothers) was an uncommon form of care for small children, at least as measured by variables of carrying or being in physical contact with a young child. The behavioral data are supported by interview data in which mothers

report minimal reliance on others for infant care or baby sitting of older children. This persistence of mother care is maintained, even during the time of weaning, when children in many societies are sent to relatives for night time sleeping or feeding during the day.

Looking for dacryon: a comparison of Martin and Howells

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When measuring skulls, osteologists may turn to standards manuals to determine where points and landmarks lie. Dacryon is one point that seems to have a very straight forward definition: it is "the point on the medial border of the orbit at which the frontal, lacrimal, and maxilla intersect. In other words, dacryon lies at the intersection of the lacrimomaxillary suture and the frontal bone" (Moore-Jensen, Ousley and Jantz, 1994, define dacryon using Martin 1956:450). Alternatively, the measurement definitions of W.W. Howells may also come under examination. Howells' definition for dacryon is a bit complex: it is defined as "the apex of the lacrimal fossa, as it impinges on the frontal bone" (1973). Clearly, the two definitions differ.
How do the definitions of dacryon effect the assessment of interorbital breadth? 60 white males curated in the William M. Bass Donated Collection at the University of Tennessee were measured once using Martin's definition and a second time using Howells' definition. Howells' dacryon led to a larger measurement in each of the pairs; it differed between one and four millimeters from Martin's measurement. Paired t-tests indicated that the measurements were significantly different. This shows that it is essential for the researcher to understand the difference between the measurements and to make note of which dacryon is being used to ensure proper comparison of data. Population histories and variation, secular change and forensic identifications all depend on the ability to correctly and consistently compare measurements.

Disease susceptibility and genetic ancestry of climatic droplet keratopathy in Mapuche populations

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Climatic droplet keratopathy (CDK) is a degenerative corneal disease found in populations worldwide. Onset of this disease occurs later in life and is often associated with a higher incidence of other corneal disorders (i.e., cataracts, pterygium). Although the causes of CDK are unknown, environmental factors such as large amounts of ultraviolet light and windblown debris (dirt, sand) are believed to play primary roles in acquiring the disease. Like other multifactoral diseases, genetic ancestry may influence how CDK is acquired or expressed. To explore whether a correlation exists between disease susceptibility and genetic ancestry for CDK cases, we examined the genetic variation among 57 Mapuche descendants from Argentina. For this purpose, we characterized mitochondrial DNA and Y-chromosome polymorphisms using DNA sequencing and custom TaqMan assays. Y-chromosome STRs were scored to delineate paternal familial relationships. The maternal ancestry in terms of mtDNA haplogroup diversity did not differ significantly between the two groups, while analysis of the paternal ancestry demonstrated that nearly 50% of the CDK group and 37% of the control group have lineages typical for indigenous South Americans. However, there was no association of the maternal or paternal lineages with disease status. Thus, at present, these results indicate that genetic ancestry is less of a factor in the expression of CDK than for other complex diseases. Consequently, we are examining the variation at certain nuclear loci (e.g., aldehyde dehydrogenase 3) that may play more of a central role in the function and health of the cornea.

Physical anthropology at the Caribbean Primate Research Center: past, present, and future.

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In 1938, a rhesus monkey (*Macaca mulatta*) colony was founded on Cayo Santiago. When the Caribbean Primate Research Center (CPRC) was established in 1970, Cayo Santiago became one of its units, along with the Sabana Seca Field Station (SSFS), a facility housing Cayo Santiago-derived rhesus monkeys in corrals and cages. The CPRC Museum (renamed the Laboratory of Primate Morphology & Genetics or LPMG in 2003) became a third unit in 1982 for housing skeletal and other postmortem materials derived primarily from the CPRC rhesus populations. Various research themes have emerged over the years in the different units, many of which are central or closely related to physical anthropology. On Cayo Santiago, studies have focused on social behavior (group dynamics, sex and reproduction,

communication, stress), life span development, locomotion and habitat use, cognition, demography, sociobiology, and various biomedical topics. At the SSFS, biomedical studies have predominated, but research has been conducted in endocrinology, bone biology, and aging that is relevant to physical anthropology. At the LPMG, research has been oriented primarily towards physical anthropology, focusing on bone biology and pathology, morphometrics (craniofacial, dental, postcranial), biomechanics, phenotypic variation, genetics, postnatal growth and development, and evolution. Anthropological studies that integrate morphology, genetics, and behavior are increasing, and utilize the LPMG in combination with Cayo Santiago and/or the SSFS. As physical anthropology continues contributing to the above themes and further expands into physiology, sociobiology, neurobiology, developmental biology, and the biomedical sciences, the CPRC will remain uniquely positioned to facilitate these research endeavors.

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Heredity of spinal osteoarthritis in *Macaca* spp.

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Human family-based studies demonstrate that 50-67% percent of the occurrence of osteoarthritis (OA) can be attributed to a genetic component. Our understanding of the complexity of the interactions of age, body mass, activity and genetics is, however, still lacking. Nonhuman primate models offer the unique opportunity to look at multigenerational data to assess the extent to which OA is heritable in families. Macaques exhibit a naturally-occurring form of OA, similar in its radiographic manifestation to that in humans, but macaques reach sexual maturity at ~5 years, providing a significantly shorter intergenerational gap relative to humans. National Primate Center records extend for several generations and include radiographic evidence obtained independently from clinical presentations of OA.

Inheritance of spinal osteoarthritis (OA) was assessed in 189 female *Macaca nemestrina*, which ranged in age from 5-29 years and were housed in WaNPRC facilities. Phenotypic markers of OA were assessed from previously collected cross-sectional data, including osteophytosis (OST), disk space narrowing (DSN), age, body mass, parity, and distribution along the thoracolumbar spine. OST and DSN prevalence within the sample were 25.9% and 24.9% respectively. OST and DSN were analyzed in 41 randomized sibling pairs sampled from 51 maternal or paternal half-sibling sibships, which ranged in size from 2-9 individuals. Nonparametric analyses support the presence of familial clustering of OST ($x^2=17.49$, $df=2$, $p<0.005$) and DSN ($x^2=17.86$, $df=2$, $p<0.005$). These results indicate that genetic factors may play an important role in OA and that the macaque model can provide important insights into the heredity of OA.

An alternative approach to cranial allocation in an historical forensic case study from Spanish Colonial Georgia.

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Cranial allocation remains one of the baseline analyses forensic anthropologists perform during the course of routine medico-legal investigations. Likewise, assessment of population affinity occurs in the context of isolated skulls found in museums or recovered from illicit sales. Biohistorical cases also frequently evaluate population affinity. Recent debate has refocused attention on the appropriateness of craniometric analyses, with particular emphasis on Fordisc and larger historical issues in physical anthropology, namely the race concept and the continuous or discontinuous nature of human biological variation. Twenty years ago Alice Brues suggested an approach for assessing population affinity which mitigates critiques of current practices. Brues suggested generating a comparative database from specific populations, rather than from broader racial categories, thereby avoiding the race concept entirely. While this is a sensible approach, it seems that this is rarely done in physical anthropology. In this paper we present an historical case study from the southeastern United States (Georgia) in which we assess population affinity for an isolated skull using Brues' approach. The skull is purported to be a martyred Spanish priest from the 16th century. Using archaeological and historical site occupation data, we constructed a comparative framework that targets the most likely source populations, as defined temporally and geographically. Principal components analysis failed to falsify the hypothesis that the skull was most similar to a medieval Spanish population. The significance of the paper is its demonstration of the potential to conduct population affinity analysis by drawing on already available data without using racial categories.

Artificial cranial deformation in Pleistocene Australian crania from Kow Swamp and Cohuna.

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Several authors have suggested that some Pleistocene Australian crania have been altered by artificial cranial deformation. The Cohuna cranium and the sample from Kow Swamp have received significant attention in this debate, with several different studies suggesting artificial deformation of the cranial contours in Cohuna and Kow

Swamp 1 and 5. The present study reevaluates the evidence for artificial cranial deformation in this sample using both larger cranial samples and more comprehensive measurement sets than those that have been used in earlier work on this subject. Additionally, random expectation statistics are used to calculate statistical significance for these examinations. The results of this study agree with prior work indicating that a portion of this sample shows evidence for artificial deformation of the cranial vault. Cohuna and Kow Swamp 1 and 5 each display strong shape similarities with a population of known deformed individuals from New Britain. This project provides added support for the argument that at least some Pleistocene Australian groups were practicing artificial cranial deformation. Likewise, these results highlight the difficulties with using frontal flatness and other non-metric characteristics of the frontal bone in arguments for regional continuity between the earliest Australians and archaic populations from Indonesia.

Human bipedality and the genetic architecture of a locomotor system.

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The shift to bipedality in the human evolutionary pedigree has been hailed as the hallmark of our lineage. The morphology of the human locomotor apparatus is comprised of a suite of highly integrated traits. Although many of these anatomical traits have been examined in the context of inter-species differences to infer locomotor association, rarely are these morphologies examined in living subjects actively engaged in this unique human behavior. Yet, despite the obvious genetic role in evolutionary change, none of the dynamic locomotor behaviors of humans have been examined in the context of genetic variation. To characterize the morphological integration and the genetic influences on anatomical and functional parameters of gait, we examined postural and walking gait data collected from three-dimensional motion analysis procedures in 437 subjects. These individuals are from 108 families in the Fels Longitudinal Study. Heritability (h^2) was estimated for all variables using a maximum-likelihood variance decomposition approach. The trait mean and mean effects of the covariates age, sex, their interactions, weight and stature were also simultaneously estimated.
Anatomical and postural phenotypes (e.g., knee alignment) were significantly heritable, with h^2 estimates ranging between 28 and 67%. Likewise, many behavioral gait phenotypes (e.g., cadence and initial double support duration), were also significantly heritable (h^2 ranged from 17 to 33%). While it is expected that many of these traits are influenced by environmental factors, our results indicate the presence of a strong genetic component. We are pleased to report the first quantitative evidence of genetic influence on human locomotion. (NIH-R01HD12252).

Analysis of cranial remains from the Zoroastrian Tower of Silence, Sanjan, India (1410-1450 AD).

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Sanjan is a large ancient mound located in Gujarat, India. It is of great historical, cultural and religious importance to the Zoroastrian community since it is believed to be the first place in India that their ancestors lived after fleeing Islamic persecution (late C7th AD). From the Dokhma, or the Tower of Silence, approximately 140 skeletons were retrieved. These represent excarnated bodies exposed to natural elements as well as vultures as part of a complex mortuary behavior associated with the Zoroastrian culture. Zoroastrian funerary rituals are discussed since they represent a unique and complex treatment of the body after death. Understanding these rituals has important implications for bioarchaeologists attempting to analyze the remains. A systematic analysis of the cranial bones revealed a relatively healthy population with very few cranial pathologies. Males and females are equally represented and the death rate was highest amongst middle-aged adults. Sexual dimorphism was pronounced in the mandibular symphyseal height with male height at 19-27 mm and female height between 24-32 mm. This pattern is also seen in present day Zoroastrians, which has been concluded based on the study of the modern skeletons. The other features are the massive mastoid processes of the Sanjan skulls, the averted nature of the gonial region and the position of the roots of the teeth. Comparisons with their ancient Iranian counterparts reveal many similarities. Further study will aid in understanding Zoroastrian adaptation to Indian environment and culture, and how this small group of people managed to survive into contemporary times.

Body mass estimation from mid-thoracic ribs in humans.

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Widespread invocation of the "cylindrical model" (Ruff, 1991, 1994, 2000; Ruff and Walker, 1993) has meant that bi-iliac breadth is commonly used as a proxy for human trunk shape, as well as a predictive measure of body mass. Due to their taphonomic fragility, the ribs, themselves, have been relatively neglected as a source of more direct information regarding thoracic shape and concomitant body mass. It is natural however, that the two be complementary as thoraco-abdominal concordance is generally supported by recent clinical studies which demonstrate significant correlations between pediatric pelvic inlet width and thoracic dimensions (Emans et al., 2005).

The present study addresses the scaling relationship between rib dimensions and body mass within a normal sample, incorporating an older age range than that found in previous clinical studies. Mid-thoracic ribs 6-9 were examined with respect to thoracic depth (tuberculo-ventral chord length; TVC) and breadth (tuberculo-ventral subtense; TVS), as well as overall rib arc length (RAL). The study sample comprises 25 Caucasian males aged 21 to 44 for whom stature, raw body weight and body mass index (BMI) are known and need not be estimated. Following Kagaya et al. (2008), rib measures were log transformed before they were analyzed using multivariate linear regression equations.

The results of the present study support the use of the cylindrical model, though the utility of mid-thoracic ribs for making body mass predictions is also upheld. Future research will incorporate an ecogeographical diverse mixed-sex sample to improve applicability to a greater range of human variation.

Liang Bua skeletal remains in comparative context: Stature in individuals, samples, populations, and species.

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Presented here are unpublished data on stature and other biological characteristics of the Rampasasa, a human population living near Liang Bua Cave, Flores, Indonesia. These direct *observations* provide a reliable standard for assessing the plausibility of *reconstructions* based on limited numbers of partial skeletons sampled from locales such as Liang Bua Cave, Palau, and elsewhere.

The stature of Liang Bua specimen LB1 originally was reconstructed as 1.06 m (Brown *et al.* 2004), but other estimates range from a low of 0.92 m (Diamond 2005) to as high as 1.38 m (Eckhardt *et al.* 2005), the high estimate being 1.5X the lower; the latter estimate was one of 11 different determinations that also yielded a low estimate of 1.13 m and unweighted average of 1.25 m. These estimates may be compared with those based on small skeletal samples derived from various sites on Palau dated to approximately 1400 through 3000 ybp. Berger *et al.* (2008) reported stature estimates in the range of 0.94 m to 1.20 m., while Fitzpatrick *et al.* gave stature estimates of 1.52 to 1.57 m. from different sites on Palau. The high estimates again are about 1.5X the lower estimates. For comparative context, the range of stature (N=76) observed in the Rampasasa living on Flores (Jacob, personal communication 2005) is 1.33 m to 1.65 m.; the shortest observed stature among people now living on Flores overlaps estimates for LB1, while the highest observed stature exceeds the tallest reported from Palau. These patterns suggest differences without distinctions.

Ontogenetic change of internal structure in macaque calcaneum.

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Limb bone structures, such as bone distributions, bone masses, and trabecular orientations, have been suggested to be influenced by the loading environments. However, few studies have examined formation of these structures during growth. This study examined ontogenetic changes of calcaneal internal structure in a cross-sectional sample of Japanese macaques (*Macaca fuscata*) to clarify formation of bone structures relative to developments of locomotor behaviors and changes of loading environments.

The sample included both fetal and post-natal specimens. Body mass of the smallest fetus is about one half of the new-born. Post-natal specimens are with age and sex data, and they were divided into age groups. Internal structures were examined using micro CT scanner images with 0.020 – 0.040 mm voxel sizes. Trabecular bones at the posterior articulation of the calcaneum are already arranged anisotropically in the fetuses. The tubercle is very small before the birth, and the trabecular alignments in this region become clear at six months, when the juveniles become capable to walk. Thickening of cortices starts around one months at the posterior articulation and around two year at the tubercle. The latter corresponds to the age for Japanese macaques to become capable to walk for long distances. The development pattern of the trabecular alignments in the macaque calcanei is similar to those of sheep calcanei, while the cortical shell development is similar to those of human proximal femora. The results suggested that bone internal structures are influenced both by genetical controls and by loading environments.

Occlusal molar microwear texture analysis of Middle and Upper Paleolithic juveniles.

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Dental microwear has been shown to have great potential in inferring diets of fossil hominins. Microwear texture analysis is a new automated and repeatable approach to the study of dental microwear where the scanning electron microscopy is replaced with scanning confocal profilometry and scale-sensitive fractal analysis is introduced as a tool for 3-D analysis of microwear features. This new technique is used to compare the occlusal molar microwear signatures of Neandertals and Upper Paleolithic juveniles from several European sites. This study has two aims: to compare the microwear signatures of Neandertal and Upper Paleolithic juveniles to identify whether their signatures differ significantly, and to compare the microwear signatures of these juveniles to those of adults from the same groups.

The results of this study show that there is a high level of variability in the microwear signature within the Neandertal juvenile sample, suggesting that the Neandertal juveniles had a wide dietary range. Compared to Neandertals, the microwear signatures of Upper Paleolithic immature individuals appear to have been more uniform, suggesting that their diets were more similar. Compared to the adults, there does not appear to be a consistent trend that sets apart the microwear signature of the immature Neandertals from their adult counterparts. The results of this study and their implications of possible differences in behavioral aspects between the two groups will be discussed. Also, it should be noted that a wide-range study including the majority of Neandertal and Upper Paleolithic juveniles is in preparation.

Dental wear in African apes: is a certain amount of attrition advantageous?

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The African apes possess thinner enamel than do other hominoids, and a certain amount of dentin exposure may be advantageous in the processing of tough diets eaten by *Gorilla*. Dental wear (attrition plus abrasion) that erodes the enamel exposes the underlying dentin and creates additional cutting edges at the dentin-enamel junction. Hypothetically, efficiency of food processing increases with junction formation until an optimum number is reached. Occlusal surfaces of molars and incisors in various species and subspecies of *Gorilla* and *Pan* were videotaped and digitized. The quantity of occlusal dental wear and the lengths of dentin-enamel junctions were measured in 220 adult and 18 juvenile gorilla and chimpanzee skulls.
Rates of dental wear were calculated in juveniles by scoring the degree of wear between adjacent molars M1 and M2. Differences were compared by principal (major) axis analysis. ANOVAs compared means of wear amounts. Results indicate that quantities of wear are significantly greater in gorilla adults compared to chimpanzees, but this difference is not seen in the juveniles. The lengths of dentin-enamel junctions were similar to the degree of wear. Western lowland gorillas have the high amounts of wear and the most molars with sub-optimal wear. The highest rates of wear are seen in *Pan paniscus* and *Pan t. troglodytes*, and the lowest rates are found in *P.t. schweinfurthii* and *G.b. graueri*. Among gorillas, *G.b. beringei* have the highest rates.

FORDISC and the determination of ancestry from craniometric data.

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Archaeologists and forensic anthropologists frequently use the program FORDISC to determine the ancestry of human skeletons. However, the program's accuracy is currently debated. This paper outlines a study that addressed three contested issues: (1) the impact of the presence/absence of the source population in FORDISC's reference sample, (2) the effect of specifying/leaving unspecified the test specimen's sex, and (3) the influence of variable number.
The test sample comprised 200 of the specimens that make up FORDISC's Howells reference sample. For each test specimen, two sets of analyses were conducted. Fifty-six variables were used in the first and 10 in the second. In both sets of analyses, each test specimen was initially compared to males and females of all reference populations, including its own. Next, it was compared only to reference specimens of the same sex from all reference populations. Thereafter, the test specimen's source population was deselected. The test specimen was then compared once to all remaining specimens, and once only to reference specimens of the same sex.
The results indicate that in order for FORDISC to provide an accurate determination of ancestry with Howells reference sample, values for >10 variables must be available, the source population must be present in the reference sample, and the sex of the specimen must be known. Even when these conditions are met, few determinations are likely to be unambiguously correct. Thus, caution is required when interpreting the results of a FORDISC analysis, at least when using Howells reference sample.
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Monkey macroecology: spatial, environmental and taxonomic influences on cranial morphology in *Piliocolobus* and *Chlorocebus*.

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Understanding and appreciating clinal variation in form is a key aspect of biogeographic research, giving important insights into the evolution and diversification of populations. Nonetheless, relatively little work of this kind has been undertaken on tropical animals, including primates. Red colobus (*Procolobus Piliocolobus* sp.) and vervet monkeys (*Chlorocebus aethiops*) are distributed widely across Africa and show considerable inter-population variation in ecology, behaviour and morphology. In this study, geometric morphometric methods were used to quantify the cranial form of these taxa from across their distributions. The extent to which environmental factors, taxonomy (as a proxy for genetics/phylogenetics) and

geography, singly and in combination, influenced the observed patterns was examined using linear and curvilinear models. Strong non-linearities in clinal patterns were found, and there were some potentially interesting congruencies between the two taxa. A trend of size decrease from west to east – a longitudinal cline - was identified in both groups. This was particularly strong in vervets, attributable in part to the effects of rainfall as a proxy for habitat productivity (with smaller animals being linked to less productive habitats). 'Historical' processes, including past isolation in small populations, also contributed to the observed patterns. This work indicates that the effects of spatial distribution on morphology should be considered when interpreting variation in modern and extinct primate groups.

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The dynamics of stress in female chimpanzees: interactions of social and ecological factors.

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Cortisol, as a biomarker of the generalized adaptive stress response, can provide critical information on the physiological effects of behavior. However, group-living animals face multiple interacting stressors from their social and ecological environments. While recent research has revealed the impact of particular social stressors in isolation, few studies have examined how diverse factors contribute to long-term stress hormone variation.

We applied multivariate analyses to a 10-year dataset to investigate urinary cortisol variation in wild female chimpanzees (*Pan troglodytes schweinfurthii*) in Kibale National Park, Uganda. In interindividual contrasts, older females had higher cortisol levels, as did females that were low-ranking for their age. Over time, cortisol was significantly predicted by rates of aggression, particularly female-targeted aggression. The effect of male-female aggression was most pronounced for cycling, swollen females, who are the most frequent targets of sexual coercion. On the other hand, lactating females were strongly affected by group size, such that cortisol levels were elevated when parties contained more females and fewer males. Fruit consumption was an important covariate for lactating females, who experienced higher cortisol when the diet was poor. Our data indicate that both social and energetic factors contribute to stress variation in female chimpanzees, but that energetic stress increases in significance for females facing high reproductive costs. Our study also contributes to growing evidence that direct and indirect competition, while subtle in their expression, can have substantial impacts on female chimpanzees.

Dental roots morphology and phylogeny of hominoids.

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Although hominoids dental root anatomy was investigated by several studies, the phylogenetic signal therein was not conclusively proved or discarded. To test the taxonomical and phylogenetic utility of roots morphological characters among hominoids, mandibles of chimpanzees, gorillas, orang-utans and gibbons were imaged through X-Ray computerized tomography. Three morphometrical analyses were then performed; a computation of the relative height of root bifurcation, a comparison of root angulations and a Procruste analysis on roots of first and second molars. All three analyses are significantly effective to discriminate specimens according to the taxonomy. Furthermore, a phylogenetic signal was significantly observed in the three analyses.

Two fossils specimens, *Khoratpithecus piriyai* TF-6223 and *Ouranopithecus macedoniensis* RPl-117, were imaged using X-Ray synchrotron microtomography at the E.S.R.F. Their roots were analyzed and compared to extant specimens. In this analysis, *Khorapithecus piriyai* is confirmed in its position as a sister-group of *Pongo*, while *Ouranopithecus macedoniensis* appears as a member of the *Pan-Gorilla-Homo* clade. Two different evolutionary patterns, involving root differentiation between premolars and molars and differential proclination for incisors and canine, were recognized and described in the *Pongo* lineage and in the *Pan-Gorilla* lineage.

Stable isotope analysis of diet among Bronze Age and Iron Age inhabitants of Xinjiang Uyghur Autonomous Region, China.

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Stable isotope analyses of skeletal remains of both humans and animals have contributed to our understanding of ancient diet and lifestyle in many regions in China, especially the Central Plains. Relatively few studies have been conducted on populations from northwest China. Xinjiang Uyghur Autonomous Region was traditionally at the center of international trade that connected western and eastern Asia through caravan routes along the Silk Road. Xinjiang was also home to people who practiced different forms of subsistence, with concurrent occupation by both agricultural communities settled around oases

and many nomadic pastoral societies. With such differing economic choices, isotopic study greatly aids in our reconstruction of the different plant and animal resources that contributed to human diet in different groups.

This study elucidates dietary practices through carbon and nitrogen stable isotope analysis of three Xinjiang archaeological collections dating from the Bronze Age (c. 1800-1200 BC) to Iron Age (c. 1000-200BC). The bone collagen of 28 adults (15 males and 13 females) and associated faunal (caprid) remains were analyzed. The herbivore faunal remains have average values of $\delta^{13}C$ (-18.61±0.39‰) and $\delta^{15}N$ (9.03±0.63‰), while the average values found among the Xinjiang human samples are δ13C (-16.61±1.38‰) and δ15N (13.78±1.32‰). These data suggest diets that were predominantly reliant on animal protein and C_3 plants with some C_4 plant contribution to the diet. ANOVA tests show significant inter-site variation among the human samples from different time periods (δ13C: F (2,24) = 87.165, p<0.001; δ15N: F (2,24) = 88.396, p<0.001).

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Bite force scaling and food mechanical properties.

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Bite force is difficult to measure using craniofacial morphology but is a key variable for understanding masticatory performance in both living and fossil species. Because generating high bite forces are particularly important for breaking down stiff foods that resist fracture (e.g., seeds and nuts), the relationship between total bite forces and tooth occlusal areas provides insights into the generation of stresses during mastication, thus providing clues about diet.

Following previous studies by Demes and Creel (1988) and O'Connor et al. (2005), we developed and tested a new method for estimating average incisal and molar bite forces using classic models of torque generation from several craniofacial measurements (muscle cross-sectional areas, and muscle in-lever and out-lever arms) for the masseter, temporalis, and medial pterygoid muscles, along with estimates of muscle pennation necessary to approximate muscle physiological cross-sectional area (PCSA). Bite force was estimated in extant hominoid species as well as in species of *Australopithecus* and *Homo*. For all species, incisal and molar occlusal area was measured and plotted against relevant bite force estimates.

Preliminary results both validate the model and indicate a generally strong, significant relationship between average bite force and molar area, but with several specimens of *Homo erectus* and *Homo heidelbergensis* who fell below the 95% confidence interval of the slope and a number of specimens of *Australopithecus* who fell above the line. These data are consistent with dental topographical data suggesting that early *Homo* consumed tough foods, while the diet of *A. afarensis* consisted of more fracture-resistant foods.

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Dietary flexibility: Subsistence of the southern gentle lemur *Hapalemur meridionalis* on a low quality diet in the Mandena littoral forest, SE Madagascar.

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Malagasy primates of the genus *Hapalemur* are exceptional in their exhibition of specializations allowing them to adapt to a variety of habitats. Unfortunately, our knowledge of these animals is minimal, leaving researchers to speculate as to how they survive in certain environments. One such case is the southern gentle lemur (*Hapalemur meridionalis*) which appears to be able to subsist within the partially degraded and highly fragmented littoral forests of Mandena in southeast Madagascar. These observations led us to conduct a preliminary investigation into the feeding ecology of this lemur. Observations were recorded on three groups from dawn to dusk via a combination of instantaneous and continuous focal sampling. We found that this species focused an overwhelming majority (75.9%) of their diet on seven species of terrestrial grass (family Poaceae). Based on the protein-to-fiber ratio of their diet, we concluded that these animals subsist on a lower quality diet than its congenerics and other folivores. Also, we observed the local *Hapalemur* population exhibiting a grazing behavior that allowed them to forage outside of the forest. Considering that this species is among the smallest herbivores in the world (855 ± 203 g, n = 12), our observations conclude that *H. meridionalis* may experience a digestive ability higher than would be predicted.

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Cranial nonmetric study of archaeological populations from different historical periods of Mongolia

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A cranial sample consisting of 300 skulls from Mongolia, ranging from the Neolithic period to modern era, was investigated using nonmetric traits. Nonmetric trait frequencies were calculated using the "individual count" method, and 19 traits were selected to calculate biological distances. Cranial nonmetric trait frequencies of pooled-sex and skull incidences for each population were arcsine-transformed and subsequently used to calculate the mean measure of divergence (MMD). Cluster

analysis was used to obtain a dendrogram of phylogenetic relationship between the populations compared.

Cluster analysis show two distinct clusters for archaeological and modern populations from Mongolia. The first cluster consisted of the Xiongnu (2nd BC to 2nd AD) and medieval age populations from Central Mongolia. The second cluster is divided further into three subclusters. Bronze age populations from the Central and Eastern Mongolia form the first subcluster with the Iron age samples from the Western Mongolia. The second subcluster is formed by the Bronze age and modern populations from Western Mongolia. Medieval age population from Eastern Mongolia joins to this subcluster. Xiongnu populations from Western Mongolia and modern populations from Central Mongolia are found to be the closest among the studied groups. The next closest groups are Neolithic and Xiongnu samples from Eastern Mongolia. These populations form the third subcluster in the second cluster.

Biological affinities of the studied populations are confirmed in the results of the archaeological investigations conducted in the different territories of Mongolia.

A new computational method for simulation and optimization of hominin gait.

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The evolution of hominin bipedalism required changes in both morphology and neural control, with dynamic interaction with the environment playing a crucial role. While several computational studies have recently been proposed to investigate bipedalism in early hominins, computational constraints have prevented these gait simulation models from incorporating reactive neural control strategies which account for variability in limb position ("feedback control"), and hence the simulated walker cannot actively stabilize its gait. This severely limits the range of models and environments that can be considered.

In this talk, we present our recent work in computational optimization that allows for the evolution of feedback controllers for bipedal gait, and enables the simulation of stable walking over changing terrain. By introducing feedback control, we can simulate models of increased complexity (and hence realism), and take into account the interaction with the environment in greater detail. To examine the utility of this computational approach for investigating hominin bipedalism, we optimized simulated bipedal walking over changing terrain using various cost functions (e.g. maximizing velocity, minimizing metabolic cost). Furthermore, in order to examine the relationship between commonly-proposed selection pressures and morphological change, we studied the effect of morphological variability on the different performance measurements. These simulations revealed a complex relationship between morphology, locomotor control and the environment, and shed light on hypotheses regarding possible evolutionary pressures which shaped the emergence and evolution of hominin bipedalism.

Temporal variation in diet in three strepsirhine species in southeastern Madagascar.

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While basic information regarding diets for many primate species is well known, there is little information concerning interannual differences in the composition of a species diet. Here we present data on the diets of three lemurs (*Varecia variegata, Propithecus edwardsi, Eulemur fulvus rufus*) living in the Ranomafana National Park. Data were recorded from January 2001 to December 2002. We quantified dietary variability in terms of plant parts (e.g., fruit, young leaves, etc.) and plant species for two groups of each of the study taxa. Interannual variation in the plant parts consumed and in the amount of time spent eating from particular plant species was greatest for *Varecia* and *Eulemur* and least for *Propithecus*. For example, in 2001 *Varecia* and *Eulemur* spent 29.8% and 36.6% of their respective feeding time on flowers, but these percentages dropped to 2.2 and 0.4 in 2002 when both taxa spent the majority of their feeding time on ripe fruits. *Varecia* and *Eulemur* also focused their feeding time on one particular plant species in each study year (*Varecia*: 2001-*Sideroxilon* sp., 2002-*Ocotea tapack*; *Eulemur*: 2001- *Sideroxilon* sp., 2002-*Harongana madagascariensis*). In contrast, from year to year *Propithecus* consistently spent similar amounts of time feeding on the same plant parts (2001: 46.6% fruit, 44.1% young leaves; 2002: 61.4% fruit, 34.5% young leaves) from several species (*Chrysophillum madagascariensis*, *Eugenia* sp., *Syzygium* sp., *Bakerella* sp.). We hypothesize that much of the interannual variation in the diets of *Varecia* and *Eulemur* may be attributed to irregular or supra-annual phenological patterns.

A pilot study of sexual dimorphism in human 5th metatarsal bones.

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Many bones in the human body are known to be sexually dimorphic. They can be used to identify the sex of an unknown individual in both forensic anthropological and archeological settings by either viewing morphological traits or taking measurements. The purpose of this study was to determine whether the human fifth metatarsal was sexually dimorphic in both linear measures and in its shape. in order to determine if this bone can be used in identification of sex of

an unknown sample. The fifth metatarsals from both the left and right feet of 17 human cadavers from Duquesne University, Slippery Rock University, and University of Pittsburgh (12 males and 5 females) were harvested, cleaned of all soft tissue, and photographed. Maximum width and length of each metatarsal and length of the styloid process was measured using ImageJ software. A shape ratio (width to length) was also calculated for each metatarsal. Means of all measurements and ratios were compared between sexes using a Student's t-test for independent measures and results were considered to be statistically significant if $p<0.05$. Only the shape ratio of the fifth metatarsal was found to be significantly different between the sexes with females having the greater shape ratio. Therefore, the shape ratio can be useful in this context, although the fifth metatarsal may not be the best bone to rely on for discriminating the sex of human skeletons.

Buccal dental microwear analyses show taht *Australopithecus afarensis* migh have benefited from both closed woodland and open savannah environments independently of climatic conditions.

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Buccal dental microwear has shown to be a reliable indicator of dietary habits in extant populations of both hominoid primates and human hunter-gatherers. Microwear analyses on occlusal tooth surfaces have also shown to be informative of dietary habits of *Australopithecus afarensis* and Early *Homo*. Buccal microwear, however, has not yet shown to correlate to dietary habits or climatic conditions and, therefore, the buccal microwear variability of a complete sample of *Australopithecus afarensis* teeth has been studied to test the hypothesis that this species shows closer affinities to the chimpanzee's dietary habits than to those of the *Gorilla* or the open enviroment baboons. As a comparative collection, a large sample of African hominoids, including three subspecies of *Gorilla* and *Pan*, as well as the cercopitecoid species *Papio anubis*, was studied. Results showed that the buccal microwear pattern of *Australopithecus afarensis* is comparable in striation density to that of *Pan troglodites verus* and *Gorilla gorilla graueri*. However, multivariate analyses of all microwear variables showed closer resemblances to *Gorilla gorilla gorilla*, *Pan troglodites troglodytes* from Cameroon and, more distantly, *Papio anubis* and *Pan troglodites verus*, which support the hypothesis that *A. afarensis* was a seasonal frugivore consuming keystone food items during the dry season. Tthe lack of correlation between buccal microwear and the ecological reconstruction for each fossil specimen is coincident with previous results on occlusal microear, suggesting that *A. afarensis'* dietary habits remained unchanged despite shifs in climatic conditions though time, searching for preferred foods independently of climatic conditions.

3D micro-CT analysis of age-related changes in prehistoric Lake Baikal hunter-gatherers.

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Hunter-gatherers are highly mobile; consequently, their cemeteries are rare in the archaeological record. However, at Lake Baikal (Siberia), prehistoric groups left numerous burial grounds with preserved skeletal remains, allowing insight into health and aging processes in hunter-gatherers. The purpose of the current study was to evaluate age-related bone changes in Lake Baikal hunter-gatherers. For the first time, micro-CT was used to analyze 3D porosity changes in prehistoric (ca. 9000 to 3000 ybp) femora (N=46). T-tests and the Kruskal-Wallis statistic indicate that younger adults differed significantly from middle-aged adults in canal number ($p<0.01$), canal separation ($p<0.01$), canal surface to tissue volume ($p<0.05$) and canal connectivity density ($p<0.05$). Younger adults also differed significantly from older adults in each of these categories ($p<0.05$), as well as in degree of anisotropy ($p<0.05$). Middle-aged adults did not differ in any respect from older adults. Interestingly, although percent cortical porosity did increase with age, it was not significant. When stratified by sex and age group, no significant differences were present between the sexes. The results suggest that males and females, regardless of any potentially culturally-mediated differences in diet and activity patterns, underwent similar age-related trajectories in bone loss. These changes were characterized primarily by slightly increasing porosity, decreasing pore separation, increasing canal connectivity, and increasing variation in pore direction. Additionally, the absence of significant differences between middle and older adults suggests that bone quality remained relatively good into older age, which is supported by a general absence of osteoporotic fractures in the skeletal sample.

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LB1's endocast compared to those from other hominins.

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Earlier observations of the virtual endocast of LB1, the type specimen for *Homo floresiensis*, are reviewed, extended, and interpreted. Using three ratios that capture evolutionarily salient features of brain shape, we performed discriminant, principal component, and cluster analyses on virtual endocasts from 10 normal humans and 10 microcephalic *Homo sapiens*. We used the resulting functions to classify virtual endocasts from two gracile australopithecines (Taung, Sts5), one robust australopithecine (WT 17000), one *Homo erectus* specimen (Hexian), one 'enigmatic' hominin that has been assigned variously to early *Homo*, *Paranthropus*, or *Australopithecus* (ER 1813), and one *Homo floresiensis* specimen (LB1). Our results show that WT 17000 clusters with microcephalics, while LB1 clusters closely with Taung and Sts 5 within normal humans. The position of ER 1813 remains enigmatic. With respect to the salient brain shape features that we studied, LB1 appears closer to the gracile australopithecines than to the other fossils. Seven derived features of LB1's cerebral cortex are detailed, which indicate that LB1's brain was globally reorganized despite its ape-sized cranial capacity (417 cm^3). Neurological reorganization may, thus, form the basis for the cognitive abilities attributed to *Homo floresiensis*. These results may have implications for assessing the phylogeny of *Homo floresiensis* (Hobbit), which resembles *A. africanus* more closely than other hominins in salient brain shape features. The intense controversy about LB1 reflects an older continuing dispute about the relative evolutionary importance of brain size versus neurological reorganization. LB1 may help resolve this debate and illuminate constraints that governed hominin brain evolution.

Paleoepidemiology of periodontal disease and dental calculus in the Windover population.

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The skeletal remains from the Windover site provide a unique opportunity to understand the dental health of an Archaic period hunter-gatherer population. Windover is a mortuary pond located in Brevard County, Florida, dated to approximately 7,400 years B.P. Excavations at the site recovered at least 168 individuals, one of the largest and best-preserved skeletal collections of this antiquity from North America. This research analyzes the epidemiology of periodontal disease and dental calculus in 76 individuals from Windover. Assessments of periodontal disease are based on measurements of the distance from the cement-enamel junction to the alveolar crest (CEJ-AC) as well as qualitative examination of the condition of the alveolar bone. The study finds that mild forms of both of these dental health problems are common in the Windover sample, with only a small percentage of individuals affected by severe periodontal disease or dental calculus. The prevalence of periodontal disease and dental calculus increases with age, but the distribution of these dental health problems is not significantly associated with sex in the Windover sample. Comparison of the periodontal disease prevalence at Windover with other early Florida hunter-gatherer populations reveals variability between these populations, indicating that factors other than diet may affect susceptibility to periodontal disease. This study suggests etiological and demographic factors that may account for variability between these populations. Factors that may influence the prevalence and severity of periodontal disease in past populations include dental calculus, age, and heredity.

Two group takeovers, infanticides and pregnancy terminations in *Theropithecus gelada* at Guassa, Ethiopia

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Over a recent 18-month period, we monitored group composition in 10 one-male units of geladas belonging to a ~220-member band at Guassa, Ethiopia. We observed no changes in leader male identity in any of the units over the first 14 months, a period of remarkable stability. Over the next four months, however, we witnessed two unit takeovers by new, unfamiliar males which followed the same general pattern. Many bachelor males would surround a unit and harrass the unit's members until one bachelor emerged from the pack to vie directly with the unit's leader male for leader male status. Both takeover attempts were ultimately successful, and new leader males monopolized copulations with cycling females from the point of the takeover onwards. Two days after the first takeover, the new leader male snatched a 1.5-month old infant from a female in his unit and killed it with a canine puncture wound to the brain. Two weeks later, this female came into estrus (both behaviorally and morphologically) and mated repeatedly with the killer of her infant. A second takeover occurred in a different unit a few months later. Within 5 days of this takeover, a 1-month old infant disappeared and is presumed to have fallen victim to infanticide. Furthermore, over the next several days, two pregnant females in the unit miscarried. Many of the anecdotal results presented here are consistent with the sexual selection hypothesis for infanticide by males. Forthcoming fecal hormone analyses will reveal whether females resumed physiological estrus in addition to behavioral and morphological estrus following takeovers and infanticides. We

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Variation in dental tissue distribution in molar crowns of human males and females.

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Dental sexual dimorphism is an important component of morphological variation in human and non-human primates. Conventional measurement techniques, however, do not provide information about dental tissues in a three-dimensional context. A multi-planar approach based on non-destructive micro-CT scans allows assessment of differences in dental tissues in a whole-crown perspective.
In this study, clinically extracted mandibular and maxillary permanent molars from known sex individuals were employed to examine differences in the quantity of enamel and dentine and in the shape of the enamel-dentine junction (EDJ).
Females have relatively thicker enamel than males; absolute thickness does not differ between sexes. Males have more coronal dentine than females, resulting in relatively thinner enamel. Local differences in absolute enamel thickness in the crown differentiate the sexes. Moreover, significant local dentine size and EDJ shape differences were found, with males possessing generally taller, wider and more widely-spaced dentine horns than females. The developmental and functional implications of these results are discussed, as well as the practical application of assessing sex from worn and broken teeth in forensic, archaeological and paleoanthropological contexts.

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Forelimb ontogeny and its relationship to anatomical mechanical advantage in rhesus macaques (*Macaca mulatta*) from Cayo Santiago.

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The climbing and rapid propulsive quadrupedal locomotor modes of juvenile macaques are proposed to be age-dependent responses to decrease ecological risk. Work on primate and non-primate mammals demonstrates that extensor and flexor muscle mechanical advantage decreases with negative allometry during growth. Thus, the relatively small muscle mass of young individuals and their increased use of arboreal substrates and climbing suggests that high muscle mechanical advantage early in ontogeny may facilitate climbing behaviors in young rhesus macaques (*Macaca mulatta)*. To test this, I investigate relative lever arm growth for muscles critical to climbing: the *biceps brachii* and *deltoid* muscles. I use a cross-sectional growth series of rhesus macaques (n=231) from Cayo Santiago, to assess forelimb length and length of the shoulder protractor and forearm flexor lever arms. I measure functionally based segment lengths as proxies for muscle mechanical advantage. Developmental stages are based on crown tooth eruption. Data are analyzed (t-tests), by age class, for differences in relation to changes between ages in locomotor behavior. Differences in allometry of bivariate reduced major axis regressions are analyzed across sexes and taxa using SMATR. Growth trajectories of *M. mulatta* are compared with *M. fuscata* and *M.* **fascicularis**. As predicted anatomical proxies of mechanical advantage of both muscle groups scales with negative allometry. These changes may be an adaptive response to compensate for growth related limits in locomotor performance, due to absolutely small muscle mass. Longitudinal studies using kinetic, kinematic, and positional behavioral data are needed to validate these inferences.
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Bonobo genome sequencing.

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Bonobos (*Pan paniscus*) and chimpanzees (*Pan troglodytes*) are sister taxa that together are the closest living relatives of humans. While humans diverged from bonobos and chimpanzees perhaps 6.5 million years ago, bonobos and chimpanzees diverged perhaps 1.5 million years ago. Despite such a recent divergence, the two species exhibit remarkably different behaviors. As a gross characterization, among bonobos, females dominate, bond and cooperate; male status is based on mother's status; and conflicts are resolved with sex. In contrast, among chimpanzees, males dominate, bond and cooperate; male hierarchy is based on aggression; and conflicts are resolved with aggression and often violence. It is debated which of these behavioral patterns is

more similar to the one existing in the ancestors shared with humans. It might therefore be fruitful to study the evolutionary and population history of chimpanzees and bonobos. However, while we have a genome sequence for human and for chimpanzee, surprisingly little genetic data exist for bonobos. Thus, we have collected over 13 billion bases using 454 SequencingTM from a female bonobo. We are building a guided assembly using the chimpanzee genome with the aim of identifying bases where chimpanzee and bonobo differ, as well as polymorphism within bonobos to perform subsequent evolutionary analyses. We will use the sequence to study the population and evolutionary history of bonobos, chimpanzees and humans.

The role of sutures in modulating strain distribution within the skull of *Macaca fascicularis*.

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The closure patterns of cranial sutures vary considerably among mammals. This may be because closure of individual sutures following the cessation of growth of adjacent bony elements is modulated by masticatory function, with sutures adapting to the changing patterns and demands of the masticatory loads. As a first step in investigating this possibility the effects of sutures in modulating strain distribution within the skull need to be investigated.

This study uses finite element analysis (FEA) to investigate strain distributions with fused and unfused sutures in a model of the skull of an adult *Macaca fascicularis* under various loading conditions. Several FE models were created with combinations of three main cranial sutures: zygomaticofrontal, zygomaticotemporal and zygomaticomaxillary. A further two models were also created, one with and one without all three sutures. The results indicate that the presence of sutures produces localised decreases in the level of strain, while in other regions the strain is elevated. The results also reveal that sutures appear to work together in distributing strain around the skull. These FE results are validated against experimental data obtained using the technique of 3D speckle interferometry. Strain distributions in the FE model containing sutures closely reflect those recorded experimentally in a region of the maxilla.
These findings provide an insight into the mechanical role of sutures and possible developmental constraints on their order of fusion and highlight the need to include sutures in FE models.
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Resolving the mystery of the Kylindra cemetery: deciduous tooth development in ancient Greece.

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The Kylindra cemetery on Astypalaia in the Dodecanese, in use 750 BC - 1st C. AD, contains a unique skeletal collection. Well over 2100 infant inhumations, each buried in its own clay pot, have been uncovered so far. The skeletal material from each burial is embedded within a ball of accreted earth; since 2001, some 850 have been recovered and conserved by a team from UCL working with the 22nd Ephorate of Prehistoric & Classical Antiquities.
A study is underway at McMaster University to section 277 teeth from 107of these infants and, using odontochronology (assigning chronology using microstructural growth markers), to estimate ages-at-death. About half of the teeth have been sectioned so far and data on the timing and rates of enamel formation in the crowns developing at the times of death as well as information on childhood morbidity using accentuated striae have been collected. It appears that some 25% of infants survived the birth process long enough to form a neonatal line and that the rest were still born.
Although the proximate objective is to reconstruct the sequences of development of the different deciduous tooth types in the upper and lower jaws, it is also hoped that results will shed some light on the enigma of why such an unusually large number of perinatal infants were interred on such a remote Aegean island over such a long period of time.

Hypocellularity in the mastoid process: differential diagnosis in two early medieval populations from Germany based on Wittmaack's concept of normal and pathological pneumatization.

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Mastoid hypocellularity is frequently used to diagnose otitis media in human skeletal remains. Hypocellularity can, however, be caused by either primary inhibition of pneumatization or by secondary

filling of pneumatized cells in case of mastoiditis.
Primary inhibition of pneumatization has been associated with otitis media in early childhood. According to Wittmaack, different diseases result in characteristic morphological features in primary hypocellular mastoids. Secondary filling is caused by inflammation in juveniles and adults.
We tested the hypothesis that it is possible to distinguish between different causes of hypocellularity in ancient human skeletal remains. For that, we investigated 254 mastoids of individuals from the early medieval cemeteries Dirmstein (n=172) and Rhens (n=82), Germany. The temporal bones were X-rayed and thereafter sectioned in the frontal plane.
Conspicuous secondary filling of pneumatized cells was present in 3 mastoids, another case being doubtful. Altogether, osseous structures diagnosed to be of the "hyperplastic" form according to Wittmaack were found in 8.3%. In Rhens, males were significantly more frequently affected than females, whereas no sex differences occurred in the population Dirmstein. Features of the "fibrous" type were found in 17.3%. In both populations, frequency in males almost doubled that in females. No significant differences existed between the populations.
Although some aspects of Wittmaack's concept are still discussed controversially, it seems possible to distinguish different diseases in early childhood using his criteria as a basis for diagnosis of morphological changes in mastoids of juveniles and adults. However, the challenge remains to relate Wittmaack's descriptions to recent clinical diagnoses.

Taxonomic and phylogenetic significance of Lorisiform female genital morphology.

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Anderson (2000) and Perkin (2007) have suggested that penile morphology is a sound means of assessing species identity within galagos. The potential taxonomic significance of female genital morphology for galagids has not yet been formally assessed, though Hill (1953) suggested that this approach may be a fruitful one and work by Treatman-Clark (2008) bears out the relevance of female genitalia for higher-level taxonomy in the lemuriformes and lorisids. A very preliminary gross morphological examination was made of galagid (N=8) and lorisid (N=3) specimens in the collections of the Field Museum of Natural History (Chicago). Remarkably, even within this small sample size, notable morphological diversity is evident among the taxa examined, suggesting that female genital morphology is in fact taxonomically significant at least at the genus level for *Galago, Galagoides* and *Otolemur* and for *Loris* and *Perodicticus* and at the species level within *Galagoides*. Consequently, a detailed and more taxically comprehensive study of female genital morphology may potentially clarify currently debated phylogenetic relationships among lorisiform primates.
This research was supported by a Pre-Dissertation Small Grant from the Department of Anthropology, University of Pittsburgh.

A Comparison of High Detail Analog and Computed Radiography Imaging Systems in Paleoradiographic Studies of Archaeological Bone

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Radiographic imaging of human remains from archaeological contexts is standard in bioarchaeological data collection, enabling researchers to explore hidden abnormalities, evaluate cortical thickness, and to assess health and activity patterns. To date, the most common modality used in paleoradiography studies is analog film/screen technology. However, newer computed radiography offers the benefits of computer-aided image enhancement and recognition, the ability to store and transmit digital images, and the elimination of film processing and its associated costs. Unfortunately, the spatial resolution of computed radiography, at least in the clinical setting, is generally lower than that of film/screen systems. Although many clinical studies comparing conventional radiography and computed radiography of living tissues exist, there are no available studies specifically targeting their use on archaeological bone. The following study addresses this discrepancy.
For analog imaging, standard source-to-image distance and a low kilovoltage setting, combined with a single-emulsion/single-intensifying screen system (Kodak MIN-R, 100-speed) produced images with exceptional visible detail. Next, a computed radiography protocol was devised using a Kodak CR imaging system and cassette, which contains a photostimulable phosphor plate with a 100-speed extremity cassette rating. Adjusting standard exposure parameters maximized photoelectric stimulation of the CR phosphor plate.
Images obtained by these two methods yielded surprising results. Not only were images obtained from computed radiography comparable, preliminary visualization shows that internal cortical, trabecular and other structures are more defined than those demonstrated using high-detail film/screen technology. These findings provide insights into future directions for radiographic imaging studies on human bone from archaeological contexts.

Investigating patterns of Ontario Iroquoian infant and juvenile health and mortality.

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Osteological data can be useful in the identification of patterns of health and mortality in the archaeological record. In the Middle and Late Ontario Iroquoian Period in Southern Ontario, Canada, some members of Ontario Iroquoian communities were excluded from communal ossuary burial and were instead buried under house floors. Many of these individuals were infants and juveniles. It has been speculated that these infants and juveniles may have been chronically ill, and therefore judged to be unfit to make the journey to the Village of the Dead that symbolically commences with the interment of individuals in an ossuary. The hypothesis that these infants and juveniles interred under house floors instead of in ossuaries were chronically ill was tested using a sample of infants and juveniles (n=19) from house floors in seven Middle and Late Ontario Iroquoian villages. Dental age was estimated and long bone length was measured, and these were compared with standards from infants and juveniles from the Denver Growth Study. Long bone lengths of infants and juveniles were also compared to Ontario Iroquoian adult outcomes in order to investigate the tempo of growth. It was found that skeletal growth of these infants and juveniles did not follow a normal pattern, which could be indicative of a period of poor health preceding death. The osteological data in this case support the contention that the infants and juveniles buried under house floors were chronically ill, and may have been excluded from communal ossuary burial for this reason.

Muscle force production during bent-knee, bent-hip walking in humans.

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Recent studies indicate that bent-knee, bent-hip (BKBH) walking is more energetically costly than upright walking in humans, but less costly than either bipedal or quadrupedal walking in chimpanzees. In this study, we examined the biomechanical determinants of these differences. Using an inverse dynamics approach, we calculated the amount of muscle volume activated per step in a sample of humans walking normally and with a BKBH gait, and compared these values to previously published data from chimpanzees. We found that BKBH walking leads to an increase in total hindlimb active muscle volume compared to normal walking, but lower total muscle volumes compared to chimpanzee bipedal or quadrupedal walking. Therefore, our results match those from studies of energy costs of locomotion in humans walking with BKBH postures compared to costs in both normal human walking and chimpanzee walking (Carey and Crompton, 2005). The majority of the difference in active muscle volume between human gaits comes from the extensor muscle groups at both the hip and the knee. By contrast, chimpanzees activate significantly more muscle volume at the hip than at any other joint, due to architectural differences in their pelvis compared to humans (e.g., ischial orientation). These results suggest that anatomical changes in the human hip decrease costs for both BKBH walking and for upright bipedalism. Thus, both BKBH and extended limb bipedalism may be plausible responses to hypothesized selection pressures for reduced energy costs in early hominins compared to a chimpanzee-like ancestor.

Craniofacial shape and allometry in sister taxa of disparate body sizes: *Nasalis larvatus* and *Simias concolor*.

B.C. Frazier, J.T. Richtsmeier. Department of Anthropology, Pennsylvania State University.

Recent molecular phylogenetics confirm the close relationship between the proboscis monkey, *Nasalis larvatus*, and its smaller-bodied relative, the simakobu monkey *Simias* (= *Nasalis*) *concolor*). Isolated on the Mentawai Islands of Indonesia, the simakobu represents a rare instance of a probable endemic dwarf primate species. This work compares the craniofacial morphology of the simakobu to that of the proboscis monkey, as a case study of derived reduction in body size. 3D coordinate landmark data, endocranial volume estimates, and a set of linear metrics were collected from wild-shot museum specimens to construct a holistic comparison of craniofacial shape and allometry between species. Only female individuals are considered in this presentation, as sexual dimorphism is significant in both taxa.

Unlike the paedomorphic cranial shape observed in many dwarfed mammals, the simakobu cranium displays a more “adult” shape in some respects relative to its larger sister species. Relative to the size of its skull, the simakobu monkey has a smaller neurocranium, a longer palate, and a more projecting mid-face than the proboscis. In contrast, compared to the proboscis, the simakobu face is juvenile in that its orbits are larger relative to its skull size. The composite of these shape differences seem to contradict accepted trends in primate craniofacial allometry. This example may be instructive in interpreting other potential cases of dwarfism in primates.

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3D landmark and semilandmark geometric morphometric analysis of the Zuttiyeh fronto-zygomatic fragment.

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The relationships of Zuttiyeh 1 (dated ca. 300-200 Ka) have been debated since its discovery in 1925. It has been variously assigned to *H. erectus,* early Neanderthals, and early *H. sapiens*. Its geographic position in the Levantine Corridor in combination with its probable Middle Pleistocene date make it a crucial specimen in later human evolution; however, because of its fragmentary condition, the Zuttiyeh fossil is rarely included in morphometric studies.
To better quantify features of this specimen, we used cutting-edge 3D semilandmark geometric morphometric techniques. Seventy-seven landmarks and semilandmarks (curves and surface patches) were located on fifteen scans of Pleistocene fossil crania representing early *H. sapiens* (N = 2), *H. neanderthalensis* (N = 5) and *H. heidelbergensis s.l.* (N = 8) and sixty-three scans of recent human crania from the AMNH. The semilandmarks were re-sampled to yield equidistantly spaced landmarks for each individual and were slid along curves to minimize the bending energy of the thin-plate spline. 3D-coordinates of these (semi)landmarks were converted to shape-coordinates using Procrustes superimposition. Two additional analyses of the specimen were undertaken using landmark (collected by KH) and curve (collected by IJ) data, respectively, so as to independently assess the robustness of the analysis. Data were analyzed using Principal Component Analysis, inter-individual Procrustes Distances, cluster and discriminant analysis. Preliminary results show that the Zuttiyeh specimen is intermediate between all archaic specimens and modern humans, though it classifies as *H. heidelbergensis s.l.* in a Discriminant Function Analysis. Implications of these findings for modern human evolution are discussed.
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Tibial shape analysis – a quantitative approach for the whole bone.

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Size and shape of the tibia vary considerably among hominoids. This mainly owes to the locomotor behavior of the species (bipedalism, quadrupedalism or arboricolism). Tibial shape also varies among modern human populations, partly because of climatic adaptation. Tibial morphology - relative position of articular surfaces, muscle and ligament attachment areas, shaft geometry, overall proportions, torsion - is thus of great relevance for the assessment of fossil specimens too. However, quantitative analysis of the complete tibial surface is missing as previous studies use only sets of distances/angles or focus on limited surface aspects.
We report a preliminary study of shapes using dense 3D surface representation (tri*TOS* surface scanner) of the whole tibia. 27 anatomical landmarks and several hundred semilandmarks on curves and surface patches were digitized. Landmarks are transformed into shapes variables by Procrustes superimposition (GPA), and analyzed via form space PCA.
This approach allows the quantification and visualization of shape changes with regard to the spatial position of muscle attachments on the shaft and of the relative orientation and curvature of the articular surfaces, characteristics improving knowledge of locomotor function. It also confirms previous findings that Africans differ from Europeans by the relative massiveness of the epiphyses in relation to bone length. The measurement scheme permits studies of both juvenile and adult tibiae (ontogeny), as well as across species (phylogeny). As the whole surface is quantified, it also allows virtual reconstruction of fragmentary specimens as is often the case in archaeological and fossil remains. Supported by the EU PF6 Marie Curie Actions grant (EVAN, Human Resource and Mobility Activity) MRTN-CT-20 05-019564.

Climate and Craniofacial shape variation among major human populations: a geometric morphometric approach.

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Craniofacial variation among major human groups has often been linked to climate as one possible factor among many, though no general agreement exists as to which exact role climate plays in human variability, and which morphological traits reflect thermoregulatory adaptations. This study follows previous work that suggested that some link between climate and craniofacial variation can be demonstrated in modern humans. In order to investigate this more closely, a worldwide sample of 520 crania was used, and 3D landmarks were recorded with a microscribe coordinate digitizer. The data were subjected to Generalized Procrustes Analysis, and standard multivariate statistics were applied in order to test whether craniofacial shape is associated with broad climate variables such as temperature and humidity ranges. The results show a distinct pattern of alveolar reduction and more coronally

oriented zygomas in cold climate populations, which can be interpreted as relative facial flatness. In addition, the neurocranium in these populations tends to be relatively shorter and wider, resulting in a more spherical shape. This is consistent with previous results that suggested neurocranial variation sensu Bermann's rule. The observed craniofacial morphology is opposed to that found in warm/dry climates, which shows relatively longer, narrower neurocrania and more projecting alveolar regions. Moreover, this pattern is found not only at a global scale, but also when continental subsets are analyzed. While no functional advantage of such a craniofacial morphology has been demonstrated yet, the results are compatible with an adaptational model, rather than with genetic drift having caused these patterns.

A three-variable analysis of carbon and nitrogen isotope values discriminates between dietary energy and protein sources in prehistoric humans.

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Within individuals, the relationship between apatite and collagen carbon stable isotope ratios indicates sources of dietary energy (C_3, C_4) and protein (C_3, C_4, marine) (Kellner and Schoeninger 2007 AJPA 133:112-127). This method, however, shows limitations in distinguishing between C_4 and marine protein. Nitrogen isotopes should resolve these diets, so we obtained previously published nitrogen data for the archaeological populations used in the earlier study of carbon isotopes. Here, we present a three-variable analysis to better discriminate between diet constituents.
Foragers from Late Woodland Georgia and Ontario, though similar in carbon, differ in nitrogen. In the former, low $\delta^{15}N$ values suggests little consumption of fish, while the latter exhibit values (mean=+12.2 ‰) supporting previous interpretations of dependence on Great Lakes fish. Cahokia agriculturalists display a narrow range of low $\delta^{15}N$ values (mean=+9.0 ‰), consistent with carbon values indicating reliance on terrestrial C_3 protein sources. A wide range of nitrogen values (+14.9-20.8 ‰) from San Nicolas Island support the interpretation, from carbon data, that these foragers incorporated both C_4 protein and various marine foods. Tierra del Fuego foragers show a bimodal division in both carbon and nitrogen. One group, mainly in the north and on southwestern islands, exhibits lower $\delta^{15}N$ values (+10.6-13.2 ‰), compared to the other group (+15.1-18.8 ‰), which clusters in the region's southeast. Overall, the inclusion of $\delta^{15}N$ with $\delta^{13}C$ values from apatite and collagen appears to discriminate among various protein sources in prehistoric diets.

Biological Anthropology, Culture, and Evolutionary Theory.

A. Fuentes. University of Notre Dame.

The integrative nature of biocultural reality in humans is implicit, historically and currently, in many anthropological perspectives. However, there remains a substantial segment of anthropologists who avoid this as a focal point for investigation or who deny its importance. There are also many who are interested in such endeavors but who utilize overly simplistic or uni-dimensional assessments of patterns and processes in culture and evolution. In biological anthropology we are underutilizing the potential integration of cultural and evolutionary themes in our preparation and practice. Today, in 2009, we are in the midst of significant enhancements in complexity and diversity in evolutionary theory. Our grasp of patterns and contexts of selection and the ways in which epigenetic and developmental interactors affect outcomes is growing by leaps and bounds. We are constantly adding to our understanding of evolutionary processes and enhancing our abilities to test and measure them. We also are increasingly realizing that cultural and experiential contexts shape our bodies and affect our trajectories in more substantial manners than previously envisioned. The formation, structuring and evolution of the processing and action systems in humans are biocultural, making cultural theory and evolutionary theory necessary mates. Their offspring are what provides biological anthropology with a potentially unique perspective for assessing humanity. In this talk I will contextualize the major themes of this symposium by providing examples of the theoretical and practical applications of evolutionary biocultural perspectives.

Life-history tradeoffs can explain vitamin A levels in human milk: an example of the maternal reproductive strategy from Kenya.

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Vitamin A deficiency (VAD) is associated with elevated morbidity and mortality. Newborns have meager vitamin A (VA) stores, and are dependent on breastmilk for physiological needs and for building liver stores needed after weaning. VAD mothers produce breastmilk with low VA, compromising their children's VA status. It has been documented that VA concentrations in breastmilk decline across the first year postpartum in women from both developed and developing nations, but the reason for the decline has not been investigated and assumed to be a sign of depleting maternal hepatic stores. Why the decline is pervasive despite potential adversity on child health merits investigation. This paper investigates the gap between breastmilk VA and maternal hepatic VA in an evolutionary framework,

using cross-sectional data from 241 lactating Ariaal mothers of Marsabit District, Kenya. Paired breastmilk and blood samples were collected from each mother for determining milk VA concentrations and hepatic VA stores via the relative-dose response test. Paired trends in milk and liver VA were projected using linear regression models. Results indicate that breastmilk VA does not track maternal hepatic VA, but instead forms a trend that is a near mirror image of the liver VA trend over 18 months postpartum, demonstrating the tradeoff relationship between breastmilk and maternal liver VA postpartum. This observation provides an important, rare example of life-history tradeoffs in humans, and demonstrates the wealth of information generated by an evolutionary investigation of human lactation.

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Dietary variability in pre-contact central California: evidence from stable sulfur, carbon, and nitrogen isotopes of bone collagen.

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Recent bioarchaeological research in central California has revealed a complex pattern of dietary variability during the late Holocene (4500-200 B.P.). Previous studies of stable carbon and nitrogen isotopes of human bone collagen and dental caries indicate high consumption of marine resources in sites from San Francisco Bay, with a greater emphasis on terrestrial resources in the lower Sacramento Valley. Additional data from sites located between the Bay and the Delta (the interior Bay) indicate variation in the importance of terrestrial, freshwater, and marine resources. The present study includes 59 adult burials excavated from 11 archaeological sites in the San Francisco Bay interior and Delta region of the lower Sacramento Valley.

In this paper, we evaluate regional and temporal patterns in paleodiets from prehistoric central California using stable sulfur, carbon, and nitrogen isotopes of bone collagen. Mean carbon and nitrogen isotope values for Delta skeletons are homogenous through time and reflect a terrestrial diet with some contribution from freshwater fish. In contrast, higher stable carbon and nitrogen isotope values from some interior Bay skeletons indicate some contribution of marine foods to the diet. Data from stable sulfur isotopes indicate site and region-specific variation, with the lowest values found in the interior Bay. We address the implications of our results to interpretations of dietary patterns in California prehistory.

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Tooth wear, age and diet in a living population of baboons from Amboseli (Kenya).

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Previous studies in wild baboons, *Papio cynocephalus*, in the Amboseli basin of Kenya documented that periodontal health decreases with age, and recent analyses on other wild mammal populations have observed dramatic changes in tooth wear with age. The present study focuses on tooth wear in wild baboons in Amboseli, and its relationship to age, sex and diet. During 2006, 2007 and 2008 mandibular and maxillar tooth impressions were obtained from 87 wild baboons using tooth putty and catalyzer; and high-resolution replicas were obtained from these impressions. Using digital image analysis of these replicas, we measured tooth wear as the percent of the occlusal surface on which dentine was exposed (% dentine exposure). The results show a significant strong and significant quadratic correlation, for males and females, between age and % dentine exposure, which increases with age, especially in first molars (M1), but also in second (M2) and third (M3). Males present lower R^2 values than females because of their higher variability in % dental exposure in relation to age. Moreover, in females, for whom long-term feeding records were available, we examined the relationship between % dentine exposure and % of different food types present in diet. Our results show that tooth wear is affected by age, by sex, and by diet, particularly the consumption of gritty foods, such as grass corms, that present a high proportion of extrinsic particles because they are underground storage organs.

Age-at-death assessment in poor preserved juvenile skeletal remains: a new methodological approach.

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Age determination methods on juvenile skeletal remains are among the most frequent interests in the bioarchaeology of children. The literature widely discusses both skeletal and dental age. However, few studies take into account poorly preserved remains. Thus, without information about age, individuals are rejected from complementary analyses such as growth or palaeodemographic studies. The purpose of this research is to develop an intra-population secondary skeletal age diagnosis in order to increase sample size in population studies and to consider

the largest part of the remains. We develop this new approach on 235 individuals ranging from perinatal to late adolescence from the early mediaeval cemetery of Mikulčice (Czech Republic, 9th to 10th centuries A.D.). Three other large European cemeteries presenting various skeletal preservations and dated from the same period provided target samples. The method follows two consecutive steps: 1) primary dental age estimation using Moorrees *et al.* 1963 technique, since tooth mineralization is considered as the least variable pattern of growth; 2) secondary skeletal age estimation from multivariate analysis and probabilistic approach on set of variables selected from 53 infra-cranial measurements. As a result, primary age of 154 individuals could be estimated. The secondary diagnosis assigned an age class to 60 individuals. We repeated this analysis on the material from the three other cemeteries and consequently increased the age determination level by more than 20%. This intra-population secondary age estimation method is a new step toward large population studies and offers the advantage of avoiding the use of reference population data.

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An R program for automating bone cross-section reconstruction.

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It is well established that long bone cross-sectional properties are a valuable source of information for understanding past human behaviors. O'Neill and Ruff (2004) described a method for reconstructing diaphyseal cross-sections from external molds and biplanar radiographs that produced accurate results (within 5% of true values). The manual image processing required, however, is both time and labor intensive. A new freely available program (written by ADS) for the computational freeware, R, automates much of the process. This study compares cross-sectional properties calculated using the R program to those from peripheral quantitative CT (pQCT) and the original manual method.

Cross-sectional images and properties for fifteen long bones (five femora, humeri and tibiae from a skeletal teaching collection) were obtained using a pQCT scanner. Images were converted to *.jpeg format and medullary cavities were removed in a photo-editing software package resulting in a bone silhouette. Cortical thicknesses were measured on biplanar digital radiographs using the freeware ImageJ. Medullary cavities were reconstructed, and cross-sectional properties calculated, from bone silhouettes and cortical thicknesses, using the R program and the original O'Neill and Ruff method.

The R program compares well with the original method as judged against the pQCT properties. Percent differences (mean, range) between R-calculated properties and pQCT values are: total area (0.6%, -2-3%), cortical area (2.4%, -4-8%), Ix (1.5%, -0.6-6.3%) and Iy (2.7%, -0.7-8.8%). These are similar in magnitude to those reported by O'Neill and Ruff. Some tibial reconstructions remain problematic and further work is being done to address this issue.

Osteological correlates of the vomeronasal system in primates.

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In the evolutionary history of anthropoids, it is hypothesized that a "trade-off" has occurred favoring enhanced abilities to perceive visual cues rather than pheromones as sociosexual signals. These trends seem apparent based on genetic data indicating relaxed selection on the vomeronasal system (VNS). However, understanding the details of olfactory evolution in primates depends on unequivocal osteological correlates of olfactory structures that may then be detected in the fossil record. The vomeronasal organ (VNO), which is important for pheromone detection, is surrounded by a cartilage (VNC) which articulates with the palate. In this study, we examined histological sections of the nasal fossa in strepsirrhines (8 genera) and platyrrhines (5 genera) which yielded several trends in the VNC. The VNC is associated with a palatal groove in all observed taxa except *Alouatta* and this groove largely reflects gross VNO dimensions. A negatively allometric relationship between body size and VNC size is observed. Ossification of the VNC is observed in some strepsirrhine taxa (*Potto*, *Otolemur*, *Cheirogaleus,* *Eulemur*). Ossification occurs posteriorly in the VNC (51% of VNC length is ossified in *Potto*, 78% is ossified in *Eulemur*). A large sample of *Otolemur* spp revealed patterns of ossification of the VNC relating to age and sex (more ossified in males and older animals). Strepsirrhines have wider VNC than platyrrhines, which is reflected in the palatal groove. Platyrrhines are more variable in VNC shape. We suggest that the VNC palatal groove may be used to indicate the presence and size of the VNO in fossil primates.

Increase of anthropology cases in the five last years in the Forensic Service in Santiago of Chile.

C. Garrido-Varas Special Program for Human Rights, Forensic Service, Chile.

The following research is based on the cases that have entered in the Special Program of Human Rights

of the Government of Chile since the year 2003, when the anthropology unit was created. The goal is to recognize the motives that produced and generated the demand of anthropology analysis from law enforcement actors. These motives were classified as: fortuitous findings, mass graves, cause of death and corroboration of identity. These motives show what kinds of cases are routinely incorporated and also what cases are understudied. Each case was analyzed in regards to origin, requirements, results and final destiny of the remains. The numbers of cases per year from 2003 to 2008 are: 29, 24, 116, 24, 91 and 86. Most of the cases are directly related to Human Rights investigations with an increment of criminal cases in 2008. The principal reason of increment in the years 2005 and 2007 were because of doubts of the identities assigned before the DNA technique was available for remains of old data.
The results show that potentially more cases could be refereed for anthropology analysis and we propose different mechanisms for this, such as continuing education to law enforcement actors, confection of friendly reports, and a twenty four hour telephone assistance for new findings.

Scurvy in a Late Roman Greek child: multiple lines of evidence.

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Much attention has recently been given to the diagnosis of scurvy (vitamin C deficiency) in archaeological remains. A complex of porous lesions of the vault and face has been proposed as pathognomic of juvenile scurvy, and has been used to study the incidence of scurvy in a number of archaeological populations. However, there is still some debate over the etiology of these cranial lesions. The examination of affected individuals using other lines of evidence to clarify their health and dietary history could assist in resolving this debate. Here we examine a juvenile from the Late Roman burial population of Stymphalos, Greece (4^{th} – 6^{th} c. CE). This individual, aged approximately 18 to 30 months at death, shows the complex of lesions in question. Radiographs of the long bones reveal anomalies that are consistent with depictions of scurvy in the modern clinical literature. Root caries are seen in four of the teeth. Although gum involvement is not often discussed as an aspect of juvenile scurvy, the clinical literature indicates that it can occur and could explain the root caries in this juvenile. Rib collagen $\delta^{15}N$ is elevated over $\delta^{15}N$ values of older individuals from the burial site, suggesting that weaning was not yet complete. Given these indications, we propose that this child suffered from scurvy, perhaps related to cultural practices associated with the feeding of young children.
This research was supported by the Social Sciences and Humanities Research Council of Canada, the University of Alberta, and the Wiener Laboratory of the American School of Classical Studies at Athens.

A case of bilateral auditory exostosis from the Pacific coast of central-south Chile.

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In August 2007 human skeletal remains were exposed during industrial excavation in the Mataco sector of the Bío-Bío region, central-south Chile. Subsequent archaeological excavation by the Universidad de Concepción recovered the remains of five individuals that had been buried on a beach along the Itata River between 1,500 and 2,000 years bp. We present an osteobiographical case study of one of these individuals, a young, male skeleton with an age at death of 24±2 years. This individual, recovered with mortuary objects that include the jaw of a marine mammal, exhibits bilateral auditory exostosis with bilobular osteal neoformation in both external meati. This evidence corroborates the presence of this occupational marker in coastally-adapted groups at 36° latitude on the Pacific coast of Chile. Evidence of coastal adaptation may also be inferred from other regions of the skeleton, including the presence of osteophytic remodeling in the subtalar joint.
Research supported by the Social Sciences Department, Universidad de Concepción and the College of Social Sciences, Saint Cloud State University.

Relative prefrontal cortex surface area in *Pan troglodytes* and *Homo sapiens*.

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In humans, the prefrontal cortex (PFC) has been linked with higher-order cognitive abilities such as planning for the future, memory for serial order, and social information processing. Compared to other primates, it is clear that humans have a large PFC (in both absolute and relative terms), but unclear whether its surface area is also greater. One outstanding issue is how to define its posterior boundary in magnetic resonance images. In previous studies, this methodological issue has led to disagreement about the scaling relationship of the PFC's surface area. Increased surface area of the PFC would suggest increased gyrification and greater interconnectivity of the underlying white matter
Here we investigate expansion of the PFC by measuring relative surface area of the PFC in *Pan troglodytes* and *Homo sapiens*.

Magnetic resonance images (MRI's) from 8 preserved chimpanzee brains (3 male and 5 female adults) were segmented and measured in Materialise MIMICS v. 11.1. In order to delineate the posterior boundary of the PFC, the frontal lobe was divided along the inferior precentral sulcus just posterior to the superior and medial frontal gyri. 3D models were generated from the segmented MRI's and surface areas for each model were calculated within MIMICS.

We show that relative surface area of the PFC differed significantly between chimpanzee and human brains ($p<0.05$ using the Kruskal-Wallis test), and consider how this affected functional complexity of the PFC during human evolution. Our findings regarding the PFC have important implications for understanding the cognitive differences between humans and chimpanzees.

Developmental perspectives on the evolution of the brain and cognition.

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Recent decades have witnessed the rise of a new discipline, evolutionary developmental biology (evo-devo), which is now elucidating gene/environment interactions leading to the evolution of complex physical and behavioral traits. Most students of human brain and behavioral evolution, however, continue to focus primarily on the comparative neurology and/or behavior of adult primates and humans. Sometimes assumptions are made, especially by evolutionary psychologists, that many readily identifiable cognitive skills of human adults, and by implication the neural areas which mediate them, are controlled by domain-specific genes. These genetic assumptions fail to explain the diversity of modern human cultures. They also ignore the cortical plasticity known to exist in many mammals and the seeming differences in human-like cognitive capacities manifested by great apes raised in the wild versus those raised in human homes. Developmental data lend themselves to a different interpretation. Specifically, with maturation, human and non-human primates, construct increasingly hierarchically complex, flexible, and information-rich behaviors. Human mental constructional capacities, however, ultimately exceed those of other primates in varied domains including language, tool-making, social intelligence, art, and dance. These enhanced cross-domain mental constructional skills reflect the interactions of neocortical, cerebellar, and other neural areas and appear to account for enhanced human abilities to construct advanced technologies, complex political systems, and complex religious and scientific world views. Hence, flexible, cross-domain human mental constructional capacities, rather than numerous domain and gene-specific cognitive capacities, may have catapulted humans to the position of niche constructors and niche modifiers par excellence.

Gene regulation in primates evolves under tissue-specific selection pressures

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In the post-genome era, a central goal of evolutionary biology is to elucidate the genetic architecture of regulatory adaptation. In humans, in particular, this question is of interest both for what it will reveal about human specific traits and because of the emerging links between gene regulation, adaptation, and disease susceptibility. I will discuss the difficulties in studying regulatory evolution in primates and outline how we address these difficulties by using a combination of genomic, computational, and targeted approaches. I will present several examples of functional regulatory differences between humans and other primates, including examples of changes in metabolic pathways and master-regulator genes. I will also provide evidence for major shifts in regulatory networks along the human lineage, as well as for tissue-specific selection pressures on gene regulation. Together, these observations provide strong support to the notion that adaptive circumscribed changes in gene regulation have fewer deleterious pleiotropic effects compared with changes at the protein sequence level, and that that changes in gene regulation have an important role in human evolution.

Phylogenetic history of the African papionins: a cladistic analysis of extant and fossil taxa using craniodental data.

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This study examines African papionin phylogenetic history through a cladistic analysis of craniodental morphology using both quantitative and qualitative characters. The narrow allometric coding method was applied to account for the influence of allometry on the papionin cranium. Results of the analysis suggest that *Parapapio*, *Pliopapio*, and *Dinopithecus* are stem African papionin taxa. Crown Plio-Pleistocene African papionins include *Gorgopithecus*, *Procercocebus*, and *Papio quadratirostris*. Notable hypotheses include: *Papio quadratirostris* is the sister taxon to the clade containing the extant taxa *Mandrillus* and *Cercocebus*; ?*Theropithecus baringensis* is strongly supported as a primitive member of *Theropithecus; Gorgopithecus* is closely related to *Papio* and *Lophocebus;* and *Theropithecus* is a primitive crown African papionin taxon. Character transformation analyses identify a series of morphological transformations during the course of papionin evolution. The origin of crown African papionins is defined in part by the appearance of definitive maxillary fossae. *Papio*,

Lophocebus, and *Gorgopithecus* are further united by the most extensive development of this feature.
The *Mandrillus/Cercocebus/Procercocebus/ Papio quadratirostris* clade is defined by upturned nuchal crests, widely divergent temporal lines, and a tendency to enlarge the premolars as an adaptation for hard-object food processing. The adaptive origins of *Theropithecus* appear associated with a diet requiring an increase in temporalis musculature, the optimal placement of occlusal forces onto the molar battery, and an increase in the life of the posterior dentition. This shift is associated with the evolution of distinctive morphological features such as the anterior union of the temporal lines, reversed Curve of Spee, and increased enamel infoldings.
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The function of coalitionary aggression among wild chimpanzees.

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Male chimpanzees frequently engage in coalitionary aggression, which is thought to be a critical determinant of dominance rank and reproductive success. Despite its ubiquity across study populations, the dynamics of coalitionary aggression are poorly understood. We use ten years of data from Gombe National Park, Tanzania to test hypotheses concerning the function of coalitionary aggression among male chimpanzees. In our sample of 132 instances of coalitionary support, kin selection played a limited role, for maternal brothers formed coalitions with and against each other at equal rates. Matrix correlations revealed that support given was significantly positively correlated with support received, but only during periods when there was a decided alpha male. When the alpha position was unclear, there was no such reciprocal pattern. Males of all ages and ranks used coalitions both as an offensive strategy to increase rank and a defensive strategy to maintain rank. A generalized linear model showed that certain males were more prone to forming coalitions than others, but when these tendencies were statistically controlled for, high-ranking males formed coalitions more often than low-ranking males. Our results support the notion that coalitionary aggression is a flexible dominance strategy that varies within and among individuals according to the current state of the male hierarchy.

Sulcus topography and asymmetry of the common chimpanzee parietal cortex.

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Identification of homologies in brain traits is central to the study of primate brain evolution but remains a challenge because primates have evolved in different branching lineages. Recognition of taxon-specific sulcal patterns hence represents an important step because these brain traits are often identifiable both on fossil and extant specimens. Moreover, during normal development, sulci and gyri formation largely serves to accommodate neuronal connectivity and tensions along axons in the white matter can explain how and why the cortex folds in a defined pattern. Diversity in sulcal patterns may therefore reflect species-specific aspects of cortical connectivity. The purpose of this study is to describe the sulcal and gyral topography, variability, left-right asymmetry and possible gender differences of the parietal opercular region in common chimpanzees (*Pan troglodytes*). This cortical region appears to have been a major determinant in hominid brain evolution, essentially through visuospatial integrative processes. 42 common chimpanzee brains (20 females, 20 males, 2 unknown gender; 6 juveniles, 36 adults) were scanned postmortem with a 1.5 T magnet. Subsequent image processing then involved a new imaging technique designed to produce a flat view of the whole free (or exposed) cortical surface. Preliminary results indicate that, like in human, 4 distinct types of common chimpanzee parietal opercular sulcus topography can be recognized but fail to indicate any significant asymmetry. This would suggest that the gross morphology of the parietal operculum is not of direct relevance to asymmetries in the posterior region of common chimpanzee's sylvian fissure.

An 18th century lithopedion from Heidelberg, Germany.

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Lithopedia (*Foetus ossei*) occur when an extra-uterine pregnancy, or an incomplete vaginal delivery, is retained within the abdomen of mother and calcified. The "Heidelberg Steinkind" (Heidlberg

Stone Baby) is a fetus that did not complete delivery and was extruded into the peritoneal cavity following a uterine rupture. The calcified fetus was retained by the mother for 54 years, until its recovery after the death of the woman in 1767. This paper reports on the analysis of the "Heidelberg Stone Baby". Morphometric and morphological data collection enabled an estimation of gestational age. The lithopedion had been sagittally bisected soon after discovery for use in anatomical instruction and some internal organs are still preserved as desiccated tissue. CT scanning and subsequent three-dimensional reconstruction enabled the estimation of gestational age, and a detailed examination of surviving soft and hard tissues.

Who's herding the sheep? Exploring the origins of pastoralism in southernmost South Africa.

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The late Holocene marks a period of significant population movement and subsistence change throughout much of sub-Saharan Africa. Around 3500 BP it appears that foraging populations in southernmost South Africa began to experience stress related to an increasing population and changing climatic conditions. A new form of subsistence - sheep herding – emerged at around 2000 BP in areas previously occupied solely by foragers, but was not exclusively adopted. The mechanisms surrounding the introduction of this new subsistence strategy – an indigenous adoption via diffusion or a foreign migration - remain unresolved. This study takes a bioarchaeological approach to this significant question by exploring a collection of seventy-three Later Stone Age adult skeletons from the Eastern Cape, South Africa that predate and postdate the appearance of pastoralism. Craniometric, osteometric, and odontometric data were analyzed in conjunction with cranial discrete information to determine if any significant changes in skeletal morphology indicative of population discontinuity could be identified at 2000 BP.
Some changes in skeletal morphology are observed, but the timing, pattern and magnitude of these changes are not consistent with a foreign migration. A reduction in overall skeletal size in the absence of shape changes corresponds with the period of forager intensification. Body size rebounds around 2000 BP when evidence for sheep herding is first observed in this region. The timing of the observed changes in skeletal size, the absence of shape changes and the homogeneity in cranial discrete trait frequencies through time suggest sheep herding was an indigenous development among existing foragers.

Diet and habitat use of mona monkeys (*Cercopithecus mona*) on the island of Grenada, West Indies.

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During the slave trade to the Americas from Africa, mona monkeys were introduced to the Caribbean island of Grenada and have since become naturalized. Here we present data collected between 1992 and 2002 on forest structure, seasonal habitat use and diet, previous to the devastation of Hurricane Ivan in 2004. Monas were observed in primary forest during 54% of encounters within which the upper and middle forest strata were occupied most (94%). The remaining encounters were equally divided between secondary and palm forest types with monas found in the middle and lower strata of the forest most in secondary (84%) and all levels equally in palm forest. Seasonal habitat use was positively correlated with fruit availability in primary forest ($r = 0.63$, $p < 0.03$) and palm forest ($r = 0.57$, $p < 0.05$). Fruit was the dominant food item in the diet. Comparisons with habitat use of African *C. mona* indicate that Grenada monas use primary forest and higher forest strata more than their African counterparts. This may be due to ecological release caused by the competitor-free environment found on Grenada. Additional surveys are recommended to reassess Grenada's forest to determine which fruiting tree species are recovering and at what rate after Hurricane Ivan.

Neuronal propagation patterns during cortical neurogenesis individuate evolutionary units in the Human neocortex.

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The neocortex is the locus of complex cognitive-behavioral faculties in humans. In principle, the evolutionary treatment of this brain structure should uncover its natural functional and structural divisions. Central to this enterprise is a theoretical framework that carefully synthesizes the logical requirements that qualify a functional-structural entity to be affected and transformed directly and sustainably, as a unit, by natural selection. This view criterially identifies organismic parts as evolutionary adaptations in virtue of their developmental modularity viz. the natural boundaries of their underlying developmental-genetic program. The individuation picks out morpho-developmental units (evolutionary units) whose boundaries (1) imply underlying unitary genetic organization, (2) indicate independent unitary evolutionary transformability, (3) demarcate independent functional-structural unity, and (4) determine what can count as unitary selective problems for an organism. The present work is a sample of a larger project that investigates the nature of the developmental-genetic program underlying the human neocortex by evaluating its morpho-developmental indices. It applies a

computational method that generates a quantitative reconstruction of morphogenesis across 3-dimensional embryonic human specimens at successive stages of development to reveal, at histological resolution, the pattern of neural propagation that builds the neocortex. Results derived from the analysis of 6 specimens (covering the first six weeks of neurogenesis) reveal a fine grained, non-random spatio-temporal pattern that does not support the claim that the neocortex as a whole acts a single evolutionary unit, nor that classically defined cortical regions act as independent evolutionary units.

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The rings of fire – tooth cementum annulation for estimation of age at death in cremated remains.

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The assessment of tooth cementum annulations (TCA) is acknowledged for its significant potential as a more accurate method for estimating age-at-death than the morphological or histological methods typically employed. Its use in cremated remains has received little attention and has only been briefly investigated in samples of unknown age, which did not allow for quantitative assessment of accuracy.

This study applies TCA to a sample of modern teeth of known age after experimental cremation at temperatures of 600°C, 800°C, and 1000°C. Cementum annulations are found to survive in these thermally altered teeth; however, their visibility is directly dependent on the maximum exposure temperature. There is a direct linear relationship between cremation temperature and the loss of accuracy in age estimation, likely due to thermal structural alteration. Physico-chemical changes induced by cremation resulted in TCA only being applicable to 63.3% of the original sample. Analyzed samples yielded a correlation to known age of only r = 0.522 and an average age underestimation of 22.46 years. The results of this study indicate that in teeth exposed to temperatures of 600°C or higher, TCA analysis no longer yields accurate enough results to be of use in either forensic or paleodemographic investigations.

The working class at Hierakonpolis. Nubian or Egyptian?

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Excavations at Hierakonpolis uncovered multiple cemeteries representing three social classes (Friedman 1999). Specifically, the condition and type of artifacts at HK43 suggested it was a Hierakonpolis working class cemetery (Friedman 1999). This Predynastic site is near other Hierakonpolis cemeteries believed to be comprised of Nubians from the C-Group and Pan Grave horizons (Friedman 2001). Nubians were often recruited or enslaved by Egyptians for work. Thus, Nubian burials were not uncommon in Egypt. Although the grave goods are different between the Nubian cemeteries and HK43, implying HK43 individuals may be Egyptian, the skeletons at HK43 have not been confirmed biologically as Egyptian or Nubian. In the current study, Egyptian and Nubian samples from areas outside of Hierakonpolis were utilized to confirm the probable Egyptian biological affiliation of HK43 individuals. The samples compared to HK43 (data contributed by Dr. Jerry Rose) include Predynastic Egyptians from Badari (data contributed by Dr. Tsunehiko Hanihara), and C-Group and Pan-Grave Nubians from Sayala (Strouhal and Jungwirth 1984). Cranial discrete traits were input into Mahalanobis D^2 with a tetrachoric matrix to calculate biological distances. The distance matrix was input into principal coordinates analysis (PCO) and the first two principal coordinates were plotted to depict the relationships among the samples. The biological distances and scatterplot indicate that the HK43 individuals were, indeed, Egyptian. This biological analysis supports the differences in archaeological data between the Nubian cemeteries and HK43, and further substantiates the idea that Nubian workers were buried in separate cemeteries from Egyptians, regardless of Egyptian social status.

My thanks to Dr. Renée Friedman, Director of the Hierakonpolis Excavations and to NSF for funding awarded to Dr. Jerry Rose (0402-01541-21-2002), which produced the HK43 data utilized here.

Dietary implications of relative infraorbital foramen size in the subfossil lemurs of Madagascar.

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Recently, one of us (MNM) completed a study of the phylogenetic and functional significance of variation in relative size of the infraorbital foramen (IOF) in primates and other mammals. Muchlinski's comparative data on extant mammals show that 1) relative IOF area is a good indicator of infraorbital nerve (ION) size and thus touch sensitivity of the rostrum, 2) primates (including prosimians), scandentians, and dermopterans have relatively low IOF areas compared to most other mammals, 3) among primates (including prosimians), IOF area co-varies with diet, such that

frugivores have relatively larger IOFs than do either folivores or insectivores. This research can provide a foundation for interpreting relative IOF size in extinct primates.

We measured cranial and IOF size in 14 species of extinct Malagasy lemurs belonging to four families (Archaeolemuridae, Megaladapidae, Palaeopropithecidae and Lemuridae). Diets of these species have been inferred on the basis of the gross morphology of their teeth and jaws, dental microwear (SEM, low magnification, and confocal microscopy), and dental microstructure. For some species (especially *Hadropithecus*), these tools have generated contradictory results. It is therefore useful to have an entirely independent tool of analysis.

Like other primates and in contrast to most other mammals, most giant lemurs had relatively small IOFs. Among extinct lemurs, there is considerable variation in relative IOF size, with all species of *Archaeolemur* falling within the frugivore range, all *Megaladapis* within the folivore range, the palaeopropithecids variable and *Pachylemur* intermediate. *Hadropithecus* had an exceptionally large IOF, likely signaling a dietary regime unusual for primates.

Differential Diagnosis of a Possible Coccidioidomycosis Infection in New Mexico: AD 1712-1903

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Coccidioidomycosis is a disease that is endemic to the desert southwest. This disease is caused by the inhalation of *Coccidiodes immitis*, a saprophytic fungus that lives in the desert soil, forming spores when released into the air. Inhaled spores frequently manifest as an asymptomatic and self-limiting infection, but may also progress to a chronic and disseminated disease, affecting bone. Early Southwestern populations, without antimycotics, were probably more susceptible to mortality from the disseminated forms of this disease, yet literature regarding bone lesion distribution and morphology is scarce. Here, we present a differential diagnosis and description of the skeletal lesions resulting from a possible coccidioidomycosis infection in an adolescent skeleton excavated from the Alameda Cemetery in Albuquerque, New Mexico (AD 1712-1903).

Lesions were examined using 10x and 40x light microscopy as well as through gross observation. The lesions primarily affect the internal surfaces of the ribs and are well-defined, circularly lytic and characterized by a stepped interior organization. Most of the lesions have a central cavitation with underlying loss of cancellous bone and moderate perifocal reactive bone. The presence of both woven bone and areas with possible healing suggest that this disease was both active and chronic in this individual at death. The lesions most closely resemble those of a metastatic cancer, tuberculosis or a mycotic infection. However, the chronic nature of the infection and the distribution and morphology of the lesions suggest a mycotic infection. Further, the regional distribution of mycoses is coincident with central New Mexico.

Evidence of treponemal disease in Archaic southern Illinois.

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There is a long-standing debate over the origin of venereal syphilis, one of the treponemal diseases, within the field of Anthropology: Did venereal syphilis co-exist in the world with humankind from the beginning of its existence, or did venereal syphilis originate in the New World or in the Old World? The growing evidence of treponemal disease in the New World prior to 1493 AD comes from small samples, pushing the dates ever earlier. This study explores the possible presence of treponemal disease in the Pre-Columbian North American Archaic Period (4000 – 2900 B.C.) site of Carrier Mills in Saline County, southern Illinois. Fifty-four individuals were examined for evidence of treponemal disease, including 9 infants, 2 adolescents and 43 adults. Paleopathological analysis suggests 39% of individuals suffered from a syndrome closely matching the expected effects of a treponemal disease. Osteitis, periosteal reaction, lesions, joint fusion, and saber shins were among the characteristics widespread in this sample.

Therefore, individuals from the Carrier Mills site provide strong evidence of treponemal disease very early in the New World, long prior to 1493 AD. The distribution of disease indicators resembles a non-venereal form of treponemal disease most similar to yaws, but not identical to the osteological characteristics exhibited by yaws. This sample exhibits widespread periosteal involvement, occurring at a much higher frequency than typically seen in yaws – almost a "super-yaws". It is possible that another form of treponemal disease existed during the Archaic period in North America, approximately 4000 – 2900 B.C.

Patterns of genetic variation at *ICAM-1* in diverse African populations.

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Infectious disease is an important selective pressure in recent human evolution. Malaria, resulting from infection by the *Plasmodium falciparum* parasite, causes millions of deaths each year, and is among the many infectious diseases that have influenced current human genetic variation. ICAM-1 (intercellular adhesion molecule-1) is a major vascular endothelial receptor for *P. falciparum* parasitized erythrocytes, and therefore may affect susceptibility to malaria. Currently, the consequences of nucleotide diversity at *ICAM-1* are not well understood. This study seeks to examine nucleotide variation at *ICAM-1* in diverse African populations to better understand the scope of genetic variation at this locus and to identify variants that may influence susceptibility to malaria. A panel of ~200 individuals originating from Nigeria, Cameroon, Ghana, Tanzania, Kenya, and the Sudan were re-sequenced across a ~7 kb region of *ICAM*-1. Individuals from Thailand and Portugal were also re-sequenced as comparative data. Using these data we have characterized levels of diversity and have used tests of neutrality to identify signatures of natural selection. Initial haplotype analyses suggest that there are more unique haplotypes in Africa than in Europe or Asia. Additionally, a well-studied SNP that may influence susceptibility to severe malaria, called *ICAM-1*^{Kilifi}, was identified at high frequency within Africa and Asia. In Asia *ICAM-1*^{Kilifi} was identified on a single haplotype background, and in Africa this variant was found on several distinct haplotype backgrounds suggesting that this variant may have originated in Africa, rather than in Asia.

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The genetic history of chimpanzees across the Gulf of Guinea region.

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Studies of intraspecific variation among chimpanzees (*Pan troglodytes*) are testing between increasingly complex scenarios of paleodemographic history, which has important implications for understanding the different genetic histories of humans and chimpanzees. These studies have revealed that the partitioning of genetic diversity among chimpanzee populations varies across Africa, but specific patterns of variation among regional chimpanzee populations remains largely unknown. Cameroon and Nigeria, which encompass the Gulf of Guinea biodiversity hotspot, is home to two chimpanzee subspecies: *P. t. vellerosus* and *P. t. troglodytes*. The ranges of these subspecies appear to converge at the Sanaga River in central Cameroon, but very little is known about the paleodemographic history of chimpanzees spanning this region. Here, we present multi-locus genetic data from mtDNA, the sex chromosomes and autosomes of chimpanzees from a geographically comprehensive sample. We tested alternative scenarios of genetic history within a hierarchical hypothesis-testing framework. This hypothesis-testing framework was designed to (1) explore how different population parameters have influenced chimpanzee paleodemographic history and (2) infer how rivers and forest history have affected the partitioning of chimpanzee genetic diversity. Our analyses suggest that chimpanzee populations spanning western to central Africa are characterized by a pattern of long-term isolation with limited historical migration between regional populations, whereas chimpanzees spanning central to eastern Africa share much of their genetic history. In addition, our analyses further suggest that riverine barriers and forest history in the Gulf of Guinea region have been important in shaping patterns of chimpanzee population genetic diversity on a continental scale.

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The internal basicranial morphology of *Victoriapithecus macinnesi.*

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This study provides the first analysis of the internal basicranial morphology of *Victoriapithecus* skull KNM-MB 29100 from middle Miocene deposits at Maboko. Computed Tomography (CT) Scanning is used to view the skull's internal structure and acquire 3-dimensional landmark data in order to calculate basicranial length, basicranial angle, angle of facial kyphosis and cranial volume.

Preliminary assessment of the scans indicates that the back of the left orbit and sphenoid are incomplete in preservation, and as a possible result of postmortem damage, the sphenoid is ventrally extended. Such damage is not evident externally on the base of the skull. Further damage occurs on the top of the skull, especially on the left side, where parietal overrides frontal

bone for 3-4 mm. Such damage interferes with accurate measurements of the skull. To correct this, measurements are also taken on a model that compensates for damage to the parietal and sphenoid.
Based on analysis of the uncorrected skull, basicranial length is estimated at 45.7 mm and basicranial angle at 156°, and the angle of kyphosis at 124°. Relative to its basicranial length, the basicranial angle of *V. macinnesi* is most similar to that of colobines, especially *Procolobus verus,* showing it to have one of the more flexed cranial bases among the cercopithecoids. Its basicranial length is only larger than *Miopithecus talopoin* with the angle of kyphosis most similar to *Macaca.* Corrected measurements and their implications are discussed.

Anthropoid body mass dimorphism: effects of taxonomic scale.

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The evolution of body-mass sexual dimorphism (BSD) in anthropoid primates is generally thought to result primarily from sexual selection pressures, in which anthropoid social structures and mating systems induce varying levels of reproductive skew, most notably in males. Large comparative studies of BSD in living anthropoids tend to support this idea. However, comparisons of BSD between closely related species or populations often follow a different pattern.
Here I identify the sex which undergoes the greatest proportional mass change: interspecifically using sex-specific mean body mass for 140 anthropoid taxa, and intraspecifically using data for a subset of 77 populations representing 25 anthropoid species ranging in population-level BSD ratios from 1.02 (*Presbytis rubicunda*) to 1.94 (*Papio anubis*). Analysis of phylogenetically independent contrasts demonstrates that in a significant proportion of comparisons at the generic level and higher, male mass differs more than female mass ($p = 0.017$), whereas the proportion of male-dominated mass differences does not differ significantly from chance (0.5) for intrageneric comparisons. Population comparisons within species show the opposite pattern, with a significant proportion having greater difference in female mass than male mass ($p = 0.043$). A simulation study investigating the effect of adding increasingly larger measurement error to mass values suggests that this gradual shift from female-driven to male-driven changes in BSD is not an artifact of measurement error. A new mathematical model is presented which shows how pattern reversal at different taxonomic levels can result from small differences in survival probability between individuals subject to various types of selection.
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The use of elliptical Fourier analysis on human orbit shape.

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Human orbit shape has previously been analyzed with a few non-specific landmarks or subjective shape descriptions. This study uses elliptical Fourier analysis, a landmark-free method of measurement, to quantify the entire shape of the orbit and test the influence of sex, age, ancestry, and geographic location on orbit shape. Digital photographs were taken of 162 individuals of known sex, age, and ancestry from the skeletal collections in Knoxville, Tennessee and Pretoria, South Africa. Orbit outlines were traced and then analyzed in the elliptical Fourier program "SHAPE v. 1.3". Principle component (PC) values from SHAPE were analyzed for significant contributing variables using an ANCOVA.
Statistical analyses reveal that geographic location and the interaction between ancestry and geography account for 81% of the variation for the entire sample. This underscores the importance of considering environmental effects over genetic ancestral affinities when analyzing human variation. Sex also shows a significant contribution. Although two principle components show some similarities to established descriptors of orbit shape, other components reveal more shape variations than have been previously prescribed. The corners of the orbits, features that are not captured in many current metric analyses, appear to play a significant role in shape variation. The technique used for this study proved to be effective in detecting significant contributing variables influencing human orbit shape. This study focused on descriptive analyses, but the quantitative data allows for the formulation of discriminant functions. These should not be hastily constructed as much of the variation in orbit shape remains unexplained.

The pattern of change during human tibial trabecular bone ontogeny and locomotor development: components of intra-tibial heterogeneity.

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The specific effects of mechanical forces on knee joint-related trabecular bone are studied in this research linking ontogenetic changes in gait kinematics, limb alignment, trabecular morphology, and bone functional adaptation. Hypotheses tested predict that the development of within-tibial trabecular heterogeneity for the structural parameters of bone volume fraction (BV/TV), trabecular number, trabecular thickness, and the degree of anisotropy (DA) is related in part to the ontogenetic adaptation of trabecular bone to bipedalism. Human skeletal remains used in this study are from the Late Prehistoric site of SunWatch, an Ohio Valley maize-dependent agricultural village (AD

1200-1300) located near Dayton, Ohio. The study cohort is a subsample of 33 seriated non-adult and three young adult proximal tibiae examined by High Resolution X-Ray Computed Tomographic scanning and three-dimensional quantitative analyses. Multiple spherical volumes of interest (VOIs) were extracted from the proximal tibial metaphysis/epiphysis. The spatial differentials in tibial microarchitecture of these VOIs are quantified by structural parameters as well as ratios describing the relative lateral to medial and posterior to anterior BV/TV and DA. The results indicate that proximal tibial trabecular bone develops non-random regional variation chronologically associated with changes in limb alignment and the maturation of gait kinematics. Tibial microstructure changes from a relatively homogeneous trabecular pattern to one with spatially differentiated segments of increased bone volume (posterior) combined with regions of decreased bone volume (central). Ontogenetic reorganization of tibial trabecular bone by the combination of functional adaptation and growth and development result in bone with a greater degree of heterogeneity.
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Chimpanzee hind limb muscle recruitment patterns during quadrupedalism and bipedalism.

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The origin of hominin bipedalism has occupied the interests of anthropologists, comparative anatomists, and paleontologists for nearly a hundred years. Attempts to understand how, why and when hominins first became habitual bipeds have relied on analyses of the fossil record, comparative anatomy, and more recently, laboratory-based experimental methods and biomechanical modeling. The focus of most laboratory based studies has been the mechanics of quadrupedal and bipedal locomotion in our nearest relatives, chimpanzees. These studies in turn provide empirical data used to model locomotor mechanics, ultimately to attempt to reconstruct the actual locomotor behavior of early hominins. However, despite the number of laboratory-based studies that have already been conducted, there is little empirical data on chimpanzee hind limb muscle function. Therefore, studies attempting to model early hominin locomotion have relied on human patterns of muscle use, raising the prospect of potential bias toward human-like characteristics. Here we present EMG recruitment patterns for 21 chimpanzee hind limb muscles during both quadrupedalism and bipedalism. Twelve of the 21 muscles displayed similar patterns of recruitment during chimpanzee quadrupedalism and bipedalism. Of these 12, 10 were similar to patterns of use in humans. For those muscles in which the activity patterns during chimpanzee quadrupedalism were distinct from those of chimpanzee or human bipedalism, the differences can be explained by differences in gait kinematics and toe-off/heelstrike mechanisms. The overall similarity in hind limb recruitment patterns in chimpanzees and humans suggests that despite morphological changes in the human lineage, patterns of muscle use have generally been conserved.
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Tannin intake in spiny forest-dwelling *Lemur catta* at Berenty reserve, Madagascar during reproductive periods: do *L. catta* females ingest condensed tannins as a reproductive strategy?

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Primates vary considerably in their choice or avoidance of plant foods high in condensed tannins (CT). Plants containing tannins are astringent and unpalatable, and when ingested, tannins interfere with protein and iron uptake. However, ingestion of moderate amounts of CT can benefit reproductive female mammals by promoting weight gain and milk production, and CT contain anti-abortive and anti-bacterial properties. Southern Madagascar's soils are characterized as sandy and siliceous, and plants growing in this region exhibit high concentration of secondary compounds, including CT. Our study focuses on CT intake during early gestation and lactation periods in two groups of *Lemur catta* residing in spiny forest habitat in southern Madagascar, and examines whether *L. catta* in this habitat avoid plant foods high in CT, and whether reproductive females ingest higher concentrations of tannins than adult males. Feeding data were collected during reproductive periods in 2006 & 2007, samples of all foods consumed were assayed for CT content, and average CT intake was determined for all focal animals. No significant difference was found in CT content of the top 5 foods in both seasons vs. other foods, nor did inter-season differences exist in CT concentrations of top foods. Reproductive females did not ingest higher concentrations of CT compared with males. *L. catta* in this study did not avoid plant foods high in CT, and reproductive females did not ingest higher amounts of CT as reported in sympatric Verreaux's sifaka. Higher CT intake cannot be suggested as a reproductive strategy for these females.

Geographical distribution of surnames in the Aleutian archipelago: Evidence from Y-chromosome markers.

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Y-chromosome haplotypes and haplogroups (based on STR and SNP analyses) and the surnames of 143 Aleut males were compared to determine if an association exists between these markers within 11 islands of the Aleutian Archipelago. The western and central Aleutian Islands were initially colonized by Russians, while the eastern Aleutians were later settled by Scandinavian and British fisherman. Our goal was to determine if surname frequency distributions matched Y-chromosome haplotype frequency distributions in these islands. Six reference populations (Russia, England, Finland, Sweden, Norway and Germany) drawn from the literature were used to investigate the paternal origins of the contemporary inhabitants of the Aleutian Archipelago. Frequency distributions were examined for both molecular and surname markers. Due to the large number of surnames, some were coalesced due to spelling and transliteration variation to reduce heterogeneity and establish ethnic origins. Surnames were designated as being Western European, Northern European, or of Russian origin. Multidimensional scaling (MDS) and Mantel tests were used to examine the relationship between haplotype-based distances and surname frequency distances in the Aleut populations. It was determined that these two markers are correlated based on current Y-haplotype information. A gradient of surname origin was found from east to west with the highest incidence being western European in the East and Russian in the West. No clear gradient was observed in Y-haplotype dispersion. R1a and R1b represented 36% and 35% of all haplotypes, with no statistically significant relationship between geography and genetics. This research was funded by NSF grants OPP#0091875 and OPP#0322749.

Empirically derived limb inertial properties of four prosimian primates: Implications for primate locomotor behavior.

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The inertial properties of primate limb segments are important for understanding how muscles function during different types of locomotion. Empirical data, however, are limited and only available for generalized, horizontal semiterrestrial primates. Little is known about inertial properties of more arboreal primates such as those that leap often or those that climb regularly. Thus, we examined inertial properties of four prosimian primates (*Eulemur mongoz*, *Cheirogaleus medius*, *Loris tardigradus*, and *Nycticebus coucang*). Location of the center of mass (COM) for the entire left fore- and hindlimb as well as the individual limb segments were determined via balance board for two or three individuals of each species. Subsequently, the segments were swung to determine the moment of inertia (MOI). These data were qualitatively compared with both empirical and modelled literature values. Paired comparisons show that segment MOI is smaller in lemurid species compared to lorisid species of similar body mass. COMs in the lemurids are also more proximally located than in the lorisid species, particularly for the more distal segments. It appears likely that these results can be explained by the more proximal concentration of muscle and rapid limb swing associated with the running, leaping gaits of lemurs compared to the slower more cryptic locomotion of the lorises. These results provide the first empirical data on limb mass distribution for these four species and further support the idea that limb inertial properties are related to locomotor mode and muscle function.
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Cultural meaning, social structure, and health in evolutionary perspective.

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Evolutionary thinking does not hold a central place in contemporary cultural anthropology. At best, most cultural anthropologists probably see evolutionary theory as irrelevant to their work; at worst, they may regard it with outright hostility. Yet one area where the complementary value of sociocultural and evolutionary perspectives is clear is in research on stress, social status, and health. Here I illustrate this point with data on the social and cultural context of mental and physical health in Puerto Rico. Ethnographic data provide evidence of shared cultural models for (a) the material lifestyle regarded as a marker of high social status and (b) the appropriate sources of social support for dealing with particular stressors. Survey data show that individuals who approximate these cultural models in their own behavior (i.e., high cultural consonance) have better health. Cultural consonance in material lifestyle is associated with lower blood pressure (SBP: p=.009; DBP: p=.025) and fewer depressive symptoms (p<.001); cultural consonance in social support is associated with fewer depressive symptoms (p=.031), but not with blood pressure, independent of standard covariates. Both evolutionary and sociocultural perspectives enrich our interpretation of these and related findings. Evolutionary theory helps to explain why human physiology is responsive to status distinctions and social affiliation. Sociocultural perspectives clarify that the relationship between social structure and physiological responses are contingent on cultural meaning. Integrating these complementary perspectives can help to stimulate new directions for research.

Testing the hormonal correlates of grandmothering in Jamaica.

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Grandmothers commonly provide important allocare, or care by nonmothers, to young grandchildren. Research on nonhuman animals suggests that female allocare may be associated with elevated oxytocin and prolactin levels. However, no human studies have investigated the neuroendocrine basis of such care. Here, we test the hormonal correlates of human grandmothering through field research conducted in Kingston, Jamaica. We recruited 45 menopausal women between the ages of 49 and 66 who either lived with and cared for a young biological grandchild (N=25 "grandmothers") or did not (N=20 "controls"). Grandmothers participated on two days: once after having cared for their youngest grandchild the previous four hours, and once when not having engaged in such care. Control women participated on a single day. All procedures were either conducted at a church or at a subject's home between 12:00-18:00 hours. This design enables both within-subject and between-subject contrasts in hormones according to allocare. Participants provided minimally invasive biological samples (saliva for cortisol, finger prick blood spots for prolactin and urine for oxytocin) for hormone assay. Participants also provided sociodemographic information, childcare data, and emic views of grandmothering during semi-structured interviews. Preliminary results indicate that salivary cortisol levels were not associated with childcare ($p>0.05$). Prolactin and oxytocin results will be incorporated when assays completed. Results of this study will expand our understanding of the neuroendocrine basis of human allocare.

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Factors contributing to hominoid shoulder morphology: muscle size, ontogeny, and behavior.

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Scapula morphology is hypothesized as being a reliable indicator of behavior, irrespective of phylogeny. Early hominin shoulders display characteristics associated with suspensory activity (e.g., relatively broad supraspinous fossae) – a contentious assertion given that these features are symplesiomorphic. To evaluate the functional significance of these characteristics, this study tests the influence of muscle size on scapula shape and the hypothesis that morphological changes during growth are correlated with ontogenetic changes in locomotor behavior. The shoulders of wild-type and hypermuscular, mutant (myostatin knockout) mice were studied to test if increased muscle size specifically alters scapula fossa size and shape proportions. Likewise, hominoid shoulder morphology was assessed interspecifically and ontogenetically, as some apes are known to decrease climbing behavior (*Pan*), while others remain predominantly arboreal throughout ontogeny (*Pongo*).

Mouse muscle mass was positively correlated with respective fossa size, though genetically enhanced musculature did not disproportionately affect relative fossa size, suggesting that differences in muscle size *alone* do not result in specific scapula shape differences. *Pan* supraspinous fossae were significantly broader than modern *Homo*, but became progressively narrower throughout ontogeny, matching predictions based on decreases in suspensory activity during growth. *Homo* and *Pongo* were more similar in relative supraspinous fossa breadth than expected, but unlike *Pan*, these proportions remained stable throughout ontogeny indicating that shoulder development is not phylogenetically constrained. These results suggest that aspects of shoulder morphology are reliable indicators of behavior between species and during growth, and may be useful in making behavioral inferences in the hominin fossil record.

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A pain in the neck: vertebral osteoarthritis and related activity patterns in Early Bronze Age Jordan.

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Osteoarthritis of apophyseal joint surfaces and osteophytosis of amphiarthrodial joints of the cervical vertebrae were examined to reconstruct activity patterns at Early Bronze Age (EBA; 3150-2300 BCE) Bab edh-Dhra' (modern-day Jordan). This study hypothesized that an increase in sedentism at the site led to declining workloads. This was tested by evaluating changes in spinal degenerative joint disease frequencies over time. Commingled remains were scored for presence and severity of lipping, porosity, and eburnation. The degree of osteoarthritic lipping appeared relatively static across EBA Bab edh-Dhra' (on average, 5% of articular facets had strong lipping and/or eburnation) (EB IA n=136; EB II-III n=547). However, a significant decrease in osteophytosis from about 21% (n=115) to 13% (n=345) on vertebral body margins over time indicated a reduction in physical stress on the neck, possibly resulting from changes in the practice of carrying loads on the head.

Archaeological evidence helped flesh out the biological data. The semi-sedentary peoples of EB IA (3150-3050 BCE) likely practiced small-scale horticulture but left no significant archaeological remains behind; in contrast, EB II-III (2900-2300 BCE) was characterized by an increasingly sedentary population residing in a fortified town. Living year-round adjacent to a perennial stream and agricultural fields, perhaps EB II-III town dwellers had shorter distances to travel for transporting water and crops, resulting in more frequent and less strenuous trips. The lack of change in apophyseal joint degeneration suggests that their spines were not less mobile, but that they likely did not have as much axial loading.

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Gimme a break – the uniqueness of midtarsal flexion within the primate foot.

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The identification of the "midtarsal break" has gained some currency in recent years as a distinguishing feature of the non-human foot. Presumably, the development of the longitudinal arch within the human foot has resulted in a loss of midtarsal flexibility. Therefore, only non-humans retain the ability to dorsiflex at, or near, the transverse tarsal joint and can thereby display a "midtarsal break." This presentation reports on the functional distinctiveness of the midtarsal joints in several primate species.

Cadaveric foot specimens (30 humans, 1 chimpanzee, 5 baboons and 2 macaques) were prepared by removing almost all the soft tissue, so that only ligaments remained to insure limb and joint integrity. Four point IRED clusters associated with an active marker tracking system were then inserted into the calcaneus, cuboid, fifth metatarsal, navicular, talus, medial cuneiform and first metatarsal. The relative positions of these bones were monitored during a plantarflexion-dorsiflexion movement cycle. These movement data were analyzed using the Functional Alignment procedure to resolve six degree-of-freedom motion patterns for five joints of the midfoot.

Results of our investigations contradict previously held notions concerning midfoot joint movements. We agree that midfoot flexion occurs primarily at the tarsometarsal joints. However, our results fail to identify significant movement differences among humans and non-humans in any midtarsal joint. While we do not refute identification of a midtarsal break in footprints, we do suggest that the mobility of these joints has not changed as the result of evolving the longitudinal arches of the bipedal human foot.

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Diseases of the vertebral column in a Bronze Age nomadic population from the southern Silk Road, Xinjiang, Western China.

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The population from Liushui dates from Late Bronze Age to Early Iron Age. The cemetery is located at the southern Silk Road, Xinjiang, West China. Up to now, the settlement could not be located. Therefore, reliable information about the living conditions of this population can only be obtained from the results of the paleopathological investigation. From the archaeological background and the results of the preliminary osteological examination, we know that the people from Liushui had a very exhausting way of life, probably due to conditions characteristic of nomadic life. Thus, not only the adults but also the subadults and even young children suffered in a high frequency from symptoms due to musculoskeletal stressmarkers. Severe degenerative and traumatic changes of the spine were observed in almost all age groups and in both sexes. In detail, many of pathological changes could be diagnosed as arthrosis of the vertebral joints (spondylarthrosis) and the vertebral bodies (spondylosis) with herniated vertebral disks, inflammatory processes, trauma and stress fractures of the joints and the vertebral bodies, spondylolysis and also Scheuermann´s disease. These changes occurred not only in old people, however, are even seen in young adults. As possible reasons, exhausting physical strain, such as carrying of heavy loads and riding on horse back to a great extent can be considered.

The caries-attrition relationship: A view from precontact Central California.

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Researchers have proposed two opposing relationships between caries and level of dental attrition. Some have suggested a synergistic relationship whereby increased attrition exposes the softer dentine to cariogenic bacteria and predisposes individuals to higher frequencies of carious lesions. Other researchers however have proposed an inverse relationship between level of dental attrition and frequency of carious lesions (high attrition and low carious lesion frequency). Precontact California populations exhibit a remarkable degree of dental wear frequently exceeding the highest score for the various wear stage systems. Explanations for this are dietary (grit from sandstone mortars and

pestles and fragments of cooking stones used in the preparation of acorns) and cultural (fiber processing for baskets and cordage). The Vineyards site (4-CCO-548) is a central California multi-use site which dates to the Middle Archaic (4350 and 550 BC). The Vineyards site offers the ideal opportunity to examine the relationship between attrition and caries. In contrast to other samples from precontact central California, the sample from this site is large (N=479), is represented by relatively equal sex ratios, and is well represented by dental remains. Results of our analysis show that there is indeed an inverse relationship between attrition and caries. The average overall attrition level for the population is 6.11 using the Smith wear system. Conversely, the frequency of carious lesions is extraordinarily low (2.5%). In addition to the high level of attrition, the members of the population sample exhibit an unusual wear pattern that we interpret to be the result of non-dietary abrasion.

Comparative forefoot form and function in *Homo sapiens* and *Pan*: joint orientation and *in vivo* kinematics.

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Quantitative results indicate that compared with *Pan paniscus*, human metatarsophalangeal joints usually dorsiflex more prior to toe-off, and this is associated with measurable differences showing that humans have more dorsally canted bases of the first and second proximal pedal phalanges than *Pan*. The current study provides greater resolution to the correspondence between these aspects of form and function for the purpose of informing future studies of fossil hominid foot bones. Predictions of dorsal canting in a skeletal sample were based on patterns of differences established by *in vivo* kinematics collected from a separate sample. Though the human first metatarsophalangeal joint dorsiflexes far more than the second metatarsophalangeal joint during gait ($p<0.001$), the skeletal sample shows that the second proximal phalanx is more dorsally oriented than the hallucal proximal phalanx ($p<0.001$). There are no differences between the measurements of dorsiflexion of *Pan* first and second metatarsophalangeal joints during terrestrial gait; however, the *Pan* hallucal proximal phalanx tends to be more dorsally oriented than the second proximal phalanx ($p<0.01$). Corresponding with the results of kinematic comparisons made between habitually shod and habitually unshod humans, no differences were found between habitually shod and minimally shod samples in dorsal canting of the hallucal proximal phalanx.

These results suggest that dorsal canting can distinguish differences in forefoot function between humans and bonobos, but may not distinguish more subtle functional differences between the digits. Further data on *Pan* metatarsophalangeal joint motion during arboreal behaviors should also clarify taxonomic differences in the inter-ray pattern of dorsal canting.

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Mind the gap. A finite element study of the retromolar space and its relation to cortical thickness distribution in the mandibular ramus.

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The retromolar space is one of the most frequently cited Neanderthal features. From a mechanical perspective, it is interesting because of its intermediate position between the main masticatory muscles and the molar dentition. This study investigates whether the presence vs. absence of a retromolar space has an effect on the strain distribution in the bone during mastication and if differences in the strain pattern correspond with differences in the internal bone structure. CT-based 3D models of modern human, Neanderthal and *H. heidelbergensis* mandibles were used to quantify the distance between the third molar and the ascending ramus and to determine the distribution of the cortical thickness within the ramus. Based on these models, finite element analysis (FEA) was used to simulate different biting tasks. In addition, 3D warping was used to vary the retromolar space and to change the shape of the anterior ramus while keeping other morphological features constant.

The results reveal that specimens with and without retromolar spaces show different distributions of cortical bone in the anterior ramus and that these distributions correspond to the strain patterns predicted by the FEA. The 3D warping simulations suggest that this finding can be explained by shape variations of the anterior ramus, which are related to the distance from the molar dentition. The study also demonstrates how the novel combination of 3D

warping and FEA provides a useful technique for studying the mechanical relationship between external shape and internal bone structure.

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Dietary diversity in Early and Middle Miocene catarrhines from Kenya

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Miocene catarrhines are a speciose and morphologically diverse group of primates. Alternative methods of diet reconstruction include molar crest development, molar-incisor ratios, and dental microwear. However, the results of published studies are conflicting. Some studies reconstruct both frugivory and folivory among various Miocene catarrhines whereas others find little evidence of folivory. Moreover, all these analyses examined only a small subset of taxa, and do not include most catarrhines found at Early Miocene sites near Lake Turkana and Middle Miocene catarrhines.

This study utilized low-magnification stereomicroscopy to examine a large sample of Miocene catarrhines from Kenya. 95 second molars representing 21 different species from the Early and Middle Miocene of Kenya were analyzed. Clear resin casts of each molar were analyzed under low magnification using a stereomicroscope. Counts of pits and scratches of various sizes were obtained from the casts. Miocene catarrhines were compared both with each other and a large sample of modern platyrrhine and catarrhine anthropoids, using Discriminant Function and Principal Components analyses.

Results of this analysis indicate that none of the Early Miocene taxa included in this study were primarily folivorous. Only one Middle Miocene taxon was reconstructed as folivorous. These results suggest that dietary diversity of Early and Middle Miocene catarrhines was lower than seen today among extant anthropoids. In additional, dietary range differed among sites from different regions in Kenya during the Early Miocene.

The morphology of KNM-ER1805: a reconsideration of an enigmatic specimen.

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In the past, KNM-ER 1805 has been designated as a paratype for *Homo erectus, H. ergaster, H. habilis*, and *H. rudolfensis*. Based on its stratigraphic position within the KBS layer (~1.85mya) of the Koobi Fora Formation, this specimen can be temporally associated with all of these taxa, and with *Paranthropus boisei*. Although the majority of researchers attribute KNM-ER 1805 to the genus *Homo*, some suggest it might be more appropriately allocated to *Paranthropus* or *Australopithecus*, thus this issue remains unresolved. This study examines 32 metric and 122 non-metric cranial and mandibular features of several groups of African Plio-Pleistocene hominins to determine the phylogenetic status of KNM-ER 1805 relative to contemporary hominin taxa. It employs multivariate exploration techniques (principal components and discriminant function analyses) and phylogeny reconstruction methods: CONTML for continuous characters as well as PAUP (parsimony) and MrBayes (Bayesian analysis) for discrete characters. Results of the multivariate analyses reveal an association between KNM-ER 1805 and specimens allocated to *A. africanus, P. boisei,* and *H. habilis*. Cladograms produced from the phylogenetic analyses show little resolution, but in each instance where a clear separation between *Homo* and the australopithecines (*Paranthropus* and *Australopithecus*) is revealed, KNM-ER 1805 consistently groups with the australopithecines. These results suggest KNM-ER 1805 is not a typical specimen of *H. habilis/rudolfensis* or *H. erectus/ergaster*, despite the fact that it has been cited as a paratype for each of these taxa. Furthermore, these results suggest the affinity of this enigmatic specimen may not lie with the genus *Homo* at all.

Rediscovery of the pygmy tarsier.

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In the early 1900's, two tarsier specimens were independently collected by Raven and Heimlich in Sulawesi, Indonesia. In 1921, Miller and Hollister identified them as a distinct species, *Tarsius pumilus*, commonly called pygmy tarsiers. The validity of the species was reinforced by Musser and Dagosto in 1986. Previous attempts to locate a living population of pygmy tarsiers have been unsuccessful. This paper presents the first behavioral and ecological data on a living population of pygmy tarsiers. Over a two month period, one female and one male pygmy tarsier from a group containing three individuals were successfully trapped on Mt Rore Katimbo within Lore Lindu National Park, Central Sulawesi. They were found at altitudes ranging from 2000-2200m, in mossy cloud forest. They exhibited several traits characteristic of pygmy tarsiers including: no postauricular white patch, claws on all digits, elongated lower incisors, as well as small body size. The body weights were 50.1g and 52g for the male and female respectively. Preliminary radio tracking data indicates that female pygmy tarsiers have a home range encompassing 1.2ha. The male range exceeded the capability of the radio tracking equipment. Observations suggest that pygmy

tarsiers live in small groups that return to the same tree each morning. The sleeping tree was approximately 12m and had a dbh of 81cm. Unlike spectral tarsiers, pygmy tarsiers rarely vocalize or scentmark. The number of mistnets, mistnet hours and the low capture rate indicate that pygmy tarsiers at this site live at relatively low densities.

Measuring Mimbres population health status during the pithouse to pueblo transition.

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This assessment of Mimbres health status documents the impact of lifestyle and social organization changes attributed to the shift from pithouse to pueblo. Specifically this analysis compares health changes between the Late Pithouse Period (A.D. 550-1000), Early Pueblo Period (A.D. 1000-1130), and the Late Pueblo Period (AD 1150-1300). Through the identification of paleopathological patterns the consequences of social change at the pit structure to pueblo transition are examined. Skeletal remains from 10 Mimbres sites in New Mexico dating at A.D. 600-1300 were included in the study. 81 burials were assessed for cranial, dental, and postcranial pathologies. The evidence indicates a proliferation of nutritional stressors, dental attrition and illness associated with population density increases. Furthermore, health status of Mimbres populations in the Mimbres River Valley did not improve until the Late Pueblo Period (AD 1150-1300). Thus the intensification of agriculture has a detrimental impact on health status during its initial reliance and followed by biological adaptation that allows a rebound in health status after several generations.
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Variability of human foramen magnum size.

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The foramen magnum is an important landmark of the skull base and is of particular interest for anthropology, anatomy forensic and other medical fields. Despite its importance few osteometric studies of the foramen magnum have been published so far. The aim of this study is to assess the variability of human foramen magnum size by sex, age, stature, ethnicity and time. We evaluated 110 transverse and 111 sagittal diameters from Central Europe male and female dry spine specimens dating from the Pleistocene to modern times (Rühli F., 2003, PhD-Thesis, The University of Adelaide). As a reference group, a series of recent individuals (N=49; 80 BP to 228 BP) were used; each of these individuals had known sex and age. We found only a moderate positive correlation between the transverse and the sagittal diameter of the foramen magnum ($r=0.35$, $p < 0.01$). Surprisingly, neither sexual dimorphism nor a clear secular trend was found for either diameter. There were no age-dependent differences for either diameter. Furthermore, the relationship between the individual stature and foramen magnum diameters was weak (sagittal: $r=0.28$, $p<0.01$; transverse diameter: $r=0.25$, $p<0.02$); thus foramen magnum size cannot be used as reliable indicator for stature estimation. The foramen magnum, as a transition zone between spine and skull, plays an important role as a landmark because of its close relationship to key structures such as the brain and the spinal cord and further knowledge on its variability is of general interest.

Multilevel Societies in Colobines.

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Multilevel or modular societies are characterized by stable nuclear one-male units (OMUs) or harems that form the building blocks of larger and relatively coherent social bands. Modular societies are uncommon among primates, being found in only a few species, e.g. hamadryas baboons, gelada baboons, proboscis monkeys, snub-nosed monkeys and humans. An interesting case are the Asian colobines which principally show a dichotomy with regard to social organization: they form either independently foraging and often territorial uni-male groups or modular associations, with the latter encompassing both tight bands composed of OMUs and loose neighborhoods of OMUs. Here, we provide a phylogenetic reconstruction of modularity in the Asian colobines, revealing that the single OMU pattern is probably ancestral and the modular pattern is derived. The socioecological underpinnings and the adaptive value of modular societies in colobines have thus far been virtually unexplored. We tested predictions of three socioecological hypotheses (thermal benefit, resource dispersion and conspecific threat) by means of general linear models and independent contrasts. We found partial support for the conspecific threat hypothesis, i.e. that the number of non-reproductive bachelor males is a significant predictor variable of band formation. The threat posed by all-male units is thought to force OMUs to aggregate as a means of decreasing the amount of harassment/infanticide and the risk of takeovers. In the odd-nosed colobines and snub-nosed monkeys in particular, phylogenetic inertia may also play a part in explaining the modular nature of their society.

Infant carrying in humans: interactions between morphometric and gait parameters.

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Recent research suggests that early bipeds' energy budgets and subsistence patterns were impacted by the elevated caloric cost of carrying infants while foraging over wider ranges. Wall-Scheffler et al. (2007) found that carrying an infant in the arms is energetically expensive; however, a broad pelvis may provide an advantage by increasing stride length, and Gruss et al. (2007) found that increasing pelvic rotation may allow individuals with short legs to lengthen their strides during walking. Wall-Scheffler et al. also found that infant carrying costs are significantly reduced by using a back sling, suggesting that early bipeds may have employed a baby-carrying tool of some sort.
This study uses a 3D kinematic gait analysis to further test the idea that early hominin females may have reduced the cost of infant carrying through tools (slings), morphology (broad pelves), and/or gait modification (increased pelvic rotation). Fourteen women were studied under four conditions: unburdened; and carrying their own infants in their arms, in a front sling, and in a back sling. Our results suggest that pelvic rotation does tend to increase when women carry infants in their arms, and that this effect is more pronounced in subjects with short legs or narrow hips. Use of a front or back sling has less impact on stride length and pelvic rotation, but results indicate significant postural adjustments that may be fatiguing and limit the advantages of a sling over long distances or long periods of time, particularly as infant-mass increases.

Bioarchaeological insights into Health and Emerging Social Differentiation at Neolithic Tell Halula (Syria).

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This research examines the large human skeletal sample recovered from the Neolithic village of Tell Halula, Syria, dating to ca. 10,500 BP. Of the 114 burials recovered from 16 houses, and multiple phases of occupation over several hundred years, all of the burials were from sub-floor pits inside of the houses. Each of these burials is a primary individual interment. Analyses reveals a very high infant mortality profile with 45% of the dead being children (ages 0-11), 9% being juveniles (ages 12-17), and the remaining 46% being adults (age 18+). Mortality rates of young children were very high with 40 of the 114 burials being less than 5 years old. Assessment of health status from the skeletal remains provides the basis for exploration of the relationships among health and subsistence strategy, and to examine human behavioral changes associated with agricultural origins. Unravelling these patterns, however, require a detailed understanding of the chronological placement of individual burials, as well as the temporal relationship between construction events of houses. To accomplish this we present results of fluorine analysis to determine the phasing of individual burials and households at Halula, and then incorporate these data into household and community scale health population models. Demographic, general pathology and oral health are examined to elucidate the life histories of this population.

The phylogenetic structure of primate communities within and between continents.

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With the ever increasing availability of phylogenetic data, there is a renewed interest in applying evolutionary approaches to community level patterns and processes. Here, we analyzed the phylogenetic structure of 120 primate communities in Africa, Madagascar, Asia and the Neotropics. For each community we calculated two measures of phylogenetic structure: 1) the net relatedness index (NRI), which provides a measure of the mean phylogenetic distance among all species in the community; and 2) the nearest taxon index (NTI), which measures the relative phylogenetic distance among the closest related species in a community. The Phylocom package uses a randomization procedure to test whether the NRI and NTI values are higher or lower than by chance alone. In addition, we used a Kruskal-Wallis test to examine differences in NRI and NTI across regions, and linear regressions to examine the relationship between species richness and NRI/NTI. We found that many primate communities exhibited NRI and NTI values that were not significantly different than random. However, 11 out of 30 Malagasy communities exhibited significantly low NTI values. NRI and NTI values differed significantly across regions with Neotropical communities exhibiting high NRI values relative to other regions, and Malagasy communities displaying low scores. NTI values were similar across regions, except for much lower scores in Madagascar. Finally, we found a significant negative relationship between species richness and NRI in Africa and between species richness and NTI in Madagascar and Asia. The average relatedness among species in communities decreased as community size increased.

The relevance of over-striding and bipedal stepping in an arboreal context: A comparative analysis of wild ateline primates.

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Discussions of primate origins often center on a suite of locomotor adaptations including a reliance on diagonal sequence gaits, enhanced

limb excursions and longer strides etc. These adaptations are linked to a tendency for the hindlimb to over-stride the ipsilateral forelimb in order to avoid collision of the limbs. Such atypical hindlimb steps are often viewed as a negative outcome of primitive primate gait characteristics, but they may be functionally significant in some contexts. This study quantifies the tendency to over-stride and/or take bipedal steps in an arboreal context in three ateline species. Video data were collected on the unrestricted movements of wild *Alouatta seniculus, Lagothrix poeppigii,* and *Ateles belzebuth* during 11 months of observation in the rainforests of Ecuador. Video segments were analyzed frame-by-frame and atypical, hindlimb dominated stepping behaviors were quantified by dividing the total number of over-striding and arboreal bipedal steps taken by total locomotor bout time. *Ateles* locomotion involved significantly more instances of hindlimb over-striding and steps taken during arboreal bipedalism than either *Alouatta* or *Lagothrix*. Such atypical hindlimb dominated behaviors appeared to be associated with quick transitions between supports of different orientations or shifts to more orthograde locomotor modes. Like *Ateles,* apes have been reported to share a tendency to over-stride and patterns of force transmission emphasizing orthogrady. The findings for *Ateles* support a prediction that apes will also use over-striding in an arboreal context and provide evidence for an arboreal origin of transient but functional bipedal stepping.

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3D imaging and study of old fossils.

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Numerous prehistoric human remains were discovered in France between the end of the 19th and the first half of 20th century. They were often fragmented in situ or in accidental way and have been restored using different synthetic materials (i.e. resin, plaster) to replace the missing parts and painted with a brown varnish. The new methods of 3D imaging allow to remove and to join virtually all the pieces of these old puzzles to obtain new restitutions. We have studied two skulls. The first one is an adult skull that was discovered in Barma Grande cave, in Northern Italy, near France border in 1884. The other one is a skull of a 2-4 years old child, discovered in the cave of Rochereil, Dordogne, France in 1939.

The skulls were scanned in a Radiology Unit using a helical modulus with 1.25 mm thickness, 0.625 mm reconstruction. CT data were exported as DICOM files (512x512) and were postprocessed data using Mimics 9.0 (Materialise©). The virtual study of two fossil craniums made it possible to highlight which each cranium presented a great number of additions of synthetic material and many fragments was placed in a wrong positioning involving erroneous dimension. A virtual reconstitution of the two skulls is proposed. We thus consider that it is necessary to re-study systematically the human fossils discovered many years ago with CT analysis and virtual reconstitution before any morphometric analysis. The previous data concerning all the fossils restored with these old methods must be considered with caution.

The Neanderthal bony labyrinth reconsidered, introducing a new geometric morphometric approach.

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The bony labyrinth in the temporal bone houses the sensory systems of balance and hearing. While the overall structure of the semicircular canals and cochlea is similar across mammals, their detailed morphology varies even among closely related groups. As such the shape of the labyrinth carries valuable functional and phylogenetic information. Here we introduce a new, three-dimensional geometric morphometric (GM) approach to shape analysis of the labyrinth, as a major improvement upon previous studies based on linear measurements and angles.

After virtually extracting the bony labyrinth from CT scans of a temporal bone we computed its midline-skeleton by thinning the encased volume. On the resulting medial axes of the semicircular canals and cochlea we placed a sequence of semilandmarks. After Procrustes superimposition the shape coordinates were analyzed using multivariate statistics.

As a first exploratory application we compare Neanderthals to a geographically diverse sample of modern humans. Our results corroborate previously described shape differences between their bony labyrinths, but with an improved ability to discriminate between the two species. Because the geometric relationship among the point-coordinates is preserved throughout the analysis we are able to quantify and visualize even subtle shape differences, such as in the torsion of the canal arcs. Furthermore, we demonstrate how GM methods can be used to quantify the morphological integration of the labyrinth and the surrounding temporal bone.

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Low Magnification Microwear Analysis of Early Pliocene Cercopithecids from Gona, Ethiopia.

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Low-magnification microwear was used to reconstruct diets of fossil cercopithecids from As Duma, in the Gona project area, Ethiopia. The sample comes from Early Pliocene localities and consists of molar teeth tentatively allocated to the cercopithecine *Pliopapio alemui* (n=7) and the colobine *Kuseracolobus aramisi* (n=7). High resolution casts were examined under a stereo microscope with reflected light to identify use wear features on the mesiobuccal molar cusp. Specimens were only included if use-wear features could be clearly distinguished from taphonomic or diagenetic ones. This greatly reduced the total sample size. *Pliopapio alemui* and *Kuseracolobus aramisi* are indistinguishable from each other in the frequency of pits and scratches, suggesting diets with similar mechanical properties for both taxa. Their microwear signatures are compatible with both frugivory and folivory, and overlap values for the extant *Papio hamadryas anubis*. Neither species exhibits evidence of grazing or hard object feeding. Additionally both species show variation in both the frequency of pits and scratches, and some individuals fall outside of the range of extant species sampled to date. Carbon isotopic values (Levin et al. in press) for both *P. alemui* and *K. aramisi* indicate the inclusion of some C4 foods in their diets, which may help explain variability in the frequency of microwear features. These results must be considered preliminary due to the small sample size; nonetheless the diets of these primate species bear on the paleoecology of the *Ardipithecus*-bearing sites at Gona.

A contribution to bioarchaeological study of the social hierarchies in a population in the Sabana de Bogotá (Colombia).

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An archeological site in Soacha (Colombia) excavated between 2007 and 2008 has revealed the largest sample of prehispanic burials in Colombia. This site is richly contextualized by 560 tombs with associated grave goods, evidences of 16 households and a disposal area with animal remains associated to the Muisca culture (ca. 1200-1500 a.D.). Current South American bioarcheological literature is focused mostly on individual case studies, while others present a general overview of paleopathological conditions mostly based on Peruvian, Chilean and Argentinean samples. Therefore, this new find represents to the physical anthropology academy, and to the Colombian and South American archaeological community, an unprecedented sample that could be used to infer biocultural adaptative processes, social complexity and identitary differences of the Muisca Culture.
The proposed work entails the osteobiography of 30 individuals (sex, age, stature and health conditions) and the analysis of their associated burial practices. Clues of their lifestyle are expected to be found in their degenerative join disease patterns, bucodental morbidity, among other morphological characteristics that highlight Muisca biocultural adaptation and social hierarchies.
This study is part of a larger archaeological project that is aimed at answering questions related to the nature of social complexity of the Muisca society, integrating ethnohistoric, archaeological and bioanthropological perspectives.

The impact of the global food crisis on the health and wellbeing of Ethiopian youth.

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Understanding the association between food availability and human health represents a core element of bioanthropology. This association is increasingly relevant as global food prices soar. In this study we explore patterns of differentially vulnerability to the impact of radically increased food prices among a sample of 2100 Ethiopian youth. We examine whether changes in youth food insecurity status are associated with changes in measures of self-reported health and illnesses and anthropometric status. Using data from a longitudinal study that began prior to the food crisis enables a rigorous assessment of the impact of changing food prices on youth food insecurity and its consequences. Results from a population based survey of youth in Ethiopia show that relative to the baseline survey, youth were more likely to be food insecure once the food crisis hit Ethiopia. Boys were significantly more likely to become food insecure in 2008, as were rural dwellers, and the poor. Social support, although protective in 2006, was no longer protective in 2008. In general, youth who became food insecure were also more likely to report poorer health in 2008. These data provide solid evidence that youth are not buffered from the food crisis and that conventional ideas about patterns of vulnerability may not apply to youth during crises. The results highlight the appropriateness of a biocultural and political economic approach to understanding human health.

Plant neurotoxins and brain development: Implications for encephalization in *Homo*.

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Successful development of the mammalian brain depends crucially on highly coordinated inter- and intra-cellular signaling cascades. Expression of several nicotinic acetylcholine receptor (nAChR)

subunit mRNAs, for example, is increased in fetal vs. adult brains. This suggests an important developmental role for nAChRs in modulating dendritic outgrowth, establishment of neuronal connections, and synaptogenesis. Serotonergic receptor levels peak in fetal or early neonatal life, later declining to adult levels. In the dopamine system, the highest number of D1 and D2 receptors occurs in the immature brain. Plant neurotoxins evolved to target and disrupt such cell signaling pathways in the peripheral and central nervous system. CYP450 xenobiotic metabolizing enzymes constitute a primary defense against plant toxins. We report results of a systematic examination of CYP450 expression in the fetus, infants, children, and adolescents relative to the developmental trajectories of synaptogenesis, synaptic pruning, myelination, synapse formation, and dendritic arborization. During the period of peak synaptic density in the prefrontal cortex, juvenile chimpanzees and rhesus macaques rely heavily on the mother for food selection and xenobiotic metabolization (i.e., by nursing). In contrast, we find that xenobiotic metabolism and, to a lesser extent, food selection in human juveniles during the same period is largely the responsibility of the juvenile itself. We also find that the developmental trajectory of CYP450 expression is consistent with the hypothesis that plant neurotoxins posed a serious risk to brain development. Both findings suggest the importance of a toxin-reduced diet to encephalization in *Homo*.

Epidemiological profile of an urban immigrant population.

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The health status and medical care of migrant populations is an increasingly important topic in light of the recent emergence of a number of ominous global disease epidemics including AIDS, SARS, Avian flu, West Nile Fever, Ebola, and Lyme disease. The prevalence of diseases, injuries and other health problems was investigated in a convenience sample of 290 Caribbean-American permanent residents of Miami,
Florida. The subjects are adult (age 21-85) family members or friends that accompanied patients who visited three health clinics. Every third such individual was included in the sample. The volunteers represent 17 different Caribbean countries of origin and had lived in Miami an average of 15.9 years. Demographic interviews elicited disease and treatment histories. 38% of the respondents indicated past or current health problems requiring professional medical care, while an additional 7% engaged in self-care. The 62 different reported conditions range from lung cancer to ulcers, kidney stones, clinical depression, scoliosis and diverticulitis. The most frequently stated disorders are hypertension, asthma, diabetes, cardiovascular disease and arthritis. These are genetically-influenced degenerative disorders correlated with aging and modernization/urbanization. Anti-hypertensives, cardiac modifiers, and analgesics accounted for the majority of the 26 reported prescription medications. A smaller number indicated the usage of chemotherapy, insulin, allergy medicines, and other individualized prescriptions. 62.5% of the respondents employ traditional medicinal plants for preventive and therapeutic care or to supplement biomedicines in the treatment of culture-bound syndromes such as "soul loss", "falling out" or nervous attacks.

The mandible of *Protopithecus brasiliensis*: implications for fossil hyoid reconstruction in alouattins.

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The *Protopithecus brasiliensis* skull exhibits morphological characters that may be related to the unique way that *Alouatta* produces their howling vocalizations. These include an airorynchous face, extended basicranial region, and posteriorly deepening mandible, which together create space to accommodate the enlarged hyoid bone. Although the hyoid bone has not been discovered, the hypothesis that it was greatly expanded and pneumatized, as in *Alouatta*, can be tested by examining the fossil's basicranial and mandibular dimensions. This study focuses on features of the mandible suggested to contribute to the enlarged subbasal space of *Alouatta*. A set of 2D measurements that describe the expansion and flare of the gonial region, ramus height, and corpus depth were taken on 319 mandibles of all extant ateline genera and *Protopithecus*. A principal components analysis of male and female species means groups the *Protopithecus* mandible within an *Alouatta* cluster, but it is less clear which species of *Alouatta* it is most similar to, an important question as there is interspecific variation in hyoid size and shape among howlers. When the sexes are analyzed separately, *Protopithecus* falls within the 95% confidence interval for *Alouatta* males, and outside of that for females, lending support to the suggestion, based on the strength of the temporal lines and size of the canine, that this *Protopithecus* individual is a male. These results should be approached with caution, as they are based on a single element, but they are a first step towards a quantifiable reconstruction of the *Protopithecus* hyoid complex as *Alouatta*-like.

The developmental determinants of craniofacial variation structure.

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Development is relevant to evolutionary explanation because the phenotypic variation on which natural selection acts is structured by developmental processes. Understanding how development

structures the expression of phenotypic variation in complex structures such as the human skull can therefore yield significant insight into their evolutionary history and evolvability. Taking an approach focused on the relationship between key developmental processes and their impact on phenotypic variation, our lab is investigating the developmental basis for the variation structure of the mammalian skull. We show that variation in key components such as the growth of the chondrocranium, brain and the interaction between the brain and the face determine major axes of phenotypic variation which, in turn, are relevant to understanding major trends in mammalian evolution. In this paper, we review our work in this area using mouse models and relate this to patterns of inter and intraspecific variation in the primate skull. This work illustrates the utility of a "middle-out" conceptual framework for studying the evolutionary developmental biology of the primate skull.

Genetic determinants for capuchin alarm calls? Comparisons between the alarm calls of a previously unstudied group of wild white-throated capuchin monkeys (*Cebus capucinus*) and previously published alarm call analyses reveal no significant difference.

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A sample of over 1500 alarm call vocalizations from a group of previously unstudied wild capuchin monkeys was recorded on Ometepe island in Nicaragua during the summer of 2008. Using linear predictive coding (LPC) and midpoint spectral slicing, the calls were analyzed for spectral peak frequencies and onset durations and compared with previously published data of *C. capucinus* alarm calls (Digweed 2007). The results reveal no significant difference between the terrestrial alarm calls analyzed in the published accounts and the calls recorded in Nicaragua. Capuchin alarm calls have been shown to include a complex repertoire with regard to the perceived danger the alarm is signifying. Since two distinct and far removed groups are producing terrestrial predator alarm calls with little or no variance, a genetic component to this complexity is suggested.

Do more manually dexterous non-human primates have a more human-like arrangement of carpal tunnel structures? Implications for the development of carpal tunnel syndrome

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Humans are the only primate exhibiting a separate muscle body and origin for the flexor pollicis longus (FPL). This condition offers increased mobility for digital manipulation of the first digit and greater control of the precision hand movements. However, increased packing of structures within the human carpal tunnel (CT) may contribute to development of carpal tunnel syndrome (CTS) due to compression of the median nerve. Recognizing that similar prehensile functions of the hand may be performed by human and some non-human primates, and the prevalence of CTS in humans, this study compares CT structures and their arrangement in humans and platyrrhine monkeys. Specimens were chosen due to the diversity of manual dexterity among these taxa, and the similarity between humans and *Cebu*s in the prevalence of manual manipulative behaviors. The following questions were addressed: 1) how does the distribution and position of the median nerve differ with respect to other structures in the CTs of human and non-human primates?, and 2) how do orientation and position of structures within the CT relate to manual dexterity and manipulative ability? Comparative data from a sample of 11 human, 2 *Cebus*, 2 *Aotus*, and 2 *Callthrix* specimens suggest that there is a positive correlation between median nerve size and carpal tunnel width, and that position of the median nerve relates to how wrist and digital flexors arise in the forearm. The *Cebus* specimens exhibited median nerve orientation that is most similar to that in humans. Research funded by a faculty grant and student research fellowship grant from the Kansas City University of Medicine and Biosciences.

Mammalian limb loading and chondral modeling during ontogeny.

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Mechanical loading is known to stimulate chondral modeling. Because chondrogenic activity ultimately influences adult form, variation in chondral modeling potentially can result in changes in characters commonly employed for phylogeny reconstruction and behavioral inference, including joint and limb proportions. However, relationships among chondrocyte behavior, ontogenetic variation in activity patterns and skeletal morphology are not completely understood.
Here we investigate how endurance exercise affects articular and growth plate cartilages of the proximal femur and humerus in exercised and pen-confined sedentary juvenile miniature swine (*Sus scrofa domesticus*). Exercised swine completed graded treadmill running to exertion limit five days a week, while an age-matched cohort was raised without exposure to exercise for the same two-month period. H&E staining was employed to identify cartilage zones for histomorphometry. Safranin-O staining was used to evaluate variation in proteoglycan content of the extracellular matrix.

Gross and micro-anatomical dimensions for four specimens from each loading cohort were compared non-parametrically ($p<0.05$). Analyses of raw and size-adjusted data indicate significant differences between femoral and humeral measures in the exercised and sedentary groups. Interestingly, histological results show that the growth plate appears more responsive to exercise-induced variation in loading than the articular cartilage. Given the singular role of growth plate cartilage in limb elongation, this suggests that the relative length of postcranial elements in mammals is differentially influenced by postnatal variation in loading behavior. Therefore, our experimental findings regarding joint plasticity have important implications for understanding the mechanobiology of limb growth and form as well as the paleobiology of fossil species.

Genetic adaptations to thermal stress in the uncoupling proteins.

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Several phenotypic traits (e.g. body mass, relative sitting height, and surface area/body mass ratio) vary with climate in humans, and this variation likely results from adaptation to thermal stress. We hypothesized that there should also be clines in allele frequencies for genetic variants that underlie adaptation to cold tolerance. We examined the distributions of allele frequencies with climate variables among 952 individuals from 52 world-wide populations for three polymorphisms previously shown to affect the function of the uncoupling proteins (UCP1, UCP2 and UCP3), which are candidate genes for cold tolerance. We found strong correlations with winter climate variables for the UCP1 and UCP3 variants, when compared to control variants genotyped in the same populations. In addition, we examined sequence variation at these genes in 3 population samples, and found evidence that a UCP1 haplotype was driven quickly to high frequency in a European population from Italy. We estimated the time to the most recent common ancestor for the UCP1 and UCP3 alleles that were strongly correlated with winter climate to be 11kya and 41kya, respectively. Taken together, our results support a history of adaptive evolution on UCP functions, possibly mediated by variation in winter temperatures.

Geographic structure of craniofacial variation in modern human populations: an R-matrix approach.

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In the last decade, a near consensus has emerged in supporting single origin of modern humans in eastern Africa. Today, the pattern of dispersals and colonization history of modern human populations as well as possible divergence times among major geographical groups are focus of debate. In recent years, a quantitative genetic approach, the R-matrix method, to worldwide human phenotypic variation has opened new channel in the investigation of the evolution of modern human morphological diversity. In the present study, R-matrix method was applied to the craniometric datasets including 14 major geographic regions for addressing a possible colonization history and divergence times among modern human population groups. The results indicate that sub-Saharan Africans are the most diverse and that the diversity of non-Africans is negatively correlated with geographic distance to East Africa, suggesting serial bottlenecks and the founder effect of ancient populations originating in Africa. The analysis supports a possible dispersal route proposed from the research of mtDNA haplotype variation, the Horn of Africa (the route across the Bab el Mandeb Strait) as a passageway in earlier human migration out of Africa. The analysis for divergence time estimation based on phenotypic data indicates that the lineages leading to the present Africans and non-Africans diverged ≈ 54,000 – 125,000 years B.P. Such findings support the current scenario for modern human origin and migration history suggested by genetic analyses, and indicate neutral evolution as a whole, but not necessarily exclusively, in producing craniofacial diversity among modern human populations.

Biomechanics of climbing in *Macaca fascicularis*: a comparison between species that exhibit varying degrees of arboreality.

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Many of the characteristic behavioral and anatomical features that define primates, such as long and highly protracted limbs, are thought to be associated with the mechanical demands of climbing vertical supports. The goal of this study is to test whether time spent climbing influences locomotor parameters such as footfall sequence, peak forces, and limb excursions during vertical climbing. Previous studies (Hirasaki et al. 1992, 1993, 2000) have already shown that these parameters are different during climbing by the semiterrestrial, pronograde *Macaca fuscata* versus the more arboreal, highly specialized, antipronograde *Ateles geoffroyi*. This study tests the hypothesis that a fully arboreal, pronograde primate will exhibit gait and force distribution patterns intermediate between *M. fuscata* and *A. geoffroyi*. The long-tailed macaque (*M. fascicularis*) was chosen because it spends a transitional amount of time climbing, between that of *M. fuscata* and *A. geoffroyi*. Footfall sequence, peak hindlimb vertical and horizontal forces, and 3-D hindlimb excursion data were collected for two individuals of *M.*

fascicularis (6.9kg-8.0kg) during multiple climbing bouts on a stationary pole instrumented with a force transducer. Results show that the footfall sequences of *M. fascicularis* are similar to those of the Japanese macaque. Peak force distributions and hindlimb excursions for *M. fascicularis*, however, are intermediate between the relative unity reported for *M. fuscata* and the extreme hindlimb dominance reported for *A. geoffroyi*. These results support the notion that time spent climbing may be an important factor in primate locomotor mechanics.
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The evolutionary implications of the cercopithecine cheek pouch for group size and sociality.

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Among the hypotheses proposed for the evolution of the cercopithecine cheek pouch (predator avoidance, feeding competition, and multitasking), feeding competition over clumped, high-quality foods has the strongest support. This study assesses feeding competition variables as predictors of cheek-pouch use. I tested the hypothesis that nearest neighbor distance, number of neighbors and distance to the center of the feeding patch predict cheek pouch use in the Cayo Santiago *Macaca mulatta* population. A non-parametric regression of cheek-pouch use against measures of feeding competition was significant ($F=428.14$; $df=3$; $p<0.001$) for the entire sample. The results of an analysis of covariance by individual for a subset of 21 subjects showed the slopes of the regression lines ($F=0.499$; $df=21$; $p=0.970$) and intercepts ($F=2.264$; $df=21$; $p=0.133$) were not significantly different among the regression equations by individual. The results for the entire sample demonstrate that the number of neighbors within a 10m radius and distance to the center of the feeding patch are significant predictors of cheek pouch use. The results by individual demonstrate that the number of neighbors within a 10m radius is a significant predictor of cheek pouch use for 20 of 21 subjects. Macaques have both the largest relative cheek pouch size and larger group sizes than other cercopithecine genera, and non-macaque cercopithecine genera, in turn, tend to have larger group sizes than non-cercopithecine primate genera. I argue that the presence of cheek pouches allow cercopithecines to tolerate larger group sizes than would be possible otherwise, and thus allow for increased dependence on sociality.
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The contribution of genes to variation in bone morphology: Considerations of co-adaptation of traits.

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Variation in bone morphology is used to gain insight into a wide array of research questions in biological anthropology. This variation is reflected in a large number of measures of bone shape including traditional osteometrics, geometric properties, and bone histomorphometrics. Bone shape is also intimately related to variation on bone composition (e.g. degree of mineralization, collagen crosslinks, biochemical content, etc.), and vice versa. Understanding the inter-relatedness and co-adaptation of all of these traits is central to studies of human and non-human primate evolution and variation.
Studies in humans and animal models consistently demonstrate that genetic variation underlies a great deal of the variation in bone shape. These genes may exert their influence in bone morphology through direct effects or through mediation of responses to environmental stimuli. The pedigreed baboons at SNPRC/SFBR provide a unique opportunity to examine the degree to which traits of bone shape and composition are phenotypically and genetically correlated to one another. Using methods of variance component decomposition we have demonstrated, in this species, significant genetic effects on midshaft femoral geometry, platymeria, cortical bone microstructure, trabecular bone density, and mechanical properties of trabecular bone. Assessment of a comprehensive suite of shape and composition traits in the same set of animals will allow for invaluable tests for shared genetic effects among these traits for a better understanding of the evolutionary relationship between functionally or otherwise related traits and the potential for co-evolution and co-adaptation of bone morphology and composition.

A new pliopithecid from the late early Miocene of Fanchang, Anhui Province, China.

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A diverse community of pliopithecids is known from Miocene localities in Europe, but until recently this group was relatively poorly represented in China. However, recent discoveries have shown that Chinese pliopithecids were taxonomically diverse and geographically widespread. The earliest pliopithecoids in China (and Eurasia) are represented by *Dionysopithecus* and *Platodontopithecus* from the early Miocene of Sihong (~17-18 Ma). During the middle Miocene (~15 Ma), several species of pliopithecids are recorded at localities in Gansu Province, Inner Mongolia, Xinjiang and Ningxia Hui Autonomous Regions. A late-surviving crouzeliine pliopithecid,

Laccopithecus robustus, is known from the late Miocene (~7 Ma) of Shihuiba in Yunnan.

Recent paleontological investigations at the late early Miocene locality of Fanchang in Anhui Province have yielded a sample of isolated teeth (more than one hundred) of a previously unknown species of pliopithecid. The associated fauna suggests an age contemporaneous with Shanwang (~16.5-17.0 Ma). All of the permanent teeth are represented, except for i2. The Fanchang pliopithecid is slightly larger in overall dental size than *Pliopithecus zhanxiangi*, *Laccopithecus robustus* and *Anapithecus hernyaki*. With its unique suite of dental features it clearly represents a new species and genus. Shared derived features confirm that the Fanchang pliopithecid has its closest affinities with the crouzeliines, but a number of primitive traits indicate that it is a stem member of the clade. The occurrence of a stem crouzeliine in China implies that the Pliopithecinae and Crouzeliinae may have diverged in East Asia during the early Miocene prior to their arrival in Europe.

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Population history and cranial morphology in a large human skeletal dataset.

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The ability of cranial morphology to reflect population / phylogenetic history, and the degree to which it might be influenced by environmental factors and selection pressures have been widely discussed. Recent consensus views cranial morphology as largely indicative of population history in humans, with some anatomical cranial regions / measurements being more informative on population history, while others seem to have been under selection pressure.

Here we test these earlier findings using the largest and most diverse cranial dataset available as yet, collected by one of us (TH). 7423 male specimens, representing 135 geographic human population samples were used in this analysis. Mahalanobis D^2 were calculated for three datasets: complete cranial dataset; facial measurement dataset; and neurocranial measurement dataset; these morphological distance matrices were then compared to matrices of geographic distances as well as of several climatic variables. Additionally, we calculated Fst values for the cranial measurements represented in our dataset and compared the results to the expected values for neutral genetic loci. Our findings are broadly similar to previous studies, supporting the hypothesis that cranial, and especially neurocranial morphology, is phylogenetically informative, and that aspects of the face and cranium are subject to selection related to climatic factors. The Fst analyses also suggest that selection to climate is largely restricted to groups living in extremely cold environments, especially in Northeast Asia and North America. The implications of these results for the evolution of modern human craniofacial diversity are discussed.

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Southeast Asian primate communities: the effects of ecology and history on species richness.

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Primate species richness in Africa and South America is positively associated with forest productivity, as well as two of its proxies: mean average rainfall and distance from the equator. In contrast, no such correlations exist in Asia. This discrepancy possibly relates to Pleistocene refugia (constricted tropical forests during glacial maxima) which continue to have higher than expected species richness today. In Africa and South America refugia were large and centralized near the equator coinciding with present primate species richness. In Asia, however, refugia were smaller and patchily distributed across the landscape. In this study, we investigate the effects of ecology on Southeast Asian primate species richness, while controlling for Pleistocene refugia. Our database includes 49 sites with more than 100 km^2 of forested area (34 mainland sites; 15 island sites). We controlled for the potentially biasing effects of Pleistocene refugia, determining correlations between primate species richness, rainfall, and latitude, first with all primate research sites for which data are available, then after removing sites that may have served as refugia (based on elevation, pollen cores, and the distribution of termites species). Results indicate that refugia sites have significantly higher primate species richness than non-refugia. After removing Pleistocene refugia, a strong positive correlation exists between closeness to the equator and primate species richness. However, even after removing Pleistocene refugia from the analysis, the expected positive correlation between rainfall and species richness is not supported. This latter result might be due to an excess of rainfall that decreases forest productivity.

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Sex and sample: classification analysis using cervical canine metrics.

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A method of assigning sex in human remains using a discriminant function classification analysis of cervical canine diameters has been tested on a burial assemblage from the post-medieval cemetery of Chelsea Old Church in London. 78 adults from this assemblage, of whom twelve were of known sex and the remainder sexed based on bone morphology, were used in the primary sample. An additional sample of 47 adults sexed based on bone morphology from the lower socioeconomic status burial ground of St. Bride's Lower Churchyard were included in the second stage of the analysis in order to maximize sample size. Using mesiodistal and buccolingual cervical diameter measurements of the permanent canine teeth discriminant function analysis was undertaken on the known sex, Chelsea, and St. Bride's samples. Sample size was too small to accept the 100 per cent success rate in classification of individuals to sex in the known-sex sample, but the analysis of the entirety of the Chelsea sample achieved a 94 per cent success rate in correctly classifying 23 individuals to sex. Analysis of the combined site sample achieved an 84 % success rate. 91% of the Lower Churchyard sample was correctly classified. Sample population proved an unexpectedly important factor in successful classification, and the lower mesiodistal and upper left buccolingual cervical diameters were seen to have the greatest discriminatory effect.
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The effect of genes on cortical bone microstructure: Lessons from the Cayo Santiago skeletal collection.

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A thorough understanding of the factors affecting bone remodeling is essential for maximal and accurate reconstruction of behavior from skeletal remains. Intracortical (osteonal) remodeling occurs though the resorption of existing bone coupled with the formation of new bone to replace the old in the same location. This process is cumulative throughout adulthood and is recorded in bone cortex as osteons. The value of bone histomorphometry, the measurement of osteon remodeling dynamics, in biological anthropology hinges on accurate interpretation of this microstructural record, variation in which stems from complex interactions among a myriad of genetic and environmental factors that result in variation among individuals, populations, and species.

The skeletal collection of Cayo Santiago macaques was instrumental in providing strong evidence for a genetic effect on variability in osteon morphology and spurring future studies of the degree to which variation in intracortical remodeling is influenced by genes. A study of the contribution of maternal lineage to variation in osteon remodeling in *Macaca mulatta* of Cayo Santiago revealed a significant effect of maternal lineage on osteon and Haversian canal size. This result inspired a subsequent study in baboons that demonstrated strong and significant genetic effects for osteon size, osteon population density, percent osteonal bone, wall width, and porosity. The Cayo Santiago macaque skeletal collection provided the first evidence for a genetic effect on osteonal remodeling that has since been replicated in another primate species and that must be considered in interpretations based on intracortical bone histomorphometry.

Aging comparisons between humans and chimpanzees.

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A grandmother hypothesis to explain the evolution of human life history highlights fertility similarities and mortality differences between humans and chimpanzees. I summarize expectations about these demographic comparisons, and, using data from the published literature, find a lack of empirical fit with those expectations. I then show how differential heterogeneity may account for the departure from initial expectations. Higher mortality in chimpanzees decreases heterogeneity in fertility over the same ages that heterogeneity in fertility increases in women. This obscures common rates of ovarian aging. Variation in population heterogeneity also affects rates of increase in mortality across adulthood. I show how this could explain similar rates of demographic aging in some human and chimpanzee populations.
The analyses explore systematic effects of mortality selection that must be recognized to recover the distinctive characteristics of age-specific fertility and mortality rates in both humans and chimpanzees. Results are relevant to cross-species comparisons generally and specifically to human life history evolution. They also challenge some widely cited generalizations about human aging.

Natural selection, longevity, and the Neandertal-modern interface.

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Neandertals appear to have lived short lives compared to more recent Upper Paleolithic Europeans, who had lifespans in the range of historic hunter-gatherers. This difference appears to result from

modern cultural factors rather than modern anatomy (Caspari R, Lee S-H. 2006, Am J Phys Anthropol 129:512). A predicted two-fold or more reduction in adult annual mortality risk may have caused population growth during the terminal Pleistocene. Additionally, genes associated with somatic maintenance and DNA repair may be expected to show a signature of selection responding to the change in mortality risk.

This study tests those predictions by (a) modeling population dynamics and (b) examining date estimates for positive selection on genes related to DNA repair and metabolism. The rates of mortality predicted from Neandertal and early Upper Paleolithic dental remains predict a much higher rate of Upper Paleolithic population growth (ca. 2% annually) than possible based on demographic and archaeological evidence. Thus, the difference between Neandertals and later people may be exaggerated by the dental evidence. This discrepancy may be explained by biases in the dental samples, reductions in birth rate or juvenile survivorship in Upper Paleolithic populations, or persistence of a "population sink" in Neandertal Europe. Seventeen genes influencing DNA repair and metabolism came under positive selection at a range of times from 20,000 years ago to the present, with no distinct clustering of dates. These data are consistent with a changed ecology of longevity in recent human populations, persisting from the Upper Paleolithic.

Test of intra- and inter-rater agreement of scoring cranial non-metric traits used in the forensic determination of ancestry.

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Use of non-metric trait analysis for the forensic determination of ancestry has recently received renewed attention. In order to effectively employ these methods, character state descriptions must be comprehensible to facilitate a high level of intra- and inter-rater agreement. This study investigates the degree of intra- and inter-rater agreement of scoring 13 cranial non-metric traits described by Hefner (2003). Scoring style varies for this set of traits, as some are scored on a scale of graded expression, some as present or absent, and some based on shape category. The sample includes 83 crania housed at the Joint POW/MIA Accounting Command Central Identification Laboratory. Each of the 13 traits was scored using the illustrations and descriptions outlined by Hefner. Scoring was conducted over a six-week period with no communication between observers (inter-rater) or reference to previous scores assigned (intra-rater). Cohen's Kappa statistic was used to test the level of agreement within and between observers.

Results indicate a high level of intra-rater agreement for all 13 cranial non-metric traits ($p<0.05$). The level of agreement between observers, however, only reached a high level for seven traits ($p<0.05$). Of those with low inter-rater agreement, two traits were scored by category and the others on a graded scale. Although category and graded scoring scales attempt to capture more subtleties of human variation, these results suggest improved inter-rater agreement is achieved when traits are scored on a present-absent scale. Experience level may also contribute, and should be investigated in future studies.

Estrogens in human remains.

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During the excavation of a churchyard in Völklingen (Germany) eight individuals with grave goods from the 15th century were found. These grave goods archaeologically characterised the individuals as women who died in childbed. Near the pelvic girdle of two of the individuals bones of fetuses were recovered. Therefore the question arose whether the other six women also died due to complications during pregnancy or childbirth. This can only be answered by analytical methods.

During pregnancy the blood serum of a woman shows increased estradiol-values. These should also be represented in the bone matrix. From the eight potential women in childbed and 18 control individuals bone samples were taken. To draw an external comparison samples from three women with fetuses in their pelvic girdle as well as one woman and man from a Medieval cemetery in Hettstedt (Germany) were also taken. The bone samples were prepared following a revised method developed by Zierdt (2005). Estradiol was extracted and the concentration was detected by radioimmunoassay. Three of the four women with fetuses and four of the six potential women who died in childbed as well as two women from the comparison group showed estradiol-concentration over 100 pg/ml. The results of the chemical analysis show that it is possible to identify women who died during their pregnancy or in child bed. The influence of diagenetic processes and other factors will be discussed. In the future this method can help answer questions in forensic and historical context which seemed to be unresolvable so far.

The Swatis of northern Pakistan—Emigrants from Central Asia or colonists from peninsular India?: a dental morphometric investigation.

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The Swatis are one of the largest Pashtun-speaking ethnic groups of the Northwest Frontier Province of Pakistan. Most authorities trace Swati origins among other Pashtun-speaking groups of Afghanistan and the Hindu Kush highlands, but others claim that Swati origins are to be found among the ethnic groups of peninsular India. This

research tests whether the Swatis of Mansehra District share closest phenetic affinities to living and prehistoric groups to the north and west (south Central Asia, Iran) or to the south and east (peninsular India). This investigation is based on measurement of maximum mesiodistal lengths and buccolingual breadths of all permanent teeth, except third molars, and assessment of dental morphology variations scored in accordance with the Arizona State University Dental Morphology System in a sample of 204 Swati school children. These data were contrasted with 19 samples of prehistoric and living individuals from Pakistan, peninsular India, Central Asia, and the Iranian Plateau. Patterns of intersample differences were examined with cluster analysis and principal coordinates analysis**.** Results obtained from odontometric and dental morphology analyses are virtually identical. In both cases, Swatis are identified as possessing closest affinities to living ethnic groups from the Hindu Kush highlands, with more distant affinities to prehistoric inhabitants of Pakistan and Central Asia. Swatis share little to no affinities to ethnic groups from peninsular India. Such results indicate that the living Swatis of Mansehra District most likely represent the descendants of ethnic groups found to the north and west, and provide no support for the claim of peninsular Indian origins.

Adiposity in 7-11 year old British children: comparison of British Pakistanis and white Britons, and 2nd and 3rd generation British Pakistanis.

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British Pakistanis are at a high risk for generalised and central adiposity and of co-morbidities such as diabetes and heart disease. This study predicted values for adiposity would be higher in British Pakistani than in white British children. It was also predicted that third generation British Pakistani children (mothers born in the UK) would have lower levels of adiposity than second generation children (mothers born in Pakistan), based on hypotheses regarding the effects of developmental environment and intergenerational phenotypic inertia.

Adiposity was assessed by waist circumference and tricep and subscapular skinfold thicknesses (SFT). Participants were children aged 7-11 years old from 5 primary schools in a north east city in England. There were 211 white British and 137 British Pakistani children, with 82 British Pakistanis in the second generation and 51 in the third generation. There were no significant differences for mean standard deviation scores (SDS) for waist circumference between British Pakistanis (0.714±1.3) and white Britons (0.988±1.1) after controlling BMI ($p=0.253$). British Pakistanis showed higher mean SDS for tricep (0.586±1.0) and subscapular (0.479±0.97) SFT than white Britons (0.537±0.96 and 0.225±0.92, respectively) after controls ($p=0.003$ and $p<0.001$, respectively). Second generation British Pakistanis showed higher mean SDS than third generation children for waist circumference and tricep and subscapular SFT, but differences were not significant.

Future investigations into generational patterns of adiposity should be longitudinal in design to observe the life cycle and include a sample size with sufficient power to detect small effects.

Body frame dimensions can predict obesity: Body mass index, body frame and fatness.

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Body Mass Index, a principal measure of obesity, oversimplifies the representation of body shape and assumes independence of lean body mass and fat mass. We explore relationships between fatness and anthropometric variables reflecting variation in lean body frame. Standard measurements of stature, weight, dimensions of the skeleton (shoulder width, hip width, chest width and depth, limb lengths), circumferences of head, trunk, limbs and triceps, subscapular and abdominal skinfolds were collected on adult Australian women (n=1250) and men (n=66) in 2002 during a National Body Size and Shape Survey. Techniques for measurements of skeletal dimensions minimised the inclusion of adipose tissue thickness. Vertical dimensions of the trunk and limbs show at best weak correlations with fatness. Body frame dimensions are significantly correlated with fatness, each explaining from 3% to 44% of variation in skinfold thickness. Skeletal dimensions explain up to 55 % of variation in skinfold thickness (multiple regression). Especially high correlations occur for chest width, depth and hip width (r from 0.42 to 0.66). Body frame dimensions reflect mostly lean trunk size. Larger trunk is associated with greater fatness. Since the size of the gastrointestinal system (GI), is reflected in the trunk size, larger frame may predispose to obesity because larger stomachs require greater bulk of food to produce feeling of satiety as mediated through antral distension while larger GIs may absorb more nutrients. By taking into account frame size, it should be possible to detect the risk of obesity among young adults.

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Wari Emissaries in the Southern Nasca Region of Peru: the oxygen isotope evidence.

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The Wari are one of the first expansive states in the highland Andean region; it exhibited extensive influence throughout what is now Peru. Archaeological evidence suggests interaction between the coastal Nasca of southern Peru and the Wari; however, there is little evidence for Wari direct control. We investigated the nature of Wari influence in the Las Trancas Valley using $\delta^{18}O$ values from archaeological human bone dating to before (Early Intermediate Period or EIP, AD 1-750) and during (Middle Horizon Period, AD 750-1000) Wari influence. FTIR patterns indicated that all bones were well-preserved and adequate for analysis. The $\delta^{18}O$ values in bone carbonate were used to assess the possibility of migration of imperial emissaries from high-altitude Wari to low-altitude Nasca regions. During the EIP, Early Nasca showed higher values and a smaller range of variation (~3‰) than in Middle (range=7‰) or Late (range=5.5‰) Nasca periods. The differences are probably due to variable evaporative enrichment in ^{18}O before and after wide-spread construction of *puquios*, the underground water control systems established at the end of the Early Nasca period. During the Imperial period, individuals buried with local Loro ceramics have higher average values than those buried with Imperial Chakipampa style ceramics. Both groups show lower ranges of variation (2‰) than in earlier periods and lower average values. The pattern may indicate the presence of foreign born individuals from higher elevations or, alternatively, indicate greater efficiency in water storage facilities.

Do vervet monkey day journeys maximize energy yield?

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We used 64 day journeys, collected from two vervet monkey troops in South Africa, to test the hypothesis that these routes were structured to maximize energy yield. To do so, we used energy assays of food items and geostatistical interpolation to derive energy grids for the two home ranges. We then compared the sum of the energy in the grid cells actually encountered during each journey with the mean value of the upper 95% confidence limit obtained from 400 random walks of the same length and with the same start and end points. The overall energy available to the animals was significantly different for the two home ranges and we found that the troop in the richer home range did not encounter more energy than it would have by moving randomly. The troop in the poorer home range, however, encountered significantly more energy than that yielded by the random walks. We discuss these results in terms of mean-variance trade-offs.

Characterizing the effects of background selection in the human genome.

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Modeling suggests that background selection against unfavorable mutations can lead to a reduction of diversity at linked neutral sites and, when many mutations are weakly deleterious, to a skew in the frequencies of neutral alleles. Moreover, several lines of evidence suggest that the deleterious mutation rate in humans is high: In addition to the tens of thousands of disease mutations that have been catalogued, population genetic analyses suggest that the majority of changes at amino-acid sites and within conserved non-coding regions decrease fitness. To date, however, there has been little or no consideration of background selection effects in humans. In particular, nothing is known about the genomic scale over which background selection is expected to shape patterns of human genetic variation. We are using a combination of modeling and analysis of resequencing data to develop a map of background selection in the human genome, integrating information about recombination, mutation and sequence conservation.

Whispers in the dark: bioacoustic signatures of owl monkeys.

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Owl monkeys (*Aotus*) are the only nocturnal anthropoids. Nocturnal prosimians are highly vocal yet little is known about acoustic communication in owl monkeys. As part of a larger study documenting the repertoire of several *Aotus* species, we recorded the vocalizations of 21 (11:10) Nancy Ma's owl monkeys (*A. nancymaae)* at the DuMond Conservancy (Miami, FL) from January-September, 2008. We identified 10 vocalizations in our sample: peep, chirp, hoot, grunt, chuck, squeal, trill, purr, moan, and resonant whoop. Because other nocturnal primates emit calls that have unique bioacoustic signatures, we hypothesized that the same would be true in these primates. To test this hypothesis we analyzed by cursor inspection two temporal variables (duration, notes/call) and three spectral variables (peak frequency, lowest frequency, bandwidth) of four calls (peep, hoot, trill, purr) using Praat software. We examined variability within and between sexes. Males differed significantly from each other in peeps, hoots, and purrs, but not trills (MANOVA; $p < 0.05$). Females differed from each other in variables of peeps, hoots and trills,

but not purrs (MANOVA; $p < 0.05$). Calls of males were compared to the same calls produced by females. Only trills differed significantly between the sexes (bandwidth: mean = 613.29 Hz ± 0.38 males, 1606.40 ± 0.94 females; $p = 0.04$). Our preliminary results provide the first spectrographic representation of the vocal repertoire in this species. Further, they suggest males and females may be distinguishable by specific call variables; however, larger sample sizes are required to understand the breadth of variation.
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Caries and dental abscess prevalence among Florida Archaic Hunter-gatherers from the burial sites of Gautier (8BR193), Bay West (8CR200), and Windover (8BR246).

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Diet, social rank, and genetic predisposition affect the prevalence of dental caries and abscesses in human populations. Notwithstanding the affects of diagenesis, previous bioarchaeological research consistently shows a low prevalence of dental caries and abscesses in hunter-gatherer samples. These results have been attributed to a diet that lacks carbohydrates. Dental wear resulting from high grit diets and/or paramasticatory behaviors may also play a prophylactic role.
We add to existing caries and dental abscess research through our investigation of oral health in Florida Archaic skeletal samples from Gautier (8BR193, n=65), Bay West (8CR200, n=39), and Windover (8BR246, n=148). Specifically, we scored the incidences of caries and dental abscesses in each skeletal sample as observed through a 5x hand lens and radiography. Five percent of teeth examined had caries within the Bay West and Windover samples; this finding was in keeping with previous research of hunter-gatherer skeletal samples throughout North America. The Gautier sample evidenced the least numbers of caries (n =17; 2.2%) and abscesses (n=5; 0.6%) of all observable teeth within these three skeletal samples. This finding was significant (x^2=12.977, df =1, p<.001). Additionally, Gautier also presented a significantly lower incidence of abscesses (x^2= 105.231, df =1, p<.001) than both Bay West and Windover (38% and 13%, respectively). Possible contributory factors related to the differences in caries and abscess frequencies within these Florida Archaic skeletal samples include dietary differences between the samples, sex differences in diet, biological age at death differences between and within the samples, and ante/postmortem tooth loss.

A palaeomagnetic age of about 990,000 years for the Cornelia-Uitzoek fossil vertebrate, hominin and Acheulian site, South Africa.

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Cornelia-Uitzoek is the type locality of the Early to Middle Pleistocene Cornelian Land Mammal Age of southern Africa. The Cornelian fauna post-dates the Makapanian and precedes the Florisian. However, few Cornelian site have precise dates. Cornelia-Uitzoek has also yielded Acheulian artifacts including hand axes and cleavers made on hornfels and a single upper molar of *Homo*. The site consists of Quaternary alluvial and colluvial gravels and clays accumulated in a small basin of Permian Karoo (Ecca) shale. The fossils and archaeological material at the Cornelia-Uitzoek main section come from two contexts; a palaeo-landsurface and a hyena burrow. The vertebrate assemblage at Cornelia-Uitzoek records similar taxa as those found in the upper part of the Olduvai sequence, including *Eurygnathohippus cornelianus*, *Hippopotamus gorgops*, *Metridiochoerus compactus*, *Kolpochoerus limnetes* and *Damaliscus niro*. The horns of *D. niro* from Cornelia-Uitzoek are in a slightly more derived state than those from Olduvai, suggesting that the vertebrate assemblage may be marginally younger than those from Olduvai Beds III & IV. Recent palaeomagnetic analyses indicate that the palaeo-landsurface and burrow are of a reversed magnetic polarity, while the white/yellow alluvial clay deposits that underlie the palaeo-landsurface and into which the burrow has been excavated are of a normal magnetic polarity and are thought to be contemporary. The basal normal is best correlated to the Jaramillo event between 1.07 and 0.99 Ma. The fossil and archaeological deposits, including the hominin fossil, lie just above the reversal from normal to reversed polarity at 0.99 Ma.

Insights into the historical and skeletal demography of an early Tucson cemetery.

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Recent bioarchaeological investigations led by Statistical Research, Inc. at a cemetery within the Joint Courts Complex in Tucson, Arizona have documented 1083 graves. The cemetery, which served as the primary burial ground for the city, represents a cross-section of nineteenth century Tucson. As such, the burial sample provides a glimpse into the development of this southwest desert city. Archival research by SRI produced an extensive burial record for Tucson during this period with interment data on 2,314 individuals spanning from 1863 to 1887. Excavation data suggests that interments from only 1862 to 1875 are represented in the burial sample (n = 974). No civilian graves have been specifically linked to the archival burial record. The laboratory analysis performed on-site focused on the construction of a biological profile, documentation of paleopathological data, and collection of standard morphological and metric osseous and dental traits. The combined archival record and burial sample provide a unique opportunity to investigate life and death in early Tucson. The examination of the two data sets is critical to identify and understand the variation within and between archival and osteological mortality profiles. A comparison of various Siler and Gompertz models for the osteological age-at-death profile and the Diocese burial record distribution produced significantly different parameters. Adult age-at-death estimates were then reassessed using transition analysis based on a limited number of adult age indicators. The transition analysis age-at-death distributions are compared to the composite age-at-death and archival age-at-death distributions to highlight the differences in these approaches.

Women's coalition aggression: The influence of allies and competition on gossiping.

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Evolutionary theories of human coalitional aggression focus almost exclusively on men. Evolutionary theories of women's cooperative behavior, in contrast, emphasize nurturing and childcare. Among non-human primates, however, females often cooperate in physical contests with other females over access to resources. We have proposed an account of human female coalitional aggression that emphasizes the cooperative collection, analysis, and dissemination of information ('gossiping') as a strategy to manipulate reputations, thereby increasing access to contested material and social resources. We report results of a study investigating the influence of allies, competition, and sex on gossiping behavior. Specifically, we tested the effects on gossiping of the value and contestability of the resource, the presence of allies, the relevance of the gossip to the competition, and sex.

Sex and size effect on human neurocranium shape.

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Sexual dimorphism in shape and size of the human skull is a well known feature, shape dimorphic features being more particularly concentrated on face. Two studies focusing on the influence of sex and size on craniofacial shape using geometric morphometrics (GM) reached partially different conclusions: Rosas and Bastir (2002) found that both sex and size have a significant influence on craniofacial shape, whereas Kimmerle et al. (2008) found that sex, but not size, had a significant influence on shape. The aim of this study is to test the effect of sex and size on neurocranium shape using three-dimension GM based on general Procrustes superimposition and thin plate splines. The material consists in 105 anonymous computed tomography reconstructions from adults (50 females and 55 males) who had visited the Universitary Hospital of Innsbruck, Austria. Three-dimension coordinate locations for a set of 12 traditional landmarks and 821 semilandmarks (including 12 traditional landmarks treated as semilandmarks) were recorded. The MANCOVA procedure tested shape differences as a function of sex (grouping variable) and size (covariate). Sex has a significant influence on shape ($F=2.881$; $df=10$; $p=0.004$) whereas size did not ($F=1.239$; $df=10$; $p=0.277$). Therefore, within each sex, significant shape differences did not exist between specimens of different sizes. Female Procrustes mean shape (PMS) is wider at the temporal bone and shows a greater anterior placement of the frontal relative to the male PMS, excepting the supra orbital region. Male PMS is wider at the occipital and shows a greater posterior placement of the clivus.

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Social behavior and genetic diversity in human populations

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Social organization and cultural practices in human populations can affect both Intra and Inter population genetic diversity. I will first present how coalescent theory enables us to detect the impact of some of these socio-demographic behaviors. In particular I will show how a cultural process like fertility inheritance, (a phenomenon in which an individual's number of offspring is positively correlated with his or her number of siblings) can have a strong impact on genetic diversity and can be detected in genetic data. The ways in which

individuals choose their mates and where they settle are also known to affect the genetic diversity inside population and between populations. I will present some of our results based on our fieldwork in Central Asia where we have shown that different social organizations (patrilineal nomadic herders versus bilineal sedentary agriculturist) have an impact both on intra population and inter population genetic diversity.

Political economy as a framework for linking biocultural and evolutionary approaches in human biology research.

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There has been much debate over both the desirability and feasibility of developing political economic approaches to human biology research. Some investigators have argued that it is cumbersome, and irrelevant to individual biological variation; others have suggested that it tells us little beyond the obvious: that poor people have poor health. We will argue that political economy is critical to biological anthropology from two perspectives. First a number of investigators have developed innovative methods to explore the relationship between culture change and individual health. We will argue, drawing from the work of cultural anthropologists, that culture change is not a neutral process but one structured by inequality, and that cultural formation is a material process contested by those with more and less access to power. This definition suggests that a consideration of politics and the economy can add critical insights to biocultural models. Second, there has been an upsurge in focus on the importance of development in evolutionary biology, both in terms of individual phenotypes, but also as a potential driver of evolutionary change. We will argue that both macro level forces and individual economic inequalities have important implications as developmental constraints, and as precursors to health inequalities. By this logic, the reverse also holds; health inequalities can only be fully understood through an evolutionary lens. Rather than being a source of contention, we will suggest that political economy actually has the power to serve as a bridge to strengthen the integration of biocultural and evolutionary approaches.

Sexual swellings and mate choice in olive baboons.

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Primate sexual swellings are among the most debated signaling systems exhibited by mammals. Many hypotheses have been proposed to explain swelling function, and these tend to focus on the information content of the signal, with the two most recent hypotheses suggesting that swellings either contain information about the probability of ovulation (the graded-signal hypothesis) or about female quality (the reliable indicator hypothesis). Here, for a population of olive baboons at Gashaka-Gumti National Park, Nigeria, we show that swelling size acts as a graded-signal of ovulation probability. While male consortship behavior was linked to swelling size, copulation behavior was not, although it was linked to the timing of ovulation. This suggests that consorting males, with close access to the female, used signals unrelated to swelling size in determining when to copulate, and indicates that we are unlikely to understand the role of swellings in mating behavior in our population without better understanding the variety of signals available, and the role of male experience and social knowledge in the use of these signals. Variation in inter- and intra-specific social and sexual systems and strategies, including in infanticide rates, consortship stability, and prevalence of male-male coalitions, may mean that we never find a swelling model universal to all populations of all species. Instead we should consider on a population-level how the information content of one element of one signal (swelling size) combines with that available from other signaling modalities, and how this comes together with social knowledge and experience in male decision-making.

Comparative analyses of size of pneumatized spaces within temporal bones of eatant species.

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Numerous studies demonstrate the reduction in temporal bone pneumatization over the course of human evolution. However, analyses of temporal bone pneumatization in fossil hominids and extant primates are mostly limited to qualitative descriptions of presence of air cells in specific regions of the temporal bone. The purpose of this study is to characterize the changes in size of pneumatized spaces that accompany the reduction in the extent (or spread) of temporal bone pneumatization over human evolution.

High resolution x-ray computed tomography scans of the temporal bone were acquired from the skulls of *G. gorilla* (N=10), *P. troglodytes* (N=10) and *H. sapiens* (N=10). Surface area and volumes of the air cell tracts in the temporal bone were calculated using Amira software, and compared among the three species. Results indicate that unscaled surface area and volume estimates are different among the three species, despite overlap in surface areas of pneumatized spaces in *Pan* and *Gorilla*. When scaled by body mass, *Pan* and *Gorilla* show similar volumes and surface areas for the pneumatized regions of the temporal bone, while *Homo* differs from both. While the extent of pneumatization, or spread of the

air cell tracts into regions of the temporal bone, is similar in *Pan* and *Gorilla*, differences in size of the pneumatized spaces may echo the overall size of specimens. These results suggest that body size should be considered when assessing the importance of differences in pneumatized spaces in various species.
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An infant Hominid first metatarsal from Hadar, Ethiopia.

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An infant first metatarsal from the A.L. 333 site in Hadar, Ethiopia, never previously described, was compared to infant humans and chimpanzees to identify adaptations for bipedal locomotion present early in development. This *Australopithecus afarensis* first metatarsal is morphologically similar to those of modern humans. This suggests fully modern bipedalism, which implies profound behavioral changes by 3.5 million years ago.

Diet, culture change, dental disease and tooth wear in prehistoric southern Peru.

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Southern Peru is at the edge of the Atacama Desert. The Ilo valley carries water down from the mountains to create an oasis next to the coast, so people living there had access to the resources of the sea, the oasis, the mist-nourished desert vegetation of the surrounding hills, and resources carried down from the mountains. As seen in the archaeological record, the earliest series of human remains come from Formative (1000 BC – AD 500) sites on the coast, with much evidence of utilisation of marine resources. Later the region developed an intense connection with Tiwanaku in the Titicaca basin (AD 300 – 1000). Although marine food sources were still used, there was a complementary use of cultivated crops and camelids. After the breakdown of the Tiwanaku empire, a local derivative, the Chiribaya culture (AD 1000 – 1400) maintained the utilisation of local resources.
Formative dentitions contrast strongly with later periods in their heavier wear pattern and much lower dental caries rates which presumably reflect far lower carbohydrate consumption. Tiwanaku dentitions nevertheless still show considerable wear, but this is associated with much more frequent caries rates, showing a strong gradient in relation to age. This pattern clearly suggests higher carbohydrate consumption, matching independent archaeological evidence of diet. Chiribaya dentitions are similar, but show somewhat lower caries rates which may reflect a move to more local resources. Periodontal conditions related to the adoption of coca chewing may also have had an effect.

Mother's milk energy shapes infant growth and behavioral development in rhesus macaques (*Macaca mulatta*).

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Maternal effects on infant phenotype are common in mammals and theses effects are likely mediated in part through the quantity and quality of milk that mothers provide during lactation. Among captive rhesus macaques, maternal condition influences lactational performance. In the present study mother's milk was associated with infant weight and growth as expected, but also predicted infant behavioral development. Here we present the first evidence for any mammal that natural variation in available milk energy (AME) from the mother was associated with later variation in infant behavior and temperament (N=59). In the early post-natal period, heavier mothers with more reproductive experience produced greater AME and their infants showed better coping behavior and greater confidence in a stressful setting later in infancy. These infants were characterized by trained observers as more confident, exploratory, curious, active, and playful than infants whose mothers produced low AME during the early post-natal period. This effect was independent of the AME their mothers produced at the time of behavioral assessment and multiple regression models controlled for maternal characteristics and infant weight, age, and sex. Our results suggest that milk energy available soon after birth may calibrate infant behavior to environmental or maternal conditions during a critical developmental period. These data provide new insight into potential mechanisms for the development of behavior and temperament and illuminate new directions for investigating maternal effects, nutritional programming, and developmental plasticity.

The Genetics of Morphology: The Primate Dentition.

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Charles Darwin first demonstrated that phenotypic variation, or more specifically heritable variation, is essential to the process of natural selection. Variation in the mammalian dentition is highly

informative of adaptations and evolutionary relationships, and consequently, a significant amount of research has explored genetic influences on the morphology of the primate dentition. In this talk we will summarize how quantitative genetics has contributed to our understanding of primate tooth morphology over the last century. We will then focus on our own research, a quantitative genetic analysis of dental variation in a captive, pedigreed breeding colony of baboons (*Papio hamadryas*) housed at the Southwest National Primate Research Center (SNPRC). We have analyzed over 200 dental traits in order to identify genetic interrelatedness and independence in the baboon dentition. Results from these analyses provide hypotheses about the genetics of dental variation in other primates -- the hypothesis that the genetic influences on the SNPRC baboon dentition are characteristic of those affecting other primates. These hypotheses are tested by comparing the SNPRC genetic correlation matrices with phenotypic correlation matrices derived from other primate taxa. While initial results demonstrate a strong similarity between SNPRC genetic architecture and phenotypic correlations within wild baboons, our expanded data sets the include *Cercopithecus*, *Colobus*, *Macaca*, and *Presbytis* provide more elaborate tests. These results provide insight to the differences and similarities in the evolutionary histories of these Old World monkeys.

Molecular divergence dates suggest an origin of crown primates near the K/T boundary.

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The divergence times of the most basal lineages within the order Primates remain controversial due to incomplete sampling of early fossil taxa. There are no crown primate fossils older than 55 Ma, however many molecule-based estimates place the origins of crown primates significantly older. The Deep Time Hypothesis (DTH) suggests that the most recent common ancestor (MRCA) of primates lived ~85 Ma, with the divergence of strepsirrhines, haplorrhines and anthropoids shortly after. Here we test the DTH using divergence dates estimated from complete mitochondrial genomes from all primate families except Lepilemuridae and including many major placental mammal lineages. To do so we have sequenced mitochondrial genomes from *Mirza coquereli*, *Otolemur crassicaudatus* and *Daubentonia madagascariensis* and added these to previously available sequences. Divergence times and evolutionary rates were estimated with Bayesian analyses that allow for variance in evolutionary rates among branches and uncertainty in fossil divergence estimates. In a comprehensive analysis involving multiple Bayesian analyses, we took an exploratory approach to calibrating evolutionary rates. Using the best available divergence estimates from fossils throughout and outside of primates, we estimate the MRCA of primates to have lived 68.9 Ma (95% BCI 63.2-76.8), the MRCA of haplorrhines to have lived 66.3 Ma (60.6-73.9), the MRCA of strepsirrhines to have lived 61.5 Ma (56.8-67.7) and the MRCA of anthropoids to have lived 43.8 Ma (40.3-47.6). We conclude that though the primate fossil record may eventually extend beyond Cretaceous/Tertiary boundary, it is unlikely to extend as deep as the Deep Time Hypothesis suggests.

Factors influencing maternal investment and infant survivorship in *Macaca mulatta*.

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A female's maternal strategies should depend upon her likelihood of conceiving and surviving until her offspring achieve independence. In an environment such as Cayo Santiago (CS), in which female rhesus macaques exist within strict social hierarchies, are susceptible to wounding and infections and may survive to advanced age, one can examine whether social status, health and age predict the intensity of maternal investment and likelihood of infant survival. Fifty years of demographic records on CS rhesus macaques indicate that interbirth interval (IBI) increases significantly from young adulthood (6-15 years) to middle adulthood (15-20 years) and from middle to late adulthood (>20 years), while the likelihood of a female's offspring surviving to reproductive age decreases sharply between young and middle adulthood. To determine whether intensity of maternal investment and maternal physical condition account for variation in IBI's and offspring survival, behavioral, morphometric, physiological and demographic data were collected from 40 CS mother-infant pairs between 6 and 22 years of age and representing low, middle and high dominance ranks. Behavioral measures of maternal investment included the amount of time mothers spent in physical contact with their infants and rates of restraint and rejection of infants. Plasma cortisol levels, plasma cytokine levels and body mass indices were analyzed to investigate relationships between overall health and maternal investment in offspring. Infant plasma cytokine levels and infant survival to one year were used to determine whether maternal condition and maternal behavior correlated with infant health.

Maturation of the temporal bone as non-neural constraint for speech perception: transformation of the speech signal during language development.

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Similarly to developmental sequencing in visual processing, this poster reports research on maturational events in the temporal bones that condition "training effects" driving the way people learn the sound systems of their ambient language(s). The pattern of a speech sound's acoustic features shifts over the years children are mapping linguistic sound systems; both individual speech sounds and their relationships to another in the map change as children's hearing approaches adult sensitivities. Learning effects form a hierarchy of perception based on auditory frequencies differentially accessible through development (ontogeny). Data were collected from adult native speakers of Diné and English and transformed with a model constructed from psychoacoustic research into children's hearing sensitivities at different ages. Vowels and vowel maps were compared, looking at how frequency information in vowels is filtered because of the immaturity of temporal bones at different developmental stages.

Data analysis demonstrates that developmental events in temporal bones contribute different structure to the acoustic waveform of vowels from the structure experienced by adults. The significance of children's less discriminant hearing is that they build interim maps of vowels systems whose dimensions and configuration depend partly on which vowels their hearing allows them to experience first and partly on what vowels are present in the ambient language(s). The relationships built up among these childhood structures have consequences for adult speech perception.

Given that immature temporal bones reflect brain expansion and rotational birth in hominids, these results contribute to the discussion of the biological underpinnings of the evolution of language.

Dental enamel increments reveal relationships to ecological factors in cebid primates.

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Over the last twenty years an increasing amount of research has focused upon dental increments as indicators of ontogeny, and has also examined tooth eruption as it relates to ecological and life history variables such as dietary consistency, timing of resource availability, environmental risk, and length of juvenile period. Not surprisingly, such eruption studies have shown that dietary factors play a major role governing the schedule of completion of the dental arcade. However, no studies have systematically attempted to seek out relationships between dental increments and such variables. This paper highlights a first attempt in this vein, using Cebidae (Primates, Platyrrhini) to explore the impact of such variables upon enamel growth.

In order to directly assess dental growth, this study draws its data from histological specimens, which were thin-sectioned, polished, and imaged with a transmitted light microscope using polarizing and phase contrast filters. Enamel secretion and extension rates – the two factors of enamel growth – were respectively estimated by measuring daily cross striations across teeth and by measuring the angles of enamel formation fronts seen in striae of Retzius. These rates were regressed against such variables as encephalization, interbirth interval, and age at first female breeding, which serve as proxies for such factors as foraging independence, environmental risk, and maternal investment. Results suggest that cebid primates schedule their enamel growth mostly according to environmental risk factors, and that maternal investment and foraging independence are minor influences.

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The effects of experimentally reduced facial dimensions on the growth of the nasal septum and premaxilla in *Sus scrofa*

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While the precise role of the nasal septum in the growth of the facial skeleton is unclear, numerous studies have underscored the importance of nasal-septal traction in normal facial development. Surgical resection of the nasal septum and/or vomer in various long-snouted animal models typically results in reduction in anterior-posterior facial growth. A primary concern of these studies, however, is that the surgical procedure itself, along with associated scar tissue and blood supply interruption, may partially account for facial length reduction. Recently, Franciscus et al. (2008) and Southard et al. (2006) experimentally reduced anterior-posterior facial growth in *Sus scrofa* via fixation of the zygomaxillary and frontonasomaxillary sutures resulting in a substantial reduction in facial length. This experimental procedure provides a unique opportunity to examine the role of the nasal septum in facial growth as facial length was reduced without alteration of the nasal septum itself. Two predictions follow from the nasal-septal traction model: 1) restriction of facial growth via sutural fixation should not affect nasal septum length; 2) restriction in maxillary growth, via zygomaxillary fixation, should result in some degree of compensatory premaxillary growth. We tested these predictions using the vomer as a proxy for nasal septum length. Our results indicate that in spite of facial growth restriction, there was no significant difference in vomer length ($P=0.9923$). Furthermore, the

premaxilla was significantly increased in the experimental group ($P<0.0025$). These results are consistent with the nasal-septal traction model and have direct implications for our understanding of facial reduction in human evolution.

A bad day at Brinkerhoff: protohistoric trauma and violence in northern Nevada.

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While conducting an ongoing survey of trauma related deaths in the Nevada State Museum Human Remains collection, a unique group of skeletons was observed. The "Brinkerhoff" series, named for the Brinkerhoff Ranch located in northern Nevada where the burials were uncovered in the mid-20th century, consists of a minimum of five individuals of mixed sex and age and in varying stages of completeness, all of which show evidence of perimortem trauma. The morphology of the victims is consistent with Native American ancestry. Radiocarbon dating tests were performed on each individual, with resulting dates overlapping at approximately 200 +/- 40 BP (uncalibrated). What distinguishes the Brinkerhoff sample from others in the northern Nevada record is that it is the only skeletal series where the individuals can clearly be treated as the victims of a single, violent incident. The individuals are varyingly represented by a single cervical vertebrae, several disarticulated skulls, and an almost complete set of postcranial bones. Perimortem injuries to the skeletons include blunt force trauma to the face and skull, multiple knife wounds to the torso and neck, projectile point punctures, and evidence of scalping. Several Desert Sidenotched projectile points and a chert knife were discovered with the remains. These were consistent with the wound patterns, and in several instances could be definitively matched with specific injuries on the victims. All evidence indicates that these individuals represent a violent incursion between indigenous people, an event not otherwise noted in the skeletal record of northern Nevada.

Osteochondrodysplasias in prehistory: new evidence from the V-VIth dynasty at Giza, Egypt.

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Errors in cartilage and bone development are rare but occur with sufficient frequency to have been documented in Upper Paleolithic to recent skeletons. Documenting the range of skeletal changes exhibited in these remains provides insights into the history of osteochondrodystrophies and, when combined with recent developments in genetics and physiology, the foundations from which to assess modifications to bone caused by specific genes and their products. To promote delineation of bone modifications associated with specific osteochondrodystrophies, we review available evidence and provide a comparative description of an undocumented skeleton.
A nearly complete dwarf skeleton was recovered from Tomb 2304 in the Western Cemetery at Giza and is associated with the Khufu pyramid. We compare data from these remains to those from the literature and a collection of skeletons from the same or nearby mastaba groups. Two prehistoric examples of achondroplasia were also examined. Standard methods were employed for data collection related to cranial size and shape, long bone sizes, and stature estimation. Craniometric data were assessed using principal components analysis. The Giza individual is a micromelic dwarf, having significantly reduced arms, legs, and feet in combination with a normal-sized head and torso. Assessment of the PCA demonstrates the overall similarity of the Giza skull to normal individuals and its relationship to the outlying achondroplastics. Osteoporosis and age-related changes complicate the observed pattern, which most likely documents skeletal changes associated with Multiple Epiphyseal Dysplasia or Pseudoachondroplasia. These conditions represent a developmental continuum differentiated by variation in *COMP* gene expression.

Palatal strain during cantilever bending: a case study of *Macaca fasicularis*.

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Idealized geometrical modeling is used as a tool in comparative analyses of complex structures. Although no such model will perfectly predict the behavior of complex structures such as the palate, they may be able to approximate relative strength in a comparative context. Strain experiments were conducted on an adult female *Macaca fascicularis* specimen to test alternative beam models, including trapezoid, thin tube, ellipse and a hollow ellipse. Four rosette strain gages were affixed to the surface of the palate at the levels of P^4 and M^2 on either side of the mid-palatal suture. Two additional rosette gages were bonded to the facial skeleton, on the right alveolar process superior to M^2, and the interorbital region. Single element gages were bonded across the transverse palatine suture. The palate was subjected to cantilever bending by loading the central incisors. Stress predictions were made using several beam formulas of different geometry. While no model showed complete agreement with observed strains, the best fit was a thin tube model. We ascribe generally poor performance of models to multiple factors including 1) presence of sutures, 2) effects of variable cross sections, and 3) accounting for elevated shear effects expected in short beams. If these various factors are taken into account, then the model would provide a better fit

for the palate in comparative analyses.

Paleoamericans in a Late Pleistocene context: assessing morphological affinities

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Recent consensus, supported by fossil, genetic and archaeological evidence, suggests that modern humans originated in sub-Saharan Africa and expanded northward to Europe and eastward into Asia between ca. 60-30 ky. Under this scenario, the morphological differentiation seen across human geographic populations today is recent and probably occurred during the Holocene.
Early American skeletons have a distinct and well described cranial morphological pattern from Late Holocene Americans. This has previously been proposed to indicate an early migration wave into the Americas, preceding colonization by Late Holocene American groups. If this interpretation is correct, Paleoamericans should show morphological similarities to earlier, generalized Late Pleistocene modern humans. Here we place Paleoamericans in the context of Late Pleistocene human variation, exploring their morphological affinities and testing for dispersal scenarios of recent human group. Our samples comprise a large set of Paleaomerican crania from South- and Mesoamerica, African and Eurasian Late Pleistocene specimens and Howell's worldwide series of modern humans. Twenty-four linear measurements, adjusted for size, were analyzed using Principal Components Analysis, Canonical Variates Analysis, Mahalanobis distances (D^2) and cluster analysis. Morphological distances among groups were also compared to distance models representing distinct dispersion scenarios, using Mantel correlation tests. Results show Paleoamerican samples grouping with Upper Paleolithic Eurasians and recent African groups. Furthermore, the best fitting dispersal scenario to the morphological distances is one that considers Paleoamericans as an early expansion into the Americas, preceding much of the current human geographic diversification.
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Gum's the word: applying knowledge from the wild to improve environmental enrichment for captive gummivores.

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Physical anthropologists that study the feeding behavior of wild primates report that many haplorhine and strepsirhine species consume the gum exuded from trees. These primates include, but are not limited to, the Lemuridae, Galagidae, Callitrichinae, and Cercopithecinae. Although gum plays varying degrees of importance in their diets, at least one species from each of these families and subfamilies is a gum specialist. Despite the prevalence of gum in wild diets, few data exist concerning gum feeding in captivity. This study evaluates whether or not the knowledge gained from wild studies is applied in captive environments.
Data were collected from 46 zoos in 12 countries via a web-based survey. The majority of responding zoos provide gum-based enrichment to marmosets (*Callimico*, *Callithrix*, and *Cebuella*- 83%), but only half provide gum to tamarins (*Leontopithecus* and *Saguinus*- 50%) and galagos (*Galago* and *Otolemur*- 50%). No zoos report feeding gum to baboons (*Papio* spp.), vervet monkeys (*Chlorocebus aethiops*), or patas monkeys (*Erythrocebus patas*).
Environmental enrichment that promotes naturalistic behavior enhances the psychological wellbeing of animals, thus gum feeding is likely to be important to the welfare of captive gummivores. This study shows that the needs of captive cercopithecines are not being met, particularly in the case of the patas monkey, an obligate gummivore. Practical application of ecological data in captive contexts is just one way physical anthropologists can contribute to the conservation and welfare of some of our closest living relatives.

Determining the effects of preparatory methods when observing cementum layering: exploration of techniques and microscopy.

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The investigation of dental cementum layering among adult humans incorporates a wide range of research. The lack of standardized preparation techniques creates confusion in comparing results of research and understanding the aging accuracy of cementum layers. This research focuses on the preparation method and types of microscopy to investigate the representation of cementum increments.
Three adult individuals of unknown age were used from The Museum of London archaeological collection. Individuals were aged through standard skeletal aging methods. Three teeth were taken from each individual for a total of nine teeth. Each specimen was embedded in methylmethacrylate, sectioned longitudinally in block and thin sections, and polished. The block sections were observed under

scanning electron microscopy (SEM). The thin sections were polished progressively from 400, 300, 200, and 100 µm then viewed under transmitted light microscopy. A definition of a cementum layer was defined and layers were recorded from digital images. The eruption age of the tooth was totalled with the averaged counted layers to calculate an age.
Results indicated that cementum layers were not observed in all specimens. Depending on the area of the root that is focused on (cervical, middle, apical), a different age is determined. Cement increments were not observed under SEM. Preparation technique, preservation of cement, quality of image, and microscopy are factors that affect the observability of cement layering. Wide ranges of age estimates were recorded in each of the individuals analyzed suggesting that preparation methods may have an impact on the ability to observe these structures.

Tail length and the sacral index in living and subfossil Malagasy prosimians.

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Tail length varies in living Malagasy prosimians from long (e.g., *Lemur catta*) to short (e.g., *Indri indri*). The dimensions of the sacral canal are correlated with tail length in some primates (Ankel 1965, 1972). The "sacral index" is the ratio of the size of the sacral hiatus to the size of the cranial opening of the sacral canal; it is large when the tail is long and small when the tail is short/absent. Here we compare the sacral index in living lemurs, lorises and macaques to relative tail length (tail length as a percentage of body length). We then examine the sacral index in a sample of giant extinct lemurs in order to assess relative tail length in categorical terms (absent or vestigial, medium, or long).

Across our entire extant sample, the rank order correlation (rho) between sacral index and relative tail length is 0.9 ($p<0.05$) at the family level and 0.83 ($p<0.001$) at the species level. Rho is also positive and significant for prosimians alone ($p<0.001$), Malagasy prosimians only ($p<0.05$), indriids only ($p<0.01$), and macaques only ($p<0.05$). Among the large-bodied subfossil lemurs, the sacral index suggests that *Pachylemur*, *Archaeolemur* and *Hadropithecus* possessed relatively long tails. Caudal vertebrae are known for these quadrupedal taxa and serve to corroborate our inferences. We reconstruct the tail of *Palaeopropithecus*, a highly suspensory sloth lemur, as vestigial. We believe that these results are promising and will extend our analysis to other extinct species, including *Babakotia* and *Megaladapis*, for which sacra are also known.

Aggression, risk sensitivity, and orbitofrontal cortex volume in the genus *Pan.*

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The orbitofrontal cortex (OFC) is believed to help modulate primate behavior by assessing reward value (medial OFC) and negative consequences (lateral OFC). In humans these areas are sexually dimorphic; lateral OFC tends to be relatively larger in women while medial OFC tends to be larger in men. This suggests sex differences in aggressive behaviors may be partly due to men having more cortex for recognizing (and biasing them towards) rewards and simple reinforcers while women have relatively more tissue devoted to considerations of risk. Because chimpanzees display greater sex differences in risky/aggressive behaviors than do bonobos, we should expect greater OFC dimorphism in the chimpanzee brain. Region-of-Interest techniques were used to measure the lateral and medial OFC in 12 chimpanzee and bonobo MRIs. Male chimpanzees have larger medial than lateral OFC volumes while female chimpanzees and both male and female bonobos have the reverse pattern, consistent with observed behavioral differences. This research was supported by a graduate fellowship from Indiana University's Center for the Integrated Study of Animal Behavior.

Sex and ancestry determination using the human orbital aperture.

P.R. Husmann, D.R. Samson. Anthropology Department, Medical Sciences Department, Indiana University.

Since Broca's index was first devised, anthropologists have been using the orbit to assess sex and ancestry, yet a method that quantifies the complete shape has not been established. Krogman (among others) created a subjective assessment, but this left many researchers desiring a more exact approach. This study compares the orbital index with a geometric morphometric technique of digital quantification by measuring the angles between two hundred points placed around the circumference of the orbit. We applied outlines to the orbital aperture of digital images of 763 orbits from African-Americans and European-Americans in the Hamann-Todd Collection. The angles were then calculated and Procrustes analysis completed before MANOVA tests were performed for significance values. This procedure allows shape to be more fully assessed than just the proportions that the index measures without the confounding factor of size. We test the hypothesis that there is a significant difference in orbit shape between the ancestries and between males and females using both the orbital index and the geometric morphometric technique. Both techniques supported the hypotheses at the $p<.01$ level; however, further analysis demonstrated concerns. The

geometric morphometric assessment determined that roughly one percent of the variation in orbital aperture morphology can be attributed to ancestry and another one percent to sex. This is far from adequate variation explained to justify use of this feature in ancestry or sex determination. It does, however, demonstrate the strength of full shape analysis using geometric morphometric techniques as equal with, and frequently more useful than, proportional indices.

The functional significance of canine height reduction in early hominins.

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The evolutionary significance of canine reduction in the earliest hominins is an importantly debated issue. Recently, Hylander and Vinyard (2006) hypothesized a functional link between canine height and jaw gape in living catarrhines. This presentation reports on a much larger sample of gape data (over 600 primates) and discusses their implications for the evolution of canine height reduction in the earliest hominins.

Relative to mandibular length, most male catarrhines have larger relative gape than do females. This indicates that most males and females differ in certain aspects of their jaw mechanics. For example, most males rotate their condyles more than do females, and therefore most females have more rostrally positioned jaw-closing muscles, or more likely, relatively shorter muscle fibers. Exceptions are hylobatids and humans in that they exhibit no dimorphism in relative gape and canine height. Also, the data indicate there are interspecific differences in relative gape, e.g., some macaque species have much larger relative gape than do other macaques. Moreover, apes generally have less relative gape than do cercopithecids, but more so than humans. Finally, those catarrhines with relatively smaller (or larger) gapes have relatively shorter (or longer) canine heights, respectively.

Important costs and benefits are linked to canine height reduction. Reduced canine height is linked to decreased gape, and this is in turn is linked to shorter jaw-muscle fibers and/or more rostrally-positioned jaw muscles. Therefore, catarrhine canine height reduction is linked to an ability to generate larger bite forces with no necessary increase in jaw-muscle size.

The significance of systematic sampling in paleoenvironmental reconstruction: A case from Koobi Fora, Kenya.

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Faunal collections from the Koobi Fora region documented in the Turkana database have had great value in paleoenvironmental reconstruction. However, these collections were done with objectives other than environmental reconstruction and thus, do not give a plausible picture of the paleoenvironment. In recent years, researchers have applied systematic sampling when collecting faunal remains from this region to understand the paleoenviroment. We aim to expose the sampling biases encountered in the Turkana database using materials from area 1A. We re-examined the data from Koobi Fora, area 1A extracted from the Turkana database and compared it to the results of one of the studies that used systematic survey to reconstruct the paleoenvironment of Koobi Fora, area 1A. Our results show that there is a pattern where some families tend to be highly represented and others not represented at all in both databases. For example, the family Bovidae forms 52% of the entire population in the Turkana database, while it makes 27% in the systematic sampling data. Fish, Turtles, and Crocodiles are not represented in the Turkana database while in the systematic sampling data they make up 11%, 3%, and 8% respectively. This implies that, data from the museums need to be combined with systematic sampling data in order to have a plausible paleoenvironmental reconstruction. In sites where collection has never been done before, systematic sampling would be the best methodology to apply in paleoenvironmental reconstruction strategies because it captures the diversity and density of fauna in the site.

Short stature among contemporary populations of highland Indonesia.

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In light of the recent findings of small-bodied hominins at the site of Liang Bua, much attention has focused on the range of variation in body size among modern indigenous populations of Indonesia. Previous studies of adult body size among rural Indonesian populations has found small stature and low body mass to be quite common, with mean adults heights ranging from 141 to 150 cm in women, and from 156 to 158 cm in men (Bailey 1962. *Trop Geogr Med* 14:11; Kusin, et al. 1979.*Trop Geogr Med* 31:571; Altena and Voorhoeve 1996. *PNG Med J* 39:23; Dounias et al. 2007. *Food Nutr Bull* 28:S294.) This study examines variation in stature, body mass, and body proportions among adults of the highland Wonosobo region of Indonesia. Adult body size is among the smallest documented for contemporary

Indonesian groups. We found extreme cases of small stature, with the three shortest individuals having heights of: 77, 89.7, and 115 cm, with all of these individuals being descendants of consanguineous marriage. Further endocronological study will be conducted to shed light the occurrence of short stature people in highland Indonesia.

Infant development and the use of gestures in a captive group of white-cheeked gibbons (*Nomascus leucogenys*).

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Vocalizations, especially long-distance calls and duets, have been the primary focus of communication studies with gibbons. Less well known has been the extent to which gibbons utilize gestures in their communicative repertoire. Being highly arboreal, close inter-individual interactions are very difficult to observe in the wild. This makes captive studies a good opportunity to complement field research and further our understanding of gibbon communicative behavior. Since the summer of 2006, observations have been conducted on the use of gestures in a group of white-cheeked gibbons at the Roger Williams Zoo in Providence, RI. The group consists of one adult male, one adult female, and one immature female. Based on these observations, it is clear that gibbons utilize a variety of gestures, including facial expressions, body postures, and hand/arm movements. An examination of the ontogeny of gestural use by the immature female during the research period shows a clear pattern of development, with increasing use and complexity of gestures over time. Initially gestures were predominantly towards the mother, consisting of contact and nursing initiation. With increased independence from the mother, interaction with the father increased. Play gestures were most frequently utilized with him. As independence further increased, especially during locomotion, the female began using more gestures with both parents. In all contexts, the immature individual was initially the recipient of gestures from her parents prior to beginning to use gestures of her own. As with great apes, gesture use was especially prominent for synchronizing behavior – especially contact, travel and play.

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Among the enemy: Dental affinities of the C-Group Nubians at Hierakonpolis, Egypt.

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Around 2050 BC some 'foreigners' moved to a city in a powerful enemy's territory. Their descendants then lived there, autonomously, for >400 years. Today, they are known as C-Group Nubians, their enemy as Middle Kingdom Egyptians, and the city as Hierakonpolis. The latter, 113 km north of Aswan, is known today for its Egyptian sites, but also contains a C-Group cemetery documenting the northernmost, long-term occurrence of this culture. Sixty skeletons were excavated. Tombs feature Nubian architecture and goods, including leather garments, though the use of Egyptian mortuary practices and artifacts increases through time. Dates range from the early 11th Dynasty into the Second Intermediate period. During this period Egyptians occupied Lower Nubia, and their state ideology vilified Nubians. Yet, at least in death, the C-Group inhabitants of Hierakonpolis proudly displayed their cultural heritage.

Beyond discerning their *raison d'etre* (e.g., mercenaries, leather-workers, or entertainers whose ethnically-attributed skills benefitted from a Nubian identity?), a focus of study is to estimate biological affinity. Were they akin to other C-Group Nubians, Egyptians, or both? Specifically, was increasing Egyptian influence in the cemetery – which may be a microcosm of Nubia's New Kingdom 'Egyptianization' – cultural, or biocultural? To find out, 36 dental traits were compared to those in 25 regional comparative samples. The most influential traits were identified, and phenetic affinities were calculated using the Mahalanobis D^2 statistic for non-metric traits. Assuming phenetic similarity provides an estimate of genetic relatedness, these affinities indicate that the Hierakonpolis C-Group is Nubian, though some Egyptian admixture is possible.

Funding for excavation in 2007 was provided by National Geographic Society and Wenner-Gren Foundation grants to the author, and the Hierakonpolis Expedition. Comparative data were collected under grants from the National Science Foundation, Institute for Bioarchaeology, ASU Research Development Program, and American Museum of Natural History.

Ecosystem in decay: Factors influencing primate species extinctions in forest fragments of Tsinjoarivo, Madagascar.

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Habitat fragmentation is thought to be one of the major threats faced by primate populations today. The proximate threats, acting on various timescales, that can cause extirpations in fragments include "edge effects" (e.g. temperature/humidity), altered food resources, disruption of dispersal possibilities, and (sometimes) human hunting. We investigated the effects of forest fragmentation on primate populations within 27 forest fragments at Tsinjoarivo, eastern Madagascar. For each fragment, we: (1) performed 17-72 diurnal census walks and 9-36 nocturnal walks (total: 305 km diurnal, 155 km nocturnal), (2) botanically assessed 0.1–1.0 ha of

habitat (total: 61 ha), and (3) assessed fragment size and shape characteristics using GIS. Two primate species were extirpated, while seven were found in the region (for five there were reliable data for incidence analyses: *Propithecus diadema*, *Hapalemur griseus*, *Avahi laniger*, *Lepilemur mustelinus*, *Microcebus rufus*). Species richness declines primarily with fragment area; other fragment characteristics did not explain much of the remaining variation. Extinctions were not random, but highly nested; some species were highly tolerant of fragmentation (*Hapalemur*, *Avahi*, and *Lepilemur*), some were intermediate (*Propithecus*, *Microcebus*) and others highly intolerant (*Eulemur fulvus*, *E. rubriventer*). Analyses of occurrence data for individual species suggest species respond differently to decreasing fragment size; in general, percentage fruit in the diet and body size are the most important predictors of fragmentation intolerance. These results suggest that for this region, fragmentation decreases local primate diversity by selectively extirpating larger and more frugivorous lemurs; ecological study is necessary to elucidate the proximate causes of these extirpations.

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Craniometric divergence of Japanese inhabitants due to gene flows from Prehistoric Northeast Asians.

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The Japan and Sakhalin Islands are situated east of the Asian Continent on the western rims of the circum-Pacific region. The rice-farming Yayoi people migrated from the East Asia Continent, possibly via the Korean Peninsula, to mainland Japan between 2,300 and 1,500 BP and people of the Okhotsk culture from northeastern Asia came to the Sakhalin and Hokkaido Islands between the 5th and 12th centuries AD. In this study, we investigated the phylogenetic relationship between the Japan Islanders and northeast Asians of prehistoric and historic ages using the R-matrix method based on the average heritability rate (h^2) = 0.55 using a sufficient number of female and male craniometric data, including new Okhotsk data. We also evaluated the phenotypic variation among the prehistoric and historic Japanese Islanders.

Prehistoric samples generally show an observed variance greater than the expected variance. For example, there is greater observed variation than expected variation in the Okhotsk series, whereas the recent Ainu series indicate less than expected variation, or less genetic variability. The multidimensional scaling of distances transformed from the R-matrix indicates that the Jomon, the prehistoric hunter-gathering inhabitants of the Japan Islands (10,000 to 2,300 BP), comprise the outlier. The two immigrant groups comprising the Yayoi included the eastern Asian cluster and separate Okhotsk series brought considerable phenotypic variation to the subsequent historic Japanese Islanders, suggesting that human migrations from the north or east had a significant influence upon Japanese population history.

Examining functional interpretations of variation in African ape hand and foot bone morphology.

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Many features of the hand and foot have been proposed to reflect differences among hominoids in patterns of positional behavior. If consistent relationships could be found between variation in these features and variation in degrees of arboreality and terrestriality, it would provide a powerful tool for the ecological interpretation of variation in fossil hominoid morphology. Among African apes, ecological contrasts between *Pan* and *Gorilla* and between *G. gorilla gorilla* and *G. beringei beringei* provide an opportunity to look for such relationships. Studies have found that *Pan* and *G.g. gorilla* engage in more arboreal climbing/suspension and more terrestrial knuckle-walking than *Gorilla* and *G.b. beringei*, respectively. This leads to the prediction that *Pan* and *G.g. gorilla* will show greater expression of features associated with these positional behaviors.

Thirty-two linear measurements of hand and foot bones were collected from *Gorilla* (n=221) and *Pan* (n=227) specimens. Twenty-two ratios were calculated. Comparisons of means demonstrate many significant differences between *Pan* and *Gorilla* and between *G.g. gorilla* and *G.b. beringei*, but only four ratios vary in the direction predicted in both pairwise comparisons. These ratios are associated with the metacarpophalangeal joint and the calcaneus. Most of the hand and foot ratios in this study appear unreliable as universal indicators of frequencies of arboreal and terrestrial positional behaviors among African apes. Until further studies identify variables that consistently track differences in patterns of arboreality and terrestriality, caution should be exercised in making functional interpretations of differences between fossil hominoid specimens in hand and foot bone morphology.

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A framework for understanding thermoregulation in primates.

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Thermoregulation has not been considered in most studies of primate behavior and ecology, yet it is fundamental to understanding primate adaptations and patterns of sociality. Understanding thermoregulation involves consideration of variables relating to the animal and its thermal environment. These include the animal's shape, skin color, density and color of its hair/fur, absorptivity of its surface, insulative properties of its integument, and its postures. Parameters of the thermal environment include insolation, air temperature, wind speed, and humidity.
The behavior and sociality of ringtailed lemurs (*Lemur catta*) are strongly affected by thermoregulatory considerations. In southern Madagascar, *L. catta* lives in a desert-like environment and experiences considerable diurnal and seasonal variation in its physical conditions. The animals regulate thermal loads by postural thermoregulation, huddling, and varying levels of heat-producing activity throughout the day and night. Ringtailed lemurs are known for their specialized sunning behavior. Deeply melaninized skin and light-colored hair on their ventral surfaces maximize heat gain and minimize radiative heat loss. We describe the timing, duration, and location of sunning, and of other potential thermoregulatory behaviors in a wild population. We show that ringtailed lemurs respond to variations in temperature, solar radiation, rainfall, and wind by altering their behavior and microhabitat. The pattern of skin and hair coloration seen in ringtailed lemurs is found in many mammals and is generalized to the whole body in many arctic mammals. Investigations of primate activity budgets and grouping behaviors would benefit from studies of the colors and thermal properties of the animals' integument.

Using the patellae for sex identification of human skeletal remains in a pilot study.

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Determination of sex is an important contribution to assessing human skeletal remains in both forensic investigations and in archeological settings. The patellae may prove to be useful in sexing human skeletal remains since they are thick, triangular bones which may remain relatively undisturbed in harsh environments. In this pilot study, six measurements were taken from patellae using a sample population of 14 contemporary cadavers from the eastern United States in order to assess sexual dimorphism. The maximum patellar height (base to apex), the maximum patellar width, the maximum height of the surface for articulation with the femur (articular surface), and the maximum width of the articular surface were each measured using sliding digital calipers accurate to the nearest 0.01mm. Additionally, a shape ratio was created for the patella (height/width) and the articular surface of the patella (height/width). Means were compared between sexes using Student's independent t-tests and all differences were considered statistically significant if $p<0.05$. Males were significantly larger than females in the average maximum height and width of the patella, height of the articular surface, width of the articular surface, and in the shape ratio of the articular surface but not for the overall patellar shape ratio. These results are in agreement with previous studies that used patellae from both contemporary and older populations. With these promising results, further studies with a larger sample size should be investigated so the use of these methods can be used in forensic anthropology cases

Sharing among captive chimpanzees and bonobos: Reciprocity and altruism.

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Even though sharing food is costly to the owner, it is a human universal and has been reported in over 40 primate species, including our closest living relatives, chimpanzees and bonobos. To investigate the mechanisms underlying food transfers between adults of the latter two species, we used experiments with monopolizable food sources (n=30 and 70 respectively) in two well established groups, containing adults of both sexes. Based on roughly 1000 recorded interactions in each species, we found that both shared food reciprocally, as well as in return for other favors such as grooming and agonistic support, especially within highly-affiliated dyads. Furthermore, there was evidence for contingent reciprocity as food was shared more after previous grooming and sharing was rewarded by subsequent grooming. We found no evidence for indirect reciprocity, as food owners were not groomed more by 3rd parties after sharing generously. We found that chimpanzees shared food more readily and sometimes actively gave food whereas bonobos seemed less tolerant and more often took food by force. Bonobos also used more tension-reduction mechanisms such as grooming and sex in the presence of food, but direct exchange of food for sex was relatively rare (bonobos) or absent (chimpanzees). These results give further support to the hypothesis that a system of reciprocal exchange is well established among primates and may be cognitively most advanced in our closest relatives.

Growth and estimated skeletal height of Mochica juveniles, Peru (A.D. 900- 1750).

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When attempting to reconstruct the health status of non-adults, growth data and stature estimates for children provide useful information about the dynamic interaction of a population with its environment and the biological and cultural strategies of past human populations. The study of juveniles is critical in understanding this environment-population interaction because the growth and development period of human life at the earliest stages is the most sensitive to environmental insults. Growth patterns of archaeological or modern populations are best assessed using inter-population seriation. Our purpose was to develop internally-consistent growth curves of an archaeological population and compare these growth patterns to published skeletal data. Maximum diaphyseal lengths of unfused femora and tibiae were plotted with the combined dental and skeletal ages of 108 Pre- and Post-contact Mochica juveniles from Lambayeque Valley, Peru (A.D. 900-1750). All measurements were taken by GJJ. Internally-consistent, population-independent equations for growth curves and velocity plots were produced in SAS 9.1. We compared the growth curves of the Mochica juveniles to those generated using juveniles from four prehistoric Ohio Valley populations. The Mochica juveniles show similar growth curves and velocity to the Ohio Valley juveniles. Mortality biases are the likely source of this similarity; the youngest individuals succumbing to disease and the adolescents to trauma. Our results indicated that comparison of stature across populations can and should be done using standardized, internally consistent data.This research was supported by the Wenner-Gren Foundation for Anthropological Research dissertation fieldwork grant awarded to Haagen Klaus (The Ohio State University, Department of Anthropology) (GR 7302).

The time of blood pressure measurement influences the effects of age on blood pressure.

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Diurnal studies of blood pressure (BP) variation clearly show that there are substantial differences in BP depending upon the time of day when it is measured. This difference may be due to both environmental factors and an intrinsic circadian rhythm. Little is known, however, about the impact of time of measurement on the relationship between standard risk factors and BP. The purpose of this study was to assess the effect of time of measurement on the age-BP relationship in 68 healthy women (age=32.5± 8.1) who wore an ambulatory BP monitor over the course of one day. BPs were measured 4 times per hour from 9 AM to 10 PM and twice hourly from 10 PM to 6 AM the next day. Average BPs were calculated for each hour. To evaluate the effects of time of day on the age-BP relationship, the average mean arterial BP were compared across 3 age groups (20's, 30's, 40's) for each hour of measurement using MANOVA and follow-up ANOVA. The results indicate that age showed a statistically significant ($p<.05$) relationship for only 9 of the 22 hours. Furthermore, the R-Squared (proportion of variance explained) for age in the hourly models ranged from .005 (.5%) to .199 (19.9%), indicating that the size of the age effect varied as well. These data suggest that the determination of an age effect and its relative importance on BP may depend upon the time of day when the BP is measured.
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Contextual dimensions of European health and lifestyle: the archaeological and historical record.

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By themselves, skeletal remains tell us little about the health history of humans and its determinants; although they can bear the signs of disease, its interpretation has its own methodological difficulties. Contextual information about the natural and sociocultural environments people inhabited is necessary to draw meaningful conclusions about how these impacted on health. Global History of Health Project members have selected the European sites currently under analysis in order to maximize the quality of both the skeletal and available contextual information. Project members are using data on the socio-cultural context of the burials being studied from archaeological evidence and historical documents. Studies of these European data provide a unique opportunity to explore correlations between health and socio-cultural context. We also plan to refine the chronological framework for analysis through the selective use of radiocarbon dating. We are making extensive use of Geographic Information Systems databases from a variety of sources to reconstruct the ecosystems inhabited by the people whose remains are being studied. These databases contain information pertaining to climatic variation and key variables of socio-economic importance such as growing season length, patterns of annual precipitation, water availability, local topographical relief, and so on. We have found that a considerable proportion (48%) of the variance in estimated adult height (a parameter that has been shown to be an excellent summary of quality of life index) can be explained by a simple multiple regression model that incorporates such local ecological variables. Our goal is not to use such environmental data to create deterministic models. Instead, we are using deviations from the predictions they produce to identify the socio-cultural factors that are the key determinants of the health history of the European population.

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Upper Paleolithic human remains from Šandalja Cave, Istria, Croatia.

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Excavations at Šandalja Cave during the 1960's yielded thirty-seven human skeletal fragments from the middle portion of the c. 12,300 BP Epigravettian "B" level. Very few human remains of this age are known from south-central Europe, and, thus, the Šandalja sample has the potential to inform us about the biology of the last Ice Age peoples of this region. Although a preliminary description of many of the specimens was published in 1972, a more thorough treatment of these remains is warranted. The present work offers a detailed descriptive and comparative analysis of all of the remains. The project addresses the taphonomy and demographics of the sample. Furthermore, issues of how terminal Pleistocene south-Central Europeans are related to and how they may have been adaptively different from earlier and later peoples are addressed through analyses of Upper Paleolithic, Mesolithic, and more recent comparative samples. Taphonomically, the Šandalja remains are very fragmentary and are unlikely to have been from burials. Demographically, the sample represents at least two adult individuals, with at least one female. Comparatively, the Šandalja remains are notable for their gracility. Sizes of seven of the eight teeth fall significantly below Upper Paleolithic and Mesolithic averages. The one supraorbital specimen exhibits browridge metrics well below Upper Paleolithic and Neolithic averages, and the shape of the browridge as well as its size is more similar to that seen in recent Europeans.

Association between fracture patterns, healing and locomotor tendencies in nonhuman primates: implications for the origins of human health.

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The presence of well-healed fractures has been used to suggest the availability of medical treatment in archaeological populations. However, assertions of medical intervention remain tentative since systematic examinations of skeletal assemblages with naturally healing fractures are few. Obtaining baseline data on fracture healing in nonhuman primates can aid in

developing more accurate assessments of medical availability in human assemblages. In this study, we present preliminary data on fracture patterns and healing among several primate species encompassing a spectrum of locomotor tendencies. We hypothesize that fractures are more prevalent and heal more extensively in primates engaged in more acrobatic locomotion.
Using macroscopic and radiographic techniques, we examined 354 primates (240 of which were nonhuman apes) encompassing 55 species from the Hamann-Todd Collection housed at the Cleveland Museum of Natural History. Results indicate that lower limb fractures generally are rare in all apes except gorillas. Gibbons, arboreal brachiators, suffer predominantly humeral fractures that tend to heal well, whereas the humerii of the terrestrial quadrupedal gorillas heal poorly. Chimp ulnae heal well, regardless of whether the radius also is fractured, whereas the human ulnae examined tend to heal poorly when the radius is affected. The majority of baboons examined possess at least one fracture, possibly due to intergroup conflict or falls during arboreal locomotion. Fractures are rare in orangutans, the most arboreal of the great apes. Based on these initial results, we conclude that locomotor differences across primate taxa are reflected in the nature and distribution of fracture prevalence and healing.

Masticatory loading, function and plasticity of the mammalian circumorbital region.

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In contrast to experimental evidence regarding the bony postorbital bar, postorbital septum and browridge, there are no data on the functional role of masticatory forces on soft-tissue structures of the mammalian circumorbital region. This hinders our understanding of pronounced transformations during primate origins, in which the first primates evolved a postorbital bar from an ancestor with the primitive mammalian condition where only soft tissues span the lateral orbital margin between frontal and zygomatic bones.
To address this gap, we investigated the postorbital microanatomy of rabbits subjected to diet-induced variation in masticatory stresses. Rabbits exhibit a masticatory complex and feeding behaviors like primates, yet retain a more primitive circumorbital region. Three cohorts were obtained as weanlings and raised on different diets until adult. Following euthanasia, postorbital soft tissues were dissected away, fixed and decalcified. Such fibrocartilaginous tissues were divided into inferior, medial and superior units, and then dehydrated, embedded and sectioned. H&E was employed to characterize overall architecture. Collagen orientation and complexity was evaluated via Picrosirius-red staining. Safranin-O identified proteoglycan content, with additional immunostaining performed to assess type II collagen expression.
Increased masticatory forces due to a hard/tough diet are correlated with a more complex multidirectional organization of collagen fibers in postorbital fibrocartilage. Therefore, circumorbital soft tissues are responsive to variation in masticatory loads. However, the lack of marked changes in the extracellular composition of the lateral orbital wall related to tissue viscoelasticity suggests it is unlikely that long-term exposure to elevated stresses underlies the development of a bony postorbital bar.

Clarifying tibial torsion in the Dmanisi tibiae in comparison to African apes and modern humans.

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Tibial torsion is defined as twisting of the tibia on its longitudinal axis, which produces a change in alignment of the planes of motion of the proximal and distal articulations. According to which plane of motion is parallel, two types of rotational deviation are possible: internal torsion is present when rotation is in the direction of the medial malleolus and external torsion is present when it is in the direction of the lateral malleolus. For recording purposes, neutral position was defined as zero (0) degrees, internal torsion in minus (-) degrees, and external rotation in plus (+) degrees.
Comparative data on tibial torsion was acquired on African apes and modern human samples. Torsion was defined as the angle between vectors in transverse planes of the proximal and distal articulations using four landmarks. Preliminary results indicate considerable variation exists within groups. African apes are distinguished by medial torsion (negative), while modern humans are distinguished by lateral torsion (positive). The Dmanisi tibia (D3901) exhibits -0.9 – 2.1 degrees of torsion, which is more comparable to the lower end of variation in African apes, and clearly shows slight medial torsion. Experimental studies of primate locomotion have shown that the evolution of bipedalism, which separates humans from other living primates, is complex and is likely a result of a complex series of transitions. The Dmanisi material is well-situated to shed light on these transitions.

Reproduction and lifespan: trade-offs, overall energy budgets, intergenerational costs and costs neglected by research.

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In human females allocation of resources to support reproduction may cause insufficient supply to other metabolic functions, resulting in a compromised physiology and metabolism, and, in the long run, increased risks of diseases and reduced lifespan. While many studies on both historical and contemporary populations show that women with a large number of children indeed have shorter lifespans, this relationship is far from universal: a lack of correlation between fertility and lifespan, or even an increased lifespan of women with high fertility have also been documented.

Reduced lifespan in women with high fertility may be undetectable due to methodological weaknesses of research or it may be truly absent, and its absence may be explained from biological principles. I will discuss the following reasons for a lack of the negative relationship, documented in some demographic studies, between the number of children and lifespan in women: 1. Number of children is only a proxy of total costs of reproduction and, cost of breastfeeding is often higher than pregnancy cost, but is often unaccounted for. 2. Costs of reproduction can be interpreted in a meaningful way only when they are compared to the overall energy budget of a woman. 3. Trade-offs between risks of different diseases due to reproduction yield different mortality predictions depending on the socio-economic status of the studied populations. 4. Costs of reproduction are related not only to having children, but also to having grandchildren. Intergenerational costs should be included in analysis of trade-offs between costs of reproduction and longevity.

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Skeletal indicators of conflict-zone populations: a bioarcheological study in Medieval Britain.

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The objective of this study is to create a macroscopic osteological and palaeopathological description of conflict-zone health which can be observed in archaeological skeletal populations. Recent studies in anthropology, history, and medicine suggest psychological and nutritional stresses caused by living in a region of socio-political conflict is associated with nutritional deficiencies, increased mortality rates, and decreased general health of local residents. Similar trends are hypothesized to be demonstrable in archaeological populations.

The hypothesis is tested by comparing the demographic and palaeopathological profiles of Medieval (ca. 900 – 1600 AD) skeletons from northern English and southern Scottish border populations. Contemporary historical documents suggest populations living close to this troubled border during the Medieval period directly experienced socio-political instability, while neighboring populations did not. Data used in this study was macroscopically collected from both conflict-zone and neighboring skeletal samples and included estimated age at death, sex, stature, body mass, dental disease, indicators of non-specific infections, and nutritional deficiencies.

Results of this direct comparison show differences in palaeopathological profiles between conflict-zone populations and their contemporary neighbors. Similar demographic profiles were observed between samples throughout the time-period. However, differences in infection and childhood nutritional deficiencies increased through time. These data suggest populations must be exposed to acute socio-political stress during their skeletal development, or chronically during their adult life, to be detected in the archaeological record. This study highlights the need for multidisciplinary approaches to the analysis of human skeletal remains to fully describe the possible experiences of past populations.

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Differential diagnosis of brucellosis from vertebral lesions at Butrint, Albania.

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Nine individuals from the site of Butrint, Albania display multiple cavitating lytic lesions on the anterior surface of the centra in the thoracic and lumbar vertebrae. The individuals date from the Late Roman (5-7th centuries) to the Medieval period (12-13th century). They include three males aged 15-20 years, three females ranging from 15-35 years, and three unsexed subadults aged from 9-14 years. Two of the individuals were selected for molecular analysis at the Michigan State University Forensic Biology Laboratory to determine if the lesions might be pathogenic in origin. The lesions from both individuals tested positive for *Brucella* (Mutolo 2006). The similarity of the lesions in all nine individuals suggests all suffered from brucellosis, as such lesions are the most common skeletal pathology in cases of brucellosis. Further, most of the individuals displayed porosity on the parietal surface of the ribs. One individual displayed visceral rib porosity similar to the brucellosis cases reported by Capasso (1999) from Herculaneum. Unpasteurized dairy products are a major source of *Brucella* infection, and are common constituents of a Mediterranean diet. Regular exposure to infected

livestock can also result in infection. Written sources from the Roman and Medieval periods indicate that adolescents were frequently assigned duties as animal caretakers and agricultural workers. The temporal distribution of the nine individuals displaying the vertebral lesions from Butrint suggests that brucellosis has been endemic since the Roman period due to diet and/or exposure to infected livestock.

Hominoid gene duplications in hominin evolution.

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Single nucleotide substitutions in existing protein-coding regions of genes are clearly insufficient to explaining the behavioral, physiological, and morphological adaptations seen in hominoids, and especially those unique to humans. Gene duplications provide an additional potential source of novel genes and function. The recent availability of several hominoid genome sequences provides a new opportunity to characterize gene duplications that have occurred not only in the human lineage, but at various times throughout hominoid evolution.
With the goal of identifying candidate gene duplications in hominoids that may have played a role in human evolution, we started with known human genes (18,558 unique RefSeq protein-coding genes), and BLASTed all against all. Results were filtered based on sequence coverage (> 80% of coding sequence), identity (K_s<0.12, based on a large scale comparison of human-macaque orthologs), and phylogenetic position. Of the 646 gene duplications remaining, we focus here on those outside of segmental duplications and human-specific copy number variant arrays. With existing genome assemblies, we estimated rates of sequence evolution of protein-coding regions as well as upstream putative promoters.
Pairwise K_a/K_s estimates between human paralogs indicate a relatively high rate of amino acid substitution following gene duplication (median≈0.6), with some of the highest K_a/K_s ratios found in very recent human-specific duplications. Additionally, we note the importance, with several examples, of considering duplications that occurred prior to the human-chimp split playing a role in human-specific changes in that even older duplications may provide raw material for subsequent adaptive evolution millions of years later.

How many genes does it take to make mammalian dental diversity?

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We will be discussing models to developmentally ordinate phenotypic variation of mammalian teeth. The first, an inhibitory cascade model, provides a developmental null-expectation about the way mammalian molar proportions should evolve. We use the model to examine whether similar developmental or genetic mechanisms may underlie phenotypic variation both within and among primate species. The second, a patterning kernel model, is constructed to examine development of individual tooth shapes. The model is used to examine the genetic basis of individual tooth shape variation, meristic shape variation along the tooth row, and variation among species. One aspect of mammalian molar morphology examined is the increase in crown complexity associated with specialized herbivory. Taken together, the results show that the mammalian genetic architecture is likely to contain developmental hotspots for phenotypic variation, and thus a limited number of regulatory genes may account for the diversity of teeth. Moreover, the models help to uncover cryptic aspects of phenotypic variation not readily discernible with morphometrical methods alone.

Molecular evolution of color vision genes in howling monkeys (*Alouatta*).

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Uniform trichromatic vision is based on the presence of three photopigment proteins (opsins) maximally sensitive to short-, middle-, and long-wavelengths of light (blue, green, and red, respectively). It is present in Old World monkeys, apes, and humans, who possess an autosomal-linked blue opsin gene and two X-linked opsin genes (red and green) that arose via a well-characterized duplication and subsequent mutation of the red opsin gene in the catarrhine common ancestor. The convergent evolution of uniform trichromatic vision in one genus of New World monkey, *Alouatta*, has been described with molecular, physiological, and behavioral studies of two closely related species (*A. caraya* and *A. seniculus*). To better understand the structure and evolutionary history of this independent gene duplication event, we sequenced exons 2-6 and the intervening introns (~8,000 base pairs) of the red and green opsin genes of two distantly related species of *Alouatta*: the black howler (*A. caraya*) and the mantled howler (*A. palliata*). For comparison purposes, the nucleotide sequence of the homologous region from the common marmoset (*Callithrix jacchus*) was obtained from the

publicly available reference genome assembly and included as well. We will present the results of our genetic analyses of these data, including an estimate of when in howler evolutionary history the opsin gene duplication occurred. By considering these results in combination with paleoecological reconstructions and fossil material, and with similar data for stem catarrhines, we may ultimately develop a better understanding of the adaptive origins of primate trichromacy.

Eskimo-Aleut craniofacial morphology: a test of the hard chewing hypothesis.

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Eskimos generate extreme degrees of bite force between their first molars, perhaps as much as two to three times that of Europeans. Hylander argues that the distinctive features of Eskimo skulls, including sagittal keeling and thickened tympanic plates, are associated with hard chewing rather than with genes or the cold. Some of these features are associated with the generation of pronounced vertical occlusal forces (e.g., high temporal lines) while others reflect the dissipation of these forces (e.g., pinched nasal bones).
Observations on craniofacial variables were made on two Alaskan Eskimo and two Aleut samples to test two hypotheses on hard chewing. Hypothesis 1: as males generate more bite force than females, craniofacial characteristics associated with the muscles of mastication should be more common and pronounced in males. Hypothesis 2: if the generation and dissipation of bite force is part of a masticatory complex involving pronounced development of the temporal, masseter, and pterygoid muscles, then the variables reflective of hard chewing should covary.

For 14 of 16 craniofacial trait comparisons, males exhibit higher frequencies and/or more pronounced expressions than females, with eight differences significant at the 0.05 level. In only one instance, gonial inversion, do females show a significantly higher trait frequency and expression. Oral tori frequently occur together within individuals and robust zygomatic bones are correlated with pronounced submalar notches. The interrelated oral tori suggests a complex involved in dissipating occlusal forces. The two associated features of the cheek suggest hypertrophied masseters that generate pronounced bite force.

Forelimb motion during quadrupedalism in ateline primates with different locomotor modes.

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Quadrupedal walking gaits of most primates are characterized by highly protracted forelimbs and a deeply yielding elbow. These features have been argued to be associated with mechanical requirements for arboreal locomotion and may be facilitated by the high shoulder and elbow joint mobility found in highly arboreal primates like the spider monkey. To test this hypothesis, we quantified forelimb motion during quadrupedalism on raised horizontal poles in *Ateles fusciceps, Lagothrix lagothrichea, Cebus apella,* and *Alouatta seniculus*, which were chosen to represent a cline in apparent shoulder and elbow joint mobility and range of motion. Contrary to expectations, however, *Alouatta*, a slow-moving, bridging quadruped, had the highest degrees of arm protraction (average=122º) and elbow yield (average=49º). *Cebus*, an active arboreal quadruped, had the next highest values of elbow yield (average= 37º), followed by *Lagothrix,* a quadruped that also progresses by arm-swinging (average= 31º). Both had similar amounts of arm protraction (average=116º and 118º, respectively). *Ateles*, the most specialized arm-swinger in the sample, was expected to have the highest values, but instead had the lowest values (yield average=18º, protraction average=111º). Simplistic assessments of joint mobility did not predict forelimb motion in this study. The fact that *Ateles* had the lowest range of forelimb motion and that *Alouatta* had the highest reflects not joint mobility but instead appears to relate to the requirements of bridging between supports and moderating oscillations during slow arboreal quadrupedalism. This pattern of forelimb use is further reflected in the thin, flexible, loosely stabilized clavicle of howler monkeys.
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Habitat and Population Status of White-collared Lemurs (*Eulemur cinereiceps*) at Manombo, Madagascar: 10 years of Recovery after Cyclone Gretelle.

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Many tropical environments are affected by anthropogenic disturbance. Some habitats are also faced with powerful stochastic events that can reduce primate populations. On January 24-25 1997, Cyclone Gretelle made landfall in southeastern Madagascar, causing widespread damage. Over 60% of canopy trees were severely damaged or destroyed at the coastal rain forest relict of Manombo Special Reserve/Classified Forest (S 23º 02', E 47º 44'; elevation 0-137 m asl). Manombo lemur populations were reduced through mortality and migration. In this study, we investigate white-collared lemur

(*Eulemur cinereiceps*) recovery by comparing pre-cyclone (1995) abundance to recent (2007) estimates through line-transect sampling (N=6 transects, 1.5-3.5 km). In addition, we use data from botanical plots (N=62, 125-500 m^2) to examine habitat structure from 1995-2007, including immediately following the cyclone (1997). Our results indicate that current white-collared lemur populations have rebounded to 1995 levels (13.5 ± 3.2 vs. 13.6 ± 6.4 individuals/km^2, respectively). Moreover, many recent forest structure indicators are similar to pre-cyclone measures. There were no differences between 1995 and 2007 in mean tree diameter ($p=0.07$), mean basal area ($p=0.11$), or stem density ($p=0.41$). However, mean tree height ($p<0.0001$) and total basal area ($p<0.005$) were significantly higher in 1995 than 2007. Overall, both the habitat and especially lemur populations at Manombo have demonstrated resilience in response to Cyclone Gretelle and ongoing human disturbance. These preliminary results are encouraging as Manombo is presently the only officially protected area within the range of white-collared lemurs, one of the most endangered primates.
We gratefully acknowledge support from Primate Action Fund (Conservation International/Margot Marsh Biodiversity Foundation), Primate Conservation, Inc., the University of Calgary, and the University of Texas at Austin.

Monoamine metabolites in the CSF of male anubis (*Papio anubis*) and hamadryas (*P. hamadryas*) baboons parallel their species-specific behavioral ontogeny.

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The activity of monoamine neurotransmitters (serotonin, dopamine, and norepinephrine) reflected in CSF concentrations of their respective metabolites (5-HIAA, HVA, and MHPG), has been related to behavioral differences within and among primate species. We here report levels of these metabolites, and in particular the HVA/5-HIAA ratio, in wild anubis and hamadryas baboons, and their natural hybrids. In both species, metabolite concentrations and the HVA/5-HIAA ratio decline with age. Mean values of adult male hamadryas are as predicted by the age-related trend, but adult male anubis exhibit lower than expected values of the HVA/5-HIAA ratio. We speculate that the difference relates to life history. Male anubis, who disperse, and thus must build social networks with non-kin, have high relative serotonin activity, commonly associated (in other monkeys and in humans) with greater social awareness and skill. Young adult male hamadryas, living among agnatic kin, and mating opportunistically, exhibit low relative 5-HIAA, generally associated with impulsivity and social irresponsibility. Relative 5-HIAA increases as a male hamadryas approaches the age at which he is normatively the leader of a One Male Unit, when his fitness depends upon his maintaining stable relationships with females and with other leaders. Among adult males of a social group with a long history of hybridization, the range of the HVA/5-HIAA ratio overlapped with both parental species, and there was a strong correlation (corr.coeff. = 0.82) between the ratio and a multifactorial measure of hamadryas-like behavior.

Dining with the Danes in Roman Iron Age Denma.

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This paper investigates human diet in east Denmark during the Roman Iron Age using stable isotope analysis of carbon ($\delta^{13}C$) and nitrogen ($\delta^{15}N$) in the collagen of archaeological human and animal bone as a direct indicator of dietary patterns. The human sample comprises seventy-seven individuals from ten burial sites covering Zealand, Lolland and Bornholm. In addition thirty-two samples of mammals and fish obtained from seven sites were analysed. The investigation characterises the human diet among different social groupings and analyses dietary differences present between sex, age and site phase groups. Diachronically, the study investigates both the Early and Late period with the Roman influences that had an effect on the social structure and subsistence economy. Geographically the locations are both inland and coastal. The isotopic data indicate that the diet within the Early and Late Roman period both between and within population groups was extremely uniform and the data is consistent throughout the Roman Iron Age. A high level of terrestrial animal protein was dominating in the diet regardless of social status, age, sex or time period and terrestrial plant protein seems to have been of less significance to any of the individuals analysed. The consumption of marine or aquatic resources does not seem to have been important, even among the individuals living next to the coast.

Mining the steppes: community health during the Sintashta period.

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Copper mining and bronze metallurgy in the Eurasian steppes have been associated with the

emergence of social complexity and territorial violence. The expected health consequences for the people who lived in these mining communities include increased musculature, developmental disruption, congenital anomalies, increased frailty, violence- and accidental trauma, and premature death resulting from strenuous metallurgical activities, prolonged exposure to a toxic environment, and defense or acquisition of resources. A paleopathological study of 82 individuals from the Kamennyi Ambar 5 cemetery dated to the Middle Bronze Age Sintashta culture (2025-1745 cal B.C.) in the Southern Urals tests these expectations. Children 5-12 years of age (n = 22) and adolescents (n = 15) predominate the demographic profile. This unusually high proportion cannot be explained by chronic infection and perimortem trauma is associated with one child only. Visible pathology was minor for the entire group: trauma (4.9%), cribra orbitalia (5.1%), sinusitis (6.9%). Schmorls nodes (30%) and osteoperiostitis (63%) were more common, but the etiology is nonspecific. Musculoskeletal stress markers were not overly robust. No evidence of neoplasms or detrimental congenital anomalies was observed, although differential burial practices bear consideration.
The negative pathological effects of traditional metallurgy observed among modern miners were negligible in this mining community. Adults were in fact remarkably healthy, although old age was an achievement. However, older children and adolescents did not fare well. This may be attributed to increased frailty due to *in utero* exposure to teratogens, aggravated later in life by the demanding activities associated with the mining industry.
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Ancestry-associated variation in endogenous antioxidant activity during high-altitude pregnancy.

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High-altitude (HA) residence compromises fetal growth. Infants of highland ancestry (e.g. Andean) experience less altitude-associated reduction in birth weight than those of lowland ancestry (e.g. Europeans), a difference that likely involves variations in maternal vascular adaptation to pregnancy. Oxidative stress has been implicated in the maternal vascular dysfunction hallmark to reduced fetal growth and preeclampsia at low altitude (LA). We hypothesized that altered redox status contributes to altitude-associated reductions in birth weight by causing endothelial dysfunction and reducing uterine artery (UA) blood flow and 2) enhanced antioxidant activity contributes to the protective effect of Andean ancestry. Maternal oxidative stress (8-iso-PGF2α), antioxidant status (superoxide dismutase [SOD]; catalase) and UA blood flow were measured in the non-pregnant state and during pregnancy (20w,36w) in women of Andean or European ancestry at HA (>3600m) or LA (400m) in Bolivia. Andeans had greater UA blood flow during pregnancy at HA, were heavier at birth (†) and were less often small-for-gestational age (SGA) relative to Europeans. Antioxidant activity was lower in Europeans than Andeans during pregnancy at HA but not LA. Europeans who delivered SGA had reduced catalase activity (†) at 20w relative to those delivering infants of normal weight. Mothers of SGA infants at HA also had lower SOD activity. Oxidative stress was negatively associated with UA blood flow at HA. Our findings are consistent with the possibility that elevated endogenous antioxidant activity contributes to the protection of fetal growth at HA afforded by Andean ancestry, and that these characteristics may be adaptive in nature.

The hobbits (*Homo floresiensis*) were not cretins.

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Various pathologies have been proposed as challenges to the biological and taxonomic validity of *Homo floresiensis*. Among these is the hypothesis that LB1 and LB6 are myxoedematous endemic cretins suffering from congenital hypothyroidism, with attendant dwarfism, microcephaly and assorted skeletal and proportional abnormalities (Obendorf et al., 2007). We review these claims and demonstrate that the cretin diagnosis can be rejected due to numerous errors of fact and unsubstantiated speculations.
CT-scans reveal that the pituitary fossa of LB1 is damaged but is not enlarged. The cranial capacity of LB1 falls far below the adult values typical of cretins. None of the cranial sutures and fontanelles of LB1 remain open; rather, the bregmatic region (and nasal bridge)

suffered damage during excavation. Unlike cretins, LB1 exhibits well-developed frontal sinuses. The jaws of LB1 and LB6 mandibles lack "chins" but do not display mandibular hypoplasia. Occlusal wear and root lengths indicate that LB1's first mandibular premolar is not a retained deciduous tooth.
The humerofemoral index of cretins is normal for humans and much lower than in LB1, and the low claviculohumeral index of LB1 is outside the known range for cretins. Foot-length to femur-length ratios in cretins are also normal and far below the value calculated for LB1. There is no evidence that the "unusual" morphology of the LB1 trapezoid is due to a bipartite anomaly; there is no facet on either the scaphoid or capitate unaccounted for by those present on LB1's trapezoid.
There are no cretins in the hypodigm of *Homo floresiensis*.
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Using macroecological methods to examine across-site variation in chimpanzee behavior.

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Much attention has been paid to across-site variation in chimpanzee behavior, but few studies have applied quantitative techniques to explain this variation. Here, we apply methods typically utilized in macroecology to explain behavioral variation in chimpanzees. We analyzed published data containing 39 behavioral traits from nine chimpanzee communities. We used a canonical correspondence analysis to examine the relative importance of environmental variables and geography for explaining across-site variation in chimpanzee behavior. In addition, we conducted a nestedness analysis using NestCalc, to test whether there was a significant degree of nestedness in the behavioral repertoires of chimpanzee communities. This would provide evidence for a cumulative, increasing level of complexity in the behavioral suites of chimpanzees. We found that environmental variables, especially rainfall seasonality explained a significant amount of behavioral variation, independent of geography. Numerous behavioral traits related to food acquisition/processing were best predicted by environmental variables. Geographic variables, independent of environmental characteristics, were poor predictors of behavioral variability. We also found that the behavioral repertoires of chimpanzee communities showed a significant level of nestedness. Chimpanzee communities exhibiting smaller behavioral repertoires were a subset of communities with larger behavioral suites. These results support the idea that the behavioral variation across chimpanzee study sites is largely due to environmental variability, with less support for genetic or social transmission due to individual dispersal patterns.

Anthropological study of dental metric and non-metric traits in 5 Chinese minorities in Yunnan Province.

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Metric and non-metric characters in Chinese minorities have not been fully studied. The purpose of this study is to describe these characters and to search for their affinity to people in surrounded areas. Materials were dental impressions of young adults in 5 Chinese ethnic minorities, Dai, Hani, Naxi, Pumi and Miao, taken in Yunnan Province form 2000 to 2007. Mesiodistal and buccolingual diameters of all teeth were measured, and frequencies of 22 dental traits were recorded based on the method of Arizona State University Dental Anthropology System. The results were compared with those of previous studies including Asian populations. Metric study revealed that tooth size of Miao was smallest among 5 minorities. A principal coordinate analysis based on Smith's Mean Measure of Divergence using the frequencies of 17 traits suggested that the five minorities were closely related as a single group and belonged to the Sundadont dentition category, but positioned close to the Sinodont groups. Although anthropological and linguistic studies suggest that the Hani, Naxi and Pumi are closely related to Tibetans and that the Dai and Miao have close affinity to Southeast Asians, it was difficult to separate these 5 minorities into 2 groups. The position occupied by these minorities suggested that they were originally derived from South Asia or Tibet, but environmentally affected probably by other Sinodont tribes such as the Han in their vicinity.

Arsinoe IV of Egypt, sister of Cleopatra identified? - Osseous and molecular challenges.

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Arsinoe IV of Egypt, the younger sister of Cleopatra, was murdered between the ages of 16 and 18 on the order of Marc Antony in 41 BC while living in political asylum at the Artemision in Ephesus (Turkey). Archaeological findings and architectural features point to the skeletal remains found in the so-called Oktogon - Heroon in the center of ancient Ephesus - to being those of Arsinoe IV. Respective remains were dated and investigated by forensic osteology, radiology and ancient DNA analysis to assess identification: Radiocarbon dating (VERA-4104) isolated the period between 210 and 20 BC (94 % prob.). Morphological features suggest a female with an estimated body height of 154 cm (+/- 3 cm) and

with limbs in good proportion to one another. Epiphyseal closure and histological age estimation (femoral cross sections) revealed a consistent age at death between 15 and 17 years. The whole skeleton appeared to belong to a slim and fragile individual (soft tissue reconstruction was applied and compared to ancient sources). Stress markers, like Harris' lines were absent and no sings for heavy workload or pre- or perimortal traumas were found. Ancient DNA analysis was carried out for several bone samples. No nuclear DNA was detected, most likely due to diagenetic factors and storage conditions. Endeavors to find mitochondrial DNA are currently in progress. Investigations could neither verify nor disprove the theory on the origin of the remains. However, after successful mtDNA typing a maternal relative reference sample would be required for final identification.

Intergenerational transfers, lifespan and human aging.

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This paper builds on a theory that links intergenerational transfers to the aging process. It presents empirical data to evaluate the hypothesis that the modal age of death in traditional human populations, 70, is very close to the median age at which intergenerational transfers become negative. We analyze data on economic transfers, aging and disability, and demography collected with Tsimane forager-horticulturalists. For both men and women, the median age at which net transfers become negative is within 2-3 years later of the modal age of death. The decrease in net transfers with age is directly linked to functional changes in the ability to work due to the aging process itself. Finally, the data show that the vast majority of Tsimane children born have at least two grandparents alive at the time, and do receive positive economic transfers from them. By the age net transfers become negative, older people have very few young grandchildren left to support.

Feeding manipulative behavior in free ranging silvery woolly monkeys (*Lagothrix poeppigii*).

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One of the key elements of primate evolution is the anatomical and neuromotor rearrangement of the forelimb to engage freely in dexterous manipulative activities. The importance of this behavior has led to a multitude of detailed studies in captivity, but has been almost neglected in the field. The present study reports on the feeding manipulative behavior of three adult female and two adult male free ranging silvery woolly monkeys (*Lagothrix poeppigi*) via the analysis of video recordings originally shot in the Yasuní National Park, eastern Ecuador. In this way, we recorded postural data, segment movements, and food acquisition data over each bout for every animal.
Both sexes kept their arms mainly below the shoulder level and adducted, and their forearms semi-pronated in all postures. However, males used more above-shoulder arm positions ($p<0.001$) and more forearm supination ($p<0.01$) than females. No correlations between postural mode and food type were recorded. In males, food was mainly acquired directly from the twig brought to mouth by hand, while females largely plucked out food items only by hand. However, males also used the hand method, as females did, when food items where placed below the animal. The present results show that feeding manipulative activities in primates reveal important issues of both anatomical and behavioral relevance, and should be explored in more detailed ways via modern field techniques of data acquisition.
Data collection was financially supported by NSF SBR-9222526 and data analysis by the Aristotle University of Thessaloniki.

Syntenic regions of human and non-human primate chromosomes differ in gene content: Implications for human evolution.

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Human chromosome 2 (HsChr2) was created by fusion of archaic hominoid chromosomes 12 and 13 following chimp-human speciation. To identify differences between human and chimpanzee genomes that might have contributed to the evolution of man from a common ancestor, the regions flanking the fusion site were compared with the syntenic regions of chimpanzee and rhesus chromosomes.
Comparisons were made using the human and chimp assemblies (H. sapiens Build 36; UCSC Genome Browser). BLAST analysis was carried out at the NCBI website. Motif and Pfam analyses were performed at the SwissProt website. HsChr2 has a 60S ribosomal protein pseudogene (RPL23A7) that is absent in the syntenic regions of both chimpanzee and rhesus chromosomes. The RPL23A7 pseudogen is expressed in proliferating cells and tissue, including human fetal brain. A region 5' to the RPL23A7 pseudogene comprises potential GC-rich transcriptional elements which may also independently drive an adjacent *Ras*-related gene (RABL2B). This G-C rich region also has 61 predicted CpG islands. Histone mapping of the adjacent putative 5' regions of the RPL23A7 psudogene indicate that H3K4 is methylated. Preliminary phylogenetic analysis with related sequences indicates that the RPL23A7 pseudogene arose before 2.47 million years ago by

retrotransposition of a copy of chromosome 22qter. Elevated levels of transcript for ribosomal protein L23 (RPL23) in hippocampus from post-coital day18 (E18) rat have been reported (Kaser (2000) J. Invest. Med., 48(1): 282A). A novel mechanism by pseudogenes that mediates gene expression is proposed.

Hunter-fisher-gatherer dietary adaptations in Neolithic and Bronze Age Siberians.

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Dietary adaptations among northern hunter-fisher-gatherers emphasize meat and fish with less emphasis on plant foods. Prehistoric populations living in the boreal forest/ taiga biome near Lake Baikal during the Neolithic and Bronze Ages created cemeteries of varying sizes, providing samples sufficient for describing diet and dietary variation using stable isotope analysis. Among the largest of these cemeteries, Khuzhir-Nuge XIV, from the Little Sea region of Lake Baikal is dated between 2700 and 2000 cal. B.C. and contained 79 graves. In order to reconstruct past diet, stable isotopes of carbon and nitrogen were analysed from preserved collagen and stable isotopes of carbon were also analysed from the carbonate apatite of bone mineral. FTIR scans were done on all samples to test for diagenesis. $\delta^{13}C$ from collagen varies from -20.1‰ to -16‰ while $\delta^{15}N$ varies from 10.3‰ to 19.1‰. $\delta^{13}C$ from carbonate apatite varies from -15.2‰ to -9.7‰. The considerable variation in stable isotope ratios results from reliance on a mix of terrestrial game and aquatic species by the individuals buried in the cemetery, and variation in the isotope ecology of the aquatic food web of Lake Baikal. The results of the stable nitrogen isotope analyses indicate that some individuals relied more on terrestrial game. Mortuary analysis indicates that these individuals were interred in larger graves with more elaborate grave inclusions. Ethnographic work suggests that meat is preferred over fish, reinforcing the interpretations from the mortuary and paleodiet studies.

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Dietary quality and brain size in platyrrhines: support for the "Expensive Tissue Hypothesis".

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The "Expensive Tissue Hypothesis" of Aiello and Wheeler (1995) predicts that a greater degree of encephalization will be associated with a more easily digestible diet, high in protein and simple carbohydrates. As originally formulated, gut size is used as a surrogate for diet quality. Fish and Lockwood (2003) tested the encephalization-diet prediction more directly by looking at diet quality (rather than gut size) in a sample of primates including 31 mostly catarrhine anthropoids. They confirm a significant positive correlation between relative brain size and dietary quality after controlling for phylogenetic effects. To further test the strength of this relationship, we assembled data for 19 species of platyrrhines from a literature of 78 field studies of diet composition, as well as body mass, and endocranial volume. We used a fully resolved phylogeny, with branch lengths, from molecular studies. A diet quality index is based on a slightly modified model originally proposed by Sailer et al. (1985). The data is analyzed with the PDAP subroutine of Mesquite, Version 2.5.

Controlling for the effects of phylogeny, increases in diet quality are associated with increases in relative endocranial volume, as revealed by a significant positive correlation between the two ($r=0.55$; 2-tailed p-value = 0.014). Our findings confirm and amplify those of Fish & Lockwood and support the Aeillo and Wheeler hypothesis. Furthermore, root-node reconstruction suggest that the ancestral crown platyrrhine had a diet rich in fruit and animal prey but not largely dependent on structural carbohydrates.

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Meat, bread, scratches and pits: Analysis of dental microwear on Byzantine monastic dentition from Jerusalem.

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This study examined dental microwear on the teeth of a monastic community from the Byzantine monastery of St. Stephen's in Jerusalem (5^{th}-7^{th} century C.E). The occulsal surfaces of twenty right mandibular second molars were examined using a scanning electron microscope, specifically focusing on the protoconid phase II facets, as they tend to show a mixture of scratches and pits due to the crushing and grinding involved in the mastication process (Hogue 2008). The aim of the current investigation was to analyze differences in levels of pitting and scratching between individuals in an attempt to determine if all individuals consumed a similar diet. This study also attempted to determine the severity of scratches and pits in order to gain more insight into the types of food consumed. Scratches are defined as dental microwear features with a length to width ratio

lower than 4:1 while pits are defined as dental microwear features with a length to width ratio higher than 4:1 (Carneri, 2003). Results indicate all samples showed similar levels of pitting, ranging from 75-42%, and scratching, ranging from 15-48%, demonstrating that all members were consuming similar diets. Averages of results showed 66% of the microwear features were pits and 34% were scratches. This pattern is consistent with a varied diet of plant and animal based products. These results fit with previous bone chemistry studies (Cooper et al. 2005, Gregoricka et al, 2005), as well as carious lesions and dental calculus analyses.

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Morphology of genetically-confirmed hybrids of *Alouatta pigra* and *A. palliata* from a natural hybrid zone in Tabasco, Mexico.

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Instances of hybridization have been reported in primate species, where hybrids are identified based on morphology. However, hybrids may not always be detected using such methods. This study investigates the morphology of howler monkey hybrids detected by genotyping of bi-parentally inherited loci. *Alouatta pigra* and *A. palliata* diverged approximately 3 mya. Whereas *A. pigra* is larger in weight and length than *A. palliata*, the latter has larger testicular volume. The two species can be distinguished based on overall appearance, but they are similar enough such that hybrids can be difficult to identify. Moreover, evidence exists for directionality of hybridization, where hybridization only occurs between *A. palliata* males and *A. pigra* females, potentially biasing the morphology of the hybrids. We compare genetically confirmed hybrids to pure individuals for several morphometric traits by sex. Hybrid females show significant dysgenesis only with respect to body length compared to *A. pigra* and significant heterosis for all other weight and length variables compared to *A. palliata*. Hybrid males have no significant differences with *A. pigra* (although a trend for increase in weights exists) but are larger in most respects than *A. palliata*. Both qualitatively and quantitatively, hybrid males resemble *A. pigra* whereas females are somewhat intermediate between the two species. The exception in males is that testicular volume is large, similar to that of *A. palliata*. The underlying mechanisms of hybrid incompatibility can influence hybrid morphology. If these results remain consistent with larger sample sizes, then it is likely that hybridization has been underestimated overall.

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New ages at first molar emergence in extant great apes and a reassessment of early hominin first molar emergence ages.

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Age at first molar (M1) emergence is increasingly being used to infer the broad pace of life history in fossil primates, including fossil hominins. Ages at M1 emergence have been calculated for five early hominin individuals: one *Australopithecus afarensis* (3.3 years), one *A. africanus* (3.0 years), two *Paranthropus robustus* (3.0-4.0 years), and one *P. boisei* (2.8 years). These compare with an average age of 3.15 years in *Pan troglodytes*. However, estimated cranial capacities in these hominin species (~450 to 500 cc) suggest that all should have somewhat later ages at M1 emergence than *Pan* (~380 cc), based on the strong correlation between age at M1 emergence and adult cranial capacity in extant primates. Moreover, mean age at M1 emergence in *Pan* is derived from captive animals, and there is increasing evidence, including data from free-living chimpanzees, that captive animals have accelerated dental eruption compared to individuals living in the wild. Free-living chimpanzees may have an age at M1 emergence closer to 4.0 years, which is more compatible with their life history values in comparison to those of modern humans.

New data are presented here on age at M1 emergence in free-living *Pongo pygmaeus* (~4.5 years) and *Gorilla gorilla* (~3.7 years), which are also broadly compatible with the comparative life histories of these apes, and which offer support for the later age at M1 emergence in *Pan*. These results are used to explore the seemingly incongruously early M1 emergence ages of the fossil hominins and their implied relatively rapid life histories.

Dating selection pressures in recent human evolution.

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A common interpretation of genome-wide selection scans is that the dispersal of anatomically modern humans from East Africa led to a number of recent adaptations. If so, patterns of polymorphism from non-African individuals should show the signature of adaptations dating to 40-100 Kya. To date, however, scans of polymorphism data from a limited number of populations have

yielded conflicting results as to both the chronology and geography of local adaptations. Reliable estimates of the age of selected alleles would greatly clarify these issues.
Here, we describe a novel method to date the onset of selective pressures by estimating the time to the most recent common ancestor (tMRCA) of a site that has been subject to directional positive selection. The method is a hidden Markov Model extension of the "phylogenetic-dating" method that allows for recombination. An attractive feature of the proposed method is that it does not rely on assumptions about the demographic history of the population. Moreover, by using full resequencing data and allowing for recombination, it extracts the maximum information available from sequence data. We discuss the reliability of our method, as well as of existing approaches, under a wide range of scenarios. We also present its application to a number of cases of recent selection in the human genome.
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Rome if you want to: immigrants in the Empire.

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The urban center of Imperial Rome is an ideal setting for studying migration in antiquity. Transportation infrastructure, broad citizenship categories, and dissemination of information about Rome meant there were few barriers to immigration to the capital. Previous research on migration in the Empire has only traced the path of upper-class Romans and soldiers emigrating elsewhere. The literary record and contemporary research largely ignore the lower classes and inward migration. Combining Rome's historical record, the populational perspective of bioarchaeology, and isotope geochemistry, however, provides a way to identify and understand immigration in the Empire.
Over 200 skeletons have been examined from two lower-class Imperial Roman cemeteries, Castellaccio Europarco and Casal Bertone. First molars were extracted from 112 individuals. An initial group of 29 human teeth were subjected to stable strontium isotope analysis to investigate population movement. Most individuals fall within the Roman range of .7093-.7103. Three males and one female from Casal Bertone and two females from Castellaccio, however, present strontium ratios in the .7083-.7088 range. These individuals likely originated over 100km south of Rome near Sperlonga or a geologically similar area. The results provide concrete evidence of short-distance migration among individuals buried in lower-class cemeteries in Rome. In this report, I present the strontium isotope data gathered to date and the archaeological context of the burials and discuss their contributions to understanding the population structure of Imperial Rome.
This research was supported by grants from the NSF (BCS-0622452) and the Wenner-Gren Foundation.

Analysis of interpopulation variation in fourth rib aging.

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The fundamental question of whether populations age at different rates is a timely issue for biological anthropologists, as the applicability of age parameters derived from contemporary American populations are broadly used in a variety of contexts. Whether applied to historic or modern populations, methods that are biologically relevant ensure that meaningful conclusions are drawn from skeletal data. The application of aging methods for forensic purposes across diverse populations is further complicated by legal boundaries placed on scientific experts and the admissibility of scientific standards in court.
Fourth rib data were collected for 623 Balkan males and females and for 300 American males and females. Specification tests are first used to determine whether the transition ages follow a normal or log-normal distribution. An analysis of deviance is then calculated using an improvement chi-square to test for interpopulation variation in the proportional odds probit regression. Given the relatively weak relationship of rib traits to aging, it is not to be expected that there would be significant differences in rates of aging between the two samples. However, the prior age distributions for the two samples are quite different so that a Bayesian analysis needs to account for this difference. Based on the calculated prior age distributions from Gompertz-Makeham hazard analyses and the ages-of-transition we present the *highest posterior density region*s for each phase within each sample.

Relatedness and temporal variability in Woodland period cemeteries in the Lower Illinois Valley.

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Previous research has linked differential access to extended mortuary practices to the generation of ancestorhood and maintenance of ancestor ideology in Lower Illinois Valley Middle (50 B.C. – A.D. 400) and Late (A.D. 400 – 1000) Woodland communities. The results of funerary activities constructing who was and was not considered an ancestor are visible archaeologically and were clearly anchored in social and biological relatedness among the living and

dead. The biological signature of these processes can be measured via nonmetric traits of the skull, and is detected as less genetic variation among processed burials than among non-processed inhumations within cemeteries. Specific ancestor-generative processes and the amount of genetic variation between mortuary tracks was not constant over time across the valley. However, fine-scale temporal control is necessary to model temporo-spatial change in patterns of genetic variability within cemeteries as well as its relation to mortuary activity.

In this paper, I present and test chronological models of intra-site genetic variability as a means to explore the changing role of ancestorhood and ideology across the study period. Twenty-three new radiocarbon dates supplement existing regional radiometric assays from 22 Middle and Late Woodland cemeteries to place biological signatures of ancestor generation within their appropriate temporo-spatial context. Results indicate that neither mortuary practices nor associated genetic signatures between funerary tracks were static across time and space. Rather, interconnections of ritual and relatedness were manipulated in multiple manners reflecting changing ideas of community membership and associated ideology.

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Warfare and violence in the Iron Age of East Yorkshire.

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The British Iron Age is well known for its hillforts and metal weapons. Initially assumed to be evidence for warfare, they have been reinterpreted as symbols of power, status, wealth, and prestige. Classical sources, however, portray a society dominated by violence. To address these conflicting views, this project assesses the occurrence of weapon-related trauma in the Iron Age cemetery of Wetwang Slack, East Yorkshire. Wetwang Slack is the largest Iron Age cemetery in Britain with over 450 individuals from all demographic groups. It spans a period of 500 years from the middle to late Iron Age, representing an example of long-term use that shows temporal change in a single community. The analysis has shown that the overall rates of violence are quite low for this population and consistent with accidental trauma often seen in agricultural groups. However, there is evidence for inter-personal violence through the presence of weapon-related trauma, the majority of which is healed or healing. This is in sharp contrast to evidence from contemporary sites in other regions of Britain, which show a higher frequency of unhealed peri-mortem trauma. When coupled with the mortuary data, the patterns reveal a much more complex relationship between ritual, violence, and warfare for this period than the previous research debates have allowed.

Morphometric data and patterns of growth in wild *Propithecus edwardsi* at Ranomafana National Park, Madagascar.

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Whereas there has been a mounting corpus of long-term primate behavioral studies in the wild over the last 3-4 decades, there still are very few lengthy studies of wild primates that include the consistent collection of morphometric data. Here we present such data collected during a 22-year study of a natural population of the Milne-Edwards' sifaka, *Propithecus edwardsi* at Ranomafana National Park, Madagascar. Identified, known-aged individuals were captured and recaptured over the years and standard morphometric measurements recorded. Using a combination of longitudinal and cross-sectional data we have been able to document patterns of growth and development in this species. Furthermore, we document variation in body dimensions and address potential sources of that variation including sex, group size, season, habitat quality, and interannual differences. We show that while most postcranial elements reach their ultimate adult size between 2-4 years of age, adult body mass is not attained until approximately seven years. Females' first offspring occasionally are born at four years, and typically at five years, prior to the completion of postcranial growth. On average, adult females weigh slightly more than adult males but this difference is minor compared to seasonal differences in female body mass. Additionally, sex differences in body mass are greatest during the wet season, with seasonal mass variation greater in females than in males. Dentally senescent, older individuals differ little in most postcranial traits from adults in their prime. This research was supported in part by NSF-BCS 721233.

Trauma and pathology in the Gombe chimpanzees.

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Eighteen complete chimpanzee (*Pan troglodytes*) skeletons from Gombe National Park are examined for signs of trauma and other pathologies. Most of the individuals have known life histories and ages at death. Because chimpanzees are frequently used as a basis for comparison in studies of the hominin fossil record, it is vital to study skeletons with known life histories so that accurate

comparisons are possible. Each individual is examined for fractures, degenerative joint disease, bite wounds, signs of infection, and other pathologies. When possible, pathologies observed on the skeleton are matched up with known instances of injury/disease. The published data on the Kibale skeletons provides a useful basis for comparison to determine what differences may exist in ecological pressures between the two groups.

Of the 18 individuals presented here, 14 show signs of pathology (78%), with 10 individuals (56%) showing signs of trauma. These frequencies are broadly similar to results reported by Carter et al. (2008) for the chimpanzees from Kibale, in which 15 of the 20 observed individuals showed signs of pathology (75%), with 13 individuals (65%) showing signs of trauma.

This sub-set of the Gombe skeletal collection differs somewhat from Jurmain's 1989 study of another sub-set of the Gombe chimpanzee skeletal collection, in which all 10 of the examined individuals show signs of trauma. The discrepancy is perhaps attributable to demographic differences in the sub-samples. The combined Gombe sample is similar in frequency of pathology (85%) and frequency of trauma (71%) to the Kibale sample.

This project was funded by the University of Minnesota's Graduate Research Partnership Program.

A nearly complete hominin radius from Area 41 of the Koobi Fora Formation (East Turkana, Kenya).

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Recently recovered hominin material from Area 41, East Turkana, Kenya, includes a right radius. The fossil is from the Okote Member of the Koobi Fora Formation, dated to 1.5 ± 0.1 Ma. This specimen represents the most complete hominin radius from the Early Pleistocene yet discovered. The lack of associated craniodental remains precludes a straightforward taxonomic assignment of the radius because both early *Homo* and *Paranthropus* were present in the Turkana Basin during the Early Pleistocene and because no other radii have unequivocally been assigned to either taxon.

The specimen is complete, except for some post-mortem damage to the carpal articular surface and the lateral surface of the neck just below the radial head. Although broken in several pieces, the shaft remains largely undistorted. The shaft is only moderately curved with a sharply developed interosseous border, similar to modern humans. The medial surface of the radial head is more barrel-shaped rather than wedge-shaped, also similar to *Homo* and unlike *Paranthropus bosei*. The radius is absolutely very long with an overall length similar to that estimated for a penecontemporaneous *Homo erectus* individual (KNM-WT 15000) based on its ulnar length. The radial neck is also relatively long and similar to early *Australopithecus* and later European Early-Middle Pleistocene *Homo* rather than modern humans. The complete nature of this specimen with a combination of derived and primitive features makes this specimen extremely valuable for assessing forearm evolution in the human lineage.

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Phylogenetic relationships of late Uintan primates from the Devil's Graveyard Formation, Texas.

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The Devil's Graveyard Formation (DGF) of trans-Pecos Texas includes extensive exposures of continental volcaniclastic sediments spanning the middle to late Eocene. Prior collecting of vertebrate fossils in the 1970s and 1980s led to the recovery of a primate fauna that includes the omomyiform *Omomys carteri* (known from Uintan localities in the DGF) and the adapiform *Mahgarita stevensi* (known only from early Duchesnean localities). Since 2004, renewed collecting at the late Uintan (Ui3) Purple Bench locality has led to the recovery of additional primates, including the omomyiforms *Mytonius hopsoni* and *Diablomomys dalquesti*, as well as the first Uintan specimens of *Mahgarita*. These new specimens permit a reassessment of the phylogenetic relationships of primate taxa from the DGF. We scored 213 dental characters for 31 omomyiform species, and reconstructed cladograms based on maximum parsimony analyses in PAUP. We also used minimally worn mandibular teeth of *Mahgarita* to reassess prior claims regarding the phylogenetic relationships of this enigmatic genus. Our analyses support the conclusion that *Mytonius* and *Ourayia* are generically distinct, and that *Diablomomys* is closely related to *Omomys* and *Chumashius*. Moreover, these 5 genera share close phyletic affinities with a larger group of Bridgerian and Uintan omomyiforms, including *Chipetaia*, *Hemiacodon*, and *Macrotarsius*. Finally, our analysis of new *Mahgarita* specimens adds further weight to the conclusion that this genus is a cercamoniine with close affinities to some Eurasian adapiforms.

A Population Genomic Analysis of the Peopling of the New World.

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We evaluate demographic characteristics of the population that originally colonized the Americas ~15,000 years ago using genomic and archaeological data. Specifically, we analyze data from >700 nuclear micro-satellite loci in a Bayesian coalescent framework with complex demographic models and incorporate existing archaeological, paleoclimatological, paleogeographic and genetic evidence into our analysis to improve our estimates of population parameters. Population genomic analyses accommodate stochastic variation between loci and provide an unbiased alternative to analyses of single genetic loci, which rely upon the history of a single locus and thus may produce biased estimates of demographic parameters. Our Bayesian coalescent analysis of the multi-locus dataset indicates that the Native American founder population that migrated to the Americas ~15,000 years-ago was small and increased over a few thousand years to reach a stable effective population size much larger than the founder size. These estimates are consistent with previous analyses of genetic systems (most notably mitochondrial DNA), which indicate that the founder effective population size was ~1,000-5,400, and with multiple lines of non-genetic evidence that we included in our study, such as archaeological, paleoclimatological, and paleogeographic data. Our population genomic analysis supports an initial migration of a small Native American founder population and a subsequent rapid and substantial increase in the effective size of Native American populations in the New World immediately after colonization.

A link between fecal testosterone and an honest signal - the loud 'wahoo' vocalizations of chacma baboons.

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To be reliable, sexually selected traits must either be physiologically constrained or costly to produce and maintain. A male trait, for example, will accurately signal male quality to rivals or mates if only some males can overcome the trait's energetic costs. Exaggerated male traits are frequently linked to testosterone, a metabolically-costly and potentially immune-suppressing hormone. For example, testosterone levels could affect the musculature of the vocal tract, which in turn could affect acoustic features of loud vocalizations – often prominent features of male competitive displays. However, among mammals this hypothesis has rarely been examined. Our previous research on Botswana chacma baboons suggested that male fecal testosterone levels reliably indicated their rank trajectory, and that male subjects were more likely to avoid approaching males when the caller had high testosterone levels. In other research, we found that loud 'wahoo' vocalizations were an honest indicator of male competitive ability; only males in good condition produced high quality calls at a fast rate. Here we explore the link between loud calls and changing fecal testosterone levels in eight habituated males over a 4-month period. We found a strong correlation between testosterone and both rank and rank trajectory. However, after controlling for the confounding effect of rank, preliminary results suggest that males climbing the dominance hierarchy had better quality wahoos than males about to descend the rank hierarchy. Our study represents some of the first primate evidence for a link between a reliable signal of male competitive ability and a metabolically-costly hormone.

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Aye-aye hand and foot postures and loading during quadrupedal locomotion.

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Primates that place high compressive loads on their hands during quadrupedal locomotion typically either possess morphology that ameliorates high loads (e.g. short, robust digits in terrestrial cercopithecoids) or use behavioral modifications to prevent high loads (e.g. knuckle-walking in African apes). Aye-ayes (*Daubentonia madagascariensis*) have exceptionally long, slender fingers and yet frequently engage in head-first descent that should increase loads on their hands. Little is known about how aye-ayes cope with this seemingly contradictory morphology and locomotion. Research has suggested that aye-ayes may curl their fingers to focus the forelimb load on the palm and shift their center of mass caudally to reduce load on the hands. We investigated hand and foot load in aye-ayes during horizontal, ascending and descending quadrupedal locomotion. Four aye-ayes walked along a horizontal and inclined (30°) wood ramp with an EMED-ST pressure mat imbedded within the substrate. Kinematic data were collected by videotaping from lateral view. Results show that during head-first descent pressure and force on the palm increased while loads on the foot and toes decreased. On a inclined substrate force and pressure increased on the foot and toes and decreased on the palm. The fingers were rarely loaded on any substrate, especially during head-first descent. These results confirm previous studies that aye-ayes adapt to their specialized hand morphology by curling their fingers off the substrate, especially during head-first descent. However, aye-ayes may not shift their center

of mass caudally as evidenced by increasing loads on their forelimbs as declination increases.

Quantitative genetics and evolution of shape: populations to phylogenies.

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Linking the genetic architecture of phenotypic traits with evolutionary processes poses many difficult methodological problems and requires information that is hard or impossible to obtain for humans. It is therefore useful to examine the core assumptions made in evolutionary quantitative genetics using model species and "model clades." Here I present a comparison of data from a wide range of animal model systems, in which shape variation was quantified using the methods of geometric morphometrics.
QTL studies in mice and chromosomal deficiency scans in flies underscore that the genetic basis of shape variation is highly polygenic. Quantitative genetic analyses in a wide range of animals show that the patterns of phenotypic, genetic, and mutational variation within populations are consistently similar, but not identical. Matrix correlations between covariance matrices for different levels of variation are significant in all comparisons, demonstrating the existence of associations among the levels of variation, but more stringent criteria of similarity such as proportionality are not met. These patterns of genetic and phenotypic variation within populations are similar to the patterns of evolutionary diversifications in the respective clades, but are not a completely congruent with them. This result is therefore close to, but does not perfectly match the expectation under a scenario of genetic drift. What do these results imply for human evolution? Above all, these studies underscore the need for caution when making inferences based on questionable assumptions. Overall, most data from human evolution appear to be consistent with drift or weak and/or fluctuating selection.

Pressure induced atrophy in the posterior cranial fossa – Suspicion of brain herniation.

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Pressure induced atrophy which leads to characteristic vestiges in the skull primarily occurs due to increased intracranial pressure (e.g., tumors, bleeding, trauma) causing the brain to dislocate into the skull bones. Additionally there are also cerebral hernias which occur physiologically and produce similar vestiges in the bone, however, without any other vestiges of pathological processes.
In the cemetery of Harting (Bavaria, Southern Germany) which dates from the early Middle Ages (6^{th} – 7^{th} century) 74 skulls of adult individuals could be examined. Two cases demonstrate vestiges caused by pressure induced atrophy in the posterior cranial fossa. In the cemetery of Wandersleben (Thuringia, Central Germany) which represents a population of the first agriculturalists in Europe (linear pottery culture) and dates from the very early Neolithic (~5600 BC), 111 skulls of adult individuals were investigated. Out of these, 13 cases with vestiges of pressure induced atrophy were found. The skulls were studied using macroscopy, low power microscopy, endoscopy, radiology, light and scanning electron microscopy. The structures examined in the posterior cranial fossa are not due to physiological cerebral herniations because those appear, as a rule, in correlation with arachnoid granulations found on the internal lamina in the neighbourhood of the sagittal venous sinus. In the examined cases, it can be assumed that the impressions are due to pathological brain herniations which characteristically develop during increased brain pressure or pathological proliferations of the meninges. Vestiges of inflammatory and partly also of hemorrhagic processes could be found on the internal skull lamina also indicating pathological events.

***Mandrillus* facial features may signal size and fitness information to conspecifics: an allometric study.**

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This novel research investigates the most highly dimorphic primate genus (*Mandrillus*) in order to test recent theoretical predictions derived from sexual selection theory as it applies to intrasexual allometric scaling of morphological features among adult males. The hypothesis predicts that the size of the canine tooth and paranasal ridges exhibit strong positive allometry across adult males, related to the potential role of sexually dimorphic craniofacial features in "advertising" or signaling overall male size and fitness to both females and other adult male conspecifics. Linear and areal estimates of canine and ridge size are determined using calibrated digital photographs and ImageJ measurement software. Model II regression of these features against multiple body size surrogates is used to analyze individual samples of *Mandrillus sphinx* (n = 29) and *Mandrillus leucophaeus* (n = 40). Results indicate a strong, positively allometric relationship between the paranasal ridges and body size for both species; however, the canine tooth scales with positive allometry only in *Mandrillus sphinx*. The hypothesis that the paranasal ridges function within the context of fitness display in both species finds support here, contrary to previous studies. The canine results reported here are less clear for the two species. Positive allometry has previously been demonstrated for many secondary sexual characteristics functioning within the context of display and

intrasexual competition in various organisms outside of the primate realm. This investigation provides the first such support in primates, further elucidating the role of sexual selection in the evolution of drill and mandrill facial morphology.
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Musculoskeletal markers of the lower limb: A look at obesity's effect on modern American males.

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Markers of occupational stress are frequently evaluated in skeletal analyses in order to suggest possible activities in prehistoric populations. Recent biomechanical research suggests that long term morbid obesity may cause a greater expression of muscle development, which could have repercussions on skeletal analyses of modern individuals. The concern from an anthropological perspective revolves around whether long term morbid obesity can mimic activity induced patterns of muscle stress on the skeleton. Contrary to the strict activity based explanations for muscle markers (Lane and Steen 1998), Zumwalt et al (2000) suggests that muscle markers correlate with body weight more than locomotor type in non-human primates, which Weiss (2003) supported in her work on the lower limb.

This study utilizes a sample of 105 white males from the William M. Bass Donated Skeletal Collection, representing modern Americans, to identify trends in the lower limb for average, obese, and athletic individuals. Robusticity and stress scores for each muscle of the hip and knee joints were scored following the scoring system of Hawkey and Merbs (1995). These scores were inputted into a log-linear model to calculate independence in relation to activity level. The results suggest that there are significant muscle associations for the severity of robusticity markers among body weight and activity levels. The distribution of the severity of robusticity markers is different across body weight and activity. These associations support both activity (Hawkey 1988; Hawkey and Merbs 1995; Lane and Steen 1998) and body weight (Weiss 2003; Zumwalt et al. 2000) as contributors to the formation of musculoskeletal stress markers.

Insights from developmental genetics and reproductive isolation in hominin species.

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Mammalian modes of reproductive isolation are examined in order to test if current morphogenetic hominin species are reflective of true biological species. Pre-zygotic modes of reproductive isolation are examined and include physical, mechanical, ethological, and chromosomal barriers to fertilization. The comparative method is used along with developmental genetics to determine which reproductive isolation mechanisms were likely present between species extant in the hominin lineage at the same time. Fossil vertebral morphologies are compared to known phenotypes governed by a shift from hoxd9 to hoxd10 in embryogenesis. The hoxd sequence of transcription factors is found on human chromosome 2. Human chromosome 2 is the result of centric fusion between panid chromosomes 12 and 13. This fusion suggests alteration in hoxd expression and moreover that all hominins likely had the same chromosomal number. Panids also possess a baculum and the genitals are more posteriorly placed than in humans which may be a mechanical mechanism of reproductive isolation. The posterior hox genes are also involved in placement and development of the genitals. While the ethological mechanism is not testable, our analyses support that chromosomal and mechanical reproductive isolation were not present in the hominin lineage. This affirms Curnoe and Thorne's four species model for human evolution. Overall, it is suggested that the number of hominin species be reduced to reflect likely biological species. A temporal-geographic naming scheme is presented to easily refer to existing fossil groups.

The excavation and analysis of an historic cemetery population from Indianapolis, Indiana.

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Historic cemeteries are often subject to the necessities of modern advancement through increased urbanization, population growth and commercial development; hence their movement is sometimes an unavoidable endeavor. Here, a highway expansion along the Northeast region of Indianapolis was the cause for relocation of the Wright cemetery. A total of 33 burials were detected within the perimeter of the site. However, only 30 of these burials contained actual skeletal material. Most of the individuals in this population consisted of three families related by marriage. Archival data shows the cemetery was active from 1841 to 1876, yet artifact data extends the sites activity to 1901 based on patent information. The familial relationships as well as shared environment and social status provided observable similarities within and between the skeletons of this population. The shared skeletal markers included pathologies as well as ancestry indicative skeletal traits. Fifteen of the individuals were documented by headstone information. However, the headstones were removed from the site for restoration, and their association to the remains required verification to assure they were in the proper locations. Careful excavation followed by osteological and dental analyses verified that the

headstones were indeed returned to their proper locations. Supplemental information regarding the identities of additional family members, not identified by headstones, was attained from archival records. This information was combined with the biological profile data to narrow the presumptive identification of the unknown individuals contained within the cemetery.

Future friends or foes: male-immature interactions in wild Phayre's leaf monkeys.

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Adult male affiliation is rare among nonhuman primates and not well understood. In addition to kin support, it may ultimately be fueled by the necessity to form coalitions in order to defend a group of females. This necessity to form bonds might also explain male affiliation with immature males, because they may become future allies. Here, we investigate adult male-immature interactions in Phayre's leaf monkeys (*Trachypithecus phayrei*), a species in which males regularly mature and breed in their natal group. It is hypothesized that males affiliate more often with male immatures. Overall, 660 episodes were observed in four groups (August 2007 - March 2008) at Phu Khieo Wildlife Sanctuary, Thailand. In ad libitum sampling we recorded initiation, termination, sequence of the interactions and its consequences for males of known rank and immatures of known age. We found that male immatures (as predicted) were significantly more often involved than females. Surprisingly, most of the interactions (70-87%) were initiated by the immatures and inversely related to their age. Interindividual variation across adult males was strong (some males never initiated). These results indicate that while forming bonds with future coalition partners might be important, the active role of immatures has been underestimated. It seems possible that from an early age immature male Phayre's leaf monkeys actively elicit affiliation from adult males to form bonds. However, long-term consequences of the observed behavioral pattern have yet to be determined. Future analyses should also incorporate relatedness and male behavioral styles ("personality") as potential factors affecting interactions.
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Genetic and social group influences on postcranial morphology in rhesus macaques of Cayo Santiago.

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The skeletal collection derived from the free ranging Cayo Santiago colony of rhesus macaques (*Macaca mulatta*) provides a unique opportunity to study inheritance of cranial and postcranial skeletal morphology. Age, gender, dates of birth and death, mother's identity, matriline, and social group membership are known for colony residents since 1957, enabling the estimation of the underlying genetic variation of skeletal traits necessary for evolutionary studies. This study examines the inheritance of postcranial skeletal dimensions of rhesus macaques derived from Cayo Santiago. We test whether social subgroups exhibit phenotypic, genetic and environmental differences in their mean morphology.
Fifty postcranial traits were measured on 275 adult rhesus macaques of known genealogy from 8 social groups. Heritability of each trait was estimated using maximum-likelihood methods. Principal component analysis and principal component scores were used to construct independent highly heritable traits, and environmental traits what are not highly heritable. Social group differences for these genetic and environmental traits were tested by analysis of variance, and genetic distance between social groups was tested by Mahalanobis' distance.
Postcranial dimensions are highly heritable, with an average heritability of 0.53. There are significant phenotypic and genetic differences across social groups, supporting the results of earlier studies. Significant differences were found between groups related by lineal fission. Differences between groups are likely due to random drift, mutation, migration and founder effects. Phenotypic and genetic variation of morphological traits are important in further consideration of the evolution of these traits.
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Dental Health in Prehistoric Central California: Sex Differences in Two Windmiller Populations from the Sacramento Valley.

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Previous bioarchaeological research has shown that the rate of dental caries often differs between the sexes, with females typically having a higher prevalence than males. In skeletal samples from prehistoric California, this pattern has been documented for the Santa Barbara Channel, the San Francisco Bay Area, and the Sacramento Valley. Although both biological and cultural factors influence dental caries rates, diet plays a central role. Thus, the higher prevalence of dental caries in females has been attributed to greater consumption of cariogenic plants compared to males. To evaluate this pattern further in central California, we report on evidence of dental disease in two late Holocene skeletal samples. These collections are attributed to the Windmiller culture (ca. 4950-2450 BP), and are from the Phelps and Windmiller Mounds, sites located in the Delta region of

the lower Sacramento Valley. Interestingly, although both skeletal samples exhibited high rates of dental attrition, 21% showed evidence of dental caries. Preliminary results suggest that the distribution of dental caries found among males and females is not significantly different, but approaches significance (χ^2 =3.61, p=0.057). Therefore it is possible that there is a difference in the proportion of dental caries for males and females from these Windmiller sites. However, further study is needed to confirm whether the distribution of caries rates at Windmiller sites conforms to the patterning found in other skeletal collections in the region.

Testing the normality assumption in transition analysis.

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One periennial problem with "transition analysis" is that the method assumes a distributional form for the unobserved ages at which individuals transition from one stage to the next higher stage. This distribution is often assumed to be normal, log-normal, or logistic. Specification tests do exist that use a Lagrange multiplier to assess the goodness of fit to the normal or log-normal (Bera et al. 1984; Johnson, 1996), but these tests have not been applied to osteological data. We first demonstrate the properties of these tests using data simulated under the normal and log-normal, as well as under a mixture of normals to represent a multi-modal age-at-transition distribution. We then test for normality and log-normality of ages-at-transition using data on the closure of ten ectocranial suture sites and the basilar synchondrosis from 1,148 individuals of known age.
All sutures were scored as "open," "closing," or "closed," and traits were tested both as three state ordinal systems, and as dichotomizations of "open versus not open" and "closed versus not closed." Taking probability values of less than 0.10 as evidence that the traits are not normally or log-normally distributed, four of the eleven traits fail to meet the distributional assumptions. More importantly, the results for the other seven traits indicate that alternate dichotomizations can lead to very different outcomes, with one dichotomization fitting the normal, and the other not. The results indicate that osteological traits should be scored ordinally and that any subsequent dichotomization should be based on specification tests.
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New anatomical variants of the ethmoid complex in *Pan troglodytes*.

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Regarding the current debate about the ethmofrontal sinus anatomy of stem catarrhines, it is noteworthy that in contrast to humans, little is known about the biological variation of the ethmoid complex in African apes. A mixed-sex skull sample of twenty-two infant and juvenile chimpanzees was CT scanned with a Toshiba XVISION CT at a slice thickness of 0.4 and 0.6 mm, respectively. Three-dimensional reconstructions of the CT scans with the WinSurf Software® revealed a system of three to four individual ethmoidal cells on each side of the skull. The most anterior ethmoidal cell was usually also the largest, and may the ethmoid bulla, found in 70% of humans. One female skull showed an exceptional extension of an ethmoidal cell along the orbital floor. This enlargement of an ethmoidal cell in the space between the maxillary sinus roof and the orbital floor is also known as ethmomaxillary sinus or Haller cell, and occurs in 8% of humans. This is the first report, to our knowledge, of a Haller cell in any non-human primate. Apart from the fact that this finding is valuable for the understanding of the pathogenesis of certain sinus diseases in non-human primates, it suggests that certain anatomical variants of the paranasal sinuses known to date only from human anatomy may also occur in non-human primates. In particular, however, this study points to the need of caution in the interpretation of certain ridges, observed in partially broken fossil skulls, as distinct feature of a particular paranasal sinus.

Mitochondrial DNA origins and affinities of the Kanak of New Caledonia.

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Genetic analyses in the Pacific have extensively documented Melanesian and Polynesian variation and origins. However, molecular analysis on the Kanak, Austronesian-speaking peoples of New Caledonia, has been limited. New Caledonia's main island, La Grande Terre, is the largest in Remote Oceania, lying isolated in the southern-most extent of Melanesia. The island, settled during the Lapita expansion, is remarkable for its linguistic and cultural diversity. The present study is conducted on 128 individuals from a collection of samples gathered in the early 1960's from four regions of La Grande Terre. The control region of the mitochondrial genome was sequenced and preliminary results indicate that at least five previously identified Pacific haplogroups are represented. Percentages for these haplogroups are distributed as follows: B (.2) P (.16), Q (.09), M28 (.05), F (.04), unassigned (.45). The unassigned samples require further sequencing outside the control region for haplogroup identification and will likely expand the defined branches within these Pacific haplogroups. Although the Kanak are Austronesian speakers, only twenty percent fall within haplogroup B, which Merriwether

et al. (1999) found to occur at a frequency near fifty percent in other Austronesian Melanesians. Findings are discussed in relation to mitochondrial DNA variation in other Pacific populations, clarifying the role this outlying island and its inhabitants played in Melanesian settlement, Polynesian expansion, and post-settlement interaction.

The skeletal remains from Kamennyi Ambar 5, a Middle Bronze Age Sintashta site of early metallurgy. Part I: dental pathology.

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Dental disease is an essential element of skeletal and paleoepidemiological analyses as associated with diet and stress levels in the group the collection represents. As part of a complete analysis on the Bronze Age site of Kamennyi Ambar 5 (KA-5), dental data were collected on 119 individuals. Extent and type of attrition, calculus, dental caries, and hypoplasias were scored accordingly. A pattern of age-related wear did not emerge; in fact, teeth rarely scored above the third level of wear. Nearly half of the total teeth presented mild calculus deposition (49.1%; n=385); 10.9% were free of calcified plaque. Caries occurred in just 4.44% of individuals (n=45) and on 0.95% of all teeth (n=525). Linear enamel hypoplasias occurred in 21.88% of individuals (n=32) and on 4.04% of the teeth (n=396). These results illustrate only slight dental wear indicating consumption of less coarse foodstuffs. The individual calculus deposition rates for KA-5 (76.19%; n=42) were much higher than that of agriculturalists (~30%) (Littleton and Frohlich, 1993) and people of the Iron Age Site of Sarai Khola (58.3%) (Lukacs, 1989), indicating a diet high in protein and low in acids derived from carbohydrate intake. This conclusion is supported by the low occurrence of carious lesions. The small number of hypoplastic events when compared to hunter-gatherers (45%), transitional groups (60%), and agricultural societies (80%) (Lukacs, 1989) suggests a healthy childhood with a minimally stressful lifestyle. Although the complete skeletal analysis supports these conclusions, we are currently testing them further via stable isotope and trace element analyses.
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The effects of travel costs on group size: a phylogenetic approach.

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Evolutionary models of primate social organization emphasize balancing the benefits and costs of group living, often through enjoying predator avoidance while suffering increased feeding competition. As groups increase in size they may respond by spending greater time and energy increasing their day range traveling to additional feeding sites in order to maintain sufficient nutrient intake. We used published data for approximately 100 primate species to investigate the relationship between group size and day range while controlling for the confounding effects of body size and phylogenetic non-independence among species data points. In addition, we explored average values for the ecological cost of transport (ECT), a measure derived from body mass and day range observations that indexes the percentage of daily energy expenditure devoted to travel. Multiple regression analysis identifies group size as a strong positive determinant of day range, and thus ECT, independently of body mass. This interspecific trend is strong in both the species values and phylogenetically independent contrasts. Regardless of body size, primate species living in larger social groups tend to have larger day ranges. Species residuals from the multiple regression help identify dietary correlates of day range that are corroborated by the contrast residuals implicating dietary grade shifts among primate groups. While day range and ECT are related to group size, values for ECT are quite low (median 1.45%), suggesting that the burden imposed by increased travel costs in primate groups, independently of their sizes, may be relatively minor.

Mothers and children: Moving in new directions.

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Primate mothers and their dependent offspring must travel together, yet juveniles move differently from adults. Juvenile primates, though economical, are slower (the majority of children cannot walk at fast adult speeds until after 7 years) and require more energy relative to their body mass. Nonetheless, groups of adults and children are typical, prompting the question: is there a cost to group mobility?
To address this question, data from the human physiology literature were used to create a mobility optimization model. For children < 5 years, the velocity associated with the minimum cost to cover a distance was less than adults, but the same as that of adults for children > 5 years. Interestingly, a minimum cost for the group to travel a given time exists (unlike for individuals) and the associated velocity is slower than normal adult walking velocity. The data used to develop this model are, however, quite limited. For instance, the children were only asked to walk until steady-state oxygen consumption was achieved (>/= 3 minutes), so whether or not children can maintain an adult pace or

consistent oxygen consumption is unknown. In order to understand group mobility strategies, data that allow realistic modeling of the costs and benefits are needed. Energy is an important resource to be optimized, though others, like time and maintenance of social bonds, may be equally important. Advanced modeling techniques, like agent-based modeling, offer the opportunity to include complex interactions and move mobility research in new directions.

Remodeling patterns of the human occipital bone: A preliminary report.

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It has long been acknowledged that skeletal growth is not a direct process of regularly distributed bony deposition on the external surface, but a highly specified progression which mainly constitutes in interrelated processes of movement: cortical drift, displacement and relocation. The current study aspires to approximate the remodeling mosaic of the occipital bone in *H. sapiens* from early childhood to adulthood in order to explore patterns of bone and cerebral growth integration.
The study sample consists of 5 adult and 10 immature (2¼ to 8 years old) occipital bones deriving from skeletal remains of the 19th century. Preparation of the samples includes the elaboration of negative impressions and positive replicas coated with gold and observed with the Reflected Light Microscope.
Cerebellar fossae are typically resorptive in both immature and adult specimens. On the contrary cerebral fossae exhibit a resorptive surface in early childhood while at the age of seven depository fields appear which are also present in the adult group. The external surface contains very few traces of the remodeling activities due to taphonomic effects.
Intra-specific variation in the distribution of the remodeling fields and taphonomic effects on the surface are making the study of remodeling processes arduous. Nevertheless the results indicate that the cerebral fossa turns into depository, around the age of seven, which places this transition within the age interval of the completion of the cerebral development. Further research is needed in order to confirm and better interpret the findings of this preliminary report.
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Insights from sequencing the Neandertal genome.

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Neandertals, a hominid group that appeared in the European fossil record around 400.000 years ago and disappeared around 30.000 years ago, are believed to be our closest extinct relatives. Although Neandertals and modern humans overlapped in certain regions in time and space, the relationship between us and them is unclear and contentious. A genetic comparison between modern humans and Neandertals could both address the relationship between us and them and offer the possibility to identify genetic changes that happened specifically on the lineage leading to fully modern humans. It may also allow to identify genes and other features in the human genome that experienced positive selection after Neandertals and humans separated. Over the past few years we have applied novel high-throughput DNA sequencing technologies to determine the DNA sequences of large parts of the Neandertal genome. This allows us to estimate divergence times for various parts of the genome between humans and Neandertals and to look for evidence of a genetic contribution of Neandertals to modern Europeans. We have furthermore developed and applied various targeted methods to sequence specific parts of the Neandertal genome. Results from each of these approaches will be reviewed.

Incisor microwear textures of five bioarcheological groups.

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Dental microwear texture analysis is a valuable tool for inferring aspects of subsistence behavior in human groups and diet in other mammals, though studies to date have been limited to molars. Here we report on the first microwear texture analysis of incisors. Five bioarcheological groups were included in the study: Aleut from various islands in the Bering Sea (*n*=24), Arikara from the Mobridge site in South Dakota (*n*=18), ethnic Chinese workers from Kodiak Island (*n*=16), a Late Woodland Bluff sample from Jersey County, Illinois (*n*=18), and Puye Puebloans from Pajarito Plateau in New Mexico (*n*=18).
First, a white-light confocal profiler was used to collect point clouds representing labial surfaces of maxillary central incisors for each individual. The area sampled was 278 µm x 204 µm, and the data matrix had 0.18 µm lateral spacing and 0.005 µm vertical resolution. Resulting data were then imported into Toothfrax and SFrax scale-sensitive fractal analysis software packages (www.surfract.com) for surface texture characterization. Results indicate significant variation among groups in several microwear texture attributes including complexity, anisotropy, textural fill volume, and heterogeneity. For example, the Puye had the highest complexity values, whereas the Aleut had the

highest textural fill volumes. Differences in incisor microwear among the groups are likely related to variation in diet, anterior tooth use, and exposure to abrasives. This study also suggests that incisors and molars may differ in the types of microwear texture attributes most likely to separate groups.
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An ethnographic and bioarchaeological assessment of Zuni warfare and leadership.

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The purpose of this study is to examine ethnographic accounts of Zuni warfare and social structure and how this is reflected in the biological and archaeological record. Examination of ethnographic accounts of Zuni social organization and ceremonial life should be reveal the ways in which the Zuni viewed warfare culturally and as a tool for socializing youth. Osteological data from Zuni burials should then also reflect an emphasis on warfare within the community through the presence of skeletal trauma. The skulls of 185 individuals from the protohistoric Zuni site of Hawikku, New Mexico were examined for evidence of antemortem and perimortem trauma. The data were then examined in relation to ethnographic and archaeological information, including identification of burials believed to belong to community leaders. The results indicate that 14 of 185 observable individuals displayed evidence of antemortem or perimortem cranial trauma. None of the individuals considered leaders, as determined through prior research examining associated grave goods and location of burials, displayed traumatic pathology. Also, the presence of trauma was not sex specific in the sample. The data suggests that Zuni ethnographic data could describe a more symbolic role for warfare, instead of the more commonly held belief that active participation in violence related to warfare was a part of daily life, resulting in a better understanding of leadership roles.

Troubling the waters of anthropology: Is wading the missing factor in the evolution of hominid bipedalism?

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Largely missing from the debate about the evolution of hominid bipedalism is a discussion of the possible role of wading in shallow water. This presentation reviews the literature that considers the concept, and suggests that it is the idea's mere association with the so-called "aquatic ape hypothesis" which accounts for its disapproval, as specific objections are largely absent. Outstanding questions exist about hominid origins relating to how bipedalism may have been practiced before traits evolved to make that mode of locomotion efficient. Recent findings have suggested solutions to these problems. One such study suggested that early hominids already walked with a Fully-upright (FUp) gait by showing that the Bent-Hip-Bent-Knee (BHBK) gait is 50-60% more energetically costly than a FUp human gait on land. Here, I report a similar study which confirmed these findings but also showed that in water the cost differential between these gaits is markedly reduced, especially in deeper water, at slower speeds and with greater knee flexion. For example, walking in waist deep water, at 0.6 m/s, with a 50 degree knee flexion reduced the cost differential between FUp and BHBK gaits to 18% ($p < 0.001$), whilst moving through water to the depth of the xiphisternum, at 0.3 m/s, there was no significant difference at all ($p = 0.631$).

On the basis of these findings, wading appears to be an extra factor which can only add value to the various models that have been published regarding the evolution of early forms of "non-optimal" hominid bipedalism.

Scaling relationships between molar crown, root and jaw size in anthropoid primates.

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Mandibular corpus form is thought to reflect masticatory function and the size of the dentition, but there is no universal association between tooth crown dimensions and mandibular corpus size across anthropoids. Previous research was based on the assumptions that crown size scales isometrically with root size, and that crown size is an appropriate proxy for overall tooth size. This study aims to assess the scaling relationship between the sizes of molar crowns and roots, and how both components are related to mandibular corpus size in anthropoids.
Permanent second mandibular molars (n = 59) representing 19 species were CT scanned and the volume and surface area of the anatomical crown and root were measured. A proxy for corpus volume at the M2 position was calculated as corpus height x breadth x M2 crown length using a subsample of 13 species (n = 30). Interspecific correlation and regression analyses reveal significant isometric relationships between crown and root volume, and between whole tooth and corpus volume, and a positive allometric relationship between root and crown surface area (i.e. as crown surface area increases, root surface area becomes disproportionately greater). In general, hard object feeders exhibit relatively larger root surface area per unit crown surface area compared to soft and tough object feeders. These findings support the hypothesis that large molar crowns correspond with large roots, which

in turn require large mandibular corpora to accommodate them.
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Calcar femorale visualized in computed tomographic images of the fossilized hominid femora, BAR 1002'00 and BAR 1003'00.

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Fossil and genetic data support an emerging consensus that human and chimpanzee lineages separated approximately 6 to 8 million years ago. Dated at 6 Ma, the fossilized femora BAR 1002'00 and BAR 1003'00, designated as *Orrorin tugenensis* (Senut *et al.* 2001), are among the oldest specimens pertinent to reconstructing hominid origins. Computed tomographic (CT) imaging has demonstrated that cortical bone distribution at the neck-shaft junction of BAR 1002'00 resembles the condition in later hominids, supporting the claim that the specimen represents a population that exhibited bipedal locomotion (Galik *et al.* 2004). However, even though these inferences have been confirmed independently on the basis of external bone morphology, they continue to be criticized on the grounds that the image quality was insufficient for the inferences made. Here we report independent evidence of analyzable CT image quality in these specimes. The calcar femorale is a dense vertical plate of bone, originating from the posteromedial portion of femoral shaft inferior to the lesser trochanter and radiating laterally towards the greater trochanter (Harty 1957). This structure, the expression of which has been taken as an indicator of upright posture (White 1984), appears discernible in both BAR 1002'00 and BAR 1003'00. In addition to supporting the claim that the image quality was adequate for the analyses and inferences published previously by our group, these new observaions provide further evidence that BAR 1002'00 and BAR 1003'00 belonged to bipedal hominids.
This work has been supported by The American Philosophical Society and Sigma Xi.

Resting in War and Peace: A Bioarchaeological Study of Group Violence in Peruvian Prehistory.

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Ethnic violence is an all too often occurrence in today's world. But to what extent do we find it in prehistoric societies? This paper reports on the bioarchaeological evidence for violence among different ethnic groups in prehistoric Peru. Human skeletal remains affiliated with the Chanka society (AD 1000-1400) were examined to see if patterns of traumatic injury due to violent conflict are associated with markers of ethnic identity. Cranial remains (n = 136) excavated from caves at two Chanka heartland sites in the highland province of Andahuaylas, Peru were examined.
This study systematically characterizes cranial modification—a known indicator of ethnic identity in the ancient Andes, and tests associations between the presence or absence of modification and patterns of traumatic injury. 60% (n = 81) of Chanka crania are modified. 50% (n = 65) of skulls show healed cranial fractures, indicating non-lethal trauma. 33% (n =44) exhibited unhealed skull fractures, suggesting that those head injuries were the mechanism of death. This study also exams the locational distribution of cranial trauma along age and gender lines. Finally, 19 % (n = 25) skulls exhibit evidence of trepanation—the purposeful, surgical piercing of the skull done to alleviate inter-cranial pressure caused by traumatic injury. As a medico-cultural practice, trepanation is an important indicator of how the Chanka coped with violence in their society. Initial results suggest that individuals in Chanka society who possessed modified crania were disproportionately targeted for violence, compared to their "unmodified" neighbors.
Vanderbilt University supported this research.

Molar crown development in *Australopithecus afarensis* and aspects of hominin life history.

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Australopithecus afarensis is one of the better represented hominin species of the African Pliocene. Crown formation time (CFT) of the anterior teeth and patterns of tooth emergence suggest that this species developed at a pace more similar to the apes than to modern humans. However, no studies have been reported on molar CFT. Given the relationships between molar CFT and life history related variables in primates, such studies are important and help build a more detailed pace of development in *A. afarensis*. We analyzed cusp and crown formation time in three naturally fractured molars from Hadar and Omo assigned to *A. afarensis*. Counts of lateral striae were multiplied by the known periodicity to obtain lateral enamel formation times. Cuspal enamel formation was calculated by measuring the linear cuspal thickness which was divided by the average cuspal daily secretion rates. All specimens had lower cusp and CFT than modern humans and more similar to chimpanzees. Total CFT recorded were: 2.02 years for M_1 (AL-333-52) and 2.37 years for the M_3 (AL-366-1). Percentage of cuspal to lateral enamel in *A. Afarensis* is different from *Pan*, early *Homo* and *A. africanus*, but similar to *Paranthropus*.
Statistically significant correlations were found between hominin M1 CFT and cranial capacity but not with body mass. This study also

shows that the lower M_3s of *A. afarensis* are characterized by an enamel extension along the distobuccal root containing a number of perikymata; this was not the case on lower M_1s. Funding: Leakey Foundation (USA) and Paleontology Scientific Trust (South Africa).

Patterns of knee joint shape dimorphism in guenons (*Cercopithecus*) reflect interspecific scaling trends among cercopithecoid monkeys.

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Body mass dimorphism (BMD) may necessitate sex-based differences in the supporting skeleton as a means of maintaining comparable joint stress. Cercopithecoids, for example, have been shown to exhibit limb joint *size* dimorphism beyond the isometric expectation. For a double-sided joint (e.g., the knee), uneven load distribution might also produce *shape* dimorphism involving differences in the relative size (and/or shape) of each condyle. This study tests for shape dimorphism in the cercopithecoid knee joint and evaluates whether patterns of dimorphism resemble interspecific scaling trends.
Landmarks and linear dimensions of the distal femur were quantified from video images for 14 cercopithecoid species exhibiting a range of BMD. Interspecific scaling of joint dimensions was examined with linear regression. Multivariate and geometric morphometric techniques were used to test the null hypothesis of shape similarity between conspecific sexes and to examine any shape differences detected. In contrast to most taxa (no dimorphism), the three sampled *Cercopithecus* species exhibit strikingly similar patterns of significant shape dimorphism in the distal femur. While sexes show no difference in the ratio of medial to lateral condyle size, males are characterized by relatively wider condyles than females. This difference is achieved via a narrower intercondylar space in males, but with no difference in overall mediolateral joint width. The *Cercopithecus* pattern of dimorphism is reminiscent of interspecific scaling trends among cercopithecoids and is likely a biomechanical response to BMD. The observance of significant joint shape dimorphism within extant taxa must be considered when interpreting variation in the fossil record.
This research was supported by a grant from the National Science Foundation (NSF SBR-9712585).

An evaluation of the relationship between living stature and vertebral body height and width measurements from C.T scans.

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The goal of this study was to determine the value of vertebral body measurements in predicting living stature. This relationship was tested with the use of C.T. images from a living British population. This sample consisted of 74 individuals: 39 males, 36 females, and an age range of 23 – 82 years. Each participant had their height measured just prior to their C.T scan. The anterior vertebral body height and maximum width of the lower thoracic and lumbar portion of the spine (T11 – L5) were measured from C.T scans using Syngo (2005), a Siemens AG Medical Solutions imaging computer program. A total of 14 measurements were taken, two from each of the seven vertebrae.
The results showed the strongest correlation when vertebral body height and width measurements were combined. Regression equations using these combined measurements on individual vertebra produced correlations of 37.2% with L1 in females and 33.2% with L3 in males. Segments with a combination of the 14 measurements produced much higher correlations 67.3% for males**,** with a S.D of 4.801, and 59.5% for females**,** with a S.D of 6.071. All results were significant at the .01 or .05 significance level. These correlations are comparable to those produced by Trotter and Gleser using long bones and suggest a possible use in archaeological and forensic samples.

History of degenerative joint disease in Europe: inferences about lifestyle and activity.

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Greek Ministry of Culture, [10]University of Durham, [11]Natural History Museum Vienna, [12]University of Freiburg, [13]University of Coimbra, [14]University of Szeged, [15]Archaeological Service, CAD Douai France, [16]State University of New York, College at Oneonta, [17]University of Sheffield, [18]28th Ephorate of Byzantine Antiquities, [19]University of Bradford, [20]University of Birmingham, [21]University of Basel, [22]University of Bern, [23]University of Rome, [24]Independent Osteoarchaeological Consultant, Ireland, [25]Nicolaus Copernicus University, [26]Stockholm University, [27]University of Athens, [28]Mount Holyoke College, [29]American School of Classical Studies at Athens, [30]Latvian University, [31]Arizona State University, [32]University of Oslo, [33]York Osteoarchaeology Limited, [34]Natural History Museum, Basel, Switzerland, [35]AOC Archaeology, [36]University of Exeter, [37]University of Chicago, [38]Université de Caen Basse-Normandie, [39]Syracuse University, [40]National Academy of Sciences Ukraine, [41]Western University, Pomona, [42]University of Leiden, [43]University of Arkansas, [44]Universitat Autònoma de Barcelona, [45]Department of Archaeology, City of Dordrecht, The Netherlands, [46]"Francisc J. Rainer" Anthropological Research Center, [47]University of York.

Degenerative joint disease (osteoarthritis) is central to behavioral reconstruction in past societies, especially as it relates to mechanical function and lifestyle. This investigation documents and interprets temporal and geographic patterns derived from the Global History of Health project in Europe. The objective is to draw inferences about activity in relation to key shifts in settlement, technology, and other factors that influence lifestyle. Skeletal samples are from sites throughout Europe and are subdivided into six periods—Prehistoric, Classical Antiquity, Early Middle Ages, High Middle Ages, Late Middle Ages, and Modern (post-Columbian). Pathological conditions were scored on six joint complexes—shoulder, elbow, hand, hip, knee, and ankle—for both presence and severity of pathology (degree of marginal lipping and articular surface degeneration).
Statistical treatment (linear regression) revealed age-related increases, which is especially rapid in the shoulder and hip and more so in men than in women ($p<0.001$). Temporal comparisons reveal significant reduction in age-standardized scores between the Prehistoric and Late Middle Ages followed by a pronounced increase in the Modern era. Right-side upper limb joints are significantly more affected than left-side upper limb joints; lower limb joints show virtually no asymmetry. Women have more right-left asymmetry than men for the upper limb. These findings indicate patterns of variation relating to shifts in lifestyle and activity reflecting general reduction in mechanical loading of joints and difference in how men and women used their upper limbs. Underlying causes explaining this variation likely relate to technological change, especially as it influences workload.
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Analysis of aDNA From Maya Skeletal Remains Using the Mitochondrial Control Region.

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Thanks to Dr. Mark Cohen excavating a Maya temple ruins in Tipu, Belize, a sample size of 588 skeletons was discovered and presently resides at SUNY Plattsburgh campus. This is the largest known collection of ancient Maya skeletons currently available for isolating and analyzing ancient DNA (aDNA). Research indicates only a limited amount of Maya aDNA has been sampled or analyzed using the mitochondrial control region. DNA sequencing of each of the presently available samples at SUNY Plattsburgh will allow for an expansion of the limited populations that have been tested and publicized. This laboratory's preliminary studies indicate differences from known published Native American contemporary DNA as evidenced by variations in the 14 nucleotide hypervariable region. Our additional studies will compare relatedness of the Maya skeletons to each other as correlated to their burial place within the Tipu site. Using Bioinformatics databases, such as the Dolan Learning Center database, further analysis of phylogenetic trees will allow examination of Maya aDNA relatedness to other presently known aDNA samples and to other published Native American mitochondrial DNA.

Comparing patterns of natural selection on life history traits in humans and lemurs.

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When controlling for body mass, Verreaux's sifaka have extremely slow life history schedules. They begin reproducing later and live longer than all other primates for which there are comparable data. In addition, when controlling for body mass, Verreaux's sifaka have longer reproductive careers than all other primates, including humans. While it is obvious sifaka and humans are different in many aspects of their behavior, anatomy, and physiology, there are similarities between the two species concerning life history schedules. These similarities include delayed reproductive maturity, extended reproductive careers, and long lives. Despite these similarities, we know little about the type and magnitude of selection pressures that shape life history schedules these two species. In this study, I compare patterns of selection acting on the sifaka life

cycle to patterns of selection acting on the human life cycle. The sifaka data are derived from an on-going study of Verreaux's sifaka in southwest Madagascar; the human data are derived from published sources. In comparing patterns of selection acting on humans and sifaka, the following similarities are found. Directional selection acts more strongly at older age classes, whereas concave (or "stabilizing") selection acts on younger age classes. Selection acts to increase the variation in fertility at young age classes and reduce it at later ages. Negative correlational selection acts on survival at any age class and fertility at that same age class or younger. These results suggest that similar selection pressures produce convergences in life history schedules among distantly related primates. As I discuss, some of these convergences might be attributed to evolution in stochastic environments.

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Using comparative genomics to improve understanding of hominid craniofacial evolution.

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The hominid skull has undergone relatively recent and rapid change characterized by reduced facial size and prognathism, increased cranial vault globularity, and reorientation of the cranial base. Morphological changes in the head are well documented in the fossil record, though the exact timing and association of the various changes to their underlying molecular factors remain unknown. The Genomics of Cranial Morphology Project brings data from paleontology, quantitative morphology, and bioinformatics together to identify DNA sequence involved in hominid skull evolution.

Bony landmarks were measured from computed tomography (CT) scans of the skulls of 420 pedigreed and genotyped baboons, *Papio hamadryas*, from the Southwest Foundation for Biomedical Research. Whole-genome linkage analysis was used to locate quantitative trait loci (QTL) corresponding to the landmarked distances, and we discovered several significant and suggestive QTL. Using bioinformatics methods under a comparative genomics framework, the homologous human regions were identified and interrogated for genes previously demonstrated to affect craniofacial growth and development in model animal, human association, and/or familial linkage studies. These candidate genes were then examined for both coding and noncoding DNA sequence changes, using alignments from the human, chimpanzee, rhesus macaque, mouse, and dog genomes. This project adds to our knowledge of hominid skull evolution by uniquely combining comparative genomic data with phenotypic observations of a highly relevant model organism.

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Incisor Root Morphology in Neanderthals and *Homo sapiens*.

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Incisor root morphology has been shown to be adaptively linked to differences in tooth use in both living and extinct primates. The relatively large and shovel-shaped incisor crowns of Neanderthals (*Homo neanderthalensis*) have been posited to be an adaptive response to high occlusal loads and a highly abrasive diet. Since tooth roots dissipate occlusal loads into the jaws, incisor root morphology can be examined to compare the loading regime of the anterior dentition in Neanderthal and *Homo sapiens*.

Previous studies have shown that incisor root length is significantly greater in Neanderthals than in *Homo sapiens*. We expand on these findings through a comparison of incisor root size variables in Neanderthals (n=15) and *Homo sapiens* (n=10). Maxillary central and lateral incisors were scanned using micro-computed tomography and 3D surface models were generated. From theses models, external linear measurements, root surface area and root volume were quantified.

Mean comparisons using Student's T test revealed that Neanderthals have statistically significant larger incisor roots in terms of length, labio-lingual and mesio-distal diameters, surface area and volume (all analyses $p \leq 0.05$). These preliminary findings are consistent with the hypothesis that Neanderthals engaged in a different incisor loading regime than modern humans. The implications of these results for biomechanical modeling of the functional incisor root morphology of Neanderthals and *Homo sapiens* are discussed.

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Postcanine occlusal loading and relative dental arcade width in pitheciine primates.

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The constrained lever model (Greaves, 1978) predicts that selection for high magnitude postcanine bite force will involve a relative narrowing of the dental arcade to facilitate increased balancing side muscle force production (Spencer, 1999). Pitheciine monkeys, a monophyletic group with well

established variation in the physical properties of their foods, are an ideal test case. Fruit pericarp incised by *Chiropotes* has a higher puncture resistance than fruit incised by *Pithecia*, but *Pithecia* masticates seeds with a higher crushing resistance (Kinzey and Norconk, 1993). Here, I test the hypothesis that, for a given jaw length, *Pithecia* possesses a narrower dental arcade than *Chiropotes*. I measured 65 adult male mandibles of *Callicebus torquatus* (18), *Pithecia pithecia* (22), *Chiropotes satanas* (13) and *Cacajao calvus* (12). Jaw length was measured as the distance between infradentale and the most posterior point of the left mandibular condyle. Dental arcade width was measured as the distance between the buccal margins of M_1 crowns. Dental arcade width was analyzed relative to jaw length. Both were analyzed relative to published species-mean body masses. Results of a nonparametric Mann-Whitney *U*-test reveal that *Pithecia* does, in fact, possess a significantly narrower dental arcade than *Chiropotes* relative to jaw length ($P<0.0001$). This is unlikely to be a size related phenomena being that there is no significant difference in dental arcade width relative to body mass ($P=0.28$). These results add support to the hypothesis that bite force and the risk of temporomandibular joint distraction have shaped the evolution of the primate masticatory system.

Extracting adult survivorship information from fossil samples: the uses and limitations of OY ratios.

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In a previous study, we proposed a new way to examine the evolution of human longevity by using the ratio of older adults to younger adults in fossil samples (Caspari and Lee, 2004). Because these ratios do not rely on age-specific demographic data, our approach can compare fossil data that are difficult to analyze when applying traditional demographic analyses. However, the scope and limitations of the approach have not been fully explored. Here, we examine how ratios of older to younger adults vary in different populations of known demographic parameters, and explore patterns of variation.
In this paper we examine the ratios of older to younger adults in several samples of modern humans, non-human primates, and model populations under the assumptions of stable population theory. The ratios of older to younger adults vary substantially among samples, but in a pattern that reflects mortality and survivorship in adult populations. OY ratios are low in populations with high mortality level, and they increase in values with decreasing mortality level. We conclude that this approach provides a powerful tool to address demographical questions in fossil samples.

Origins of enslaved labor force from 18th century colonial Albany inferred from mtDNA: Africans, Native Americans, and Madagascarians?

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A burial ground in the Town of Colonie, NY along the Hudson River revealed fourteen individuals dated from the 17th through the early 19th centuries. Bioarchaeological analysis suggested these individuals were of African ancestry who had worked and died on the property owned by the prominent Schuyler family. Mitochondrial DNA analysis was carried out on seven adult remains using restriction fragment length polymorphism typing and direct sequencing of the control region to infer their origin and relatedness. Results show that none of the individuals are maternally related with five individuals identified as African haplogroup L, one identified as a Native American haplogroup X, and two identified as belonging to haplogroup M7. Individuals of African ancestry correlate with published data on African Americans as well as various exit points in Africa before entry into New York State. Individuals identified as haplogroup M7 resemble lineages in Madagascar from which documents suggest several hundreds of people were imported through illegal trading to New York by the end of the 17th century. This study highlights the diverse origins of the enslaved labor force in colonial New York and contributes to our understanding of African American history in the northeast.
This study was supported by the New York State Education Department.

Paleopathology of a 19th-century cemetery in Tucson, Arizona.

T.L. Leher, S.B. Black. Statistical Research, Inc.

In 2006, Statistical Research, Inc. (SRI), under contract with Pima County, Arizona, began the task of excavating, analyzing and identifying burials that were to be impacted by the construction of the Joint Courts Complex, on the site of the former location of Tucson's "National Cemetery". It is unclear when the first burials were interred. Nevertheless, archival research suggests some of the earliest documented graves date to around 1862. The city officially closed the cemetery in 1875; however, the military section continued to be used until 1881. As of the completion of analysis, SRI analysts were able to document 1083 graves containing at least 1397 individuals of all ages. This study focuses on the impact of infectious disease on the adult population recovered from the civilian section of the cemetery. Preliminary findings focus on the pattern and distribution of both nonspecific and specific indicators

of disease, including periosteal reactive bone, lytic and proliferative reactions, osteomyelitis, reactions on the visceral aspect of ribs, as well as other conditions. A detailed examination of the most prevalent diseases in this population is presented, while highlighting some examples of unique pathological conditions. Finally, the relationship between pathological manifestation and the various sex and age groups within the cemetery population is explored and compared to other historic cemeteries excavated in the United States.

Orangutan's flexible deployment of techniques in problem solving.

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Some human cultural traditions change over time and accumulate modifications made by different individuals in the direction of greater complexity, which has been described as cumulative cultural evolution or "ratchet effect". While striking cultural variation in behavior from one site to another has been described in chimpanzees and orangutans, cumulative culture seems to be limited to humans. In recent experiments captive chimpanzees were found to be rather conservative, as they maintained the technique they had learned initially. Behavioral flexibility in problem solving in the sense of striving for new solutions after having learned a first technique is a vital prerequisite for cumulative build-up of techniques. Our aim was therefore to experimentally investigate how flexible captive orangutans would be in applying techniques in a problem solving task. We provided nine Sumatran orangutans with two types of transparent tubes partly filled with syrup, along with potential tools such as sticks, twigs, wood wool and paper. In the first phase of the experiment the orangutans could reach inside the tubes with their hands (regular conditions), in the second phase tubes were too narrow for their hands to fit in (restricted conditions). We found that orangutans showed high behavioral flexibility, applying ten different techniques under regular conditions and switching techniques under restricted conditions. Additionally our experiment yielded a complex technique that built up on earlier ones. This suggests that orangutans might have some power for cumulative build-up of techniques. Research on cumulative culture in Great Apes might be promising in orangutans.

Dental eruption, age estimation, and life histories in papionin primates.

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Life history analyses require accurate estimates of event timing throughout the lifespan. Dental eruption estimates often provide basic chronological age data, and tooth eruption may be correlated with several life history events, especially maturation events. This study tests the hypothesis that patterns of dental eruption in two papionin primate species covary with life history distinctions between taxa and sexes.
Mixed longitudinal dental eruption data were collected from captive sooty mangabeys (*Cercocebus atys*, N=53) and *Papio* baboons (*Papio hamadryas*, N=218). Maxillary molars from the right side were scored as either not fully erupted or fully erupted. We applied transition analyses to interval-censored data to estimate the parameters for distributions of eruption ages. This approach leads to better estimates of developmental event timing than traditional methods (e.g., regression analysis).
Transition analyses show that, counter to expectations, dental eruption may be independent of key life history events. Mangabeys erupt molars later than *Papio* baboons but typically reproduce much earlier. Within species, females erupt both M1 and M3 later than males, but M2 eruption ages are comparable. Dental eruption in these species may be independent of other maturation events.
These results raise major concerns about how well dental eruption tracks life history variation in primates, at least during maturation. Independence between molar eruption patterns and maturation markers suggests multifactorial influences on the evolution of dental eruption. Sex differences in eruption may reflect differential mortality rates.
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Locomotor mechanics of the kinkajou (*Potos flavus*): another case of convergence with primates.

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Kinkajous are highly arboreal South American procyonids that travel and feed on relatively thin branches (1 to 5 cm in diameter) for mammals of that body size (1.4 to 4.6 kg). In several ways, kinkajous converged with primates and some arboreal marsupials in behavior and ecology. Therefore, they represent a critical species to test functional links between primate-like biomechanics and arboreal locomotion. To this end, we examined in the laboratory the locomotor mechanics of kinkajous. Synchronized high-speed digital video (125 fps) and force platform data were recorded in two individuals of similar body mass when walking quadrupedally on a 25-mm pole. Over 100 strides were analyzed and several locomotor parameters were observed or measured: (1) footfall pattern, (2) degree of arm protraction at forelimb touchdown, and (3) peak vertical substrate reaction forces (V_{pk}) on the forelimbs and hindlimbs. Like primates and some arboreal marsupials, kinkajous

relied primarily on diagonal-sequence and trotting gaits during walking. At forelimb touchdown, average arm protraction was 126°, well within the range reported for primates and woolly opossums. During walking, average V_{pk} was 23.6 N (63.7% body weight) on the forelimbs and 24.3 N (66% body weight) on the hindlimbs. Slightly more weight was borne by the hindlimbs comparatively to the forelimbs. Overall, the locomotor profile of kinkajous resembles that of primates and woolly opossums more than any other mammals. This case of convergence strengthens the functional link between primate-like biomechanics and arboreal locomotion, particularly when locomotion takes place on relatively thin substrates.
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Implications of alternative carrying strategies for infant thermoregulation.

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Human infants are particularly vulnerable to the effects of cold stress. Neonatal cold injury represents an important cause of morbidity and mortality among populations living in northern climes. Although infants have the ability to increase metabolic heat production in response to cold, their small body masses and high surface area to weight ratios place them at a substantial thermoregulatory disadvantage compared to adults. Consequently, the ambient temperatures associated with minimal metabolic rates in infants and newborns are 5 to 7 degrees higher than for adults. Among traditional societies living in cold climates, infant carrying strategies play a critical role in buffering young children from thermal stress. This paper examines the metabolic and thermoregulatory consequences of different infant care taking practices among indigenous populations of arctic and high altitude environments. Physiological studies carried out among infants of highland Peru (Tronick, *et al*. 1994) and Mongolia (Narangerel et al. 2007; Tsogt et al. 2006) show that traditional techniques used for carrying infants create microenvironments with higher and more stable temperatures, and reduced partial pressures of oxygen. Together, these changes serve both to reduce cold stress and decrease metabolic rates of infants. It appears that the development of effective infant carrying techniques was critical for promoting child survival with the expansion of human populations into cold environments.

Ontogenetic scaling of facial orientation and basicranial flexion in the African apes.

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This is the first comprehensive test of whether differences in facial orientation and basicranial flexion between *Pan* and *Gorilla* reflect shared ontogenetic scaling. Lateral view radiographs were used to quantify facial orientation as the angular relationship between the hard palate and three neurocranial reference planes and basicranial flexion as the angles formed between various representative planes of the anterior and posterior cranial bases. Growth-related change in the African hominoids was assessed by calculating the value and significance level for Pearson's product-moment correlation coefficient between the facial and basicranial angle values and a size surrogate in mixed cross-sectional series for each taxon. Lowess line-fit procedures were also used to qualitatively map such changes in bivariate plots of the angles versus size.
Adult gorillas exhibited significantly more dorsally rotated midfaces than adult common chimpanzees and exhibited significantly flatter or more open basicranial angles. Neither group displayed significant sexual dimorphism in the expression of the included angles. However, the growth trajectories for *Gorilla* and *Pan* were roughly coincident for each angle and suggest these taxa follow similar trajectories for age-related changes in facial orientation and basicranial flexion. The size-controlled data do not support a fundamental divergence between *Pan* and *Gorilla* in these characters. In both taxa, the basioccipital clivus rotates posteriorly to a significant degree during ontogeny which affects the interpretation of any angular measurements made in relation to this standard registration plane.
These results have implications for evolutionary scenarios of hominoid skull form evolution as well as for broad comparative primate studies.

Chest staining variation as a signal of testosterone levels in male Verreaux's sifaka.

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Adult male Verreaux's sifaka (*Propithecus verreauxi verreauxi*) exhibit variation in the staining of the chest hair in association with the activity of the sternal gland. Scent-marking behavior and social relationships have been shown to vary with the state of male chest staining. Research on other mammals suggests that sternal gland activity is modulated by testosterone. The goal of this study was to examine the relationship among fecal testosterone, testes mass, and chest staining in sifaka. I predicted that (1) testosterone and testes mass are positively correlated, (2) stained males have higher testosterone and larger testes than clean-chested males, and (3) testes mass is greater during the mating season than the birth season. Eighty fecal samples were collected from eight adult males in five social groups in the Kirindy Mitea National Park of Madagascar during the mating season and

analyzed using enzyme immunoassays. Males were captured during the mating season and the subsequent birth season to measure body mass and testes size and to document chest staining. All predictions were supported by this analysis. Males with stained chests had significantly higher fT and larger testes mass. Testes mass was significantly greater during the mating season than the birth season for all males. However, the stained males exhibited less testes mass reduction during birth season. These results are consistent with the hypotheses that (1) the activity of the sternal gland is regulated by testosterone, and (2) the staining on the chest is a visual signal of testosterone levels in male Verreaux's sifaka.

Natural selection and alcohol.

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We have previously presented strong evidence that selection has been responsible for increasing the frequency of the ADH1B*47His allele in some East Asian populations especially when in cis with a variant in the ADH1B promoter region. This amino acid substitution, Arg47His, results in a more rapid conversion of ethanol to acetaldehyde. In conjunction with a dominant-negative form of ALDH2 (also common in East Asian populations), the ADH1B*47His allele is responsible for the flushing reaction due to high acetaldehyde levels so common in East Asians after alcohol consumption. If selection were operating on elevated acetaldehyde levels—the prevailing hypothesis—there should also be evidence for selection for the dominant-negative allele at ALDH2. However, the nature of DNA variation in the region of ALDH2—extensive long range linkage disequilibrium in all haplotypes—has made direct examination of genomic signatures of selection at ALDH2 difficult/impossible to date. One possibility is that the 47His variant only became significant in elevating acetaldehyde levels in the presence of decreased ability to eliminate acetaldehyde. To further explore this possibility we have been collecting data in our lab, from the Asian literature, and from colleagues on multiple populations in East Asia to examine the joint geographic distributions of the frequencies of the relevant variants at ADH1B and ALDH2. Our new data show that the relevant frequencies at both loci increased in the eastern part of East Asia, and that both alleles increased at about the time of the emergence of agriculture.

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A genetic association study of normal variation in facial features.

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Although facial feature variation among individuals and populations clearly suggests genetic causes, little research has focused on the genes underlying genetic variation in these traits. Given admixed populations trace their genetic ancestry to multiple parental populations that differ in facial features, they can be useful in studying the genetics of genes underlying these traits. We have tested for correlation between normal variation in facial traits and genetic ancestry, showing significant relationships. Here, selection-nominated candidate genes with known involvement in Mendelian craniofacial dysmorphologies and high allele frequency differences between West African and European populations were tested for admixture linkage to normal facial traits. The study consists of 254 subjects, ages 18-35, of West African and European genetic ancestry. 3D images of faces were acquired using the 3dMDface imaging system and 22 standard anthropometric landmarks were placed on each image. Landmark data were collected using 3dMD Patient software and analyzed using Euclidean Distance Matrix Analysis (EDMA). Each individual was genotyped at 176 Ancestry Informative Markers, allowing for proportional estimation of genetic ancestry from four parental populations.

ANOVA analyses tested for associations between the pairwise landmark distances and candidate genes, using sex, height, body mass index (BMI), and maximum-likelihood genetic ancestry estimate as covariates. Results indicate distinct patterns of facial variation associated with each gene. Next, ADMIXMAP was run using a four-population model with sex, height and BMI as covariates. Results indicate concordance between the two analyses, although ADMIXMAP has fewer significant associations as it better controls for false associations due to stratification.

Biomechanics of foot strike in habitually barefoot versus shod runners.

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Hominins evolved to run long distances, possibly as much as 2 million years ago, and until recently, humans ran either barefoot or in soft sandals with minimal cushioning or arch support. Here we investigate whether heel strikes, characteristic of approximately 80% of modern shod runners, are typical of habitually barefoot runners. We also investigated how the foot's initial contact with the ground influences the rate and magnitude of the heel strike transient (HST), an impulse several times body weight that travels from the ground to the head in less than 10 ms, and which is thought to be a

major cause of injury among distance runners. Leg kinematics, HST ground reaction forces, and foot strike patterns were recorded in habitually shod runners, habitual barefoot runners, and in a group of habitually shod runners training to run in Vibram FiveFingers (VFF, a shoe that protects the sole of the foot but provides no arch support or cushioning). We found that habitual barefoot runners while running barefoot avoid heel strikes, and tend to exhibit lower rates of HST loading than do habitually shod subjects in the same condition. In addition, after several weeks of training in VFF, runners transitioned to a higher percentage of midfoot strikes. For all groups in the barefoot condition, decreased HST loading rates were significantly correlated with a lower angle of incidence of the foot at heel strike and with greater limb compliance during the initial part of the stance phase. Although running shoes with large cushioned heels decrease the magnitude and rate of loading from the HST, habitual barefoot runners face different HST loading regimes than habitually shod runners.

Mechanical stress and activity among middle Holocene foragers of Siberia's Cis-Baikal region.

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This paper examines osteoarthritis and musculoskeletal stress markers (MSMs) in Siberia's Cis-Baikal region, focusing on the reconstruction of mid-Holocene mobility and activity patterns. Of particular interest is an apparent seventh millennium BP biocultural hiatus characterized by an 800-1000 year interruption in the region's cultural continuity. The skeletal remains of approximately 200 adult individuals from four cemetery populations – two representing the Early Neolithic (pre-hiatus) Kitoi culture (8000-7000/6800 cal. BP) and two the Late Neolithic/Bronze Age (post-hiatus) Isakovo-Serovo-Glaskovo (ISG) cultural complex (6000/5800-4000 cal. BP) – are considered. Prevalence, severity, and distribution of MSMs and osteoarthritis are investigated both within and among these populations in order to test the hypothesis that pre- and post-hiatus peoples engaged in different activity levels and mobility patterns associated with distinctive adaptive strategies. Results of osteoarthritic analyses reveal that activity levels remained relatively constant throughout the middle Holocene period, but that specific activity patterns did not. For example, the data point to increased sexual disparity among the Kitoi, with males exhibiting significantly higher knee degeneration and females significantly lower vertebral degeneration. Results of MSM analyses also reveal higher heterogeneity in overall activity among Early Neolithic populations - with Kitoi males exhibiting more pronounced upper limb MSMs than both contemporary females and ISG males - but relative constancy during the Late Neolithic/Bronze Age. Finally, for all occupants of the middle Holocene Cis-Baikal, activity patterns - especially the consistently high-ranked costoclavicular ligament and *deltoid* and *pectoralis major* muscle attachments - appear to be consistent with watercraft use.

Assessment of the dietary transition in the Southern Lower Mississippi Valley through the analysis of dental paleopathologies.

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The timing of the dietary shift from foraging to maize agriculture, and the rapidity with which such practices were adopted, are important considerations in the cultural evolution of the New World. In the southern Lower Mississippi Valley, maize agriculture traditionally was believed to have been practiced during the Coles Creek period (A.D. 700-1200); however, direct evidence for maize is lacking in the archaeological record prior to A.D. 1000. Additionally, recent bioarchaeological research (Listi, 2007) using dental caries supports the notion that Coles Creek populations did not practice maize agriculture.

The present study further explores the question of the dietary transition in the southern Lower Mississippi Valley by examining the frequency and interaction of multiple dental paleopathologies, including abscesses, antemortem tooth loss (AMTL), calculus, caries, periodontal disease, and tooth wear. Data were collected from the dentitions of 302 individuals from eight sites in the southern Lower Mississippi Valley following recommendations in Buikstra and Ubelaker (1994) and Lukacs (1989). Temporal variation was assessed by dividing the sample into Pre-Coles Creek, Coles Creek, and Post-Coles Creek categories. Data were analyzed using SPSS. Results suggest that, though the Coles Creek sample has the higher frequency of AMTL, calculus, and periodontal disease, the frequencies of all pathologies, with the exception of caries, decrease through time. Furthermore, based on the Kruskal-Wallis test, significant differences exist among temporal categories for caries ($p = .038$), tooth wear ($p = .000$), and in the frequency and severity of periodontal disease ($p = .000$). Results from this study further support the conclusion that Coles Creek populations did not practice maize agriculture.

Identification of infanticide in the Greco-Roman world: a contrary view from the Agora of Athens.

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The identification of infanticide in perinatal skeletons is a topic that has engendered considerable controversy; distinguishing normal infant mortality from catastrophic death or large-scale infanticide is difficult at best. Roman-era infant skeletons deposited in a sewer at Ashkelon, Israel (Smith and Kahila 1992) have been identified as victims of infanticide, based

primarily on the age-at-death distributions and the lack of formal burial. Similar age distributions from Roman cemetery burials have been interpreted both as infanticide in Britain (Mays 1993) and natural infant mortality in Egypt (Tocheri et al. 2005). Analysis of a late Hellenistic/early Roman group of perinatal infant skeletons (n=457) deposited in a well in the Athenian Agora, suggests that infanticide may not be the appropriate interpretation of perinatal mortality, even in the absence of formal burial. The frequency distributions of long bone lengths indicate that all of these sites have similar patterns, but the Agora infants also have been demonstrated to have died from a variety of natural causes including premature birth and infectious disease (Liston AAPA 2007). The age distribution is similar to that found in other collections of infants, all identified as natural perinatal mortality. As further evidence against wide-spread infanticide, morphological evaluation of the 321 preserved ilia from the Agora tentatively suggests a nearly balanced sex ratio as expected with natural deaths, in contrast to a subsample from Ashkelon (Mays and Faerman 2001). However, the identification of developmental defects in at least nine Agora infants suggests that infanticide may be implicated in some infant deaths.

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Seasonal rainfall and male invasion alter fecal glucocorticoids in female Verreaux's sifaka (*Propithecus verreauxi verreauxi*).

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Several studies across non-human primates have established a complex relationship between the stress response and various ecological and social factors. Fluctuations in glucocorticoid levels have been linked with food availability, climatic variation, anti-predator response, dominance relationships, and group dynamics. However, most of this research has focused on males, and relatively little is known about these relationships in female primates.

This study addresses the changes in female hormonal profiles associated with seasonal rainfall and group dynamics in wild Verreaux's sifaka (*Propithecus verreauxi verreauxi*) in southwest Madagascar. Fecal samples and behavioral data were collected over the five month period of lactation in eight females with infants from four separate groups. Fecal glucocorticoid (fGC) levels were assessed by corticosterone radioimmunoassay of dried samples. The first rains of the season occurred in mid-October, during which time two of the focal groups were subject to male take-over events resulting in the observed and inferred infanticides of five infants. Mean fGC levels were significantly lower after the onset of rain than in the preceding dry months. However, fGC levels of females in unstable groups showed a subsequent increase after the onset of rain, resulting in significantly higher post-rain fGC levels than those of females in stable groups. Thus, while the onset of the rains resulted in decreased fGC levels for lactating females, this response was attenuated by increased social stress due to male take-over events and the loss of infants.

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Estimating age from developing teeth: a comparison of methods.

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Developing teeth are used to assess maturity and estimate age in several disciplines. The aim of the study was to determine which of the most well known dental age estimators was best at assessing true age. Tooth formation was assessed from radiographs of healthy children attending a London dental teaching hospital. The sample of 491 boys and 455 girls (aged 3.00 to 16.99 years) includes similar number of children from Bangladeshi and British Caucasian ethnic origin for each year of age. Panoramic radiographs were examined and seven mandibular teeth staged. Dental age was calculated using four dental maturity scales and eleven methods that use data for individual teeth. Several different statistics are needed to understand performance of an ageing system. These include bias, median absolute difference, percentage aged to 6 months of age and percentage aged to 10% or less of age. Methods that perform worst include those based on 'mean age of entering a stage' as well as Nolla's method. The dental maturity scale of Willems *et al.* (2001) performed best based on 827 individuals with developing teeth. Average difference was -0.14 year, median absolute difference was 0.51 year, 49% of individuals were aged to within six months and 71% of individuals were aged to 10% or less of age.

Positive natural selection in the MMP9 gene correlates with placental invasion in primates.

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Evolutionary changes to the placenta likely have large fitness effects due to its important role in sustaining fetal life. Placental morphology varies greatly among primates. The most dramatic difference in primate placentation is the degree to which the placenta invades maternal tissues. The extent of placental invasion affects fetal nutrient availability. Morphological changes to the placenta have long been thought to facilitate key adaptations including humans'

increased brain size. Phylogenetic analyses show that strepsirhine placentas are non-invasive while the haplorhine clade possesses the more invasive phenotype. Further modifications in hominoids and along the human lineage result in even greater nutrient transfer from the mother to fetus. Despite its importance, primate placental evolution has been poorly studied and molecular changes that underlie placental invasion have been largely ignored.

This study seeks to link adaptive morphological change in the placenta to its underlying genetic mechamisms. Placental invasion occurs though the action of the Matrix Metalloproteinase 9 (MMP9) enzyme. Using newly-generated and published MMP9 DNA sequence data from 18 species, I test the hypothesis that positive selection remodeled the MMP9 protein to enable placental invasion in haplorhines. Maximum likelihood analysis and a new full Bayesian test for positive selection show statistically significant signals of adaptive evolution in MMP9 at the phylogenetic points where changes to placental morphology occur. An intensification of positive selection is detected in regions critical to MMP9's enzymatic ability within the human/chimpanzee/gorilla clade and along the human lineage. Molecular comparisons to non-primate taxa with deeply invasive placentation will be discussed.

Understanding Middle and Late Archaic forelimb removal: An experimental approach.

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Several Middle to Late Archaic cemeteries dating from 3,000-6,000 years ago from the Ohio River Valley have individuals bearing signs of forelimb removal. In order to better understand the means of removal and to test the idea that the limbs were still fully fleshed when taken, cadaver forelimbs (n = 24) were removed in a manner thought to be consistent with how limbs were removed in antiquity. Cuts on the cadaver limbs were limited to those places where cuts were found on the archeological specimens, particularly on the supracondylar ridges and above the coronoid fossa. Moreover, interpretations of cut mark micro-morphology directed the force and direction of the experimental cuts. This approach, however, was insufficient to remove limbs because no cuts were made on the distal aspect of the humerus. Twisting the forelimb broke bones (a condition not seen in forelimb trophies), but wedging the cutting instrument into the joint worked well. Follow-up maceration showed no cuts on the joint surfaces because they were protected by cartilage. The results of the experimental study indicate that the ancient cut marks do not represent enough locations to remove a forelimb; however, it is plausible that forelimbs could be removed with the cut mark pattern seen in the archaeological specimens, provided additional cuts were made in places where the bone was protected (i.e., around the joint surfaces). Thus, the hypothesis that the archaeological arms were taken while fully fleshed cannot be rejected.

Sub-Adult sex estimation with dental cervicometrics.

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Sex estimation for sub-adult skeletal material presents many obstacles. The objective of this research was to identify and test a non-destructive method based on sexual dimorphism of the teeth. Dental tissues are preserved well in archaeology and, because teeth are formed in childhood at the full adult size, direct comparisons can be made between children and securely identified adult male and female skeletons. Published studies have successfully used odontometrics as the basis for dental sex estimation. Conventional crown dimensions, however, are strongly affected by tooth wear, which makes it difficult to compare adults with children. The current study therefore utilizes dimensions taken at the neck of the tooth, or cervicometrics. This study has examined three different assemblages from which a varying number of individuals were selected for analysis: MIN86 Royal Mint Site, London (*n*=59), et-Tereif, Sudan (*n*=44), and the Commoner's Cemetery, Amarna, Egypt (*n*=25). Measurements from adult individuals were taken at the cervix of each tooth mesio-distally and bucco-lingually and were used to create discriminant functions for each assemblage to estimate sex. The measurements of the permanent dentition of the sub-adult individuals were then entered into these functions and sex assigned. The initial functions using all adult measurements yielded an accuracy of greater than 80%, in some cases reaching a high of 85.7% correct classification. Sub-adult measurements were then assigned a sex based on these, and subsequent functions derived from different measurement combinations. Based on these findings, cervicometrics appear to be a viable option for assessing sub-adults possessing permanent dentition.

Natural birth control: seasonal increases in fecal progestins affect reproductive function in wild female Phayre's leaf monkeys (*Trachypithecus phayrei*).

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Female primate reproduction is generally thought to be intricately linked to food consumption via

caloric intake and body condition. However, recent evidence suggests that food items may also affect reproduction via plant steroids. These compounds can mimic endogenous steroids, thereby influencing sexual behavior, ovulation, and/or conception. Here we investigate reproductive function of 10 females in a wild group of Phayre's leaf monkeys (*Trachypithecus phayrei*) in Phu Khieo Wildlife Sanctuary, Thailand by analyzing fecal progestin (fP) and estrogen (fE) metabolites (N=2097 samples) and sexual behavior over the course of 20 months. We found a seasonal pattern of fP secretion, with fP levels increasing to pregnancy levels during similar periods of time over two calendar years in all females, regardless of reproductive condition. Female cycling profiles established from fE data indicate either irregular cycles or extended cycle lengths during these periods. Furthermore, these months were characterized by a decrease in days on which copulations were observed. Phenological data indicate that the irregular periods coincide with the beginning of the young leaf and fruit season, suggesting that fP levels result from a seasonally introduced plant source. Likely candidates for this source include three species of *Vitex*, a genus known to not only contain endogenous progestins, but influencing the progestin levels of the consumer. Plant-induced increases in progestin levels might mimic the effect of birth control, suppressing ovulation and possibly also sexual behavior. As such, it is unclear why individuals would consume these plants unless there is a comparative trade-off.

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Morphometric analysis of the Herto cranium (BOU-VP-16-1): Where does it fit?

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The placement of the hominid fossils from the Herto Member of Bouri Formation in the Middle Awash, Ethiopia offers insight into the timing and location of the origin of anatomically modern *Homo sapiens*. Evidence for the two competing hypotheses regarding the origin of am*Hs*, "Multi-Regional Continuity" and "Out of Africa," remains inconclusive due to the paucity of the hominid fossil record in Africa from 300,000 to 100,000 years ago. Both the location and age of the Herto fossils offer a unique opportunity to investigate the origin of am*Hs* in Africa. The present analysis uses C-scores, geometric shape vectors, and cluster analysis to determine the relationships among Middle and Late Pleistocene hominids and the relative position of the Herto specimen, BOU-VP-16-1, in the bush of hominid evolution. Previous analysis of the Herto specimen (BOU-VP-16-1) places it in an intermediate position between am*Hs* and the more archaic Kabwe fossil. Thus, the Herto specimen is argued to be transitional between more archaic hominids in Africa and am*Hs*, supporting the theory of recent African origins from am*Hs*. Both the principal coordinates of C-scores and cluster analysis agree with previous assertions (White et al. 2003) that the Herto fossils fall just outside the range of variation for am*Hs*. It is not clear, however, that the Herto remains are intermediate between Kabwe and am*Hs.* Both Neandertal and *Homo erectus* fossils were craniometrically closer to the Herto remains than Kabwe.

Molarization in extant primates.

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Many aspects of primate dental morphology vary in response to the mechanical and physical properties of consumed foods and can therefore inform hypotheses about diet. Among the features that characterize some early hominin species is distinctively "molarized" premolars, a condition wherein premolars approximate molar morphology in size and/or shape. This morphology is part of a suite of features that are thought to signal a diet consisting of hard and/or tough foods. The goal of this study was to test the hypothesis that premolar, in particular P4, molarization is an adaptation to a mechanically resistant diet.

Dental metric data were collected from 24 species of platyrrhines and 48 species of catarrhines. The sample was divided into three dietary groups (hard-brittle, soft-brittle, and soft-tough) based on the physical and mechanical properties of consumed foods. Molarization was measured by comparing P4 to M1 occlusal area (size) and P4 mesiodistal length to buccal-lingual length (shape). Among platyrrhines, a more molar-like P4 size characterized hard-brittle groups but not soft-tough or soft-brittle groups. In the shape analysis, only female platyrrhines in the soft-tough group had P4s that approximated the condition in molars, wherein length and width are nearly equal. The catarrhine sample did not yield any significant differences among dietary groups for analyses of either size or shape. The hypothesis that molarization is indicative of the consumption of hard and/or tough foods is only partially supported by this analysis.

Measurement of fallback food hardness in the field.

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A number of living primates have been shown to feed for part of the year on seemingly hard food objects as fallback foods. But how hard is 'hard', and can reliable numbers be placed on this quality? We report here a macroindentation method for measuring the hardness, defined as resistance to indentation,

and the elastic modulus, defined as material stiffness, of such foods. The foods tested were seed shells and root vegetables. The approach was verified by also testing a number of industrial polymers (polymethylmethacrylate, polycarbonate, polytetrafluoroethylene and polystyrene foam) of known hardness and modulus. The hardness and modulus polymers and seed shells were accurately predicted while estimates of the moduli of root vegetables were higher than in the literature. The results on seed shells were applied to a simple analysis of tooth-food loadings. These 'hard' foods were much less hard than enamel and unlikely to make it yield on the surface. However, from a prediction of the loads at which mechanically-protected seeds fail, it is possible that they cause deep fractures in teeth that initiate at or near the enamel-dentine junction. As predicted in the literature, blunt cusps and thick enamel help sustain the integrity of teeth up to high loads.

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The role of the Melanocortin 1 receptor in domestication induced changes in alpaca coat color.

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It has been demonstrated that the Melanocortin receptor 1 (MCR1) plays a key role in the pigmentation of tissues including skin, hair, and nails in many divergent species, including humans, mice, horses, sheep, cattle, pigs, dogs, cats, chickens and alpaca (Andersson, 2001). The MCR1 controls which pigment gets deposited in a particular tissue, phaeomelanin (yellow to reddish brown) or eumelanin (black to dark brown) via it's control of the melanocyte stimulating hormone. These pigments are found in hair/fur/feathers and eyes (Rana et al., (1998). The wild ancestor of the alpacas (a domesticated South American camelid) is the vicuna. Vicuna are fawn colored, yet alpacas come in over 16 recognized colors and numerous patterns. In fact, alpacas have been described as the most color variable mammal. The MCR1 gene itself is highly variable with over 30 reported amino acid substitutions and indels that contribute to pigmentation variation in other species (Jobling et al., 2004). In an effort to see how domestication has influenced the ways in which the MCR1 has impacted camelid pigmentation, we obtained DNA from blood samples from over 80 alpaca (selected from a total of approximately 500 samples that had been obtained from various US and Australian Alpaca farms). Most of the alpacas used in this study were born in the US or in Peru. Here we report the results of sequencing the entire MCR1 gene in over 80 domesticated animals representing the full spectrum of alpaca coloration.

Comparative morphology of modern Malay and fossil deciduous teeth from central Java (Indonesia).

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Morphometric features of human deciduous teeth are not well documented for living or prehistoric populations of Southeast Asia. Four deciduous teeth were recently recovered from Glagah Ombo, Sangiran (Java, Indonesia) and include a maxillary right central incisor (GLOM 1), a mandibular left first molar (GLOM 2), and a left (GLOM 3) and a right (GLOM 4) maxillary second molar. These teeth are described using standardized methods for scoring non-metric traits and measuring crown dimensions of deciduous teeth. A two phase comparison was conducted in which the Glagah Ombo specimens were compared with morphometric variation of deciduous teeth in a modern sample of Malay school children from Yogyakarta, central Java and with several prehistoric and modern samples from South Asia. Morphological observations include: prominent shoveling and lingual tubercle development in di^1; five cusps, a closed anterior fovea, and deep talonid basin in dm_1; and a well-developed hypocone, non-cuspal forms of Carabelli's trait and accessory tubercles (mesial and lingual paracone tubercles) in dm^2. The GLOM teeth are generally consistent with the range of trait variation expressed in modern Malay deciduous teeth. In tooth size GLOM 1 (rdi^1) and 2 (ldm_1) tend to be larger than living modern samples but similar to, or smaller than, prehistoric samples. By contrast GLOM 3 (rdm^2) and GLOM 4 (ldm^2) tend to be significantly larger than both living Malay and both prehistoric and living samples from South Asia.

Are variations in tool use behaviors amongst wild chimpanzee populations the result of genetic differences or social learning processes? A phylogenetic assessment.

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Over the last 30 years it has become increasingly apparent that there are considerable behavioral differences among wild populations of *Pan troglodytes*. Some researchers argue these differences are a consequence of the behaviours being socially learned. Others contend that the available evidence is too weak to discount the possibility that the behaviors are genetically determined.

A recent study tested the genetic hypothesis and concluded that the interpopulation variation was unlikely to be genetically

determined [Lycett et al., 2007, *PNAS*, 104: 17588–17592]. However, the results of this study are problematic because the sample did not include populations from central Africa. Here, we present the results of a study designed to address this shortcoming.

We carried out cladistic analyses of presence/absence data pertaining to 19 tool use behaviours in 10 different *P. troglodytes* populations plus an outgroup . Genetic data indicate that chimpanzee populations in West Africa are well differentiated from those in eastern and central Africa. Thus, we predicted that if the genetic hypothesis is correct, the tool use data should mirror the genetic data in terms of structure.

The three measures of phylogenetic structure we employed (the Retention Index, the bootstrap, and the Permutation Tail Probability Test) did not support the genetic hypothesis. They were all lower when all 10 populations were included than when the three western African populations are excluded. Hence, our study also refutes the genetic hypothesis and provides further evidence that patterns of behaviour in chimpanzees are the product of social learning.

Exact determination of year-of-birth in unidentified corpses using the human eye lens.

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Lens crystallines are special proteins in the eye lens that never remodel. Human tissue ultimately derives its ^{14}C content from the atmospheric carbon dioxide. The ^{14}C content of the lens proteins thus reflects the atmospheric content of ^{14}C when the lens crystallines were formed. Precise radiocarbon dating is made possible by comparing the ^{14}C content of the lens crystallines to the so-called bomb pulse, i.e. a plot of the atmospheric ^{14}C content since the Second World War, when there was a significant increase due to nuclear-bomb testing. Since the change in concentration is significant even on a yearly basis this allows very accurate dating. We are able to demonstrate a close relationship between the formation date of the lens crystallines and the birth year of the individual.

A forensic application of this relationship is to determine the year of birth of an unidentified corpse. The eye lens is extracted (a minimally invasive procedure), radiocarbon dating of the lens crystallines is performed, and then, based on a mathematical expression on the formation rates and bomb pulse, the year of birth may be calculated to within +/- 1.5 years. An actual case involving determination of year of birth of three dead new-born babies found in a deep-freezer is presented. We were able to show with this method that the babies were born ca. 1986, 1988 and 2002.

Body size and activity inference: femur length and midshaft index.

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The long bone measurements collected as part of the Global History of Health Project provide important new historical information on the living conditions and workloads within European populations. Studies of modern populations show that impoverished environments suppress the growth and, if chronic and severe, substantially reduce adult body size. Correlations also exist between long bone robusticity and the stresses generated during strenuous habitual activities.

Humeral and femoral lengths and mid-shaft diameters are currently available for 4,669 of the European skeletons we have studied. Analysis of covariance indicates that after controlling for sex, settlement type and historical period, that latitude has a highly significant ($F= 38.9$, $p< 0.00001$) positive association with estimated height. This is strong confirmation for the operation of Bergmann's rule in the European populations. The same analysis indicates that on average, Medieval Europeans living in rural settings were taller than people who lived in towns or cities ($F=46.4$, $p< 0.00001$).
Analysis of size standardized midshaft cross-sectional strength indices (Zp) show that greater long bone robusticity was associated with higher levels of net primary productivity and the prevalence of seasonally wet forests and woodlands mountain vegetation types. Greater femoral robusticity is characteristic of people living at higher latitudes. During the Medieval Period, there is a general decrease in femoral robusticity. This is probably accounted for by the significantly ($t=4.01$, $p< 0.0001$) greater femoral robusticity of people who lived in rural communities relative to the inhabitants of towns and cities.
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The effects of disease and malnutrition on skeletal growth.

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Anthropologists have long held that the presence of disease or malnutrition during childhood will retard skeletal growth. Sub-adult individuals from the Hamann-Todd Collection (n=42) in Cleveland and the Luis Lopes Collection (n=55) in Lisbon, Portugal, were analyzed to test the validity of this assumption. Diaphyseal lengths were measured for all individuals. Data from the two collections was combined for analysis. Presence of disease and malnutrition was determined from hospital and cemetery records as well as visual inspection, autopsy photos and reports. Five categories of pathology were analyzed: tuberculosis, pneumonia, dental enamel hypoplasia, porotic hyperostosis, and malnutrition. Individuals with more than one pathology were placed into separate analytical categories based on the number of pathologies observed. Those who did not exhibit the pathologies under analysis were deemed the normative sample. No significant difference ($p<0.05$) was found between diaphyseal lengths of any of the pathological categories and the normative sample. Dental enamel hypoplasias had the strongest statistical difference ($p=0.17$), while pneumonia had the lowest ($p=0.976$). Individuals with three and four pathologies were found to be statistically different from the normative sample ($p=0.005$ and $p=0.042$, respectively), however, these individuals were significantly larger than the normative sample. The results of this study indicate that the presence of disease and malnutrition in children does not significantly retard skeletal growth.

Long-term inter-sexual association patterns among wild chimpanzees.

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The widely accepted socio-ecological model of primate sociality assumes that male and female chimpanzees do not exhibit differentiated social relationships. However, despite anecdotal evidence to the contrary, this assumption has never been explicitly tested. We used 14 years of data from the Kanyawara community in Kibale National Park, Uganda to describe inter-sexual association patterns among these chimpanzees. We calculated a composite index using temporal and spatial association data to characterize the relationships between 336 male-female dyads. We considered any dyad with a composite index greater than one standard deviation above the mean to be strongly associated. We found that: (1) while the majority of male-female dyads were not strongly associated, a subset of dyads showed greater than average association across several two-year time periods; (2) all but one of the maternal kin dyads (either mother-son or brother-sister) had differentiated relationships; and (3) the association preferences of some dyads remained consistent despite changes in the reproductive condition of the female over time. We used generalized linear models to determine the effect of reproductive state, rank and seasonality on patterning these long-term associations. Our finding that chimpanzees exhibit differentiated inter-sexual association patterns will have far-reaching effects on studies of other forms of male-female interaction such as aggression, and further our understanding of the evolution of human pair-bonding.

The ancestor's tail: evolution of taillessness within the Catarrhini.

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The evolutionary mechanisms responsible for the emergence of hominoid taillessness during the Early Miocene and the widespread reduction in tail length among extant cercopithecoids have yet to be clearly determined. A number of hypotheses have been proposed to account for primate tail loss and tail length reduction that emphasize the role of increasing body size,

powerful grasping (Kelley, 1997), and terrestriality (Wilson, 1972). In order to examine these hypotheses, an allometric study was performed to examine the interspecific and adult intraspecific relationships between tail length and body mass among extant cercopithecoids. Means of adult tail length and body mass for 74 species (63 catarrhines and 11 platyrrhines) were compiled from the literature and separated into nine groups according to phylogeny and substrate preference. In addition, the relationship between powerful grasping and the evolution of the tail was considered. Allometric results indicate that semi-terrestriality is an important factor influencing the reduction of tail length among cercopithecoids, in agreement with Wilson (1972). Furthermore, the relationship between tail length and body mass in semi-terrestrial primates is characterized by a significant reduction in tail length occurring at a mass of approximately 10kg, in contrast to strictly arboreal primates who exhibit a gradualistic relationship between these variables. Finally, in the absence of terrestriality, comparative evidence supports the role of a functional replacement for the tail, such as powerful grasping, in the evolution of catarrhine tail loss and tail length reduction.

A facultative mutualism? Interspecific associations between a small raptor (*Harpagus bidentatus*) and two species of capuchin monkey (*Cebus capucinus, C. apella*) in Costa Rica and Suriname.

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There are many anecdotal accounts of foraging associations between capuchins (Genus *Cebus*) and small raptors, but a review of the literature reveals scant published data for *Cebus* and *Harpagus*. Here I describe associative behaviors between these species in the Santa Rosa sector of the Area de Conservación Guanacaste, Costa Rica and Brownsberg Nature Park, Suriname. I observed these associations throughout fieldwork in 1992, 1993, 1998, 2004, 2005, and 2006. These data were recorded opportunistically while work on other projects was underway. The majority of these sightings took place in the low under-story of primary and secondary forest, concurring with published reports on the behavior of this small raptor (Skutch 1965; Fontaine, 1980; Boinski and Scott, 1988; Schulze, et al., 2000).
90% of the observations (n = 115) were characterized by the two species occurring in close to moderate proximity (i.e., <10m between one of the kites and one of the capuchins), and in the lower strata of forest (i.e., ground to 10m); binoculars were often unnecessary for viewing their behaviors. Associations lasted from several minutes to 5+ hours (mean = 2.5 hrs). Data on prey capture by the kites while foraging in association were recorded opportunistically (*ad libitum*); it was extremely difficult to categorize prey items beyond general type (e.g., large insect). This association may be an example of a facultative mutualism—an association that is not essential for the survival of either species, but one that occurs when individuals of each species are present. Other ecological reasons will be discussed.

Dental evidence for subsistence strategy differences in pre-contact Ipiutak and Tigara of Point Hope, Alaska.

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Habitual behaviors and cultural practices of a population are invariably imprinted on their skeletal and dental remains. Among the information that often can be garnered from dental investigations are food preparatory techniques, dietary choices, and tool usage. The dentitions of Inuit populations are particularly informative because of the unique ways teeth function for non-alimentary purposes. The pre-contact Ipiutak (100 BC-AD 500) and Tigara (AD 900-1700) of Point Hope, Alaska represent two culturally and temporally distinct populations who inhabited the same geographical environment. Other research has established that the Ipiutak did not participate in whaling activities and instead focused on smaller sea mammals and caribou though this information is garnered from associated artifacts found alongside skeletal remains. Minimal skeletal research has been conducted to support the cultural material evidence. The Tigara, characterized by the Thule culture, represent a whaling population dependent on a subsistence strategy that necessitated distinct labor roles among the sexes. In these populations, men engaged in whale hunting while females predominately tended to hide processing and clothing manufacture. This study examines 58 Ipiutak and 231 Tigara sets of dentition for degree of attrition, presence of carious lesions, antemortem loss, and cultural modifications (e.g., pressure-chips, occlusal striae, anterior wear) to determine inter- and intra-population differences in the distribution of dental pathologies and modifications. The results suggest that the groups were utilizing their teeth in different ways to accommodate their distinct subsistence regimes, a finding consistent with the archaeological material evidence.

Changes in women's fertility can be tied to their population's demographic processes.

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In this paper, we examine which variables best explain variation in fertility of women who lived in the Central Valley of Costa Rica during the 1600-1900's. We consider independent variables such as her own and her mother's longevity, the

size of her family of orientation (SOFO), and the year in which she was born. A century-by-century analysis indicated that the correlation among fertility, longevity, grandmother's longevity and SOFO did not remain stable through the centuries. For example, the correlation between the year in which a mother was born (within each century), and the number of children she produced was low but positive in the 1600's (r=0.05) and the 1700's (r=0.09), showing that there was a weak increase in the number of children produced throughout both centuries. However, for the 1800's the correlation between both variables became negative and larger (-0.10) and for the 1900's it increased dramatically (r= -0.64). This shows that women born in the earlier part of the 1800's and the 1900's produced more children than did those born in the latter part. Our results show that even within this limited region in Costa Rica, the factors that influence a woman's reproductive success change with the century in which she was born. Particularly important is the issue of whether the population was expanding geographically (here associated with high fertility) or if the population had settled to a stable land-tenure system (here associated with the beginning of a fertility decline). Supported by a grant from National Institutes Aging (1-R03-AG022616-01).

The social adaptations of rhesus macaques: the secret of their success?

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Rhesus macaques are one of the most successful primate species in Asia and have thrived on Cayo Santiago for 70 years. In this presentation, I will argue that the evolutionary success of rhesus macaques is due not only to their ecological flexibility and adaptability (an omnivorous diet, adaptability to different physical habitats, ability to reproduce under a wide range of environmental conditions, and resilience to stress), but also to their social adaptations, and that a similar relationship between social adaptations and evolutionary success applies to humans as well.

Decades of behavioral research on Cayo Santiago have shown that rhesus macaques possess a gregarious and aggressive temperament, high individualism and social opportunism, tendency to form despotic and nepotistic social systems in which individuals do not compete directly for resources but for power, strong xenophobia, and high within-group cohesiveness under conditions of external threat. Rhesus macaques exhibit their social tendencies in any environment in which they find themselves, whereas humans exhibit "rhesus-like" social tendencies mostly in capitalistic societies or when strong cultural influences on their behavior are eliminated. Similar social behavioral tendencies in rhesus macaques and humans probably arose by convergent evolution during long periods of intense within- and between-group competition in the evolutionary history of these species. The social adaptations of rhesus macaques and humans may have given them an edge in the ecological competition with other related species, and also served as a selective engine for the further evolution of larger brains and complex intelligence.

Fractures of the metacarpal bones in a historical population.

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Paleoepidemiological data clearly shows that bone fractures involving the head, arms and legs are culturally related. Metacarpal bone (MCB) fractures have rarely been studied. In contemporary western populations, fractures of the fifth MCB especially those involving the head portion of the bone (a.k.a. boxer's fracture) are due mainly to striking hard objects with the clenched fist. The purpose of this study in a large historical sample from France was to analyze the prevalence of MCB fracture overtime.

We examined all MCBs recovered from the historical burial site at Notre-Dame-du-Bourg that served the city of Digne, France from the 6th to 17th centuries. Sex and age at death were determined by studying pelvic features.

The overall prevalence of MCB fractures was low (13/3721: 0.35%) with a significantly higher prevalence of fifth MCB fractures (8/289: 2.8%) in comparison with other MCB fractures (5/3432, 0.15%) ($p>10^6$). Most fifth MCB fractures were isolated and left-sided without any preferential bone location. These fractures were more common in males over the age of 50. They were more frequent in the medieval period than the pre-modern one. All other MCB fractures were multiple crushing fractures of the shaft. Fracture of the MCB was relatively rare in this historical sample with a predominance of fifth MCB fractures. The diversity of bone locations and the high prevalence of left-sided fifth MCB fractures argue against brawling as the cause of fractures. Other hypotheses are proposed for discussion.

Quantitative histomorphometric evaluation of the Endosteal Lamellar Pocket: Comparing digital and point-count methods for the measurement of modeling drift remnants in the long bones of adults.

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Previous research has identified a distinct endosteal pattern in adult lamellar bone resulting from formation during periods of significant modeling drift. The current authors refer to this feature as the endosteal lamellar pocket

(ELP), a name simultaneously reflecting its histological composition and hemicircumferential shape in transverse cross-section. Until now, no quantitative means for the histological measurement of any aspect of drift processes has been proposed. Our intention is to demonstrate and compare two techniques that can be used to quantitatively measure ELP drift remnants in compact femoral and humeral bone diaphyses. The point-count method is a simple and readily available means of sampling a field of view for count and/or area measurements using a counting reticule in the microscope's eyepiece. More accurate digital techniques are becoming more accessible and permit a record and replicability of measurements impossible using the point-count technique. However both methods require users to delineate subjective boundaries for transitions between compact bone tissue types. More modern digital analysis software, such as Image Pro®, can apply standardized recognition parameters for features contrasted by polarized light. A method using this technique is suggested as a means to more objectively delineate ELP boundaries and facilitate the quantification of modeling drift histomorphology.

Cross-sectional Variation at the Femoral Mid Diaphysis: Evidence for Sex Bias in Contour Categories.

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Computer aided cross-sectional analyses of femora are commonly used in anthropology and bioarchaeology for reconstructing activity patterns of past populations. These methods give highly accurate and reproducible area and linear measurements. However, less attention has been paid to the gross contour patterns of cross-sections. In this study, we analyzed the shape variation in femoral cross-sections by categorizing midshaft cross-sections of two population samples (Xcambó, Classic Period Maya, Mexico and Barbing, Early Medieval population, Germany) into four macroscopic, qualitative shape categories. These were evident in both populations and showed a strong relationship with sex. Possible explanations for this are loading differences due to differing hip morphologies and/or different physical activity patterns. In some cases, the position of I_{max} co-varied with the shape categories. This was especially the case for cross-sections with strongly pronounced contour prominences and could affect the results of computerized cross-sectional analyses on a population level.

Development of M1 enamel thickness.

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The timing and sequence of enamel development can sometimes correlate with enamel thickness. In modern human lower first molars (M1), thicker enamel can take longer to form, and growth usually ends in the longer forming cusps. Understanding these relationships is fundamental to understanding changes in dental form and structure in an evolutionary context. Recent studies report that M1 distal cusp enamel may be thicker than mesial cusp enamel. Yet, this does not seem to be accompanied by a change in the rate at which enamel forming cells move towards the future outer surface, when compared between equivalent cusp regions. The aim in this study is to examine the relationship between M1 enamel thickness and rates of extension.
Unworn molars (n=15) were embedded in a polyester resin, histological thin sections were prepared and analyzed using transmitted light microscopy. Fourteen 2D measures of enamel thickness, and rates of enamel extension (n=8) in three regions (cusp, lateral, cervical), were calculated from digital images of the mesial and distal cusps using image analysis software.
Results support some previous findings. Overall, enamel was thicker on the distal cusps compared to the mesial cusps, except at the cusp tip. Enamel was thickest on the hypoconid, and thinnest at the occlusal fovea. Enamel extension rates along the enamel-dentine junction followed the general reported pattern for hominoids, though when compared between equivalent regions in different cusps where daily rates of enamel secretion were constant, enamel extended more rapidly in the cusp region of the hypoconid.

Genetic evidence of a prehistoric Athapaskan migration.

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The Navajo and Apache of Southwestern North America belong to the Athapaskan language family. Other members of the Athapaskan language family are located in the Subarctic and along the Pacific Coastline of North America. In this study, we analyze mitochondrial DNA (mtDNA), Y chromosome, and autosomal variation to gain insight into an Athapaskan migration to the Southwest. The distribution and frequency of mtDNA and Y chromosome haplotypes in the Navajo and Apache suggest that the ancestors of these tribes may have experienced a founder effect during the migration south from the Subarctic. In addition, genetic evidence in Southwest populations suggest that Navajo and Apache were absorbing Southwestern individuals but non-Athapaskan-speaking Southwestern tribes were not absorbing Athapaskan-speaking individuals.
This research was supported by NSF-BCS-0422124 to RSM.

Systematic characterization of locomotor head movements in *Lemur catta*.

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Semicircular canals sense rotational head movements. Variation in canal morphology has been attributed to differences in locomotor behavior, but the manner in which morphology reflects movement remains uncertain. Previous studies have relied on qualitative descriptions of locomotor agility or jerkiness to assess the inputs to the inner ear. We present the first characterization of angular head velocities associated with the common locomotor behaviors of a non-human primate.
Kinematic data were collected while animals wore head-mounted markers. Angular head velocities were calculated for gait cycles sampled from terrestrial walking, terrestrial running, arboreal walking, and leaping. Some behaviors produced identifiable angular velocity tracings or "fingerprints." For example, pitch velocity plots as a 4-phase curve during walking and as a 2-phase curve during running. Average pitch and roll velocities increased with speed of terrestrial quadrupedalism. Surprisingly, only slight increases in pitch occurred between walking at 0.8 m/s and running at 2.3 m/s, while pitch increased markedly at running speeds above 2.3 m/s. Average velocities of pitch were significantly greater than roll in all pair-wise comparisons. However, average pitch and average roll did not differ significantly across study behaviors.
Reliable associations between behaviors and angular velocity patterns support the use of canal morphology to predict locomotor repertoire. Because average pitch velocities exceeded roll in all behaviors, analysis of *Lemur catta* vestibular morphology should reveal differential sensitivity to pitch and roll. Finally, the unexpected relationship between average pitch velocity and speed of running further emphasizes the utility of characterizing head movements by kinematic analyses.
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Ancient demography, not climate, explains within-population phenotypic diversity in humans.

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The relative importance of ancient demography and climate in determining worldwide patterns of human phenotypic diversity is still open to debate. Several morphometric traits have been argued to be under selection by climatic factors, but it is unclear whether climate affects the global decline in morphological diversity with increasing geographic distance from Sub-Saharan Africa. Using a large database of male and female skull measurements, we apply an explicit framework to quantify the relative role of climate and ancient demography. We show that ancient demography (i.e distance from Sub-Saharan Africa) is sole determinant of human within-population phenotypic diversity, while climate plays no role. By selecting the most informative set of traits, it was possible to explain over half of the worldwide variation in phenotypic diversity. These results mirror the ones previously obtained for genetic markers and show that "bones and molecules" are in perfect agreement for humans.

The peopling of Gabon (Africa) seen trough its genetic and linguistic diversity.

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Gabon is a country located in central western Africa. In the frame of a project financed by the European Science Foundation (OMLL Origin of Man, Language and Languages), 12 samples of around 50 individuals each have been collected and typed for autosomal, Y-chromosome and mitochondrial genetic markers. Our purpose was double fold, 1) to investigate the genetic relationships between the different Bantu ethnic groups in order to depict their demographic history, migrations and admixture, as well as 2) to compare such biological history with their cultural diversity. To this end, a linguistic database constituted by lists of 160 words recorded in 39 dialect varieties has been used as a proxy for existing cultural differences.

Autosomal markers do not show any differentiation among Bantu groups living in Gabon, while mtDNA and the Y-chromosome exhibit some differentiation that is geographically meaningful only concerning mitochondrial variation. The application of computational linguistic methods enabled us to visualize dialectal diversity as distance matrices and multidimensional scatterplots that indicate the existence of four major clusters that, interestingly correspond to mitochondrial genetic differences and are correlated to geography ($r = 0.4$).

We conclude that Gabon has been peopled, in historical times, by a genetically homogeneous population. We do not see any genetic evidence of different migration waves that, instead, are supported by linguistic material. The correspondence between mitochondrial and linguistic variation suggests that matrilocality may have been widespread among Bantu ethnic groups of Gabon.

Animal models in taphonomic experiments: an interspecies comparison of cortical bone properties.

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This research compares the cortical properties of human, pig, and deer bones in order to examine the

suitability of these animals as human analogues in forensic experiments involving skeletonized remains. The use of animal models in these kinds of experiments can provide a basis for determining time since death and reconstructing taphonomic events in forensic cases with extended postmortem intervals.

While previous research has investigated the use of domestic pigs as models for soft tissue decomposition in humans, no studies have investigated which species is best suited to serve as a model for the disintegration of human bone. The present study examines whether the skeletons of deer (*Odocoileus viginianus* and *O. hemionus*) and pigs (*Sus scrofa*) are suitable human analogues based on the cortical and metric characteristics of the long bones of each species. The major long bones of humans, deer, and pigs were measured to compare the length, diameter, cortical density, cross-sectional area, and cortical thickness of these bones. While the limb bones of deer are more similar to those of humans in some respects, those of pigs are more comparable in others.

The findings demonstrate that both species can serve as suitable models in forensic experiments based on their geometric and densitometric similarities to human bone. The results of this research have been applied to a taphonomic experiment using pig and deer carcasses to observe weathering changes in the skeleton and could prove valuable to future studies on postmortem modification of bone.

Well-digging by Semliki chimpanzees: new data.

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The chimpanzees (*Pan troglodytes schweinfurthii*) of Toro-Semliki Wildlife Reserve, Uganda, are the only population of wild apes known to dig wells for drinking water (Hunt & McGrew, 2002). By hand, they scoop out holes in sandy riverbeds, from which they drink either directly by mouth or indirectly via absorbent tools of compressed vegetation ('sponges'). A previous pilot study (McGrew *et al.,* 2007) done over several days in the dry season (July, 2006), revealed bi-lobed (left vs. right) tailings of excavated sand, suggesting manual lateralization in digging skills. Crude measurements of volume of these tailings showed them to be symmetrical. Here we report new findings gathered over 6 months (May-November, 2008) that include both wet and dry seasons, and that entail more precise measures of the wells and of the displaced sand, which was weighed. Wells were dug in both wet and dry seasons, and frequency of well-digging was not correlated with rainfall. However, use of sponge tools was seasonal, being absent in the wet season. Lack of asymmetry in excavated sand piles (and hence, by implication, lack of manual lateralization in the diggers) was confirmed with the more accurate measurements. Lack of manual bias at the population level is congruent with behavioral data from other studies of wild chimpanzees.

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Metatarsal neutral axis and head torsion in hominoids.

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Human head torsion is significantly different from that of apes for all metatarsals except the fifth. In particular, the first metatarsal head of apes is rotated laterally but has a plantar orientation in humans, while the metatarsal 2-4 heads are generally medially rotated in apes and laterally rotated in humans. These results have been used to identify if ape characteristics were present in the *Australopithecus afarensis* foot. A complete fourth metatarsal of *A. afarensis* from Hadar showed head torsion falling within the distribution of humans and outside the distribution of apes. Even though this method is extremely informative, it is applicable only to complete fossil bones. Here we propose a method for inferring metatarsal head torsion from fragmentary metatarsals. We measured the neutral axis angle at three locations of the diaphysis, at 35, 50, and 65% of bone length in a sample of *Homo sapiens*, *Pan troglodytes*, *Gorilla gorilla*, and *Pongo pygmaeus*. Results show that, for all species, correspondence between the neutral axis angle and the metatarsal head rotation increases from proximal to distal. The values and patterns of the neutral axis angle at the 65% level (distal) of metatarsal 2-5 are strongly correlated to those of metatarsal head torsions. This method of estimating metatarsal head torsion from diaphyseal neutral axis orientation, besides validating the results obtained by previous studies, shows that it is possible to use fragmentary early hominin metatarsals to better understand the pattern of acquisition of human-like, pronated distal foot.

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The operational sex ratio (OSR) among hunter-gatherers: cause or effect of male-male competition?

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We present data on mean ages of females and males at first marriage among hunter-gatherers to see how they are influenced by the degree of polygyny. Mean age at first marriage is 14 years for females (n = 201) and 21 years for males (n = 176). Mean percent of polygyny is 14% (n = 202). The minimum and maximum marital ages range from 5-22 years for females and 12-35 years for males. The higher the degree of polygyny the younger is

the mean age at first marriage for females ($r = -.232$, $p = .005$, $n = 143$) and the older the mean age at first marriage for males ($r = .541$, $p < .0005$, $n = 130$). When some males are able to acquire more than one wife male-male competition forces up the mean age at which males can acquire their first wife. While sexual selection theory posits that OSR affects male-male competition, male-male competition itself also affects the OSR. In calculating OSR, we count all females who are in their reproductive years (post-menarche to menopause) and not pregnant. It is less clear how to count the number of men. Should we count from the age at which viable sperm are produced until the age of maximum longevity? If we count the ages at which males regularly copulate, this varies greatly across societies in response to male-male competition. We discuss the implications of these results not only for sexual selection but for somatic investment and growth trajectories.

Functional implications of the unique Neandertal face.

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Mechanical interpretations of the unique facial anatomy of the Neandertal face have largely centered on the anterior dental loading hypothesis, proponents of which postulate that Neandertal craniofacial morphology functions in dissipation of heavy anterior occlusal loads. Testing hypotheses of such nature may not rely on traditional anthropological techniques, and the present study employs the Finite Element (FE) analysis to compare stress and strain patterns that are introduced to the facial skeleton by loading of the anterior dental segment.
Representative of the generalized (primitive) hominid face, a FE model of the common Chimpanzee (*Pan troglodytes*) was generated based on medical CT scans. A Neandertaloid-Chimpanzee face was subsequently sculptured on the original skull, emphasizing the key anatomical features that are highly diagnostic of Neandertals (e.g., infra-orbital plates and nasal bridge), and a second FE model was generated, representative of an idealized Neandertal face.
Final FE models comprised more than 0.5 million 10-noded tetrahedral elements. Material properties and muscle forces for anterior biting tasks were obtained from the literature. According to our results, lower strains occur in the facial skeleton of the Neandertaloid face than in the generalized one. This evidence may provide a clue in the attempt to decipher the Neandertal face.

Periosteal appositions: a non-specific index of the history of health in Europe.

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Periosteal appositions are the osseous manifestation of periosteal inflammation or stimulation and reflects the body's response to bacterial infections, traumatic injury, vascular disorders and a variety of other pathological processes, many of which have synergistic interactions with nutritional deficiencies (e.g., scurvy) and specific infections (HOA associated to tuberculosis; leprosy; treponematosis). The prevalence of periosteal appositions in the Global History of Health

Project European sample thus serves as a non-specific index of temporal-spatial variation in the health status of the European population.
Using an ordinal scale, we scored the severity of periosteal appositions on the major long bones (clavicle, humerus, radius, ulna, femur, fibula, and tibia) of 9,814 of the burials in the Global History of Health Project European sample. We then used these data, along with information on the proportion of each long bone that was observable, to construct a periosteal reaction severity index for each individual.
Signs of periosteal appositions were present in 15.3% of the burials studied. It is more than seven times more common in the bones of the lower limb than the bones of the upper limb and, during all historical periods, the tibia is the bone most frequently affected. The bones of males exhibit periosteal appositions more frequently than do those of females. Periosteal appositions rates decline significantly (x^2=31.4, p<0.0001) between the Classical Antiquity and the Early Middle Ages Period and then increase significantly (x^2=19.0, p=0.0001) during the High and Late Medieval periods. There is no significant rural-urban difference in upper limb periosteal reactions. For the lower limb, in contrast, there is a very large highly statistically significant difference with a higher frequency in the urban sample (x^2 = 135, p< 0.0001). We discuss some etiologies of periosteal appositions as possible explanations of this unexpected result.
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Landmark selection and statistical significance for a cranial vault thickness study in an eco-geographically diverse recent human sample.

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Cranial vault thickness (CVT) variation has been included in *Homo* species definitions, with species divided by statistically significant thickness variation at broadly selected landmarks. Landmarks are selected with no specific reference to intra-specimen variation, and statistically significant ranges of CVT variation have been cited as evidence of inter-specific divisions, whereas human biologists identify statistically significant differences between the modern human sexes and recent human populations. This study evaluates variation of a geographically diverse recent human sample (Australia, Egypt, Greenland, India, Northern Europe, Northern Canada, Northern Russia, and Sub-Saharan Africa) to identify trends in variation across the entire vault, articulating a framework of proper landmark selection and statistical evaluation. Computed tomography (CT) scans facilitate CVT measurements on complete specimens. Landmarks are identified in grid-like patterns defined by distance percentages of the bregma-lambda arc, and an arc defined between bregma and the temporal suture, thus defining the superior vault. The CVT patterns suggest that intra-specimen variation is governed by ossification trajectories, with thicker values expressed at primary centers of ossification and thinner values in areas originally composed of fontanelles. Landmark selection must be concerned with the ontogenic history of each represented region. Value ranges in this recent sample encompass variation seen throughout fossil *Homo*, suggesting that statistically significant CVT value ranges as simple measures of species membership are not a true biological determination. This research serves to exhaustively evaluate the extent of a diverse sample's variation as an appropriate comparative framework for greater *Homo* species identification.

Testing multiple hypotheses explaining primate species richness.

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Previous broad-scale analyses of primate species richness have focused on analyzing a single explanatory variable, most often mean annual rainfall. Additional studies of primate and non-primate taxa have also demonstrated that additional factors may be related to species richness patterns, including geographic factors, evolutionary history, and anthropogenic effects. In this study, we simultaneously examined several independent variables to explain variation in species richness from over 100 primate communities in Africa, Asia, and the Neotropics. For each community, we collected data on nine independent variables: mean annual rainfall, rainfall seasonality, mean minimum temperature, mean maximum temperature, latitude, longitude, altitude, human population density, and species' divergence time variance. We utilized two analytical techniques to find the best predictive models for each continent, least square multiple regression and Akaike's Information Criterion. We found that different factors best predicted primate species richness on each continent. Primate species richness in African was related to mean annual rainfall, rain seasonality, minimum temperature, and altitude. Asian species richness was best predicted by rain seasonality and human population density. In the Neotropics, mean annual rainfall was the only significant predictor. This study demonstrates that a variety of factors affect primate species richness. These intercontinental differences are likely due to the unique combination of species, evolutionary history and environmental background in each continent.

Assessment of childhood health using skeletal indicators in a 19th century quarantine cemetery from the Northeastern U.S.

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Archaeological excavation at the Staten Island Marine Hospital and Quarantine grounds (1799-1858) yielded a skeletal sample of 24 juvenile and adult patients, who were most likely immigrants from the Irish Potato Famine of the mid-1840's, as supported by historical records and mortuary practices. Demography, linear enamel hypoplasia, anemia (in forms of porotic hyperostosis and cribra orbitalia), stature, and juvenile pathologies such as rickets and general periostitis were analyzed. Data were compared to the skeletal sample (N= 296) from the Monroe County Poorhouse (MCP) in Rochester, New York (Lanphear 1988) based on similarity in time period, ancestry, and status. Results suggest that the Staten Island immigrants enjoyed better childhood health than those from the MCP. LEH was seen in 12.5% of the Staten Island sample as compared to 73% in MCP, the rate of anemia for Staten Island was half that of MCP, and only 5% of the Staten Island sample showed rickets as compared to the 8.4% in MCP. Stature was the only indicator in which the MCP sample seemed healthier, exhibiting a 3cm greater mean stature in both sexes, although the difference was not statistically significant. This study indicates that the immigrants coming from unbearable conditions such as the Irish Potato Famine had better childhood health than those individuals of the MCP, but still exhibited some stresses possibly related to protein deficiency based on their shorter stature. It should be noted, however, that taphonomic processes and nonstandard sampling techniques could have caused bias in the Staten Island sample.

Sex differences in canine crown fluctuating asymmetry *Gorilla gorilla*: A result of ontogenetic mechanisms underlying adult canine size sexual dimorphism?

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Small, random deviations from bilateral symmetry in individuals can produce fluctuating asymmetry (FA), a population pattern of asymmetry in which size differences between left and right body structures are normally distributed around a mean of zero. Such random deviations from symmetry have been argued to reflect an organism's inability to buffer itself from perturbations during development. As compared to non-sexually selected traits, sexually-selected traits have been argued to be more sensitive to revealing such perturbations, and thus to serve as honest indicators of fitness. It has been suggested that FA in non-human primate male canines is high because it serves this purpose. Regardless of whether developmentally-derived canine asymmetries serve as honest indicators of fitness, males of sexually dimorphic non-human primate species would be expected to have higher levels of canine FA than females simply as a result of the longer period of time their canines take to form, affording males a "window of vulnerability." Mesio-distal and bucco-lingual dimensions of maxillary and mandibular canines were measured to calculate FA in the canines of 47 male and 40 female gorillas. Previous studies, measuring crown height, have not isolated the fluctuating asymmetry component of canine asymmetry. Male FA is significantly greater in the bucco-lingual dimensions of both maxillary and mandibular canines, supporting the hypothesis. However, FA in the mesio-distal dimensions are not significantly different between the sexes. The results of this pilot study therefore lend qualified support to the hypothesis, but to fully evaluate it, similar analyses on additional species will be conducted.

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Methodological challenges in field-based primate parasitology.

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The interaction between non-human primates and their parasites is an area of increasing research interest in primate behavioral ecology. Opportunistic fecal collection can be a relatively simple, inexpensive and non-invasive way to gather parasitological data; however, preservation and analysis of the parasite stages found in fecal samples can be fraught with challenges and biases. We evaluated the consistency of preservation and laboratory techniques used during the analysis of fecal samples for endoparasite infection in the white-collared lemur, *Eulemur albocollaris* (= *cinereiceps*). A total of 86 fecal samples from *E. albocollaris* were used in 215 trials to test: (1) parasite recovery using two common preservation solutions (90% buffered ethanol and 10% buffered formalin), (2) two common recovery methods (sedimentation and flotation) and (3) four variable aspects of flotation and sedimentation (flotation solutions with different specific gravities, centrifuge spin cycle times, rinsing solution, and grams of feces needed for each analysis). Most importantly, samples stored in formalin yielded higher egg counts and more parasite species than those preserved in ethanol using both flotation and sedimentation recovery techniques. Across experimental conditions, the measures of infection were found to vary by parasite species, including inconsistency within techniques. The sensitivity and specificity of egg counts will be discussed and the costs and benefits of various techniques are addressed.

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Quantitative genetic insights on the evolutionary processes operating on human skull shape.

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Determining the genetic architecture of the human skull is crucial to elucidate the evolution of this complex phenotype. The response to evolutionary forces does depend on its patterns of inheritance, which are reflected by the genetic covariance matrix for skull shape. The structure of the G matrix can constrain or favor some directions of shape change, deviating evolutionary trajectories. The collection of skulls in the ossuary of Hallstatt (Austria) is a unique opportunity to estimate such parameters, since skulls are individually identified and church records permit to reconstruct the life history of the individuals, as well as their genealogical relationships. Using geometric morphometrics and multivariate quantitative genetic methods, we estimated the G matrix for skull shape. Furthermore, we obtained direct estimates of the action of natural selection on the skull morphology of this population by assessing the relationship between fitness and morphological traits over a period of 200 years.
Our results clearly indicate that natural selection is operating on the skull morphology of the Hallstatt population. However, other processes need to be advocated to explain the evolutionary paths observed. For instance, development may have played a crucial role determining the response to selection. Genetic integration within the skull is so strong that when hypotheses of independent evolution of each of the main derived characters of modern humans are tested, similar responses to selection that involve the whole suite of characters are usually obtained.

Assessing the relationship between craniofacial morphology and genetic variation in a population with admixed ancestry.

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Numerous approaches exist to study the relationship between genotype and craniofacial phenotype. Much effort has been put in identifying genes that underlie normal and pathological variation in humans, extrapolating genetic-induced phenotypes in animal models and intercross experimental populations. Recent research has focused on describing the pattern of craniofacial variation across populations in correlation with neutral genetic markers, searching for selective signatures in primate comparative genomics, as well as studying patterns of morphological admixture.
This study examines normal variation in human craniofacial morphology and its correlation with genetic variation in a single population with admixed ancestry from Chile. A sample of 150 virtually reconstructed medical CT scans were analysed by means of geometric morphometrics. In addition, we assessed the nucleotide sequence of the hypervariable segment 1 (HVS1) of the mitochondrial DNA in 90 of these individuals. As reported in previous studies for this population, mitochondrial DNA shows predominance of Native American contribution due to imbalanced parental admixture in which female ancestors were mainly Amerindian. A weak association between nucleotide sequence variation and lower components of craniofacial shape variation is observed when haplogroup data is used as the independent variable in regression analyses. These results are consistent with expectations regarding the admixed nature of this population. Further research will focus on nuclear genes previously associated with cranial growth and development such as GHR and MCPH1.
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Buccal dental microwear analyses in *Paranthropus boisei*, *Homo habilis* and *Homo ergaster* confirm that buccal microwaer is highly informative of dietary habits and ecological conditions in fossils hominin species.

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Buccal dental microwear has shown to clearly discriminate dietary habits of hunter-gatherer human populations. Despite it has also been applied to characterize the diet of Neandertal fossil specimens, no clear associations between buccal microwear data and diet in fossils hominins from distinct ecological environments has been attempted yet. The shift in climatic conditions throughout the Pleistocene in Africa allows for testing hypotheses of dietary changes in relation to ecological conditions. In order to determine if buccal microwear is sensitive to dietary habits, we have analyzed all available specimens of three distinct fossils hominin species: *Paranthropus boisei*, *Homo habilis* and *Homo ergaster*. The prediction was that buccal microwear would significantly differ among the three species in accordance to their dietary specificities. *A. boisei* was expected to show the highest densities of striations, whereas Early *Homo* should display the lowest, given its pressumed highly carnivorous diet. The results show that *Homo*

ergaster has the highest density of striations, suggesting that its dietary scope includes highly abrasive foodstuffs, perhaps seasonally dependent. Statistically significant differences in overall microwear patterns were observed only between *H. ergaster* and the other two species, whereas Early *Homo* and *P. boisei*, do not differ significantly. However, a discriminant analysis of species affiliation based on dental microwear variables shows a 94% correct classification probability, indicating that buccal microwear greatly depends on taxonomic attribution. *P. boisei* showed the lowest striations density, most likely due to a differential effect of tooth use on occlusal and buccal surfaces.

Osteoporosis in medieval human and sheep femurs from the site of Dubovany (western Slovakia).

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While bones affected by osteoporosis are rarely reported in animal palaeopathology, numerous studies have documented the presence of this disease in ancient human skeletal remains. In such cases osteoporosis is often recognised by a significant reduction of trabeculae in spongy bone and/or the decreased thickness of cortical bone. However, palaeopathologists should employ histological analysis to avoid the possibility that diagenetic change is confused with the symptoms of osteoporosis. Among the skeletal remains excavated from the site of Dubovany (western Slovakia), four suspected osteoporotic human and one osteoporotic sheep (*Ovis aries* L.) femurs, dated to the eighth - ninth centuries AD, were recognised. Macroscopically, some hypostoses were identified at the osteoporotic femurs. However, no osteoporotic fractures were found for both humans and sheep. Histologically, a significant reduction in both spongy and compact bone was observed in the osteoporotic specimens. Moreover, various measurements of the Haversian canals and secondary osteons had different values in the osteoporotic human and sheep femurs in comparison with the non-osteoporotic ones ($P<0.05$). However, no resorption cavities were identified in the microstructure of osteoporotic sheep femur as compared to the osteoporotic human bones. This could be partially explained by the age of the individual (adult sheep) and/or the increased movement of the animal compared with humans. We did not find tunnel-like canals caused by the post-mortem growth of fungi or algae in the microstructure of all osteoporotic femora. Anyway, histological analysis has confirmed the presence of early stage osteoporosis in the examined femurs.

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Examination of pressure distribution across the manus of knuckle-walking apes.

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Observational studies have revealed differences between knuckle walking postures of chimpanzees (*Pan troglodytes*) and gorillas (*Gorilla gorilla*). Knuckle walking chimpanzees vary more in positioning their forelimbs and in the number of manual digits contacting the ground surface. In contrast, gorillas consistently hold their forelimbs in a pronated position and digits II-V contact the ground. To better understand variation in knuckle walking, manual pressure distributions were obtained for captive chimpanzees and gorillas using an RS Scan footscan© plate (0.5 x 0.4 x 0.008m). The chimpanzee group included one male and five females representing one adult age cohort. The gorilla group comprised one silverback and 3 females (12 years and older). Knuckle-walking bouts were recorded using a Panasonic DVD digital camcorder. Pressure data were included in comparative analyses if individuals contacted the plate at their normal walking pace. Results support the variability of chimpanzee digit contact noted in observational studies, and reveal different patterns in weight distribution for knuckle walkers. The highest pressure point for both gorillas and chimpanzees is found on digit III regardless of whether all digits contact the surface or subsets of them do. In addition the center of pressure for both groups during hand-to-surface contact runs from the medial aspect of the hand (digits V or IV) to the lateral aspect (digits II or III). Further pressure analyses including non-knuckle walkers and comparative examinations of skeletal material should enhance our understanding of the effects of biomechanical forces on the manus.

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Lethal neural tube defects from the Dakhleh Oasis, Egypt: an analysis of three cases.

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The discovery of well preserved archaeological fetal remains displaying congenital birth defects is a rare occurrence. Neural tube defects (NTDs) are developmental abnormalities of the central nervous system resulting from improper formation of the embryonic neural tube. NTDs are among the most common congenital malformations in humans, yet variation among the types of neural tube defects is poorly understood. The range of NTDs extends from non-life threatening conditions to lethal conditions. Individuals with non-

life threatening NTDs, such as mild forms of spina bifida, are well represented in archaeological collections, as many survive into adulthood; however individuals with lethal forms of NTDs, anencephaly and inencephaly for example, are vastly under-represented in the archaeological record. Preservation, mortuary context, burial practices, and other factors contribute to the low number of archaeological specimens. The arid climate, high alkalinity of the soils, and cultural practices of the peoples in the Dakhleh Oasis, Egypt, have resulted in remarkable preservation of human remains, including a large collection of fetal skeletons. Ongoing excavations of the Roman/Christian Kellis 2 cemetery (ca. 50 – 400AD) have revealed three individuals (out of a total of 104 fetuses), aged between 30, 39, and 42 gestational weeks, which display the classic skeletal characteristics of lethal neural tube defects. One case of anencephaly and two cases of inencephaly with craniorachischisis are presented. Skeletal diagnosis of NTDs and the social ramifications of these individuals being interred in this cemetery are considered.

Cluster analysis and social network theory applied to the study of socially learned traditions in primates.

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The study of behavioral traditions in wild subjects is of great interest currently in primatology and animal behavior. This topic is particularly relevant to human evolution because of the potential to contextualize the evolution of human cultural abilities within a broader comparative and evolutionary understanding. However, there have been relatively few species for which data are sufficient to test tradition and social learning hypotheses, especially given the need to rule out alternative explanations that invoke genetic and asocial learning effects. In response to this problem, I develop a cluster analysis method based upon social network theory and apply it to data on potential food processing traditions in wild capuchin monkeys. The cluster methods use pairwise matrices of spatial proximity associations within a social group to assess the presence of proximity clusters. I then test if the clusters explain the majority of observed behavioral variation in food processing. The results of cluster analysis both support the findings of established techniques, and illustrate that cluster analysis can operationalize more fine-grained predictions that better rule out alternative explanations. I show that the clustering and social network methods are applicable to a broad range of species and questions, and may enable primatologists to expand the range of species in which tradition hypotheses are tested.

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Investigation of the relationship between body mass and cremains weight.

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The increasing trend in average body mass has significantly affected the funerary industry. Cremation is a popular resolution, requiring reduced mortuary apparatus and expenditure. Simultaneously, cremains are more common in forensic issues of evidence destruction, unethical disposal of burned remains, or disputed identity. Therefore, it is vital to understand the physical properties characterizing and influencing cremains.

The present study investigates the relationship between body composition, particularly body mass index (BMI), and cremation weight. Data was combined from five collections of cremains, sourced throughout the United States and rendered through commercial crematoriums. Amputees, bone donors, skeletally immature samples were excluded from analysis. Additional data was gathered by the author observing and weighing remains prior to and post-incineration. Body mass index (BMI) was then calculated as weight divided by height squared: $(kg)/ (m)^2$ for samples with the available perimortem data.

Pearson's Correlation demonstrates clear association between BMI and cremation weight ($r = 0.56$; $p = <0.0001$). However, multiple linear regression reveals that variables sex and age also have a significant relationship ($t = 7.198$; $t = -2.5$ respectively). When BMI, sex, and age are regressed in conjunction, they contribute approximately 67% of all variation observed in cremation weight ($R^2 = .668$). Explanations include bone modification resulting from increased loading-stress, as well as glucose-intolerance and altered metabolic pathways related to obesity. ANCOVA analysis (using source location as classification variable) further indicates regional variation in body and cremation weight.

Genetic variability in three South African vervet monkey (*Chlorocebus aethiops*) populations.

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This project investigates genetic variability in a subset of vervet monkeys that have been trapped as part of an on-going project designed to understand the genetic structuring of these animals in South Africa. Using microsatellite loci, differentiation in vervets from three populations (Blyde, Oribi and Polokwane) are compared using tools from both population and landscape genetics. Population

genetics tools include an analysis of molecular variance (AMOVA), Fst and Rst. Landscape genetics tools include a Bayesian assignment test. Population genetics requires that populations be designated beforehand and considers the differences between them, while landscape genetics uses the individual as the unit of measurement and tests whether the animals' genetic makeup clusters them into distinct populations. The results from all tests indicate little genetic structuring in these animals. There is no evidence of linkage disequilibrium. The AMOVA results indicate that over 95% of the genetic variation in these animals occurs within, rather than between the populations. While Fst values indicate significant differentiation between all pairs of populations, Rst values, more appropriate for use with microsatellites, indicate significant differentiation between Oribi and Blyde only. These results, however, are likely due to sampling error in this small population subset. The output from Structure, a Bayesian assignment test statistical program, indicates that the best fit for the data is one, genetically interchangeable population. These results will be confirmed with an analysis of the full sample.

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The Otjiseva skull reconsidered: a renewed look at the geological context, dating, and significance of a lost Namibian fossil.

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In 1964, an early modern human cranium was discovered during road construction on the Otjiseva farm in north-central Namibia. Further excavations in 1968 uncovered more pieces of the cranium, the mandible, and a few other fragmentary postcranial bones. While initially viewed as an important find by virtue of being one of only a handful of then-known early modern human skulls, interest declined dramatically due to the failure of attempts to date the fossil. Sometime prior to Namibian independence, the Otjiseva skull disappeared from the National Museum of Namibia, with only a single humerus fragment and casts of the cranium and mandible remaining.

Given current anthropological questions concerning modern human origins, the Otjiseva skull takes on renewed importance. This paper reports on recent attempts to (1) collect observations made on the cranium and mandible, (2) make new observations on the casts, (3) reassess the geological context of the find, (4) collect sediment samples for OSL dating, and (5) integrate this information into the broader context of our knowledge of early modern humans in southern Africa.

The phylogeography of the Angolan Black and White Colobus monkey, *Colobus angolesnsis palliatus*, in Kenya and Tanzania.

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The Kenyan habitat of the Angolan Black and White Colobus monkey, *Colobus angolensis palliatus*, is becoming increasingly fragmented due to human disturbance. This subspecies lives in isolated populations throughout Kenya and Tanzania and is currently considered Data Deficient by the IUCN/SSC. A population of *C. a. palliatus* found in the Tanzanian Southern Highlands has been purported to belong to a different subspecies based upon pelage differences. A comparative analysis of *C. a. palliatus* was undertaken by estimating mitochondrial genetic variation in 103 individuals across its geographic range. A 1794bp mtDNA fragment was sequenced, spanning from cytochrome *b*, across tRNA-Thr and tRNA-Pro, and into hypervariable region I of the d-loop. The 103 sequences defined 19 unique haplotypes in 4 populations, two from Kenya, one from central and one from southern Tanzania. Analysis of molecular variance (AMOVA) demonstrated greater among population variation than within (Φ_{st} 0.663, $p>0.001$). Phylogenetic analysis suggests that sampled Kenyan haplotypes are paraphyletic, with one common haplotype (Shimoni2; n=10) basal to all other Kenyan and Tanzanian haplotypes. No genetic support is found for the putative subspecies level differentiation of *C. a. palliatus* in the Tanzanian Southern Highlands. Both phylogenetic and population genetic results highlight the evolutionary importance of the two Kenyan populations, however, Tanzanian black and white colobus habitat currently enjoys much greater protection. These results suggest that for *C. a. palliatus* conservation and management, Kenya and Tanzania be considered distinct units, Kenyan habitat protection be extended, and connectivity among the two Kenyan populations should receive conservation priority.

Recovery and preservation of a mountain gorilla skeletal resource in Rwanda.

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Regular monitoring of known individual mountain gorillas (*Gorilla beringei beringei*) of the high-altitude forests of the Virungas has been conducted almost continuously since Dian Fossey

established the Karisoke Research Center in 1967 (Fossey 1983). Despite decades of political instability and other threats to their conservation, long-term field observations from Karisoke have contributed substantially to our current knowledge of gorillas. But research on their skeletal remains also has the potential to contribute significant and unique insight into the biology of these critically endangered great apes. We report on a collaborative effort to assist the Rwandan Office of Tourism and National Parks in the recovery and curation of existing skeletons of mountain gorillas from Rwanda's Parc National des Volcans (dating 1995-recent), and to help build local capacity for the long-term preservation and management of this collection as a resource for education and research at the Museum of Natural History in Kigali. During the summer of 2008, skeletal remains from over 70 mountain gorillas, representing both sexes and all age classes (N = 31 infants/juveniles, 41 adults), were recovered and catalogued from locations within and outside of the national park. Detailed skeletal inventories, dental emergence and epiphyseal union, and other skeletal observations were also collected. Cleaning and preparation of these materials is ongoing, and associated life history and veterinary records for known individuals in the collection are being compiled. We will present information concerning skeletal condition, inventory and records of the collection, and plans for making this collection available for study in Rwanda.

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Natural selection for adiposity and metabolic traits.

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Investigations of the potential role of natural selection on shaping the distribution of adiposity and metabolic characteristics have largely focused on identifying complex genetic influences including family aggregation, quantitative trait loci and candidate genes. Evolutionary scenarios have focused on adiposity and metabolic phenotypes within a context of human population history, adaptive scenarios about putative selection for energetic efficiencies and interactions with the modern nutritional environment. In particular, thrifty genotype ideas are sources for scientific curiosity about the role of natural selection and genetic influences on obesity and related metabolic disorders, but they remain difficult to test. Evidence for genetic influences on body weight, adiposity and metabolic traits are briefly reviewed. Emphasis is placed on reviewing the specific role of natural selection on adiposity and metabolism in humans from the perspective of the available evidence for differential reproduction of individuals associated with energetic adaptive superiority.

Stable isotope analysis.

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The European Module of the Global History of Health Project for the first time processes large quantities of skeletal data from all parts of the European continent and creates the potential of detecting varying patterns in nutrition, morbidity, migration, and social stratification over space and time. Precise indicators of many of these cultural attributes are made possible by stable isotope analysis (^{13}C and ^{15}N in bone collagen, ^{13}C and ^{18}O in bone structural carbonate, $^{87}Sr/^{86}Sr$ in bone apatite) of human skeletal finds. The GHH Project offers the unique opportunity for a large-scale comparative analysis rather than single series analyses which deal with selected points of the global pattern only. Palaeodietary analyses of early medieval socially stratified burial sites in southern Germany, thought to reflect the dawn of later medieval nobility, do not confirm the hypothesis that the socially priviledged were better nourished than the common folk, and show that particularities of the population under study must be taken into account. Were the sick and destitute individuals recovered from poorhouse cemeteries chronically undernourished, and how large were the catchment areas of such pre-industrial institutions? What are the baseline values typical for European farming communities and how large was the extent of population admixture?

Virtually no isotopic information from early modern times or the later stage of the Industrial Period in Europe exists. Given the many participants of this project, a comprehensive isotopic databank can be generated which will serve as a comparative record for any such further investigations.

Associations of gait, support use and limb morphology in West African colobines: the effects of bounding on locomotor biomechanics.

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Among anthropoids, bounding -- involving simultaneous footfalls -- is a gait feature uniquely observed in the black-and-white colobus clade. The adaptive significance of this locomotor idiosyncrasy is unknown and its impact on skeletal morphology has yet to be fully explored. In the Tai Forest, *Colobus polykomos* contrasts with sympatric *Procolobus badius* in terms of overall leaping frequency, tendency to run during travel, and use of compliant supports. Existing data suggest that postural components of these positional behaviors may include more extended and less abducted limbs in the black and white colobus

To investigate skeletal morphological correlates of the contrasting locomotor profiles, we

measured a set of shaft and articular dimensions in the femur and humerus of *Colobus polykomos* (N = 11) and *Procolobus badius* (N = 24). While joint surface areas were similar between taxa, shaft dimensions were diminished in *Colobus*, possibly as a structural response to the ground reaction forces acting through both limbs during bounding. The expanded deltoid crest and medial epicondyles of *Procolobus* are features associated with the use of more abducted postures on compliant supports.
Our results suggest that despite the likelihood of greater substrate reaction forces in *Colobus polykomos*, locomotor stresses due to bending are relatively reduced. We hypothesize that bounding is a means of minimizing effects of ground reaction forces engendered while traveling rapidly on non-compliant supports.

You got to know how to fold'em: biassed wadge-folding in wild chimpanzees.

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All well-studied populations of wild chimpanzees (*Pan troglodytes*) orally compress detached vegetation between tongue and palate, then discard it after juices have been extracted ('wadges', Goodall, 1986). Thus, wadging is a universal form of food-processing, typically focussed on fibrous fruit, bark, or pith, that yields a characteristic remnant or artefact. Most wadges are tangled, amorphous masses, but here we report a newly-discovered technique, from the chimpanzees of Toro-Semliki Wildlife Reserve, Uganda. Variable (8-50 cm) lengths of pith stripped from wild date palm (*Phoenix reclinata*) fronds are repeatedly folded to produce a zigzag-shaped artefact. (Systematic folding of plant matter for any reason is rare in chimpanzees, e.g. chimpanzees at Bossou, Guinea, fold leaves to extract water from tree-holes, Tonooka, 2001). Not surprisingly, number of folds per wadge was correlated with length of pith, i.e., longer piths had more folds, which presumably was necessary to fit the material into the confines of the mouth. However, 83% of the 110 wadges unexpectedly had an odd number of folds, versus only 17% with an even number of folds, a highly skewed departure from an expected 50:50 distribution. There is no obvious reason why a concertina-style, folded object should have an odd or even number of folds, but the explanation was supplied by later observations of another Ugandan population of chimpanzees; the Kanyawara community at Kibale National Park sometimes processes the pith of papyrus (*Cyperus papyrus*) in a way that produces similarly folded remnants.
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Infant carrying and contact: it's not just about transportation.

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The human infant's extreme neurological immaturity at birth is used to help explain both its inability to cling to its mother's ventrum and why it cannot locomote on its own. That human infants exhibit only 25% of their adult brain volume also explains why the fundamental analytical unit for studying human infant growth, feeding, antibody production, thermo-regulation, sleep architecture, breathing and heart rate is not the infant alone, but rather the mother-infant dyad. Sleep laboratory studies of infants sleeping alone and together in bed with their mothers reveal that when mothers and infant sleep in contact breastfeeding episodes double, heart rate and breathing frequencies become more stable, mother and infants exhibit increased percentages of their total sleep period time in safer sleep stages, with increased overlapping EEG defined arousals that serve to oxygenate the infant. Altogether these data reveal that nothing an infant needs, or can or cannot do, makes sense except in light of its mother's body. These data remind us that energy invested by caregivers during infant carrying, whether the infant sleeps or is awake, provides much more than transportation. Simultaneously, carrying behavior extends the critical ways in which contact with another body regulates the human infant's physiology in adaptive ways.

Ancestry estimation from metacarpals.

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Ancestry estimation is an important part of the formation of a biological profile. Although the skull is most often used to estimate ancestry, in many cases it may be fragmented or otherwise unavailable. Therefore, it is important to develop other methods of assessing ancestry. Very little research has been done on the ability of the metacarpals to accurately determine ancestry. Falsetti (1995) noted that significant differences between ancestries were found in measurements taken on the first and third metacarpals. Using discriminant analysis, Smith (1996) produced accuracy rates ranging from 91.25% for the left hand to 96.86% for the right hand.
The present study attempts to estimate ancestry using a modern sample. Thirty-eight females (32 white and 6 black) and 88 males (43 white, 35 black, and 10 Hispanic) from the William M. Bass Donated Skeletal Collection were examined. The measurements used were adapted from Smith (1996) and consisted of maximum and interarticular length, mediolateral and dorsopalmar base width, mediolateral and dorsopalmar head width, and

mediolateral and dorsopalmar midshaft width. Discriminant function analysis found that ancestry could be estimated with an accuracy of 85.71% for white females using the first metacarpal and 63.64% for black females using the third metacarpal. White males exhibited a correct classification rate of 62.2% using the fourth metacarpal, while black males possessed 75% accuracy using the fourth metacarpal. Hispanic males were classified correctly 75% of the time using the fifth metacarpal. The current study finds lower classification rates than previous studies on ancestry estimation from metacarpals.

The geometry and architecture of craniofacial inheritance.

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Morphological studies of modern and fossil humans typically assume that skeletal variation is strongly grounded in genetic inheritance. Advances in genomic and morphometric analyses allow us to test this assumption by relating detailed morphological variation to patterns of inheritance and to begin to localize specific chromosomal regions of interest. To identify the genetic architecture influencing normal craniofacial variation, we collected coordinate data comprising 47 landmarks and 51 semi-landmarks from lateral cephalographs of 200 healthy participants from 10 nuclear and extended families in the Fels Longitudinal Study. Configurations were superimposed by generalized Procrustes analysis, with semi-landmarks sliding so as to minimize the bending energy; resulting PC scores were used to quantify craniofacial shape. In addition to morphometric data, detailed pedigree information was available for each individual, and 119 individuals were genotyped for some 400 autosomal markers spaced approximately every 10 cM. Heritability (h^2) of these measures, estimated using a variance components-based maximum likelihood method for pedigree data, was significant for nine of the first ten component scores, ranging between 0.25 and 0.63 (average = 0.49 for significant heritabilities). Preliminary linkage analyses on the first ten components also resulted in four highly suggestive linkages to markers on chromosomes 1 (PC 1), 5 (PC 6), 17 (PC 4), and 19 (PC 2). These results demonstrate that modern human craniofacial morphology is under substantial genetic influence and identify chromosomal regions of interest for further examination.

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Evidence for the influence of diet on cranial form and robusticity.

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The evolutionary significance of cranial form and robusticity in early *Homo* has been variously attributed to allometry, encephalization, locomotor activity, and masticatory forces. However, the influence of such factors is variably understood. To evaluate the effect of masticatory loading on neurocranial form, sibling groups of weanling white rabbits were raised on different diets for 3.5 months until subadult. The 'over-use' cohort (n=10) was fed a hard/tough diet of intact rabbit pellets and hay blocks, while the 'under-use' cohort (n=10) was fed a soft diet of powdered rabbit pellets. Micro-CT was used to quantify and visualize morphological variation between treatment groups. First, cranial vault thickness (frontal and parietal bones) and zygomatic arch dimensions were compared using non-parametric ANOVA. Second, 3-D coordinate landmark data were collected from the midline and right side of the basicranium and analyzed using EDMA. Results reveal trends (p<0.10) for greater outer table thickness of the frontal bones and greater zygomatic height in the 'over-use' cohort. Furthermore, the basicrania of 'over-use' rabbits exhibit a significant anteroposterior reduction in the anterior basisphenoid, increased superoinferior depth of the pterygoid plate, as well as altered overall morphology of the posterior crania fossa. Thus, differences in cranial regions not directly associated with the generation or resistance of masticatory forces (i.e., frontal bone, basicranium) may be interpreted as indirect consequences of diet-induced variation in maxillomandibular morphology. These findings also suggest that long-term variation in masticatory forces associated with differences in dietary properties can contribute to the complex and multifactorial development of neurocranial morphology.

Community structure and history: patterns of ecospace among fossil primate communites.

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Primate communities currently exist in four biogeographical regions of the globe. These primate communities demonstrate different patterns of ecological space. This "ecospace" is measured by ecological adaptations such as body size, diet, activity pattern and substrate use. Plotting ecological variables in two-dimensional space allows comparisons of primate communities within and between each biogeographical region.

Despite the variety of ecological factors within a region, primate communities show much more similarity among regions than between them.
We hypothesized that fossil primate communities on various continents would thus mimic the space held by living primate communities on those same continents. Thus, in this study, fossil communities from three biogeographical regions were compared to extant primate communities. These include the Fayum, Egypt, Africa; La Venta, Columbia, South America; and Western Interior, North America (hypothesized to be similar to South American communities) and four well-known primate localities from South America and Africa. We compared the fossil sites with univariate and multivariate analyses to these extant primate communities. The fossil communities, despite their ages are more similar to modern communities within the same or nearest regions. Thus it is evident that historical circumstances influence primate community structure and communities appear to retain the structure developed during initial adaptive radiations. This is likely a function of habitats in each region differing with respect to plant resources, both in structure and type of plant.

Camelid domestication in the Americas.

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Camelids first appear in the fossil record, only in North America, 40+ million years ago, and spread across the Bering land bridge into Asia 3 mya and via the isthmus of Panama 2 mya. All species of camelids then went extinct in North America around the time of the Pleistocene. Two wild species (Vicuna and Guanaco) and two domesticated species (Alpaca and Llama) exist in South America today. Several different hypotheses exist for the relationship between the wild and domesticated species, the most prominent of which has the alpaca as descended from the vicuna and the llama as descended from the guanaco, with subsequent interbreeding between alpacas and llamas since the time of the Spanish conquest of the Inca. Alpacas and llamas appear to have been domesticated over 6000 years ago in the altiplano of Peru. The first complete sequence of a camelid, an alpaca, is currently being completed in collaboration with scientists at Washington University of St. Louis, NCI, Binghamton University, and the Broad Center, among others. The trace sequences are available now for analysis and we used them to develop primers for PCR of STRs, SNPs, and candidate gene regions. Species-specific STRs (specific to Vicuna or to Guanaco) were identified and used to estimate admixture between alpacas and llamas, as well as to infer the origins of the four species. Ancient camelid DNA was also used to test inferences about the origins of the two domesticated species and the role of human intervention in the process.

Using psychology experiments to simulate the cultural evolution of archaeological artifacts.

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Cultural evolutionary theory asserts that human culture constitutes a Darwinian evolutionary system of inheritance that shares key characteristics with biological/genetic evolution. A key aspect of Darwinian evolution is population thinking: evolutionary biologists emphasise that populations of biological organisms vary, and devote their efforts to identifying and understanding the microevolutionary processes such as selection, drift and mutation that alter this variation over time. Similarly, cultural evolution researchers seek to identify and understand the cultural microevolutionary processes that alter cultural variation over time using a range of theoretical, experimental, observational and historical methodologies. I will illustrate the benefits of adopting an evolutionary approach to culture using a case study concerning technological change. Using mathematical modelling techniques drawn from population genetics, Boyd & Richerson (1985) defined and modelled two cultural microevolutionary processes: guided variation (modifying a culturally acquired behaviour according to trial-and-error individual learning) and prestige bias (adopting the cultural trait of a successful or prestigious model). The archaeologists Bettinger & Eerkens (1999) subsequently proposed that prehistoric projectile points from the Great Basin show evidence of these processes: points from prehistoric California exhibit high diversity consistent with guided variation, while points from prehistoric Nevada exhibit low diversity consistent with prestige bias. Finally, I will present findings from laboratory experiments in which participants design their own virtual projectile points and engage in either guided variation or prestige bias (Mesoudi & O'Brien 2008), with the experimental data matching those found by the archaeologists and yielding additional insights not possible with archaeological methods alone.

Craniofacial growth and development in the Arikara.

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This study examines the changes in size and proportion of the craniofacial complex throughout growth and development in a single skeletal sample from the Arikara of South Dakota. Standard craniometrics and metrics developed at the University of Wyoming are employed. Emphasis

is placed on measures that are useful in the differentiation of adult modern human skeletal populations. Age is estimated from dental eruption stages, suture closure, dental wear, and postcranial indicators. The skeletal sample includes individuals from birth through old age and is examined via both univariate and multivariate statistical techniques.

This study demonstrates that the timing of cessation of growth in regions of the face is concordant with expectations from previous studies. Measures of the breadth, projection, and proportion of the upper midface fall within adult ranges derived from the same population at or soon after birth. The lower midface does not approach adult size or proportion until later ages, frequently not until late adolescence.

Discriminant function and logistic regression analyses are used to compare the adult Arikara to samples of adult Euroamericans and African Americans. The subadult sample examined in this study does not follow the multivariate classification pattern of the adult Arikara. Notably, subadult individuals frequently classify within the adult ranges of Euroamerican and African American samples rather than with the Arikara. These results are consistent even when the analysis is limited to variables that present at early ages, suggesting that individuals should not be compared to adults in a multivariate analysis until they reach full adult status.

Brachiation: insights from forelimb anatomy and kinematics.

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Gibbons, known as excellent brachiators, live in a complex, three-dimensional and unpredictable environment. Animals living within such an environment are expected to have an excellent coordination and control capability. However, little is known about how gibbons react biomechanically to an unpredictable, compliant substrate. To examine this aspect of their locomotion an integrative approach is needed. We will provide quantitative anatomical data on the muscle-tendon architecture of the forelimb of four gibbon species (*Hylobates lar*, *H. moloch*, *H. pileatus* and *Symphalangus syndactylus)*, collected by detailed dissections, as well as preliminary kinematic results.

Muscle masses, fiber lengths, pennation angles, physiological cross-sectional areas and tendon characteristics are obtained for the major forelimb muscles. A comparison is made between gibbon species and with published data of other primates such as humans, rhesus macaques (*Macaca mulatta* and *M. fascicularis* = non-brachiators) and chimpanzees (*Pan troglodytes* = modified brachiators). Results indicate a low interspecific variation among gibbons. We find an increased flexor capacity at the level of the wrist and elbow for the specialized brachiator, compared to the non-specialists and especially in comparison with the habitual bipedal human. This supports the hypothesis that arm flexor activity is primarily needed to adjust the path of the centre of mass for efficient pendular energy exchange when brachiating. This hypothesis is further examined by kinematic analysis of the body movements and the path of the centre of mass during brachiation. Here we find that gibbons indeed flex their arms to lift their body before grabbing the next support.

Three-dimensional geo-morphometric analysis of the pelvis of *Alouatta*, *Lagothrix*, and *Ateles*.

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Despite a common reliance on prehensile tails, the atelines present a continuum of postural behavior, from the generalized, quadrupedal *Alouatta* to the relatively suspensory *Ateles*, with *Lagothrix* intermediate between the two. Bony features of the forelimb, thorax, and vertebral column correlate with differences in forearm suspension and orthograde behaviors in these genera. Although the ateline pelvis plays an important role in the distribution of forces during locomotion and postures involving the prehensile tail and the hind limbs, relatively little attention has been paid to comparative pelvic girdle morphology among genera.

I use 3-dimensional landmark data to compare the pelvic morphology of *Ateles*, *Alouatta*, and *Lagothrix*. 73 landmarks were collected from articulated sacra and innominates of 37 adult individuals and analyzed in Morphologika. Although the shape of both the innominate and the sacrum scales with overall size, *Ateles* is even larger than expected for its size and exhibits a comparatively wide sacrum, suggesting an increased weight-bearing role of the pelvis in this relatively orthograde genus. The three genera, however, all possess a relatively large auricular surface for the sacro-iliac joint, which creates a more stable connection between the bony elements of the pelvis to counteract the stresses placed on this joint by the weight-bearing role of the prehensile tail. Overall, the ateline pelvis is more similar across genera than is upper body morphology, suggesting that pelvic shape is greatly influenced by their shared reliance on the supportive functions of the prehensile tail.

Biological structure of the Early and Middle Holocene Gobero site burial complex, Niger, Western Sahara desert.

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Gobero is a series of closely-spaced cemeteries located in the center of the Sahara Desert in the country of Niger. The area was occupied during two "green" phases of the Holocene period coinciding with the formation of a paleolake which anchored the subsistence activities of two biologically distinct groups of people. Reconstructing the site use history is critical to understanding the nature of biocultural adaptation of the peoples that lived at Gobero. In particular, previous archaeological research suggests the earliest Holocene occupants of the Sahara were sedentary hunting-fishing communities (Kiffian) that congregated along the shores of paleolakes. This phase has been dated at Gobero to 9500 calBP. Following an arid spike and occupational hiatus, pastoralism is introduced to the Sahara and it is assumed that a pastoral community (Tenerian) re-occupied the region ca 6500 calBP. The distinct subsistence and mobility regimes should manifest in the mortuary record, with the Kiffians demonstrating a more formal mortuary program. To test for differences in the spatial organization of graves, odontometric data were collected and subjected to bootstrap resampling and calculation of inter-individual biodistances. Analyses indicate a cluster of closely-related individuals dating to the Kiffian period that appear to be buried in a structured cemetery. To the contrary, the Tenerian burials are more stochastic in organization. These analyses confirm the hypothesized differences in settlement structure and mobility patterns, documenting a more formal and structured mortuary program associated with the sedentary fishing community and a more opportunistic and less structured program associated with nomadic pastoralists.

Nutrition and stature: The residents of the island of Gotland, Sweden killed in the Battle of Wisby, 1361.

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European medieval societies are often characterized as hierarchical with extreme economic disparities in association with land, food, and wealth. Such economic inequalities are known to contribute to nutritional deficits and chronic health problems in lower status segments of societies. One approach towards better understanding nutrition and health in past populations is through a bioarchaeological assessment of skeletal features. This study explores the issue of inequity in nutrition and health during the medieval period in Scandinavia through a bioarchaeological assessment of adult stature, a skeletal feature directly affected by nutrition. Numerous skeletal studies of medieval Europeans have primarily examined skeletal samples of the elite or the very poor. In contrast, this paper focuses on a medieval skeletal sample of presumed non-elite, high socioeconomic individuals from the Island of Gotland, off the coast of Sweden. During historic times, Gotland was a place where most citizens were presumed to be wealthy. For these reasons, in 1361, this island was invaded by the Danish army in the Battle of Wisby. Afterwards, approximately 1800 Gotlanders were buried in five mass graves. Femora from these commingled graves were examined in order to determine adult stature. Mean stature values were subsequently compared to values reported for the Battleship Mary Rose, Battle of Towton, and the Battle of Good Friday. Preliminary analyses indicates that the Gotlanders were significantly taller than their Mary Rose and Towton counterparts. This study indicates that the Gotlanders may have experienced less socio-economic disparities than that previously shown for other medieval populations.

Assessing the uniqueness of human milk composition: old assumptions, new hypotheses.

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Human infants show a greater degree of postnatal brain growth relative to other mammals, which has been modeled as a continuation of the fetal brain to body growth relationship for at least the first year after birth. This shift in brain growth trajectory necessitated a change in maternal energetics, with mothers bearing a larger energetic burden during lactation. In 1983, Robert Martin proposed that encephalization in genus *Homo* must have been accompanied by selection for milk constituents that could support rapid brain growth in the neonate. Thus, modern human milk composition should be species-specific due to the unique ontogenetic priorities of human neonates compared to nonhuman primates. Recent findings on nonhuman primate milk composition, which includes data on protein, amino acids, lactose, fat, and fatty acids, suggest human milk composition shares many features with anthropoid milks in general and hominoid milks in particular. A relatively larger brain in humans may not be related to human milk composition in any direct or immediate way. However, there still may be unique attributes of the larger human lactation strategy (e.g., milk volume, nursing frequency, weaning foods) and/or the human reproductive strategy (e.g., neonatal and maternal fat storage). In addition, components in human milk that are not directly related to nutrition, such as antibodies, have yet to be investigated in a comparative context. Human milk may be derived from other primates as the result of a higher concentration of immune factors common to mammalian milks or the presence of species-specific immune components.

Using 3-D geometric morphometric techniques to further understand the relationship between Neanderthals and *Homo sapiens*.

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Either Neanderthals are a distinctly separate species from *Homo sapiens* that were replaced by *Homo sapiens* without any genetic interaction or there was at least a minimal genetic interaction between contemporaneous Neanderthals and early humans. The purpose of this research was to further explore this issue by conducting a quantitative analysis on several aspects of morphological variation evident in crania of Neanderthals and *Homo sapiens*. Cranial landmarks were digitized on the cranial vault and midfacial area of the specimens. Digitizing cranial landmarks preserves the information inherent in those landmarks relative to other landmarks in three dimensions. The data was fitted using generalized procrustes analysis, and then analyzed using multivariate statistical methods that included principal component analysis and canonical variates analysis. The results of the cranial vault analysis distinguished Neanderthals from both modern humans as well as early modern humans. In the discriminant analysis of the cranial vault data set, several individual specimens were misclassified into the Neanderthal group through resubstitution and cross-validation using linear discriminant functions. It is clear that these individual specimens have a unique morphology compared to their associated groups, and that they are closer in morphology to Neanderthals than their associated group means. The morphological degree of variation cannot conclusively define the taxonomic position of Neanderthals because morphologically based research is limited to explaining the differences and similarities inherent in forms, but cannot accurately define a species.

Coalescent simulations of human louse (*Pediculus humanus*) evolution reveal contact between archaic *Homo* species and modern humans.

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A central debate in human evolution is whether archaic *Homo* species and modern humans had contact throughout their colonization of the Old World. Attempts to address this debate by studying humans directly have achieved limited success. A look at ectoparasitic lice, which have coevolved with hominids for millennia, reveals a story much older than human remains can. While human mitochondrial DNA (mtDNA) coalesces to a single lineage very rapidly (within ca. 100,000 years), human louse (*Pediculus humanus*) mtDNA lineages date back to the origin of the genus *Homo* (ca. 2 million years ago). Further, the same genetic signature of population expansion seen in human mtDNA is evident in louse mtDNA and dates to the same time. Therefore, inferences about human evolution can be made from the study of human louse evolution. Two hypotheses have been put forth to explain human louse evolution; 1) archaic *Homo* species (e.g. Neanderthals) carried louse lineages that still exist today due to host switching events or 2) founding populations of modern humans out of Africa carried at least three louse lineages into modern populations. We used coalescent simulations to model these and other hypotheses of human/louse coevolution to determine which models are more likely to produce gene trees like the observed mtDNA gene trees for lice. The results strongly support the host switching event hypothesis, thus suggesting contact between archaic *Homo* species and modern human.

Male chimpanzees form enduring and equitable social bonds.

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Current controversy exists regarding the nature of primate social relationships. While individuals in several species have historically been argued to form enduring relationships with others, recent studies suggest that these relationships are labile, with animals interacting only over the short-term to satisfy immediate needs. Here I use data collected over 10 years on an unusually large community of chimpanzees at Ngogo, Kibale National Park, Uganda, to investigate whether male chimpanzees establish long-term social relationships and to determine the factors that affect variation in relationship quality and the stability of social bonds. Results indicate that kinship and dominance rank influenced the quality of relationships. Maternal brothers and males of the same dominance rank class groomed each other more equitably than did unrelated males and males who were dissimilar in rank. In addition, males who formed strong social bonds groomed more equitably than did males who displayed weaker bonds. Kinship and the quality of social relationships also affected the stability of social bonds. Maternal half siblings and males who groomed each other equitably maintained longer lasting bonds than did nonkin and males who groomed each other unevenly. Virtually all of the males established at least one enduring relationship with another individual. The most enduring bonds formed between a few pairs of maternal brothers and dyads that maintained balanced grooming interactions. In sum, these results indicate that male chimpanzees maintain long-lasting and equitable social bonds whose formation is affected by kinship and the quality of social relationships.

The ontogenetic trajectory of the phenotypic covariance matrix and its effect on human cranial evolution.

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Heritable phenotypic variation is the substrate for natural selection and thus central to most quantitative models of organic evolution. Joint variation of traits due to common genetic and developmental causes may lead to indirect evolutionary effects that deviate from the actual direction of selection. But the phenotypic variance-covariance structure arises from the joint variation of a large range of developmental processes and hence is not constant over the period during which a population of developing organisms is actually exposed to selection. To examine how development shapes the phenotypic covariance structure, we ordinate the age-specific covariance matrices of shape coordinates for human craniofacial growth. The metric that we use for this purpose is given by the square root of the summed squared log relative eigenvalues - the natural metric on the space of covariance matrices. The craniofacial covariance matrix appears to change continually throughout the full period of postnatal development. The resulting "ontogenetic trajectory" of the covariance matrix alters its direction at major changes of the developmental program whereas it is fairly straight in between. Consequently, phenotypic covariance matrices - and thus also response to selection - should be expected to vary both over ontogenetic and phylogenetic time scales as different phenotypes are necessarily produced by different developmental pathways. We give examples how developmental processes with different pleiotropic ranges modify phenotypic variances and covariances in the course of human cranial ontogeny, and discuss the consequences for the evolution of archaic and modern human cranial shape.

Salivary testosterone and dominance in captive brown tufted capuchins (*Cebus apella*).

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Testosterone, a steroid hormone responsible for the growth and maintenance of male characteristics, is also associated with aggressive behavior and social dominance in a variety of species. Though studies of animals such as lizards and mice have typically found positive associations between testosterone and aggression or dominance, this relationship is much more variable in primates including humans. One possible explanation for this variability lies in Wingfield et al.'s (1990) "challenge hypothesis," which predicts rises in testosterone only when such rises confer fitness benefits, since elevated levels of this hormone are energetically costly.
This study tests whether the challenge hypothesis applies to captive male capuchins (*Cebus apella*) by investigating the relationship between salivary testosterone and dominance rank. We collected over 200 saliva samples in ten weeks by training ten capuchins (both males and females) to chew on an unflavored rope, and validated a Salimetrics (State College, PA) assay kit for use with capuchin saliva. In addition, we completed 50 hours of behavioral observations to determine the order and linearity of the male dominance hierarchy, which was experiencing a period of social instability. We found a significant, positive correlation between salivary testosterone and male dominance rank, and as expected, male testosterone values greatly exceeded those of females. We also found no differences in morning and afternoon testosterone levels. We hope that future researchers will use the effective, noninvasive collection and analysis methods presented here to expand the hypotheses they can test in captive monkeys.
This study was funded by the Yale University Center for Human and Primate Reproductive Ecology, the Yale College Dean's Research Fellowship in the Sciences, and the Richter Fellowship.

Why do capuchin and squirrel monkeys form interspecific associations? A GIS based test using ranging and feeding data.

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Researchers of capuchin (Genus: *Cebus*) and squirrel (Genus: *Saimiri*) monkeys have long noted the frequent associations these species form in the wild. Various hypotheses have been proposed to explain these associations, including the hypotheses that *Saimiri* gain an antipredation benefit and/or an increased knowledge of food resources by associating with *Cebus*, while *Cebus* gain nothing and incur a foraging cost due to increased feeding competition. We examined these hypotheses in *Cebus albifrons* and *Saimiri sciureus* living at the same site in the Ecuadorian Amazon. Field experiments at our site were consistent with *Cebus* exhibiting more effective antipredation responses than *Saimiri*. We tested the remaining hypotheses with ranging and feeding behavior data. Using ArcGIS software and a detailed georeferenced site map, we compared the path length and movement speed for follows on each species, both when they were alone and when associated. An increase in feeding competition predicts that both measures would be greater during interspecific

associations, a prediction our results generally support. The hypothesis that *Saimiri* monkeys improve their foraging efficiency from the better food location knowledge of *Cebus* predicts that *Saimiri* will visit more feeding trees per distance traveled when associating with *Cebus*, and that they will travel in more linear paths between feeding trees when associated with *Cebus*. The results supported these predictions as well. We conclude that interspecific association provides benefits to *Saimiri* but it is unclear if *Cebus* derive any such benefits.
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Natural selection and high altitude.

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While studies of human adaptation to high altitude have played a central role in our efforts to understand natural selection, no consensus exists as to whether genetic factors are involved and if so how they operate. We have used three approaches toward such an end. First, we asked whether population variation in the duration of high-altitude residence protected longer-resident groups from maladaptive consequences, using birth weight as an example. Second, state-of-the-art techniques have been employed to identify the physiological processes responsible for such birth-weight reductions. Third, ancestry-information genetic markers (AIMs) and genome scans have been conducted to determine whether multigenerational high-altitude residents differ systematically from low-altitude controls and, if so, what genes are located in such regions and whether their variants are related to physiological characteristics. Serial studies in Andean vs. European residents of high (3600 m) and low (400 m) altitudes in Bolivia demonstrate that Andean weighed 253 g more at birth than Europeans at high altitude after controlling for gestational age and other known influences. Andeans had twice as much UA blood flow and O_2 delivery at 20 weeks of pregnancy, before the onset of marked differences in fetal growth, and such physiological characteristics were related to the percent Amerindian AIMs. Genome scans identified several hypoxia-inducible factor (HIF) targeted or regulatory regions that distinguished Andeans from low-altitude controls with variation in some of these regions also being related to Andean-specific phenotypes. We concluded that genetic factors enabled Andeans to achieve a greater pregnancy-associated rise in UA blood flow and O_2 delivery than Europeans at high altitude, consistent with the concept that natural selection has preserved genetic variants capable of protecting against hypoxia-associated reductions in fetal growth.

A comprehensive regression tree to estimate body mass from the skeleton considering pathology, cross-sectional geometry and bone density.

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The ability to estimate body mass from the human skeleton has received considerable attention, but previous research has failed to take into account extremes of body mass due to the restraints of the research collections. The William M. Bass Donated Skeletal Collection at the University of Tennessee, Knoxville offers a unique opportunity to study individuals of known age, height and weight. This research combines three different lines of inquiry: bone density (DEXA), cross-sectional geometry of the femur (CT) and paleopathology. Standard measurements of bone mineral density (BMD)(g/cm2) were calculated automatically for the femoral neck, Wards triangle, the greater trochanter, proximal shaft and total BMD. For the cross-sectional geometry, the DICOM images were segmented into three-dimensional bone surface models. Cross-sectional geometry of the femur was calculated at five locations along the diaphysis. For the paleopathological analysis, the variables chosen were bi-iliac breadth, heel spurs, diffuse idiopathic skeletal hyperostosis (DISH), width/breadth of the proximal tibia, and osteoarthritic (OA) of the femur and tibia. When comparing the BMD of obese (BMI>30) individuals to that of emaciated (BMI<18) individuals, the results were significant ($p<0.05$) at all locations. Using the statistical program 'R', the best multivariate regression models includes midshaft cross-sectional area, BMD, heel spurs, DISH, OA of the proximal right tibia m-l breadth and right medial lipping. With the prevalence of obesity in our society, the ability to estimate body mass from the skeleton would add one more useful tool for the forensic anthropologist. This tool could further be useful for bioarchaeology and paleoanthropology.

Levels of resolution in the geographic distribution of pelage color characters as diagnostic taxonomic markers. An example from the *Callicebus* Cupreus-group.

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The relationship between pelage color variation, taxonomy, and species demarcation is well documented in primate systematics. This delineation has inevitably led to numerous instances whereby confusion in taxonomy arises in the

face of such things as hybridization, introgression, backcrossing, polymorphism, cryptic species, and the interpretation of speciation mechanisms. This study tests the levels of applicability of taxonomically diagnostic pelage coloration characters with specific reference to the Cupreus-group of the platyrrhine genus *Callicebus*. It was assumed that known taxonomically diagnostic characters will, all things being equal, provide resolution as a congruent arrangement between pelage coloration and the spatial distribution of species' demarcations.
128 specimens representing 5 of the 6 species of the *Callicebus* Cupreus-group were scored for their respective species-specific pelage color characters. Variability was then compared to differing levels of geographic resolution with respect to diagnostic markers and species boundaries. Frequency tests for all species support the presence of both clinal variation along a geographic transect, as well as localized intrapopulational variability in diagnostic pelage color characters. This increases the margin for errors in taxonomic assignment when color differentiation within a formally recognized species is present across such a wide gradient of geographic resolution. In such instances, microevolutionary forces could be convoluting the taxonomic designation as a geographically partitioned coat color variant or as a valid species. The primate systematist is cautioned to test the congruency between disparate morphological, behavioral, and where possible molecular characters, when considering the relationship between taxonomic assignment and geographic distribution.

Search for founder mitochondrial lineages in Holocene human remains in Patagonia.

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The archeological register of Patagonia is extremely interesting; it has the oldest record of human occupation in America (Monte Verde, 14,500 BP). It also has many Holocene sites that contain human bones as old as 8,800 years BP. Due to the favorable environmental conditions (cold and dry), the conservation of human remains is good enough to allow obtaining mitochondrial DNA, and in exceptional cases, nuclear DNA. We extracted and amplified mitochondrial DNA sequences of samples from northern, central and southern Patagonia distributed in a temporal range from 8,800 to 400 years AP. The majority of the samples studied belonged to haplogroups C and D; in one proto-Kaweskar we found haplotype C (16318G), previously described in a historical Aonikenk. Haplotype D4h3 (16241G and 16342C), which is found in present Patagonian populations and was recently described in a skeleton of 10,300 years BP in Alaska was also found, reinforcing the hypothesis of a connection between the populations of Patagonia and the hunter-gatherers of the beginning of the Holocene. In northern Patagonia we also detected the presence of haplogroup B in two individuals from the early Holocene. This haplogroup had not been found in present-day populations south of 43 degrees south latitude. Finally, in the most recent samples (400 years BP) we found haplotype D (16187T), very common in current populations of southern Chile, suggesting a possible population movement between them.
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Study of orbital lesions in Anglo Saxon England.

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There are several pathologies which may cause a skeletal change of the orbital bone, including haemolytic, haemorrhagic, and inflammatory conditions. Previously there have been few studies on identifying the aetiology of these lesions, and little consideration of other skeletal pathology, believed to be unrelated. My aim was to identify orbital changes in Anglo Saxon populations, and determine the prevalence of orbital pathology affecting these individuals. Also, where orbital lesions are present, any other skeletal pathology was incorporated into the analysis in an attempt to refine the diagnosis to a specific condition. True prevalence rates were obtained for all pathologies visible on the skeletal remains from four Anglo Saxon populations, and a sub-sample of individuals presenting with orbital lesions was established. The lesions were recorded by type, whether they were porotic affecting the cortical bone, or porotic affecting a hypertrophic layer of bone.
A total of 885 individuals were analysed, including 611 adults and 274 sub-adults. The true prevalence rate of individuals affected with orbital lesions was 8% of adults, and 26% of sub-adults. There was no pathology elsewhere on the skeletons which significantly correlated with the presence of orbital lesions, except in the individuals diagnosed as having suffered from scurvy. Each skeleton is subject to a differential diagnosis based on the types of orbital lesions, their distribution, and the distribution of other skeletal lesions. A range of pathologies are thought to be represented in the sample, including haemolytic, haemorrhagic, and inflammatory conditions.

The evolution of the human hand: making a fist.

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Features that distinguish human hands from the hands of other apes facilitate our ability to make and use tools. However, the aggressive behavior of humans led us to suspect that the anatomical

configuration of our hands may also protect the hand from injury when striking an opponent. Relative to other apes, humans have shorter fingers (digits2-5) and a thumb (digit 1) that is much larger, more mobile and muscular. These changes allow humans to form a fist in which digits 2-4 are firmly buttressed by contact of the fingertips against the palm and by the wrapping of the thumb around the distal phalanges of digits 2, 3 and partially 4. We suggest that this buttressing provides greater stiffness at the metacarpal-phalangeal and phalangeal joints, and thereby protects the fist from injury when striking. To test this hypothesis, we measured the stiffness of the 2nd metacarpophalangeal joint in a closed fist using a force transducer and a linear transducer. Subjects used three different fist postures: full buttressing, no thumb buttressing, and no buttressing. Results confirm that the buttressing inherent in a formed human fist increase the stiffness of the metacarpal-phalangeal joints. On average, the no thumb posture exhibited approximately 1/2 the stiffness of a fully buttressed fist and the no buttressing exhibited 1/3 the stiffness of a fully buttressed fist. These results are consistent with the idea that the selection for aggressive behavior played a role the evolution of the human hand.

Heterochrony of cranial features associated with wide jaw gapes in common marmosets (*Callithrix jacchus*).

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Marmosets are unique among platyrrhines in habitually gouging trees with their anterior teeth to stimulate exudate flow. We previously demonstrated that juvenile, subadult and adult marmosets exhibit cranial features that facilitate biting at wide jaw gapes during gouging as compared to skulls of non-gouging tamarins. Here we examine the timing of when these shape differences arise during ontogeny.

To better understand the role of heterochronic shifts during the ontogeny of cranial features facilitating wide gapes in marmosets, we measured three cranial dimensions associated with wide gapes as well as three dimensions related to load resistance in ontogenetic series of common marmosets (*Callithrix jacchus*, N=87*)* and saddle-backed tamarins (*Saguinus fuscicollis*, N=90). Ontogenetic series ranged from neonates to adults. All specimens were captive individuals housed at Oak Ridge Associated Universities' Colony with known ages (in days) at death.

Marmosets exhibit a complex pattern of heterochronic shifts in cranial features linked to wide gape throughout ontogeny when compared to tamarins. The relatively elongated AP glenoids and condyles of marmosets appear peramorphic arising primarily via acceleration during ontogeny. The relatively reduced condylar height, however, appears paedomorphic following a primarily neotenic trajectory. Similarly, features associated with load resistance, such as corporal and symphyseal dimensions, consistently appear paedomorphic in marmosets.

These results support a hypothesis that the shape differences facilitating wide jaw gapes are the result of multiple heterochronic shifts in ontogenetic trajectories between gouging marmosets and non-gouging tamarins. These interspecific differences further describe the potential evolutionary changes in the marmoset skull linked to tree gouging.

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Relationships between menstrual attitudes, health, and behavioural characteristics.

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Women's attitudes towards menstruation and menstrual, health, and behavioural characteristics were examined as part of a larger study on the "Menstrual Cycle: Health, Sexuality and Well-being". The 136 participants varied in their sexual activity, sexual orientation, and use of hormonal contraception. Data collected using questionnaires included age at menarche, cycle length, duration and intensity of menstrual flow, smoking, TV watching, physical fitness, and life satisfaction. Mean age at menarche was 12.4 years old. Women's estimated cycle length was accurate when compared to observed cycle length ($F(3,156) = .05$; $p = .98$). Women who smoked had a shorter duration of flow ($p < .01$) and were more likely to view menstruation as 'no problem' ($r = .20$; $p < .01$). Overall, 83% of women viewed menstruation as 'natural' but women not using hormonal contraception were more likely to view it as a 'sign of fertility' ($F(1,133) = 7.05$; $p = .009$). Women using Depo-Provera were less likely to view menstruation as 'natural'compared to abstinent, sexually active heterosexuals, or those using traditional oral contraception ($F(5,141) = 2.43$; $p = .04$). We found that women using hormonal contraception differed in their attitudes towards menstruation but did not find predicted differences in menstrual attitudes, health characteristics, and life satisfaction based on sexual orientation.

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Ranging behavior flexibility in response to habitat disturbance by Milne-Edwards' sifakas (*Propithecus edwardsi*) in Ranomafana National Park, Madagascar.

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The links between a species' ranging patterns, resource needs, and the quality of the habitat that it occupies has been well-established in the literature. However, in cases where anthropogenic habitat disturbance has degraded previously suitable habitats, studies have revealed that species specific traits (e.g., niche breadth) play an important role in shaping how a species responds. Using data collected during a long-term study of Milne-Edwards' sifakas, this project examines changes in home range size and daily path length exhibited by a large-bodied lemur species following the selective logging of their forest. Given that sifakas living in the disturbed area of the forest were known to have adopted a more folivorous diet than their pristine forest counterparts, it was predicted that social groups living in the disturbed forest would have smaller home ranges and exist at higher population densities; a hypothesis that was only partially supported by the data. Furthermore, it was predicted that daily path length would be shorter within the disturbed forest given the higher proportion of leaf material within sifaka diet at this site. Although preliminary analyses appear to support this prediction in general, the relationship is obscured upon the addition of variables such as weather and sifaka food preferences. Ultimately, although it appears that sifakas can (and do) alter their ranging behavior to compensate for habitat changes resulting from disturbance events, such changes should be regarded as transitory and highly context dependant within this species.

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Paleopalynological Investigations at FwJj14E, a Hominid Footprint Site in Ileret, Northern Kenya.

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The discovery of 1.5 Ma hominin footprints at FwJj14E, a site in Northern Kenya, has given new life to the possibility of paleopalynological investigations as a tool for reconstructing the paleoenvironment of hominin habitats. The solid taxonomical identification of the pollen preserved within the sedimentological layers that contain and bound these footprints would shed light on the paleohabitats of hominins at the time surrounding the emergence of the genus *Homo*. Over 100 sediment samples were taken over the summer of 2008 during the course of a sedimentological analysis of the footprint-bearing outcrop and are being analyzed for the presence of fossil pollen grains. The presence of paleosols and multiple types of fluvial depositional settings makes the likelihood of pollen preservation higher than those of other footprint sites in East Africa where fossil pollen has previously been found. Paleopalynology is a critical tool with which to gain valuable insights into the past vegetation that provided critical assets such as shelter, food and shade to our ancestors. The results of this study will be able to contribute not only to the study of hominin habitats, but to the field of paleopalynology in general, as we discover what depositional settings are likely to yield preservation.

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Layers of history within humanity's genomes.

J.L. Mountain. 23andMe, Inc., Department of Anthropology, Stanford University.

Twenty-five years ago allele frequency-based genetic distances between human populations first yielded inferences of bifurcating relationships among those populations. Although geneticists knew then that these inferences were highly simplified summaries of population history, there was little information in those data regarding population size changes and changes in rates of exchange between populations. Since then gene trees, in particular for the Y chromosome and mitochondrial genomes, have provided opportunities for investigating layers of history. In particular, these data allow researchers to delve beneath the high levels of migration of the last few thousand years to infer earlier, deeper relationships. More recently data for hundreds of thousands of single nucleotide polymorphisms (SNPs) from across the genome have yielded additional insights into both very recent migration events (within the last 500 years) as well as levels of isolation over the last 10,000 years. We examine inferences from a set of over 1000 individuals from around the world, genotyped for over 550,000 SNPs. By combining data from a broad range of genomic regions, we can draw far more robust and detailed conclusions regarding human history than was possible twenty-five years ago.

The phylogenetic relationship of adapoids, omomyoids, plesiadapiforms, and extant euarchontans based on infraorbital foramen size.

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The infraorbital foramen (IOF) is located below the inferior margin of the orbit. In 1977, Kay and Cartmill documented that 1) all primates have smaller IOFs than all other mammals and 2) haplorhines have smaller IOFs than strepsirrhines. Since the publication of these findings, the IOF has become one feature used to strengthen phylogenetic affiliations

among extinct crown primates. The objective of this study was to document the placement of plesiadapiforms, adapoids, and omomyoids among extant mammals using IOF size. Specifically, this study seeks to identify if plesiadapiforms and extinct crown-primates show a similar reduction in IOF size as extant primates. To assess this question, IOF area was measured and size-adjusted for 305 extant and 20 extinct crown-primates and 16 plesiadapiform species. An ANCOVA was used to test for differences between sampled groups. In this study, it was found that among extant mammals 1) primates, scandentians, and dermopterans (Euarchonta) have a 59% reduction ($P<0.0001$) in IOF size when compared to other mammals and 2) there are no significant differences in relative IOF area between haplorhines and strepsirrhines ($P<0.0001$). For extinct mammals, results show that plesiadapiforms have larger relative IOFs than all euarchontans (~49% larger, $P<0.0001$), while extinct crown primates show a similar reduction in IOF size to extant primates and other euarchontans. Bloch et al. (2007) suggest the monophyletic plesiadapiforms may be a sister group to crown-primates (Euprimateformes =''Euprimates'' plus Plesiadapoidea). Results from this study suggests that plesiadapiforms may be stem euarchontans rather than a sister group of crown primates.

Geographic patterning in subfossil primate community dynamics in Madagascar.

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Subfossil sites containing the remains of at least 17 species of extinct lemur have been found in all regions of Madagascar, except the eastern rainforest and Sambirano. Multiple lines of evidence demonstrate late Pleistocene climatic change before human arrival on the island, and human-caused transformation of the environment in the late Holocene. In this paper, we examine changes in the distributions of individual species, and their effects upon lemur community composition in the late Quaternary, using the statistical techniques and mapping capabilities of a Geographic Information System (GIS).

We assembled a database of extinct lemur occurrences at 40 subfossil localities. Variables collected for each locality include species occurrence, geographic coordinates, as well as radiocarbon dates and paleoenvironment (when available). Paleoenvironmental data consist of pollen and microfaunal records. These data were mapped using ArcGIS software.

Our results indicate important spatial patterns of species loss and ecological change on the island. Certain species associations appear to be more stable than others. While several localities support more than one species of archaeolemurid and palaeopropithecid, sympatry in the Megaladapidae occurs only in the south and southwest. Furthermore, monotypic and ecologically specialized genera, such as *Babakotia*, and *Hadropithecus*, occupy smaller ranges and are not present at the youngest known sites on the island. Our application of GIS to the spatial analysis of extinct lemur distributions demonstrates how this technology can be used to predict paleoecological associations, and test ecological and evolutionary hypotheses in Madagascar.

The problem of distinguishing spina bifida occulta from clefting without neural tube defect in the sacrum: what is an anthropologist to do?

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Incomplete formation of the sacral neural arch can result from a neural tube abnormality, but more commonly represents a developmental defect in the paraxial mesoderm. The term "spina bifida occulta" is often used to describe both conditions, although it should be reserved for cases where dysraphism (neural tube defect) is clearly present. By uniformly assigning the diagnosis of "spina bifida occulta" to skeletal remains that have any cleft neural arches, anthropologists are inflating the perceived frequency of neural tube defect in the past.
The purpose of this study is to determine whether skeletal remains with open sacral neural arches have any other evidence of neural tube defect, such as an enlarged spinal canal or other vertebral abnormalities. A review of cases of sacra with a completely open neural arch in a sample of 2210 Native American skeletal remains resulted in the identification of 35 individuals, including 6 subadults and 29 adults with this condition. Only one of these shows clear evidence of neural tube defect, with posterior expansion of the edges of the arch resulting in an enlarged canal. While some cases of occult dysraphism could lack additional skeletal indicators, it is unlikely that the majority of cleft neural arches observed in archaeological remains fall into this category. Anthropologists should be more conservative by providing a description of the observed abnormality, but withholding a final diagnosis that implies neural tube defect in the absence of additional evidence.

Work-related trauma in Washington DC's black poor: evidence from the W. Montague Cobb Skeletal Collection.

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A wealth of historical documents, including census records, occupational statistics studies, and US Commission on Civil Rights reports, indicate that Blacks in the 20th century District of Columbia were socially and politically restricted to certain occupations. Both males and females worked long hours, under harsh conditions, with little pay and little hope of advancement. Black men, the majority of whom were laborers, suffered from both underemployment and seasonal unemployment. Most Black women worked as domestics or laundresses. In many cases, women become the primary breadwinners of the household, and were additionally stressed by displacement from the family.
This study addresses the evidence of work-related trauma among 206 individuals from the W. Montague Cobb Skeletal Collection. Based on the analysis of associated mortuary records and archives, the Cobb Collection is representative of the poorest of Black Washingtonians living from 1861-1969. The overall frequency of trauma in the sample is high for both males and females at 75% and 59% respectively. In conjunction with archival and clinical data on occupation and injury, the pattern of fractures suggests that many may be attributed to occupational hazards. For example, 9.32% (37/397) of all fibulae are fractured, with the majority affecting the distal third, especially the lateral malleolus. The frequency of fibular fractures is significantly higher among males than females. This is expected as fibular fractures commonly result from falls from a height, and males are at much greater risk of these fractures given their laborer positions.

Male coercion and female choice in wild chimpanzees.

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The question of whether female primates, in promiscuously breeding species, exhibit preferences for particular males, and subtly attempt to bias paternity, is famously intractable. Previous studies from three sites have shown that, in wild chimpanzees (*Pan troglodytes*), females mate more restrictively during the fertile period, and this has been taken as evidence for female choice. A common problem with these studies, however, was a failure to test whether female sexual solicitations and refusals, during periods when females are most attractive, resulted from free choice or from fear of male aggression.
We used 10 years of data from the Kanyawara community in Kibale National Park to test whether male aggression influences female mating patterns. As with previous studies, we found that females mated more restrictively during the periovulatory period (POP), and that males who were generally approached by individual females for copulations were approached more frequently by those females during the POP. However, individual females at our site initiated periovulatory copulations most frequently with the males who had been most aggressive toward them throughout their cycles (i.e. during both estrous and non-estrous periods). We interpret this as evidence for a form of "conditioning aggression" in which males are aggressive in a variety of contexts to manipulate female sexuality over the long term. We suggest that the resulting mating patterns fit with a model of male coercion, but not with models of female choice based on preferences for "good genes."

Culture matters: Genes, environment, and complex disease.

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One of the greatest challenges of current biomedical research is to determine the etiology of complex diseases, such as asthma, diabetes, and hypertension. Although complex diseases are caused by the combined effect of multiple genes and multiple environmental factors, most current research focuses narrowly on the genetic basis for complex diseases. We report the first example in which sociocultural data -- a culturally meaningful measure of ethnic classification (*color*) and socioeconomic status (SES) -- reveal a hidden association between a candidate gene variant and a complex disease, hypertension. We investigated the association of diverse genetic and sociocultural data with blood pressure phenotypes in southeastern Puerto Rico. Using multiple linear regressions, we found a significant association between systolic blood pressure (SBP) and the Del322-325 polymorphism in the α_{2C} adrenergic receptor gene only when *color* (evaluated as '*negro'*, '*trigueño*' and '*blanco'*) and SES (evaluated as 'high' and 'low') were added to the model. Examination of the α_{2C}Del322-325 homozygotes revealed the existence of three categories of individuals: *negro*/low SES, *negro*/high SES and *trigueño* plus *blanco*/low SES. Within each category, the α_{2C}Del322-325 homozygotes had lower SBP relative to non-deletion homozygotes. Thus, the sociocultural information was needed to partition the culturally heterogeneous categories within the α_{2C}Del322-325 homozygotes and reveal a genetic association that was otherwise hidden. Our results show how greater attention to the measurement of sociocultural phenomena can empower the next generation of genetic association studies.

Investment in health resources: A pilot study using HDR indicators.

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Human behavioral ecology can assist in understanding disparities in health across the world, focusing our attention on the trade-offs that individuals have to make when resources are limited. In this study, I consider the importance of investment in health, specifically whether individuals would still invest in their health when resources are limited, or whether they would tend to invest resources elsewhere. I use indicators from the United Nations Development Programme's Human Development Report to consider the possible relationships between available resources (Gross Domestic Product per capita), overall quality of life (Human Development Index ranking), and resources invested in health (Health Expenditure per capita) in 177 countries. Overall, in countries with high GDP per capita and high HDI rankings, I find a linear relationship between these indicators and HEC. Countries with very low GDP values and low HDI rankings appear to invest very little in HEC; however, this relationship is less clear, though it appears that it is slightly stronger among countries with the lowest HDI rankings. I also compare HEC to the rate of mortality of children under the age of five to determine if there is a country-specific threshold for mortality. In these comparisons, the relationships do not appear linear, instead suggesting a "universal threshold" for under-five mortality; however, this relationship is less clear at the lowest HEC values. This pilot study can lead to more specific research on the relationship between health risk and differential resource investment, crucial to local and global health program development. Kristen Munnelly is a graduate student in the University of Michigan Department of Anthropology and School of Public Health, and is funded by the University of Michigan Literature, Science & the Arts Regents' Fellowship. She would like to thank Dr. Bobbi Low in the School of Resources and Environment at the University of Michigan for assisting with data analysis and for helpful feedback.

Rank-dependent Reproductive Energetics in Free-living Female Chimpanzees (*Pan troglodytes schweinfurthii*).

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Mammalian females invest more in offspring than males do in most species; they gestate for long periods and provide the bulk of parental care. Understanding how females deal with reproductive costs is therefore of primary interest. In this study, we examine the influence of reproductive state on activity budgets and the correlation between behavioral adaptations to reproduction and dominance rank in free-living female chimpanzees (*Pan troglodytes*) at Gombe National Park, Tanzania. We found that females increased the time spent feeding and traveling when pregnant and lactating (feeding: $F_{2,10}= 33.69$, $p < 0.0001$; traveling: $F_{2,10}= 11.63$, $p < 0.0025$). However, behavioral strategies differed by dominance rank among pregnant females ($F_{19, 64} = 10.64$, $p = 0.0001$). Dominant females focused on energy accumulation when they were pregnant by traveling further and procuring better food resources. By comparison, pregnant subordinate females adopted an energy conservation strategy typified by less travel and a lower quality diet. Given the well-documented relationship between prenatal nutrition and offspring health and development, we suggest that dietary differences during pregnancy may contribute to lower survival rates and delayed maturation for offspring of subordinate females.

Laetoli hominin footprints site G: the changing views of sustainable conservation of Tanzania's ichnofossil record.

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Since their discovery in 1976/77 by Mary Leakey and her co-workers, the 3.5 million years old Laetoli hominin footprints have and continue to pose conservation and preservation challenges for Tanzania and the international community. The footprints, which are preserved in the volcanic Tuff 7, are the rarest, oldest, and important ichnofossil evidence today that provide a snapshot of the locomotor repertoire of our ancestors during the Pliocene. Preservation of ichnofossil sites such as Laetoli can be accomplished by a combination of 'primary' and 'secondary' strategies. Primary strategies include building of protective structures (*P1*), burial of footprints (*P2*), and repair of tracks or removal of original specimens to museums (*P3* & *P4*). Secondary strategies involve replication of the prints in 3-dimension (3D) physical molding (S1), imaging in 3D including photogrammetric and digital scanning (*S2*) or 2-dimension photography, tracing and mapping (*S3*) or written documentation (*S4*). All these strategies are equally important conservation measures; however, they usually depend on the nature of the site, location and its importance to the region or nation where one or a combination of strategies can be utilized. In this paper reviews the recently proposed Tanzanian conservation efforts of

the hominin footprint site G and lay out a framework for a long term and comprehensive plan which calls for a combination of *P1* and *P2* strategies and the rationale for the new Tanzanian plan.

Anatomical representations of the human body : a comparative study of sites with evidence for cannibalism.

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Cannibalism is documented in many modern societies. Reasons for its presence vary from the needs for nourishment to forms of ritual. Several archaeological sites have been claimed to possess evidence for cannibalism, including Zhoukoudian and some Middle Paleolithic sites in Europe. While the evidence for some of these has been discounted (i.e. Zhoukoudian), others, for example, Moula-Guercy (Ardèche), are well documented. Excavations at the site of Les Pradelles (Charente) have uncovered, numerous artefacts of the La Quina Mousterian techno-complex and a rich mammal fauna. Neandertal bones have also been recovered, cranial and postcranial bones comprising major parts of skull, dentition and skeleton of approximately 8 individuals. Many of these bones show evidence of cut marks and green bone fractures produced by stone implements. In order to further understand these bony modifications and to discover if there is evidence to document deliberate butchery and cannibalism, a comparative study of anatomical representation was undertaken of the bones from Les Pradelles and those from the Neandertal remains from Moula-Guercy, La Quina (Charente), the Abri Suard (Charente) and Krapina (Croatia), as well as the human samples from the Mesolithic site of les Perrats (Charente) and 5MTUMR-2346 (los Mancos, Colorado), the latter two with documented evidence of cannibalism.
Sites at which cannibalism has been accepted present similar representations of anatomical parts. At Les Pradelles, although there is considerable evidence of human manipulation of fresh corpses, the representation of anatomical parts differs from these and appears similar to other Mousterian sites in the Charente.

Molecular identification of brucellosis in human skeletons from Butrint, Albania.

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Ancient skeletal remains may harbor unique information about past civilizations, not only at the anatomical level, but at the molecular level as well. Numerous diseases manifest in bone, however only a small subset have been objectively identified through DNA analyses confirming both the causative agent of the disease process and the pathogen's presence in ancient societies. In general, chromosomal or plasmid markers specific to the pathogen are identified via the polymerase chain reaction (PCR). In the current study, anthropological research on skeletal remains from the ancient Albanian city of Butrint produced two adolescent males from the 11th – 13th century AD with multiple lytic lesions on the thoracic vertebrae, as well as porosity of the ribs. Thought to result from chronic tuberculosis (TB) infection, molecular testing of the lesions was repeatedly negative for members of the Mycobacterium Tuberculosis Complex, the causative agents of TB. An alternative hypothesis was examined in which *Brucella spp*., the causative bacterial agent of brucellosis, generated the skeletal abnormalities. DNA extracted from the affected spinal columns and/or ribs tested positive for two *Brucella* markers, the IS6501 insertion element and Bcsp31 gene. Based on the skeletal lesions, negative tests for TB, and positive *Brucella* findings, we report the first documented occurrences of brucellosis in ancient peoples. This indicates that the disease, which is still relatively common in Albania, has a long history in the region.

Grandmothers and mothers on the move: How age and frontal loads affect biomechanics and energetics.

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According to the grandmother hypothesis, the extended period of post-reproductive longevity of Homo relative to great apes evolved as the result of significant transfers of support from peri- and post-menopausal grandmothers to their children and grandchildren. In order to provide such help, grandmothers would have had to have maintained significant physical capabilities even as their fecundity dwindled. Evaluating the grandmother hypothesis and its corollaries requires an understanding of age-related changes in the physical and physiological capacities of females, as well as estimates of the costs that grandmothers might have incurred while helping their descendents. Toward these ends, we measured the metabolic cost, movements patterns, and core strength in 10 young females (mean=20.9yr) and 10 older females (mean=51.4yr) as they walked on a treadmill with and without frontal loads at four self-selected speeds. Previously we reported that older females showed (largely) non-significant trends toward small differences from

younger females in cost of transport (higher) and the speed of minimum cost of transport (lower). We now know that older and younger females are similar in their walking movements, although once again there are trends for small but consistent differences between the two age groups. Older females tended to have shorter stride periods and more lateral and vertical movement of the sacrum at a given speed, and had significantly weaker upper abdominal strength (p=0.05). In general, grandmothers appear to be quite capable, even while carrying loads, although their presence in a group might slow travel speeds marginally.

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Longitudinal analysis of grip strength over the lifespan.

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Low muscle strength is related to frailty in later life. Higher peak strength and a slower rate of decline with aging can delay the onset of sarcopenia. Studies examining muscle strength using serial data over the life span are rare. The purposes of this study were to (1) investigate the longitudinal pattern of change in grip strength during adulthood controlling for sex, stature, BMI, and secular trend, and (2) assess the associations between that pattern and birth weight, early growth rate, physical activity, smoking, alcohol consumption, and menopausal status.

Serial data from 344 men and 370 women (age 20-97, born 1905-1969) in the Fels Longitudinal Study were analyzed using a mixed model. Participants had from 1 to 11 observations (mean 4) collected over their lifespan. Our data suggest that grip strength increases linearly, peaks at age 38y for both sexes, remains constant through age 55y for males and 52y for females, and then declines linearly. For males, higher birth weight was associated with higher peak grip strength. This supports a few studies that have found an association between birth weight and muscle phenotypes in later life. Peak grip strength was also positively associated with physical activity for both sexes, and with alcohol consumption for females. The rate of decline from peak grip strength was not associated with any of the variables considered.

In summary, we were able to identify factors associated with peak muscle strength during adulthood; however none of these factors were related to the later rate of decline.

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Welcome back Paleodemography. An archaeological case study in medieval France (AD 1300-1500).

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For the past 10 years, paleodemographic studies have been revived through careful evaluations and challenging analytical methods. Several approaches are now available to robustly explore past demographic life ways in archaeological populations. We estimated paleodemographic parameters and age-at-death distributions from the population of Saint-Laurent de Grenoble, France (N=261) through 3 diverse approaches: paleodemographic indicators ($_{15}P_5$ ratio, adult's average age-at-death), Iterative Bayesian Proportional Fitting Procedure and Teeth Cementum Annulations analysis. The hypothesis was that results should be concordant regardless of the data (immature to adult ratio in $_{15}P_5$, femoral heads for IBPFP, teeth for TCA) as they are estimated from the same meta-population. Paleodemographic indicators and IBPFP provided coherent and similar results with 2 comparable ($p.=0.7653,\ \alpha=0.05$) age-at-death distributions (both with a mortality mode around the 20-40 years classes). TCA analysis, however, probably because of methodological and taphonomical sampling issues, was not conclusive. The variety of inputs now available for age-at-death distribution estimates and beyond paleodemographic parameters provides valuable options to best fit the reality of the archaeological data and allow for robust results. After a prolonged farewell, and several tentative come backs, Paleodemography seems to have found its way back.

Adaptations of *Microcolobus* discovered from Nakali, Kenya.

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Microcolobus tugenensis is the earliest cercopithecid currently known. Its hypodigm includes only a single mandible discovered from the 10 my-old Ngeringerwa Bed in Tugen Hills, Kenya. In 2007, associated dental and postcranial fossils of a colobine were discovered from the penecontemporaneous Nakali Formation in Nakali. The dental material is a lower M3. It is similar to the one from Tugen Hills and reasonably attributable to the same genus. The postcranial materials include a proximal femur. From the femoral head diameter, the body mass of this individual was estimated as 5.6 kg (95% CI: 4.1-7.6 kg). Among living colobine species, only *Procolobus verus* is smaller (4.7 kg for male and 4.2 for female), and even the 95% upper limit of the estimated range is lower than the average body mass of

many African colobine species (female). Interestingly, when the dental size is scaled on body mass, *Microcolobus* is aligned with extant colobines. Thus, the megadonty, which is characteristic for Early-Middle Miocene African catarrhines, is lost in this early cercopithecid. Alterations of dental structure for efficient foliage processing likely account for the dental size reduction. Supported by Grant-in-Aid from the JSPS (#18255006).

Eurasian hominine origins: phylogenetic, paleobiogeographic and paleoenvironmental evidence.

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In 1871, Charles Darwin recognized Africa as the probable geographic place of origin of the Hominidae. However, he also acknowledged the presence of "anthropomorphous" apes in Eurasia and the likelihood of intercontinental faunal exchange during the Miocene. Since then, an African origin hypothesis has become dominant in paleoanthropological research. Here, we examine the alternative Eurasian origin hypothesis, through a multidisciplinary integration of phylogenetic, paleobiogeographic and paleoenvironmental data into a chronogeographic framework. We used ArcGIS 9.3 to combine data on late Miocene mammal distribution, together with paleobotanical and ecomorphological data. The results of our analysis identify episodes of intercontinental dispersal of taxa commonly found in association or with similar niche requirements as Eurasian apes. Furthermore, the presence of late Vallesian/Turolian forest refugia along dispersal corridors, together with occurrences of late Miocene Eurasian apes in open contexts indicates ecological compatibility between these taxa and their environments. These findings together with strong evidence of a close evolutionary relationship between the Dryopithecini and the Homininae, demonstrates the means, motive and opportunity for late Miocene dispersal of hominines into Africa. Hominines appear in Europe 2Ma prior to their occurrence in Africa. The fossil record is currently inadequate to know what type of Eurasian hominine may have dispersed into Africa; a forest-adapted taxon such as *Rudapithecus* or a taxon with open country adaptations such as *Ouranopithecus*. The absence of direct evidence of this taxon, however, is not evidence of its absence, particularly in light of the many lines of research that are consistent with this hypothesis.
This research is funded by the Natural Sciences and Engineering Research Council of Canada and the National Geographic Society.

The Expensive Tissue Hypothesis revisited.

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The Expensive Tissue Hypothesis (ETH) suggests that, assuming equal energy input, enlargement of the brain can be achieved by reducing the size of other expensive organs. Published data show a significant negative correlation between brain mass and gut mass in anthropoids, but other studies found mixed support for the ETH.
In the present study, we used an improved set of primate brain size data that, together with a careful revision of the Chivers' data on primate gut surface, yields a sample of N=30 anthropoid species. While we did not find a significant correlation between gut surface and brain size within anthropoids, we confirm a significant negative correlation between gut surface and brain size within catarrhines ($r = -0.72$, $P=0.0008$; trend for independent contrasts analyses: $r=-0.42$, $P=0.09$). We discuss implications of a possible grade shift in gut and brain size between folivores and frugivores, which may be also linked to a shift in basal metabolic rate (BMR). In addition, we analyzed published organ mass data of 39 species from 8 mammalian orders and found only a weak trend between brain mass and gut mass ($r=-0.26$, $P=0.11$). In conclusion, our results show that evidence for a more general validity of the ETH is rather weak at present. A broad comparative analysis of different organ masses in mammals, using brain and organ data from the same individuals, is clearly warranted.
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Effects of malaria control and modernization on health across the lifespan: the health transition in Vanuatu.

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The health transition, the shift from predominantly infectious to chronic diseases, represents a major health concern in developing regions. As chronic disease burdens increase, individuals suffer continued infectious diseases, holding implications particularly for early growth and development. Infectious disease control is associated with catch-up growth, but obesity rates also often rise after infectious disease control with increasing energy intake, decreasing activity levels, and rapid modernization. Analyses must disentangle negative and preventable causes of energy balance shifts from positive effects of infectious disease control, across the lifespan. The Vanuatu archipelago exhibits gradients in economic development and malaria endemicity across islands. We collected anthropometric and physiological measurements of 1,200 adults and children and assessed diet, physical activity, and

modernization through a survey. We compared these data across islands, assessed weight-for-age longitudinally (1990-2007) on one island, and compared findings to data from 1972 from multiple islands to illuminate changing health patterns with modernization and malaria control. Wasting was uncommon among children in 2007, but rates of stunting ranged up to 25% and varied over time, with both modernization and malaria control. The island with the highest rates of stunting in 2007 also exhibited the highest rates of childhood overweight (up to 10%), most pronounced among young females and consistent with rapid modernization and increased tourism. Health risks in urban areas were mostly associated with overweight and obesity among adults, which increased over time with modernization. Adolescent and adult health risks were primarily associated with behavioral patterns, and are preventable through intervention programs.

Comparative ecology of exudate feeding by Asian lorises (*Loris, Nycticebus*).

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Craniomandibular variation characterises the seven species of Asian lorises, but until now, few ecological studies have been available to understand the factors that underpin it. Here I review and present novel data on the feeding ecology of Asian lorises, with emphasis on the importance of exudate feeding. Asian lorises range in body size from 120 g (*Loris tardigradus)* to more than 2 kg (*Nycticebus bengalensis*) Two of the smallest species (*L. tardigradus*, *N. menagensis*) rely mainly on insects and small invertebrates. Active gouging of bark to extract exudates or consumption of plant sap has now been observed in all other taxa, with four species (*N. coucang, N. bengalensis, N. javanicus, N. pygmaeus*) relying on exudates as a regular year-round food source, but not at all sites where they have been studied. Tree genera from which gum is extracted include: *Sapindus*, *Vernicia*, *Saraca, Spondias, Parserianthes, Albizia*, *Anacardium, Glupa.* When searching for gum, all species move steadily and closely inspect many branches, even within a single tree. Gouging is accompanied by audible breaking of bark and is done with the lower anterior teeth. Gouging behaviour is observed in lorises as young as 10 weeks old, and is also an important part of dental hygiene; captive lorises not provided the opportunity to gouge may perish from periodontal disease. Variation in cranial morphology has previously been predicted to stem from variation in toughness of the diet. With hard object consumption represented across all taxa, phylogeny may be a better explanation for craniomandibular variability.

Digit length ratio (2D:4D) and female dominance rank in rhesus macaques from Cayo Santiago.

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Female rhesus macaques live in matrilineal, kin-bonded social systems. The social processes underlying inheritance of dominance relationships are well understood; however, the biological mechanisms underpinning these processes are not well known. Work in spotted hyenas, a species in which resource competition is intense, and with inheritance processes of dominance ranks similar to many Cercopithecinae, suggests that prenatal androgens are associated with the expression of dominance behaviours and may be implicated in maintaining dominance relationships (Dloniak *et al*. 2006). Variation in prenatal androgens has been linked indirectly to individual differences in the length of the 2nd to 4th digit ratio (2D:4D): low 2D:4D ratios are associated with higher prenatal androgen effect (PAE) while high 2D:4D ratios are linked with low PAE. In humans, low 2D:4D ratios in both males and females have been associated with dominance-related behaviours such as higher levels of aggression and competitiveness. Here we use 2D:4D ratio to determine whether PAE co-varies with socially inherited dominance rank in a sample of female rhesus macaques from Cayo Santiago. Results showed that 2D:4D was negatively related to dominance rank when controlling for group size. This evidence suggests that prenatal androgens may be involved in the support and maintenance of dominance rank in primates.

Comparing endocranial ontogenetic trajectories between humans and chimpanzees.

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The pattern of human brain growth is unique among primates. Compared to chimpanzees, the proportion of adult brain size at birth is smaller and adult size is achieved approximately 2 years later. Moreover, there is evidence for a longer period of structural shape changes in the human brain. Here, we combine CT imaging and geometric morphometrics to quantify endocranial morphology and to compare endocranial ontogenetic size and shape changes between humans and chimpanzees. Our sample comprises cross-sectional ontogenetic series of human and chimpanzee crania (55 individuals each). Using CT scans, we generate virtual endocasts and measure 3D coordinates of 29 endocranial landmarks as well as several hundred sliding semilandmarks on endocranial curves and the endocranial surface. Procrustes shape variables and

centroid sizes are used in principal component analyses. Ontogenetic trajectories are analyzed as regressions on log centroid size and as mean shape differences between subsequent dental age groups.
In shape-space, the human ontogenetic trajectory is curvilinear with a point of inflection during the eruption of the deciduous dentition and another one prior to adulthood. The chimpanzee trajectory has only one point of inflection after the eruption of all deciduous teeth. Thereafter, it is roughly linear until adulthood. The analysis in form-space demonstrates differences in growth rates and timing. We show that chimpanzees and humans differ in their growth pattern not only in terms of timing and size, but also in shape. We discuss the ontogenetic and evolutionary implications of our results and how they contribute to comparative hominin brain research.
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The Woodland Ridge site: evidence of conflict in a small late prehistoric Indiana population

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The Woodland Ridge site is located in Carroll County, Indiana, approximately 2 km north of the Wabash River. Radiocarbon dating and artifact association place the site in the context of the Late Woodland / early Mississippian period. Excavation of the site (October 1999 by Purdue University) produced nineteen individuals (eleven adults and eight subadults). While the population is relatively small, evidence of scalping (cut marks on the frontal bone of at least three skulls), at least one mass burial, projectile point wounds, and possible depression fractures suggest the incidence of small scale warfare or raiding. The similarities between Woodland Ridge and other examples of conflict (i.e., Crow Creek and Norris Farms) are striking. Thus, evidence of warfare can be seen in smaller sites suggesting that late prehistoric intergroup conflict was not limited to large villages and towns.

Internal nasal floor configuration in contemporary fetal and postnatal subadult *H. sapiens*.

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Internal nasal floor configuration in *H. sapiens* has been relatively well documented among adults. However, questions remain regarding the ontogeny of this trait. Work by McCollum and Ward (1997) indicates that the adult pattern manifests fairly early in development, by at least 6 years of age. The presence of a higher frequency of one configuration (bilevel) among Neandertal adults and subadults (Franciscus, 2003) makes establishing a developmental baseline for when and how this trait manifests among *H. sapiens* an issue of paleoanthropological importance.
This study investigated whether all three adult nasal floor configurations, as put forth in Franciscus (2003), were present from the earliest phases of *H. sapiens* development. Coded observations were taken lateral to the incisive foramen on mixed sex samples of Euroamericans and African-Americans ranging in age between 3 months fetal and 21 years (total n=223), with the majority of the sample aged between 6 and 9 months fetal. Results show that all three stages described by Franciscus (2003), i.e., level, sloped, and bilevel, were present from the age of 3 years onward. Individuals less than 3 years of age, however, only demonstrate one configuration: sloped. Although minor degrees of sloping seemed discernable, full conclusions upon such a minute level of variation requires further study. The relatively homogeneous configuration of all 169 specimens below the age of 3 years postnatal indicates that the full spectrum of internal nasal floor variation in *H. sapiens* increases only after this age in response to later facial development.

The nasal cavity of Pleistocene hominins: implications of climate-related variation among modern humans.

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Neanderthal nasal morphology has often been linked to the physiological demands of a cold climate. Supporting evidence has largely been based on external aspects of the modern human nose, whereas it is the nasal cavity that is the main area for heat and moisture exchange (Franciscus & Long 1991 AJPA 85:419-427).
In a geometric morphometric study we examined possible associations in modern humans between two climatic factors, temperature and humidity, and the dimensions of the bony nasal cavity and nasopharynx. Three-dimensional landmarks are used to model the nasal cavity of five climatic groups, each comprising of multiple unrelated populations. Principal component analyses reveal significant differences between climate groups, and morphoclines related to temperature and humidity. Different cavity shapes in colder and warmer climate groups appear to relate to contrasting patterns of turbulence enhancement. Features enhancing contact time between the air and internal nasal surface are found especially in the cold and temperate groups. Variation in nasal cavity shape associated with temperature may partly represent an allometric effect, and may also reflect more general, temperature-related variations in overall craniofacial shape. The link between humidity and nasal cavity shape, on the other hand, appears direct and without

involvement of such underlying factors.
The modern human pattern of variation is used to assess possible climate-related signals in the nasal cavity shape of two Pleistocene hominins, Broken Hill 1 and Gibraltar 1 (Forbes Quarry). Preliminary results suggest a possible adaptation in Neanderthals to aridity rather than to low temperatures.
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Musculoskeletal stress markers in agriculturalists: Pueblo villages and panish subsistence farmers.

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This study uses musculoskeletal markers of stress to examine evidence of the habitual activities of three populations engaged in agricultural subsistence strategies in central New Mexico. Individuals from the Pottery Mound (n=57) and Tijeras Pueblo (n=24) sites represent late prehistoric Puebloan agriculturalists; the Alameda cemetery sample (n=21) represents early historic Spanish subsistence farmers. All three populations engaged in similar activities associated with agriculture and sedentary lifestyles. However, Pottery Mound and Alameda are surrounded by relatively flat terrain, while Tijeras Pueblo is in a mountainous area. Alameda also differs in that Spanish colonialists used domesticated livestock for cultivation. Musculoskeletal stress-markers (MSMs) on long bones of the arm and leg were recorded from each site to test two hypotheses: 1) leg musculature will be more pronounced in individuals from Tijeras; and 2) there are visible differences in the skeletal signatures of habitual activity associated with the use of domesticated livestock. Mann-Whitney U-tests and Kolmogorov-Smirnov Z tests were used to test for significant differences in MSM development within and between sites. No significant differences in MSM development were detected among age groups within each site. Pottery Mound males and females are similar in asymmetry and development of arm musculature, but there is evidence that males were doing more walking than females. Tijeras males have more asymmetrical MSM development than females, and Alameda males and females are very similar in all comparisons. In general, this study did not detect significant differences in MSM development indicative of differential terrain or the use of domesticated livestock.

Mitochondrial DNA diversity of Yemenite and Ethiopian Jewish populations.

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A great diversity of populations have lived around the Red Sea over the past 100,000 years, making southern Arabia and the Horn of Africa important regions for genetic studies of human population history. Analysis of Jewish groups from these regions is of particular interest as they provide a glimpse into more recent histories of populations in these areas. Furthermore, the Semitic language family is the only Afro-Asiatic language family with speakers both within and outside of Africa, attesting to the high mobility of populations throughout this region. In this study, we explore the mitochondrial diversity of both Yemenite (n=44) and Ethiopian (n=41) Jewish populations in comparison to each other and neighboring non-Jewish populations. Through mismatch distributions, phylogenetic networks, and AMOVA analyses, we test competing oral, Biblical, and historical theories about each population's origins. One striking result of our study was the clear difference between mismatch distributions of Ethiopian Jewish versus non-Jewish populations, indicating a distinct demographic history for Ethiopian Jews, whereas the Yemenite Jewish and non-Jewish mismatch distributions were very similar, suggesting a shared demographic history. Identification of a rare mtDNA control region variant at high frequency in the Ethiopian Jewish population prompted us to sequence half of the coding genome (~7000bps). Although no mutations were identified in these genomes, application of a unique analytical simulation method allowed us to narrow the coalescence estimates and simultaneously achieve an estimate of the effective female population size. These new data shed light on competing theories regarding the origins of each population.

Megafaunal extinctions during the OIS 3-2 transition in Japan: A human blitzkrieg sensu lato model.

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The nature of late Quaternary megafaunal extinctions has been the subject of intense debate since the 1960s. Traditionally, scientists cite either climatic changes or human predation as the primary reason for worldwide megafaunal extinctions. In many island cases (e.g., Madagascar, New Zealand), scientists have had a tendency to lean toward humans as being the direct or indirect dominant cause for the relatively quick extirpation of indigenous megafaunas. The Japanese case, at least for the Honshu-Shikoku-Kyushu (HSK) islands, appears to be similar. Our evaluation of the bone surface modifications from the Tategahana, Nojiriko site (~50-30 ka), located

on Honshu, indicate that humans were butchering and likely hunting the megafauna (e.g., *Palaeoloxodon*, *Sinomegaceros*) excavated from the site. By extrapolating these results, along with other proxies, we draw the tentative conclusions that: 1) humans were the prime contributors to the disappearance of these megafaunas in the HSK region; and 2) the megafaunal extinctions likely began earlier than originally proposed; during the oxygen isotope stage ("OIS") 3-2 transition rather than during the OIS 2-1 transition that coincides with the advent of the Jomon culture in Japan. The implications for the earliest peopling of the Japanese archipelago are discussed.

Sex differences in brachial and crural indices in relation to climate.

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This study examined the relationship between climate and brachial and crural indices in human skeletal remains representing a wide ecogeographic range. According to the predictions of Allen's Rule (1877), cold climate populations tend to have shorter extremities relative to their height than warm climate populations. This is thought to be related to the body's ability to retain or dissipate heat. In a cold climate it is more advantageous to have shortened distal limb segments, and in a hot climate it is more advantageous to have elongated distal limb segments (Trinkaus 1981; Holliday 1997).
In order to approach this question, osteometric long bone measurements were collected from adult human postcranial skeletal samples (n=486) representing populations from a wide range of climatic regimes. Climate was quantified using latitude, mean temperature of the coldest month (MTCM), and mean temperature of the warmest month (MTWM) from each locality. The Pearson product-moment correlation was utilized to examine the relationship between brachial and crural indices and climatic variables.
Results indicate that both brachial and crural indices for males and females are statistically significantly correlated with latitude, MTCM, and MTWM. In all cases the correlation coefficients were higher for crural indices than for brachial indices, and in all cases females have higher correlation coefficients than males.
These results indicate that for the samples included in this study, the lower limb adheres more closely to the predictions of Allen's Rule than the upper limb, and females follow the predictions of Allen's Rule more closely than males.
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Causes and consequences of reproductive skew in male primates.

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Reproductive skew models have been proposed as a unifying framework for understanding animal social systems, but few studies have investigated reproductive skew in a broad evolutionary context. We collected comparative data on both mating skew and reproductive skew in primates to test two key hypotheses. First, under the limited control hypothesis, male skew reflects the degree to which dominant males can monopolize estrous females. Second, under the concessions hypothesis, a dominant male is assumed to monopolize reproduction, and he shares reproductive opportunities (concessions) with other males to gain their cooperation, for example in territorial defense. We used phylogenetic comparative methods to investigate predictions from these hypotheses; thus, we focused on how evolutionary changes in the degree of male control or the benefits of cooperation vary with measures of skew.
In support of the limited control hypothesis, male mating success declined with increases in the number of males in groups, and male reproductive success declined with increases in female estrous overlap. These results suggest that skew is impacted by competitive factors that make it more difficult for a male to monopolize females. We found no support for the concessions hypothesis. Specifically, male philopatric species do not exhibit significantly higher levels of mating skew, as predicted under reproductive concessions models when relatedness increases. Similarly, skew was not significantly lower within groups when a threat of extra-group paternity exists. We conclude by considering the consequences of reproductive skew for primate social groups, including effects on kin selection and the spread of infectious disease.
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Locomotor developmental timing in humans and other apes.

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How does human locomotor development compare to that of other apes? In this study, we examined walking in juvenile and adult humans and orangutans to test the hypothesis that humans reach locomotor maturity later than other

apes. We recorded muscle activity, kinematics, and kinetics for a sample of human children (n=10, ages 1-8 years) and in a comparative sample of adults (n= 10) in order to establish a developmental schedule for the acquisition of adult gait in humans. Human gait development was then compared with kinematic data for a juvenile (age 3 years) and two adult orangutans. Our results suggest that human gait matures in a mosaic manner, with muscle activation (tibialis anterior and gastrocnemius) and kinetics developing ahead of kinematic characteristics. By five years, children's walking was essentially like that of adults. In contrast, orangutan walking appears to be fully mature by age three; kinematic analyses revealed no difference between the juvenile orangutan and the adult orangutans in our sample. These results are consistent with analyses of chimpanzee walking in the literature, which suggest chimpanzee gait is essentially mature by two years. Together, our results support the hypothesis that walking matures more slowly in humans than in other apes. We discuss possible biomechanical and developmental causes for the delayed human pattern.

The effects of a long term psychosocial stress on reproductive indicators in the baboon.

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Most research on stress in higher primates has been in macaques, which tend to be seasonal breeders and have reproductive axes sensitive to environmental cues. Baboons typically have menstrual cycles without seasonal breaks and may thus be a better model for understanding human reproduction and stress. We examined the effect of extended individual caging of baboons on ovulation, cycle length, reproductive steroids, FSH, and tumescence, while monitoring stress with cortisol.

Twenty female baboons (15-19 years) were moved from outdoor social cages into indoor individual cages. Ten were moved in the luteal phase (LPM) and ten in the follicular phase (FPM). Daily urine samples were collected and, tumescence and menstrual bleeding were monitored for 120-150 days. Urines were assayed for estrone conjugates (E1C), pregnanediol-3-glucuronide (PDG), FSH, and cortisol. Linear mixed effects models were used to examine 1) effects of the move on the frequency of anovulation, hormone levels, tumescence, and cycle length; and 2) the relationship of cortisol with the reproductive indicators. Comparisons were made between LPM and FPM baboons.

Extended individual housing reduced FSH, PDG, tumescence, and follicular phase length, but did not affect ovulation, E1C or luteal phase length. Tumescence tracked changes in FSH and PDG, and thus may be a useful indicator of the impact of stress on the reproductive axis. Elevated cortisol was associated with reduced FSH, supporting a model of cortisol mediation at the hypothalamus or pituitary. After 4-5 menstrual cycles the reproductive indicators began to return to normal, suggesting adaptation to the new housing conditions.

The evolution of female sexuality: Are females responsible for relaxed male–male competition among chimpanzees in Budongo Forest?

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Adult male chimpanzees are commonly popularised as 'aggressive'. I show targeted aggression by male chimpanzees in Budongo Forest, Uganda is unexpectedly low (infrequent, relatively trivial and short in duration), relative to other populations, suggesting relaxed competition among males. I propose inter-population differences in female sexuality is implicated as one major contributing force in determining levels of male–male competition as the availability, and attractiveness, of sexual options open to males will affect the intensity of competition. I present five lines of evidence in support of this proposal: 1) male mating strategies, 2) interference at copulations, 3) aggression toward females, 4) female counter-strategies against male aggressors, and crucially 5) the prolonged and repeated sexual availability of females. Using an inter-population comparative approach I show differences within the lines of evidence are consistent with the hypothesis that female sexuality influences the intensity of male–male competition. Sexually-active females are a limiting resource for males. When a resource is of relative low value it will be less keenly contested over. The results indicate females at Budongo fall into a 'low value' resource category (low attractivity through high sexual exposure) while females at Gombe, Tanzania and Kanyawara, Uganda are considered by males there as 'high value' resources (high attractivity through low and novel sexual exposure). Although power differences among males and community demographics are undoubtedly important in determining the extent of inter-male competition, the study demonstrates that the significance of females in influencing the congeniality of the social milieu may have been previously underestimated.

Facial mechanics in early hominins: a study combining geometric morphometrics and finite elements analysis.

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Early hominins manifest considerable diversity of facial form. In part this can be attributed to phylogenetic history and in part to functional adaptation. Both factors may also have led to the considerable variability of post-canine dental form among these hominins. In the present study we use geometric morphometrics (GM) and multivariate regression to explore relationships between craniofacial shape and post-canine dental size in *Pan troglodytes, Australopithecus afarensis*, *A. africanus*, *A. boisei*, *A. robustus*, *A. aethiopicus*, and early *Homo*. Based on the GM results, CT based three-dimensional models were warped to create craniofacial morphologies associated with either large or small post-canine areas. The extent to which these predicted facial morphologies actually represent mechanical adaptations was then explored using finite elements analysis (FEA). The results of this novel analysis generally support prior hypotheses about functional adaptations in hominins. They indicate that mechanical adaptation to post-canine loading explains many aspects of craniofacial variation and underline the large degree of functional integration between facial and dental form in early hominins.
The approach outlined here, in combining GM with FEA has many potential applications in studying form-function relationships. The methodological advances that arise from combining these approaches impact widely on diverse aspects of functional modeling, including model validation, interpretation and comparison of FEA results between different studies. These further aspects of the combined GM-FEA toolkit will be discussed.
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Phyletic affinities of *Samburupithecus kiptalami*: a late Miocene proconsulid.

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The 9.5 Ma partial maxilla of *Samburupithecus* from Samburu Hills, Kenya, is thought by many to belong to the African ape and human (AAH) clade. A paucity of hominoid fossils from the African late Miocene, combined with estimated divergence dates among extant AAH genera around this time, make the link between *Samburupithecus* and AAH compelling. Here we analyze internal and external aspects of the *Samburupithecus* maxilla and its dentition using high-resolution microCT. Results reveal many characters in common between *Samburupithecus* and proconsulid primates from the early Miocene: e.g., relatively small premolars, small M1 relative to M2, closely spaced molar dentine horns that are tall but heteromorphic in height, nearly identical protocone cingulum morphology measured at the enamel-dentine junction (EDJ), thick molar enamel (Martin's relative enamel thickness ~19) covering a high-relief EDJ resulting in deep inter-cuspal fissures, a low and posteriorly positioned zygomatic root, and strong superior inclination of the nasal aperture margin. The unique combination of these traits suggests affinities to proconsulids and precludes a close relationship to the AAH clade. Early/middle Miocene hominoids (e.g., *Afropithecus*, *Morotopithecus*, *Kenyapithecus*) share some of these characters with *Samburupithecus* and proconsulids, but more advanced dental features link them to extant great apes (e.g., premolar enlargement). The presence of a "relict" proconsulid species in the late Miocene, also suggested by several isolated teeth from Ngorora, extends the temporal range of this lineage at least 6 million years, and indicates that catarrhine diversity in the late Miocene was greater than currently recognized.
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Natural selection and genetic drift in Old World Monkeys skull evolution.

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A central controversy among biologists is the relative importance of natural selection and genetic drift as creative forces shaping biological diversification. Historically, this controversy has been an effective engine powering several evolutionary research programs during the last century. While all biologists agree that both processes operate in nature to produce evolutionary change, there is a diversity of opinion about which process dominates at any particular organizational level (from DNA and proteins to complex morphologies). To address this last level we did a broad scale analysis of cranial diversification among all living Old World monkeys. Quantitative genetic models yield specific predictions about the relationship between variation patterns within and between populations that may be used to test the hypothesis that genetic drift is a sufficient explanation for morphological diversification. Diversity at several levels in a hierarchy of taxonomic/phylogenetic
relationship was examined, from species within genera to families within super-families. The major conclusion is that genetic drift can be ruled out as the primary source of evolutionary diversification in cranial morphology among most of the taxa. However, the null

hypothesis of drift may account for diversification among species within some groups.

Effect of cadmium on femoral bone structure in rats: an animal model for human exposure to this metal.

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It is generally known that cadmium causes tissue damage in humans and animals. Bone tissue is characterised by markedly lower, compared to soft tissues such as liver and kidney, ability to Cd accumulation. Nevertheless, some results indicate that even a low exposure to Cd may affect the mineralization and biochemical properties of bone, thus enhancing the risk of fracture. In order to better investigate possible Cd-induced effects on the bone structure, we have undertaken experimental study using male rats. This model could be widely used in Cd exposure-related studies in humans because of known metal doses for analogue manifestation. Six 4-month-old male rabbits (experimental group) were injected intraperitoneally with a single dose of 2 mg $CdCl_2$/kg body weight and killed 36 h after cadmium administration. Control group (six 4-month-old male rabbits) received no cadmium. The right femurs of each individual were collected for both macroscopic and microscopic evaluation. We have found that Cd-exposed animals had higher values for the mean femur weight. It indicates a stimulation effect of Cd on bone weight. However, no differences have been observed for the mean femur length between animals from experimental and control groups. Cortical bone area was significantly lower in Cd-exposed animals. The measured values of Haversian canals were greater in animals from experimental group ($P<0.05$). In these animals, a few resorption cavities were also identified at the endosteal borders. Our results indicate that Cd causes changes in femoral bone structure leading to early stage osteoporosis even after a low intraperitoneal administration.

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Musculoskeletal design predicts the cost of locomotion: a test of the force production model across speed and gait in a nonhuman primate.

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Locomotor cost is believed to have played a significant role in the evolution of limb design in human and nonhuman primates. However, data empirically linking limb design to energetics are quite limited. Here, I test a predictive relationship between musculoskeletal anatomy and the cost of locomotion in a nonhuman primate.

Data were collected from three adult *Lemur catta*. Rates of oxygen consumption were measured at moderate walking (0.5 ms^{-1}) and running (2.0 ms^{-1}) speeds on a treadmill. Ground reaction forces (GRFs) and kinematics were then collected as each lemur walked or ran along an instrumented runway. The GRFs and kinematic data were combined with muscle morphometrics to estimate the mechanical advantage, active fascicle lengths and active muscle volumes per step.

Lemurs use 5.3 times more metabolic energy (WN^{-1}) to run than to walk. I found that most (~4.0×) of this difference is explained by an increase in the rate at which limb muscles apply force to the ground. The remainder (~1.3×) is accounted for by a decrease in limb mechanical advantage and, to a lesser degree, the use of muscles with longer fascicles at faster speeds. Altering musculoskeletal parameters (mechanical advantage, fascicle length) across speed increases the volume of muscle that must be activated to generate 1 N of ground force. These data provide a direct link between musculoskeletal design, gait and energetics in nonhuman primates. This is a necessary step for studies of fossil and extant primates attempting to tie morphological evolution to changes in locomotor cost. NSF BCS-00525034, Wenner-Gren 7380.

Considerations for the population history of the Wkhan Corridor: an odontometric investigation of Wakhi biological affinity and diachronic analysis of biological interaction between Norther Pakistan and South Asia.

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The Wakhi are a Tajik-speaking ethnic group occupying the Korakoram Highlands of far northern Pakistan and figure prominently in the current controversy over the appearance of Indo-Aryan languages and the spread of traditional Vedic culture throughout South Asia. Overall, little is known about the Wakhi in terms of population history or genetic affinity. Historical sources indicate patterns of migration and inter-regional contact between various cultural-linguistic groups in the region, but scientific evidence is still largely absent from critical investigations of the temporal depth and patterning of biological affinities produced by such interactions.

The Wakhi claim to be the descendants of ancient South Asian populations. Odontometric data, obtained from one hundred fifty six

Wakhi young adults (seventy eight males and seventy eight females) from Gulmit, in northern Pakistan, does *not* support Wakhi claims of an origin among groups in peninsular India. Instead, a contrast of tooth size allocation with living and prehistoric samples from peninsular India, Pakistan, Central Asia, and Iran places Wakhi origins with ethnic groups in the latter two regions. Maximum mesiodistal and buccolingual diameters were measured for all permanent teeth, except third molars, and this data was compared against 19 samples of prehistoric and living individuals, after which patterns of intersample differences were examined via cluster analysis and principal components analysis. As such, results from odontometric investigation support linguistic analyses that identify close affinities between the Wakhi of northern Pakistan and living ethic groups of South Central Asia and the Hindu Kush Highlands.

Caudal vertebral structure of *Cebupithecia sarmientoi*.

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Cebupithecia sarmientoi (UMCP 38762), a basal pitheciine from the middle Miocene of La Venta, Colombia, preserves an almost complete caudal vertebral sequence (18 vertebrae). Behavioral reconstructions for this taxon based on appendicular elements suggest a combination of vertical clinging and leaping, similar to that of *Pithecia*. General tail morphology, assessed by Meldrum and Lemelin (1991), suggests some similarity with prehensile-tailed *Cebus* in the proximal tail region, although overwhelming similarity with nonprehensile-tailed *Pithecia* in the distal tail region. Ultimately, the tail of *Cebupithecia* was identified as nonprehensile. These assessments, however, relied on external dimensions alone; internal architecture of these vertebrae was not considered. Prehensile tails have vertebrae structured to resist relatively higher torsional/bending moments than those of nonprehensile tails (Organ, 2007). While conclusions based on external dimensions often accord with those based on internal architecture, the cortices of *Cebupithecia* caudal vertebrae are thicker than most other New World primates, suggesting they may be capable of resisting higher bending/torsional stresses than their external dimensions would predict. To test this prediction, we compared the cross-sectional geometric properties of *Cebupithecia* caudal vertebrae with 61 extant platyrrhine individuals comprising 8 genera (4 prehensile-tailed and 4 nonprehensile-tailed). In general, our results indicate that the thicker cortices of *Cebupithecia* translate to higher resistance to axial compression/tension, bending, and torsion of the tail, within the range exhibited by prehensile-tailed platyrrhines. These results suggest that *Cebupithecia* may have employed its tail differently than most extant nonprehensile-tailed platyrrhines, possibly for frequent tail-bracing during positional behavior.

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Sexual selection and primate extinction risk.

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Conservation biologists have sought to predict those factors that increase species likelihoods of extinction. While body mass, human population density, and habitat variation are the most common correlates with extinction risk, a small body of recent work has focused on a potential relationship between extinction risk and sexual selection. Sexual selection may exhibit a positive relationship with extinction risk because the survival cost of sexually selected traits will be magnified during times of environmental degradation. Alternatively, other researchers argue that sexual selection may reduce extinction risk in small populations by reducing the probability of fixation of deleterious alleles. We tested for a relationship between sexual selection and extinction risk in three taxonomic groups: primates, haplorrhines only, and strepsirrhines only. We gathered data from over 100 primate species on well known correlates of extinction risk, such as body mass, as well as three measures of sexual selection: body mass dimorphism, canine height dimorphism, and testis size. Data were analyzed using both minimum adequacy models and Akaike's Information Criterion. Our results indicate that while sexual selection is not related to extinction risk across all primates or within haplorrhines, there is a significant negative correlation within strepsirrhines. Strepsirrhines with higher degrees of canine size dimorphism exhibit lower levels of extinction risk. In particular, galago species have relatively higher levels of canine size dimorphism and lower levels of extinction risk compared to other strepsirrhines. Therefore, these findings may support the sexual selection hypothesis or may be the result of taxonomic bias.

Three-dimensional midcarpal kinematics during wrist extension in five anthropoid species.

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Among anthropoids, wrist mobility in extension varies according to habitual locomotor hand posture and midcarpal morphological

differences probably contribute to variation in wrist function. However, there have been few comparative studies concerning carpal biomechanics (e.g., ranges and patterns of motion for specific joints), and such information is crucial for reconstructing hand postures in extinct taxa. To examine anthropoid midcarpal mechanics, a computed-tomography-based method of deriving 3D carpal kinematics was applied to cadaver forelimbs of *Pan troglodytes* (n=3), *Pongo pygmaeus* (n=3), *Papio anubis* (n=3), *Macaca mulatta* (n=2) and *Ateles geoffroyi* (n=1). The study had two goals: 1) determine how individual joints composing the midcarpus contribute to wrist extension, and 2) test the hypothesis that the African ape midcarpus facilitates a pronounced conjunct rotation to stiffen the wrist when the hand is used for propulsion in knuckle-walking. The scaphocapitate ROM is similar between *Pan* and *Pongo*, and the interspecific difference in midcarpal ROM is primarily due to differences in lunatocapitate kinematics. *Papio* exhibits reduced midcarpal ROMs compared to *Macaca* and *Ateles*, but all three monkeys demonstrate less within-individual disparity between the scaphocapitate, lunatocapitate and triquetrohamate ROMs. Emphasis on lunatocapitate motion in the apes is probably due to the enlarged hominoid lunate.
Compared to *Pongo*, rotation axes for the midcarpus in *Pan* are more obliquely oriented relative to the hand flexion-extension axis, supporting the conjunct-rotation hypothesis. However, the monkey wrists show a similar kinematic pattern, suggesting it is a general characteristic of quadrupedal primates and may not be derived within the African hominoids.
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Evaluating the race concept in the classroom and community: insight from student research.

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Over five academic years (2003-2008) students enrolled in an upper division course on human variation were required to interview subjects (n=450) living in the Midwest regarding concepts of race. Students completed ethical research training and an IRB protocol prior to data collection. All posed the same questions to their selected sample including: (1) define race; (2) how many races exist?; (3) what proportion of ancestry determines membership into a racial group?; (4) what features, characteristics and/or behaviors do you associate with each group?; and (5) additional comments. Subject's age, self-identified racial affinity, relationship to interviewer, profession, and date, time, and location of interview were also recorded. In this sample, most respondents indicated that race exists and consistently identified Asian/Oriental, Caucasian, Native American/Indian, African-American, and Hispanic as racial entities. Other common categories included Middle Eastern, Jewish, Pacific Islander, Ethiopian, and Native of South America. Respondents suggested that as little as 25%, and as much as 75%, ancestry designated racial affiliation. Accordingly, discrete phenotypic features were associated with specific racial groups. After learning that race is socially constructed, students encountered an affirmative response for race as biology from respondents who also identified specific behaviors for each racial group. By actively engaging this important topic, students had the opportunity to examine classroom knowledge in the context of real world experience and societal stereotypes. Many students reported a change in their own perception of race while gaining a new insight into the impact of a culture who embraces race as biology.

Modeling chimpanzee site-suitability: a useful addition to the primatologist's "toolbox".

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The chimpanzee (*Pan troglodytes*) ecological niche-space is shaped by its phylogeny, ecological adaptations, interactions with other species, and historical events. Detailed knowledge of this primate's potential ecological niche is increasingly important for surveyors seeking new sites for research as well as conservation. However, analytical tools to detect locations suitable to the chimpanzee niche are currently lacking from the field primatologist's toolbox. To fill this knowledge gap, we model chimpanzee niche parameters such as: preferred vegetation type, annual rainfall and temperature variability, net primary productivity, and relevant anthropogenic effects, to construct an empirically-based statistical model, useful for predicting potential chimpanzee site locations. Our data includes more than 1,000 sites throughout Africa where chimpanzees are known to be currently and historically present or absent. Correct predictions derived by this model are significantly greater than by chance alone, and they are summarized as probability prediction maps throughout the African continent. Resulting prediction maps are well suited for researchers interested in documenting new or previously overlooked chimpanzee sites. Likewise, conservation and restoration biologists may apply this analytical tool when addressing management decisions and establishing sanctuaries for reintroduced chimpanzee populations.

Population estimates of Mentawai primates on the Pagai Islands,

Mentawai, West Sumatra, Indonesia.

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The Mentawai Islands are home to four endemic and endangered primates - Kloss's gibbon (*Hylobates klossii*), the Mentawai pig-tailed macaque (*Macaca pagensis*), the Mentawai Island leaf langur (*Presbytis potenziani*), and the simakobu monkey (*Simias concolor*). This study was conducted to calculate population estimates for these primates on two islands - North Pagai and South Pagai. Forest cover was determined using Google Earth Pro composite satellite imagery (Google, 2008). Forested areas were differentiated from unforested and developed areas by color (dark green *vs*. lighter hues). Forested areas were outlined using the Google Earth Pro polygon tool. Once delineated, the program calculates the area of a polygon to one hundredth of a unit. The total area of forest on each island was divided by the total area of the island and multiplied by 100% to obtain the percent of forested area on each island.
Density data from Paciulli (2004) were used to calculate population estimates of each primate species. The average density (individuals/km^2) of each species was multiplied by the amount of forested area to yield an estimate of the total number of individuals in forested areas on each island. The estimates for the two islands were added to obtain population estimates for both islands. Using this method, it was estimated that there are approximately 1,049 Kloss's gibbons, 7,984 pig-tailed macaques, 1,545 leaf monkeys, and 3,347 simakobus on the Pagai Islands. These estimates are compared to previously published estimates of the Mentawai primates.

Studying the genetic basis for differences in gene regulation between human and chimpanzee

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Changes in gene regulation are thought to play a major role in the evolution of phenotypic differences, in particular in primates. Consistent with this theory, the past decade of research has yielded an increasing number of cases where regulatory changes contribute to species-specific adaptations and to reproductive isolation. However, the extent to which evolution of gene regulation is influenced by changes in either *trans* acting elements or *cis* regulatory sequences is still largely unknown. In order to characterize changes in *cis* and *trans* regulatory elements that underlie differences in gene expression between human and chimpanzee, we focused on ten genes whose regulation was previously inferred to have evolved under directional selection in the human lineage. We used reciprocal reporter gene assays in human and chimpanzee cell lines to identify inter-species differences in *cis* and *trans* regulatory elements. We further studied the effects of lineage-specific substitutions in *cis* regulatory elements by using site directed mutagenesis. Our results suggest that changes in *cis* account for substantial variation in gene regulation between the human and chimpanzee. The characterization of changes in regulatory elements and their effects will help us understand the genetic basis for human-specific traits.

The state of health of Roman Republic to Imperial Roman period burials from the necropolis of Aquinum, Italy.

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We are offering a paleopathological assessment for 125 Roman Republic- Imperial Roman period burials from the archaeological site of Aquinum, Italy. The necropolis was discovered as part of a motorway service area construction project (The Casilina East Service Area). The burials date from the 1st century BC to 2nd century AD. Thirty-four males, fifty females, twenty-five adults of undetermined sex, and sixteen sub-adults are examined for the presence of skeletal lesions. None of the sub-adults exhibit skeletal lesions. The rates of adult skeletal lesion by sex for arthritic problems (osteoarthritis of the vertebral bones, and DJD of the long bones), trauma, dietary/metabolic stressors (cribra orbitalia and cranial pitting) and non-specific infection (periostitis) are presented. We found that 58% of the females and 76% of the males exhibit some form of skeletal lesion. Periostitic lesion frequency was significantly higher in males than in females, $p = 0.05$. One specific burial includes lesions consistent with leprosy. Tomb 15 (an adult male, age 42-50 years) exhibits extreme lytic destruction of the hands and feet complete with fractures and fusion of tarsal bones to the metatarsals The terminal phalanges of the foot exhibit cupped shaped proximal ends. There is also considerable periostitic activity to the hands, feet, and both distal ends of the tibia & fibula. This burial may represent one of the oldest cases of leprosy seen in Italy. In the end, this group of burials is important because they represent some of the very few Roman Republic burials available for examination.

Assessment of human installations and activities on vervet body mass indices.

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Understanding the effects of a human presence on the anatomy and physiology of primates has become a more pressing concern as more and more primate groups are being forced into interactions with encroaching human populations. This study surveyed human alterations made within the home ranges of vervet (*Cercopithecus aethiops*) groups at nine sites in South Africa where vervets had been trapped and sampled for a study of genetic and morphological variation. Human activities and installations were recorded and transects were defined and censused. Recording the human installations in the environment was used as a convenient measure of how human populations in the area are using the landscape. Body weight and body size were available for all animals. Body mass index (BMI) was calculated for all adult animals using weight in kilograms divided by the the sum of body length, leg length, and head length, in a similar formula to that used to calculate human BMI. All sites were also either designated as high altitude (over 1000m) or low altitude (under 1000m). Since altitude closely correlates with temperature, body mass indices were expected to be closely related to altitude, however, this was not supported by our data. Male vervet BMI was not found to be statistically linked to human intrusion, while female BMI was. These sex differences are similar to other studies of vervets living in diverse habitats.

Testing the adaptive significance of the catarrhine symphysis using Finite Element Analysis.

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Catarrhine symphyseal morphology displays considerable variation, while this has been related to dentition, phylogeny, sexual dimorphism and facial orientation, most emphasis has been given to the adaptive significance of symphyseal to the mechanical loading during chewing. The association of the adaptive significance of the symphysis with the mechanical environment is based on a combination of allometric studies, *in vivo* strain gauge analyses on *Macaca fascicularis* and biomechanical modelling of the mandible as a curved beam. These approaches have correlated the superior torus, the symphyseal depth and the oblique symphyseal inclination with the masticatory biomechanics but do not test directly the significance of the toral morphology to the typical bending experienced during mastication.

Finite Element Analysis (FEA) was used to test the mechanical adaptation of the anterior mandibular morphology of an adult *M. fascicularis* mandible and a series of modified hypothetical morphologies including absence/presence of tori and variation in the inclination of the symphysis.

FEA results confirm the mechanical hypotheses that the symphyseal width highlighted by the presence of a pronounced superior torus, the symphyseal depth and a more oblique symphyseal inclination are an adaptive response to dorsoventral shear and lateral transverse bending. The results also demonstrate that labio-lingual thickness and oblique inclination counter stresses under dorsoventral shear. Finally the results showed that an increased in depth symphysis assists in countering the stresses not only during dorsoventral shear as it has been previously hypothesized but also during lateral transverse bending.

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Fluvial transport of hominin-and carnivore-modified long bone fragments.

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No study has evaluated the affect of fluvial processes on frequencies of hominin/carnivore marked bone in paleoanthropological assemblages. This study tests 1) the hydraulic transportability of long bone fragments typically created through hominin and carnivore carcass consumption and 2) the effect of the differential transport of long bone fragments on the incidences of hominin-and carnivore-induced bone surface modifications. Experiments were carried out using an oval race track flume and 311 long bone fragments from published collections of hominin- and carnivore-modified bone.

Results show that animal size classes and cortical thickness of bone are significant predictors of fluvial transport of long bone fragments. Long bone portions (midshafts, near-epiphyses and epiphyses) and the type of carcass consumer (hominin, carnivore or both) do not significantly affect transport. Cut-marked and percussion-marked bones were transported significantly less than their unmodified counterparts, while tooth-marked and non-tooth-marked bones were not differentially transported. However, there is no significant difference in the transport of modified or unmodified long bone midshaft fragments.

Implications of this study are: 1) animal size classes and cortical thickness can be used to identify lag and winnowed bone assemblages; 2) measures of carnivore competition that employ epiphysis:shaft fragment ratios may still be applicable to fossil assemblages deposited in fluvial environments; and 3) analyses of the incidence of bone surface

modifications on fluvially disturbed assemblages should focus on long bone midshaft fragments.

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Hypothyroidism in alpine medieval Switzerland.

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Hypothyroidism is a condition of mild to severe impairment of physical and mental development due to untreated deficiency of thyroid hormones. The condition can be endemic, genetic or sporadic. Sporadic and genetic hypothyroidism results from abnormal development of the foetal thyroid gland. Endemic hypothyroidism arises from a diet deficient in iodine. Populations living in iodine deprived areas are most at risk. On the Alpine region of central Europe endemic hypothyroidism was very common until the beginning of the 20th century, when the aetiology was discovered and it was eliminated. In historic and prehistoric populations such cases have practically never been described. This study reports the presence of endemic hypothyroidism on a medieval Swiss alpine population (Tomils/Sogn Murezi, 11th-15th c. AD). The sample concerns 404 adult and subadult individuals, who exhibit a high rate (ca. 10%) of delayed epiphyseal fusion, epihyseal dysplasias, limb asymmetries and abnormal length of the long bones, changes on the skull form, congenital anomalies and small stature. Males were more affected than females while the condition did not affect the demographical profile of the community. Macroscopical and radiological comparisons to related literature (e.g. Guggenbühl, 1853; Weygandt, 1904; De Quervain and Wegelin 1936; Wieland 1940) and diagnosed cases of hyperthyroidism (Galler reference series, Rühli et al. 2003) from Switzerland (19th-20th) showed significant similarities to the above conditions. This is one of the first documentations of endemic hypothyroidism in archaeological populations contributing significantly to the biological history of the alpine regions under a broader ecological and historic context.

The history of anemia and related nutritional deficiencies in Europe: evidence from cribra orbitalia and porotic hyperostosis.

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Porosities in the outer table of the cranial vault (porotic hyperostosis) and orbital roof (cribra orbitalia) are among the most common pathological lesions seen in ancient human skeletal collections. These conditions are frequently associated with substandard living conditions. They can be a result of marrow expansion associated with both acquired and inherited hemolytic and megaloblastic anemias. They also are sometimes associated with the subperiosteal new bone formation that occurs in response to

trauma and nutritional deficiencies such as scurvy.
Using a standardized recording system, we scored 6,697 of the individuals in the Global History of Health Project European sample for cribra orbitalia and 7,702 individuals for porotic hyperostosis. Logistic regression indicates that people living in rural villages and Eastern Europe are much more likely to have cribra orbitalia ($x2=30.9$ $p<0.00001$) than are people living elsewhere. Low cribra orbitalia rates are characteristic of the Medieval Europeans who lived in boreal forest (subtaiga) regions of Europe. Porotic hyperostosis shows similar, although not identical environmental correlations. Like cribra orbitalia, porotic hyperostosis is rare among people living in the subtaiga habitat ($x2=176.7$, $p<0.0001$) and more common among people living in Eastern than Western Europe ($x2=126.5$, $p<0.0001$). In contrast to cribra orbitalia, which is more common in females than males ($x2=10.9$, $p=0.001$), porotic hyperostosis is more common in males ($x2=14.2$, $p<0.0001$). The prevalence of both conditions increases between the Early and High Middle Ages and then declines markedly during the Late Middle Ages.
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Modifications to a fecal hormone extraction method: implications for storage of fecal hormone metabolites.

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Six experiments were conducted to test different aspects of a "field-friendly" fecal hormone extraction method that utilizes methanol extraction in the field followed by storage on C18 solid-phase extraction cartridges (Beehner and Whitten 2004; Beehner and McCann, in press). Fecal samples were collected from geladas (*Theropithecus gelada*) housed at the Bronx Zoo, and experiments were conducted in a laboratory setting to ensure maximum control. Experiments were designed to simulate conditions fecal samples are subject to during fieldwork. Experiments tested the relationship between fecal hormone metabolite preservation and (1) the time samples were stored at ambient temperature; (2) the number of times samples were thawed and refrozen; (3) whether storage on a C18 cartridge was more effective if the cartridge was capped (and stored "wet") versus left open (and stored "dry"); (4) the effectiveness of different C18 cartridge washes; (5) sample storage in methanol versus on the C-18 cartridge; and (6) the necessity of solid-phase extraction. Samples were radioimmunoassayed for both fecal glucorticoid metabolites (fGC) and fecal testosterone metabolites (fT). Significant differences were observed for fGCs in experiments 1, 3, and 5 and for fT in experiment 3 only. All other experiments exhibited no significant differences between control and test samples. These results suggest that, when utilizing C18 cartridges for fecal steroid storage, researchers should consider several methodological options to optimize hormone recovery from fecal samples.

Genetic diversity in South Amerindian populations.

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In the present study genetic diversity in South American Aboriginal groups was analysed. Several sets of markers and populations were considered in this work. Diversity at 11 protein loci and in mitochondrial DNA haplogroups were compared in 20 populations (N= 24.228): Chrirguanos, Pilagá, Chorote, Mocoví, Toba, Wichi, Mapuche(Arg.), Mapuche(Ch.), Tehuelche, Aymará, Lengua, Ayoreo, Guaraní, Kaningang, Macushi, Wapishana, Xavante, Yanomama, Makiritate and Ticuna. Other comparation was made, in relation to 11 protein loci, with class II HLA system, Y chromosome, autosomals and X-chromosome STRs which, were compared among 12, 10, 7 and 5 South Amerindian groups, respectively.
Genetic diversity lowest value was observed at protein level (Ht= 0.308) and the highest in HLA-DRB1 locus (Ht= 0.902).
The intrapopulation genetic variability (Hs) explained most of the diversity, with a variation range (Hs/Ht) from 0.753 at mtDNA to 0.937 at protein level. The lowest interpopulational genetic variability was observed at protein level (Gst'= 0.066), and the highest at mtDNA (Gst'= 0.257) and Y chromosome haplotype (Gst'= 0.226). Autosomal STRs (Gst'= 0.086), X-chromosome (Gst'= 0.097) and HLA-DRB1 locus (Gst'= 0.126) presented intermediate values.
Genetic variability calculated is discussed taking into acount the migratory, historic and demographic processes that South Amerindian populations went through.
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Evolution and natural selection of skin color.

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Pigmentation shows a remarkable diversity in human populations, and in this sense, it is an atypical trait; numerous genetic studies have indicated that the average proportion of genetic variation due to differences between major continental groups is just 10-15% of the total genetic variation. In

contrast, skin pigmentation shows large differences between continental populations, and follows a clear latitudinal gradient. I review the major evolutionary hypotheses that have been put forward to explain the distribution of pigmentation and the current state of our knowledge about the genes involved in the variation of skin, hair and eye pigmentation within and among human populations. Our understanding of the genes involved in normal pigmentation variation has increased substantially in the last five years, and recent studies have identified several pigmentation candidate genes that show strong signatures of selection and therefore, may be functionally important in pigmentation. At the current pace of discovery, the next decade will clarify many of the remaining gaps in our knowledge of the genetic architecture and evolutionary history of this fascinating trait.

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Age at sexual maturity in humans: implications for life history analysis.

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Sexual maturity is an important variable in life history theory because it represents a fundamental tradeoff between growth and reproduction. Researchers, however, have variously and inconsistently defined sexual maturity. Using data from the published literature, we examine the human pattern of age at menarche, age at first birth, and the intervening period of adolescent subfecundity worldwide to clarify aspects of sexual maturity from a life history perspective. Our findings show that the norms of reaction for age at first birth in non-contracepting populations is less variable than age at menarche. We argue that age at first birth is the reproductive event that best represents sexual maturity. Ecological and environmental influences on age at menarche, in addition to the presence of adolescent subfecundity further highlight the importance of age at first birth. This has implications for demographic and life history models that consistently characterize 15 for age at sexual maturity, 4-5 years earlier than our findings suggest. Comparison with non-human great ape species confirm relatively late ages for all aspects of human sexual maturity, a pattern consistent with our slow life history.

The impact of basicranial growth on craniofacial shape variation.

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This study uses a transgenic mouse model with deficient cartilage growth to address the question of how changes in growth of the basicranium affect the overall shape as well as the covariance structure of the mammalian skull. As the cranial base is the only part of the bony skull that depends directly on cartilage growth, we hypothesize that chondrocranial development is a key determinant of skull shape as well as variation structure. Therefore, we predict that reduced growth of the chondrocranium leading to a shortened basicranium will cause shape changes in both the face and calvarium. A transgenic, selenium-deficient mouse model that exhibits decreased cartilage growth is used to test this hypothesis. Preliminary results from a geometric morphometric analysis show that the mutant mice with short basicrania exhibit significantly shorter faces and globular calvaria compared to wild-type littermates, suggesting that covariance structure of the skull is influenced by basicranial growth. This research is directly relevant to physical anthropology, as the cranial base, face and cranium represent major axes of change within primate craniofacial evolution. Hominins exhibit substantial variation in basicranial size and shape, the length of the face, and the height of the neurocranium, shortened basicrania and face, as well as a more globular cranium. Our results show that an alteration known to directly affect only one region of the skull, the cranial base, produces substantial and evolutionarily significant variation in other regions of the skull.

Phase versus Component Systems in age-at-death estimation I: The methodology and usage of Component Systems.

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This presentation will explore the methodology of component systems in age-at-death estimation from the human skeleton. The goal of this presentation is to illustrate that when skeletal features are broken into coded traits, these traits perform better alone than when they are further reduced to a combined total score or derived phase.

Component system performances were evaluated using multiple age-at-death estimation methodologies applied to various skeletal samples. The aging methods examined include: Buckberry and Chamberlain's auricular surface method (2002), McKern and Stewart's pubic symphysis method (1957), Miendl and Lovejoy's cranial suture method (1985), and Passalacqua's sacrum method (2007). Performance of these methods was assessed at three stages: separate component scores, total score, and derived phase. Performance of each stage was then assessed using linear regression, and decision-tree regression.

Results suggest that when the components are combined to create a summed total, precision and accuracy actually decrease. This is demonstrated by weaker correlations with age as well as increased standard deviations for age estimates. These deficits are slightly increased when summed scores are derived into phase classifications. Test data on independent samples further confirms this trend, as bias and inaccuracy both increase when separate component scores are used rather than total and derived phase stages (test data on independent samples was limited due to data availability, however, because all the methods follow the same trend, the results are likely to be repeated). Based on these findings, component systems produce their most valuable age-at-death estimates without trait aggregation and future methods should present their data accordingly.

Manual digital proportions and sexual dimorphism in a North American skeletal series.

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Manual digital proportions, specifically the relative lengths of the 2nd and 4th fingers, are thought to reflect developmental stability and are shaped by exposure to sex hormones in utero. Sexual dimorphism in manual digital proportions as measured from images of palmar external surface anatomy of living subjects is linked to many factors including health, attractiveness, reproductive parameters, and waist-to-hip ratio. In the present study we assess manual digital proportions directly from osteological measurements collected on 343 hands from the Terry Collection (National Museum of Natural History, Washington, DC). We examined variation in four ratios: 1) summed length of metacarpal and all phalanges for digits two and four (2D:4D), 2) summed phalanges only (2F:4F); 3) metacarpals only (MC2:MC4); and 4) proximal phalanges only (PP2:PP4). We also used principal components analysis (PCA) to adjust data for scale using geometric means.
Despite substantial overlap, males and females differ significantly in their manual proportions. In all ratios except for MC2:MC4, females have index fingers that are relatively longer compared to their ring fingers than do males. This difference is most marked in 2D:4D and 2F:4F, but only weakly in PP2:PP4. PCA also showed separation between male and female means, but with significant overlap among individuals. Our results indicate that sexual dimorphism in digit ratios are primarily a result of metacarpal length. These analyses demonstrate clearly that males and females differ in their digital proportions although with a large degree of overlap, reinforce osteologically previous results for digital proportions of fleshed hands, and point to potentially fruitful research with archaeological, palaeontological and radiological series.
This research was supported by the Institute for Cognitive and Decision Sciences, University of Oregon.

Functional morphology of metacarpals in digitigrade and palmigrade cercopithecoid monkeys.

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Even though all non-human primates utilize arboreal substrates, some extant species prefer terrestrial habitats. The primate fossil record also suggests that terrestriality was common in the Pliocene and Pleistocene, particularly among cercopithecoid monkeys. In living cercopithecoids, a preference for terrestrial substrates can be inferred from an animal's forelimb skeleton. Because only habitually terrestrial cercopithecoids adopt digitigrade hand postures during terrestrial locomotion, being able to identify if a fossil primate adopted digitigrade postures would be particularly revealing of terrestriality in this group. This study examines the functional morphology of metacarpals in order to identify biomechanically relevant osteological correlates of digitigrade hand postures in extant cercopithecoids. Linear measurements were obtained from 16 digitigrade and 43 palmigrade species (n=324) and comparisons were made between hand posture groups. Results show that digitigrade species have shorter metacarpals relative to both body mass and humerus length. Also, digitigrade species have metacarpal diaphyses with larger dorsoventral diameters relative to metacarpal length. The size and shape of the metacarpal heads do not significantly differ between groups. Multivariate analyses indicate that overall metacarpal shape weakly discriminates cercopithecoids based on preferred hand postures. Morphological similarity between digitigrade and palmigrade cercopithecoids is likely related to the fact that even habitually digitigrade cercopithecoids utilize palmigrade hand postures in different situations (e.g., running and arboreal locomotion). There appears to be few morphological correlates of digitigrady in primate hand bones (based on external morphology), thus making it complicated to determine whether fossil primates adopted digitigrade postures as a component of their terrestrial behaviors.

Evaluation of metric methods of sex assessment using ulnae from the Windover site.

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Sex assessment using the ulna has potential value in skeletal biology as the proximal ulna is often preserved in archaeological contexts. This study tests the sexing

potential of the ulna for a population where sex was estimated using standard cranial and pelvic assessment (Doran 2002). Windover is an Early Archaic site of 86 individuals (49 male, 47 female) from Florida. The ulna measures included notch length (NL), olecranon process width (OW), corocoid process height (CH), radial notch length (RNL), radial notch height (RNH), midshaft diameter (MD), and minimum circumference of the distal end (MC) (Cowal and Pastor 2008). T-tests were used to determine that measurements were significantly different between males and females. A discriminant analysis was used to determine the best predicators of sex. All variables from the proximal ulna (NL, OW, CH, RNH) with the exception of radial notch length (RNL) predicted sex more accurately for females (90%) than for males (40%). Combinations of three or more variables increased the accuracy of predictions for both sexes to approximately 85%.

Data from a previous analysis using talus measures (maximum length (TL), maximum width (TW), trochlea max length (TTTL), and trochlea maximum width (TTTW) (Hoover 1997) were then added to the discriminant analysis to determine whether the use of additional skeletal elements would increase sexing accuracy. The addition of these variables did not produce more accurate sexing, with accuracy remaining around 85% for both sexes. The addition of other elements improves accuracy, but ulnae provide reasonable accuracy for sex assessment.

Triadic conflict behavior and female dominance in captive *Pan paniscus.*

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Recent research has revealed despotic rank hierarchies in captive bonobos, yet they retain their reputation as the "peaceful" apes, exhibiting female dominance and low levels of aggression. The proximate mechanism thought to maintain this unusual social structure is the tendency for unrelated females to form strong coalitionary bonds, enabling them to dominate males. This study asks whether patterns of third-party conflict-intervention in a captive bonobo group fit this hypothesis. Observational study was done over three months in the Planckendael Zoo, Antwerp, Belgium. Females are found to intervene in conflicts more often than males, but only rarely in support of other females versus overwhelmingly often in response to male-male conflicts. Furthermore, several of the interventions fit the criteria for 'controlling' or 'policing' behavior, that is, interventions that successfully lead to the cessation of aggression, or those operationally defined as 'impartial' or 'bilateral', that is, favoring neither party. Females did most (>80%) of these controlling interventions, of both types. This sex bias cannot be attributed to female coalitions, but instead is related to the 'dominance skew' in *Pan paniscus,* as corroborated by a statistically significant correlation between individual dominance measures and interventional behavior. Emerging understanding of conflict management mechanisms and dominance structure in *Pan paniscus* suggests a level of behavioral plasticity that diverges notably from its closest living relatives, *P. troglodytes* and *Homo sapiens,* which has implications for our understanding of hominoid sociality and its evolutionary origins. Support was generously provided by the Durham Fund, King's College, Cambridge, and Planckendael Zoo and the Centre for Research and Conservation, Antwerp Zoo.

Assessment of pathological conditions in the Huntington Collection, Smithsonian Institution.

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The George S. Huntington Collection housed at the National Museum of Natural History consists of over 3400 partial human skeletons collected from the College of Physicians and Surgeons in New York City during the late 19th through the early 20th Centuries. The remains generally consist of the appendicular skeleton with some flat bones. This collection predominantly represents European immigrants as well as other New York City residents, reflecting the ethnic demography of the times. The Huntington Collection is currently under an extensive re-housing project to upgrade its storage, identify co-mingling, and to inventory gross pathological conditions; all to better facilitate the use of these remains for research purposes. Of the 1400 individuals which have been re-housed and surveyed to this point, about 19% have noted pathological conditions or abnormalities (approximately 6% infectious activity, 7% healing and/or healed fractures, less than 1% developmental abnormalities). The incomplete nature of the skeletons and the approximate 14% commingling of the remains decreases the identification accuracy of some of the pathological conditions. Examples of these conditions will be photographically illustrated. The types and frequency of pathology in this collection infers the general health and living environment of this specific population during the turn of the 20th Century in New York City. These incoming immigrants had limited access to resources and financial support, and frequently took jobs as physical laborers under hazardous conditions with little or no healthcare.

Evaluating genes related to non-metric dental variation in European Americans.

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Human dental variability is thought to reflect demographic trends in

migration, genetic drift, and possibly natural or sexual selection. In this study dental molds were made of adult volunteers recruited at the Pennsylvania State University. Casts made from the dental molds of self-described European American adults (n=166) were scored for twelve non-metric dental traits of the maxillary and mandibular dentition by comparing them to the Arizona State University dental system of plaques. Tooth crown traits of the permanent incisor (shoveling and winging), canine, premolar, and molar (Carabelli's trait, parastyle, cusp number and pattern) teeth were evaluated. To determine concordance, both quadrants of each jaw were scored independently by two observers

The biogeographical ancestry of each individual was determined using a panel of 71 autosomal single nucleotide polymorphisms (SNPs) known to have large frequency differentials between major continental groups, European, West African, East Asian and Native American – ancestry informative markers (AIMs). These estimates were used to assess admixture that may be present within individuals that is not reflected in their self-identified ancestry. Additionally, SNPs in two dental candidate genes, previously demonstrated to affect tooth growth in rodents and congenital tooth disease, *EDAR* and *PAX9*, were genotyped for all samples and evaluated for contribution to the dental phenotypes observed.

Relationships among skeletal dimensions correlated with body mass.

O. M. Pearson, S. Daneshvari, and V. S. Sparacello. Department of Anthropology, University of New Mexico.

Many skeletal dimensions - lengths of long bones, articular dimensions, diaphyseal diameters, and bi-iliac breadth – have been used to predict body mass. Our study investigated the patterns of interrelationships among these dimensions. We used two data sets with sexes pooled in each: a world-wide sample of humans from nine populations (total n = 439) and a sample of skeletons of individuals with known weight from the Terry, Todd, Maxwell, and University of Tennessee documented collections (total n = 671). In each data set, we used pair-wise correlations and stepwise regression to examine interrelationships among femoral, tibial, and humeral lengths, articular dimensions, diaphyseal diameters, and other variables (including bi-iliac width in the documented data). In both data sets, the skeletal dimensions were closely interrelated. Even though body mass could not be estimated very precisely (R^2 = 0.34) in the documented data, the other skeletal dimensions served to estimate femoral head diameter and bicondylar width fairly well (R^2 = 0.91–0.86 and 0.91–0.90, respectively). Articular dimensions were paramount in these equations; bi-iliac and shaft dimensions made less impact. Likewise, bi-iliac breadth was less easily predicted from the other skeletal dimensions (R^2 = 0.49 by stepwise regression). Scrutiny of pair-wise correlations showed that the sets of bone lengths and articular dimensions were more closely interrelated than shaft dimensions. The results show that skeletal dimensions can be accurately estimated from other measurements, especially in a multivariate setting.

Mosaic macaque morphology and its implications for the evolution of African papionin crania.

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Due to the effects of homoplasy in the African papionin molecular clades (i.e., *Cercocebus*/*Mandrillus* vs. *Lophocebus*/*Papio*/*Theropithecus*), the character polarity of papionin integrated form remains unclear. *Macaca*, the sister taxon to the African papionins, does not inherently approximate the ancestral papionin morphotype. However, given its separate lineage and mosaic morphology, *Macaca* is integral to teasing apart the pattern of morphological differences between members of the molecular clades. Therefore, this study investigates the structural relationships between internal and external cranial components to better understand the intricacies of macaque morphology in a phylogenetic context.

The variation in internal (midsagittal) and external cranial morphology of 48 adult papionins was examined; all six genera were included as well as three species of *Macaca*. Three-dimensional landmarks were obtained from reconstructed spiral CT scans (slice thickness, 1mm; reconstructed increment, 0.5mm) and subjected to generalized Procrustes analysis and PCA using Morphologika. Analyses were performed on the entire cranium and cranial subsets, including the internal basicranium.

Overall, the mosaic morphology of macaques is highlighted; the external/bilateral analyses group *Macaca* with *Cercocebus*/*Mandrillus* (e.g., position/orientation of the zygomatic arch and petrous); whereas, internally/midsagitally, macaques group with *Lophocebus*/*Papio*/*Theropithecus* (e.g., posterior cranial base and palate). When midsagittal and bilateral landmarks are combined, *Macaca* plots as an intermediate, overlapping both molecular clades. Species separation within *Macaca* is also demonstrated (e.g., *M.fascicularis/M.sylvanus* separate from the remaining taxa, including *M.mulatta* in the anterior cranial base). Implications for these morphological patterns and the evolution of African papionin crania are discussed. Supported by: LSB Leakey Foundation; Sigma Xi; Wenner-Gren Foundation(Grant7172).

A study of 2D landmark data accuracy in representing 3D mouse skull form.

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Though 3D landmark technology is increasingly available, studies still incorporate 2D landmarks for ease, budgetary reasons, and theoretical appropriateness. Understanding how accurately 2D landmarks reflect 3D objects is necessary to improve research design, to determine the aptness of 2D data, and to enable integrated analysis of 2D and 3D landmark datasets. To characterize the differences between 2D and 3D data, we acquired photographs of the inferior, lateral, and superior aspects of thirty mouse skulls. 2D coordinates of 15 visible landmarks were captured from these images and scaled for comparison. Micro-CT images were acquired for these skulls and 3D coordinates of all landmarks were recorded using eTDIPS software. Linear distances (LD) between landmark pairs were calculated from the 2D (LD_{2D}) and 3D (LD_{3D}) landmark coordinates. Differences between corresponding LDs ($LD_{3D} - LD_{2D}$) were calculated. We hypothesized that 1) overall, $LD_{3D} > LD_{2D}$ and 2) $LD_{3D} - LD_{2D}$ will increase as the distance between involved landmarks along the plane perpendicular to the 2D camera lens increases. Most $LD_{3D} - LD_{2D}$ are significantly different from zero, but are quantitatively small. Our results support hypothesis 2. Surprisingly, $LD_{2D} > LD_{3D}$ in some cases. This seems to be a product of 2D measurement scaling and the variation in distance of some 2D landmarks from the lens of the camera. Although 3D landmarks may represent biological forms more accurately, 2D landmarks can provide accurate spatial data; the degree of accuracy depending on the relative orientation of the biological surface and the photographic plane.

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Gene gain, gene loss, and primate evolutionary ecology.

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Primate genomes are structurally dynamic, with surprising turnover in gene content even on relatively short evolutionary timescales. For example, there are literally hundreds of genes that can be found in either the human or the chimpanzee genome, but not both. Some of these structural differences reflect the fixation of gene duplications, which can impart novel phenotypes. However, there are also many other genes that have been maintained by purifying selection for hundreds of millions of years in a diversity of mammalian taxa, but were lost suddenly in either the human or chimpanzee lineage – perhaps a reflecting our divergent ecological histories. In this context, I will present an analysis of within-species copy number variants (duplication and deletion polymorphisms) that were discovered among the genomes of 30 humans and 30 chimpanzees, as well as copy number differences that were found to be fixed between species. By adapting population genetic analyses for use with copy number data, functional categories of genes that have likely evolved under purifying or positive selection for copy number changes were identified. For example, duplications and deletions of genes with inflammatory response and cell proliferation functions may have been fixed by positive selection and involved in the adaptive phenotypic differentiation of humans and chimpanzees.

The location of the jaw adductor resultant vector in strepsirrhines.

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Optimization suggests that the resultant vector of the jaw adductors in mammals should lie directly behind the posterior mandibular molar (Greaves, 1988); this point lies at approximately 30% of the distance from the mandibular condyle to the lower central incisor in most mammals (Greaves, 2000). Data on the cross-sectional areas of the jaw adductors in strepsirrhine primates, coupled with analyses of the sites of attachment on lateral photographs of strepsirrhine skulls allowed us to estimate the orientation and position of the muscle resultant. We assumed that all muscles are equally active and scaled each muscle's contribution to the resultant by its cross-sectional area. On average, the resultant is located at only 21% of the distance from the mandibular condyle to the lower central incisor (range = 14%-26%). This suggests that strepsirrhines sacrifice bite force and endure less-than-optimal joint reaction force due to the more posterior location of their jaw adductor resultant. There is a significant negative relationship ($p=0.037$) between the location of the resultant and the percentage of fruit in the diet: the resultant is located more posteriorly for strepsirrhines that eat more fruit. This may reflect a more posterior placement of jaw adductor fibers to increase gape in frugivores and/or a more anterior placement of jaw adductor fibers providing greater jaw adductor leverage in folivores and insectivores. For most strepsirrhines, the resultant lies within ten degrees of the vertical plane (perpendicular to the occlusal plane).

Homicide at Qasr al-Hallabat: analysis of blunt force trauma in an 8th-10th century A.D. Jordanian skeletal sample.

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Recent excavations by the Spanish Archaeological Mission at Qasr al-Hallabat in Jordan's eastern desert recovered the skeletal remains of six individuals, one adult female and five adult males, from the bottom of an inner courtyard cistern. Five out of six of these individuals (one female, four males) display cranial blunt force trauma. Macroscopic, microscopic, and radiographic analyses all confirm that these traumas occurred at or near the time of death.

Bioarchaeological, archaeological, and historical data are used to help develop a profile of these individuals to clarify reasons for their violent death and corpse desecration. ^{14}C analysis of skeletal samples (n=2) indicates that these individuals died between the late 8th and mid 10th centuries A.D., after the Qasr (fortress/palace) went out of official use. Historical evidence from this period implies that these individuals could have been involved in tribal conflicts or political unrest after the transition from Umayyad to Abbasid rule in the mid-8th century. Assessment of health and disease using skeletal indicators suggests that, compared with regional populations, these individuals were relatively healthy. Four out of six (one female, three males) had healed cranial trauma, signifying that this was not their first violent episode. We hypothesize that these individuals perished during an intraregional struggle for resources, particularly water, when the area was in a political vacuum after the 8th century. Future isotopic analyses of these individuals, indicating their primary dietary sources or non-local origin, could further elucidate who these individuals were and why they perished at Qasr al-Hallabat.

The excavations at Qasr al-Hallabat are funded by the Spanish Agency for International Cooperation and the Spanish Institute for Cultural Heritage.

High resolution radiometric and stable isotopic analysis of pre-Columbian Puerto Rican paleodiet.

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The ability of biogeochemical techniques to produce information on the diets of individual consumers in past societies is something that no other line of archaeological inquiry is capable of providing. Given the scale and resolution of the data they produce, such techniques are ideally suited for the high resolution study of past social structure and change. Despite this usefulness, paleodietary studies have far too often relied on the analysis of just a few individuals from any given past site or society to form conclusions about socio-political patterns and processes. A reliance on such small sample sizes represents a major flaw in many such studies.

Contrary to this trend, the present work presents the results of an exhaustive radiometric and stable isotopic study of four large skeletal samples (combined n=396) excavated from four pre-Columbian Puerto Rican sites. The radiometric and stable isotopic analysis of all of the individuals in these samples has made possible an unusually high resolution reconstruction of culturally and socio-politically driven synchronic and diachronic dietary variability in the pre-Columbian polities of Puerto Rico. While expensive and time-consuming, detailed and exhaustive studies of this sort present what is, perhaps, our best chance to reconstruct the inner-workings of past food systems and societies.

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Morphometric variability in *A. africanus*.

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The taxonomy of the *A. africanus* fossils has been a topic of routine controversy, and recent discoveries have only complicated the situation. A 3D morphometric analysis of basicranial shape was undertaken on a sample of South African specimens in order to identify divergent specimens. As these fossils are highly fragmentary, however, it was necessary to devise a method by which to estimate shape-space distances between specimens that share few common landmarks. A series of tests were conducted in which pairwise Procrustes distances were obtained for fossils sharing particular landmarks. These distances were compared to a corresponding distribution in a sex-, species-, and subspecies-balanced *Pan* sample. The percentage rank of each fossil pair's distance in the *Pan* distribution was recorded for each test. When a number of tests were available for a given pair, the percentage ranks were averaged with weight given to the number of included landmarks.

The resulting matrices of fossil pairs' average Procrustes distance percentiles in the *Pan* distribution were ordinated with both the PCO and NMDS approaches. Each ordination indicates that Stw 505 is substantially distinct from the other specimens. Sts 19 is also distinct, and always along an axis orthogonal to the one distinguishing Stw 505 from the other specimens. The Procrustes distances between these specimens, and between each of them and the remainder of the fossils, tend to be large. It is therefore unlikely that Sts 19 and Stw 505 are both conspecific and distinct from *A. africanus*.

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Regional patterns among Holocene hunter-gatherers of southern Africa.

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In the characterisation of the human past, hunter-gatherers are often portrayed in general terms, serving as the baseline from which subsequent populations deviated. Sample sizes are rarely large

enough to make generalizations about regional adaptive strategies. The coastal and near-coastal environments of the southern tip of Africa provide archaeological evidence of continued exploitation by foragers for several thousand years, with little input from populations of adjoining inland locales. Hundreds of skeletons, curated at several institutions, have been the focus of a coordinated research program. They can now be described in terms of biological and behavioural similarities and differences. There is apparent homogeneity across the region in many features of skeletal morphology and patterns of child growth. There are local differences in dietary patterns and evidence of interpersonal violence. Habitual behaviors show both similarities and differences. The strategies of resource exploitation that were successful in this environment illustrate this region's past, but also probably illustrate fundamental features of hunting and gathering in other non-marginal regions. The research provides a rich example of the interplay between biology and behaviour, as modulated by environment.

Influence of androgen receptor variation in primate and carnivore female social dominance.

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Female social dominance over males is a rare social behavior within mammals, found only in the Primates and Carnivora. Dominance behaviors are correlated with androgen levels. Androgen hormones act by binding to androgen receptors (AR), which upon binding function as a transcription factor initiating a cascade of events. In mammals, the AR gene exhibits extensive variation within the first exon, characterized by variable length CAG repeats. AR expression *in vitro* is inversely related to the number of CAG repeats. Human males with many repeats suffer androgen insensitivity when androgens fall with age. Since females produce less androgen than males, a possible mechanism to increase androgen effects is by increasing the receptor availability. This can be accomplished by reducing the number of the AR CAG repeats. Thus, short AR repeats may act as a proximate mechanism contributing to female dominance. To test this hypothesis, publically available AR sequences for 24 species (15 primates, 9 carnivores) are analyzed for repeat length. Social behavior data comes from the literature. Within each order, female-dominant species *Crocuta crocuta* (spotted hyena), *Lemur catta* (ringtail lemur) and *Propithecus verreauxi* (sifaka) exhibit significantly shorter repeat lengths than related species. This suggests that AR repeat length contributes to a female-dominant phenotype, though a short repeat length alone would not be predictive of such a complex phenotype. Future research will examine more species to explore the correlates of CAG repeat length and social dominance at both within and between sex levels of analysis.

Fighters, victims and average Joes: fracture patterns at the site of El Brujo, northern coastal Peru.

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In an effort to understand the nature and frequency of interpersonal violence in the pre-Hispanic Moche culture of northern coastal Peru, an analysis of fracture patterns was undertaken. Fracture pattern analysis includes comparisons of overall fracture rate, fracture location, timing (ante- or perimortem), and fracture mechanics. Fracture pattern analysis from the site of El Brujo, a ceremonial center in the Moche heartland, produced three distinct fracture profiles, suggesting they marked three distinct categories of individuals. The first group had fractures that were largely accidental in origin. The patterns identified among the second and third groups were strongly indicative of interpersonal violence, but with notable differences. The second group's fracture pattern is consistent with injuries sustained in armed combat. The members of the final group, while also demonstrating a fracture pattern linked with interpersonal violence, appear to have been lower status individuals singled out as targets of aggression. These distinct patterns provide insight into the ways in which interpersonal violence impacted individuals in Moche society. This research was supported by grant #BCS-0731552 from the National Science Foundation.

Genetic and Behavioral Observations of "Kinda" Baboons (Papio cynocephalus kindae) in Zambia.

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Though rarely recognized as such, the "kinda" baboon is one of the most distinctive and widely distributed forms of Papio baboon. Its range extends across the miombo woodland of central Africa, from eastern Zambia, through southern DRC to western Angola. Generally considered a subspecies of the yellow baboon, kindas are distinguished from typical P. cynocephalus by small body size and associated short muzzle, silky fur, light-pink skin around the eyes, midline crest of hair or 'mohawk' on the head, and

the white natal coat of most infants. Our surveys in the Luangwa and Kafue drainages have yielded observations and genetic information documenting limited zones of contact and interbreeding between kindas and the other two baboon taxa recognized in Zambia: grayfooted chacmas (P. ursinus griseipes) in Kafue National Park and larger yellow baboons (P. cynocephalus subsp.) in the Luangwa Valley.

Kinda baboons live in multi-male troops without obvious substructure, but that probably are larger on average than typical yellow baboon troops. Preliminary observations also suggest some distinctive behaviors. Females exhibit vigilance and alarm calling behavior more characteristic of males in other baboons; adult males give high-pitched, female-like calls, rather than deep "bahoo" barks; and we observed many instances of an expression of male-female affiliation rarely seen in other baboons, in which an adult male groomed and huddled with a non-estrous female, often a mother with a nursing infant. Together with the kinda's reduced sexual dimorphism, these behaviors suggest a distinctive suite of behavioral, morphological and physiological characters that merits further study.

Effects of habitat disturbance on population density of pileated gibbons (*Hylobates pileatus*) in Southeast Thailand.

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Logging causes varying degrees of disturbance to forest structure resulting in large-scale habitat alterations. Arboreal and frugivorous nonhuman primates are especially vulnerable to this disturbance as the removal of canopy trees could affect directly their survival and breeding success. In this study, we investigated how past logging relates to population density of pileated gibbons *(Hylobates pileatus)* and how well this endangered species may recover from disturbance. The study was conducted in Khao Ang Ru Nai Wildlife Sanctuary, Southeast Thailand, where selective logging had occurred in the past 30 years. An auditory census method was used to assess the density of gibbons in 24 sites randomly placed throughout the sanctuary within four habitats with different logging history. In addition, in each forest type six 1-ha plots were established to census tree species including measures of canopy height and diameter class.

We found that the average gibbon group density showed a decrease from ca. 3 groups/km^2 in areas with minimal logging 30 years ago to less than 0.5 in areas more heavily logged 15-20 years ago. Forest structure did not differ between these sites, but areas with a longer post-logging recovery period showed significantly higher tree species richness and thus food abundance. Hence, this result shows that gibbon populations can persist in disturbed areas where forest is subsequently protected and gibbons have not been hunted out, but it appears that recovery to previous densities is retarded by the slow pace of regeneration of forest quality.

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The facial reconstruction of the Lapedo Child.

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Lagar Velho 1 is a largely complete Upper Paleolithic-associated skeleton of an approximately 4-year-old child from Portugal dating to ca. 24,500 years BP. The specimen has been argued to present a mosaic of European early modern human and Neanderthal features. The mandibular mentum osseum and the dental size and proportions, supported by mandibular ramal features, align the skeleton with early modern humans. Here we detail a recently-realized facial reconstruction of the specimen. For decades, facial reconstruction has been a misunderstood and underused scientific tool. Nearly all museum displays and popular articles about hominins include at least one facial reproduction; this is indicative of its value as a teaching tool. Facial reconstruction is a relatively new science, and has only been executed with competence in the last decade. In this reconstruction, we used all of the available scientific and forensic tools to create the likeness of Lager Velho 1. The methods used in this reconstruction were based on the Manchester method, utilizing the most current measurements, techniques and materials. Most of the skeletal features that support a Neandertal pedigree for the specimen are postcranial and as such do not manifest in this reconstruction. The final appearance of the reconstruction is consistent with the geological age of the remains in that it retains a heavy brow and robust features, but is clearly that of an early modern *Homo sapiens* with few, if any, discernable *H. neanderthalensis* features.

Health status and lifestyle in early Neolithic and later Iron Age Taiwan: dental indicators.

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Examining several indicators of oral/dental and physiological health

and lifestyle in teeth (dental caries, antemortem tooth loss-AMTL, alveolar defect, dental calculus, linear enamel hypoplasia-LEH, and dental attrition), this study investigates biocultural implications of changes in subsistence from the beginning of the Neolithic to Iron Age Taiwan. The skeletal assemblages analyzed are from 1) Nankuanli East (NKLE) (*n*=24 individuals), a site located in Tainan County in southern Taiwan associated with the Tapenkeng culture (c. 5000 years BP), the oldest Neolithic cultural sequence in Taiwan and 2) Shihsanhang (SSH) (*n*=23 individuals), an Iron Age site (c. 1800-500 years BP) located in northern Taiwan. The main hypotheses tested are that higher frequencies of indicators of stress will be observed in the later Iron Age skeletons than in the earliest Neolithic skeletal series and variation in individual indicators of health will be observed between males and females.

Contrary to expectations, low frequencies of dental caries, alveolar defect, and AMTL were observed in both archaeological series. Likewise, significantly lower frequencies of LEH were observed in the SSH assemblage. As expected, significantly higher frequencies of extreme dental attrition were observed in the NKLE series and significantly higher frequencies of calculus were observed in the SSH series. Significant differences in frequencies of these indicators for males and females in these two series were not observed. With the exception of dental calculus, the overall health of the later Iron Age series was slightly better than the earliest Neolithic ancestors of Aboriginal Taiwanese.

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Buccal dental microwear and tooth crown morphology in Neandertals and modern humans show
significant correlations with prevailing climatic conditions thoughout the Middle and Upper Paleolithic in Europe.

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Geometric morphometrics and buccal dental microwear analyses were applied to a large collection of fossil Neandertals and modern humans' lower, M1 teeth to determine if the morphological evolution of tooth shape and cusps distribution could be significantly correlated to shifs in dietary habits and/or climatic conditions throughout the Middle and Upper Palaeolithic in Europe, spanning marin oxygen isotope stages (OIS) 2, 3 and 4. *Homo neanderthalensis* and *Homo sapiens sapiens* teeth can be clearly discriminated by geometric morphometrics analyses, and dental microwear has shown to be a reliable indicator of dietary habits in both extinct and extant hunter-gatherer human populations. Only well-preserved teeth, with observable cusp tips on occlusal view and undamaged buccal enamel surfaces, were considered. The final sample that could be studied with both techniques at the same time only included 12 fossil specimens. The results showed significant correlations between some of the morphological and microwear data, suggesting that dental morphotypes might depend on dietary related adaptations. In addition, both morphometrics and microwear variables varied throughout OIS periods in a parallel maner, with higher densities of striations and more elongated shapes in colder OIS periods. Natural selection in relation to ecological conditions might be responsible for dental morphology in both Neandertal and modern human populations.

Chullpas, caves, and biological affinity: a case study from Marcajirca, Peru.

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Chullpas and caves are mortuary contexts frequently used in the north-central highlands of Peru during the Late Intermediate Period (LIP) (AD 1000-1476). One interpretation of their function has been that specific structures were utilized by kin groups or individuals with a shared ethnic identity. The tradition of ancestor veneration documented in Andean cultures and supported by archaeological evidence tends to support this interpretation. This project tests the hypothesis that assemblages from separate chullpas and caves represent individuals of common ancestry.

Craniometric data was gathered during the summer of 2008 from skeletal remains during a pilot project at the Marcajirca site in the Huari Province of Peru. Individuals were sampled from two chullpas and three caves dating to the LIP. Only adults with no evidence of cranial modification were included in this study. A multivariate distance analysis was employed to assess possible biological affinity between individuals. Results from the analysis interpreted in a bioarchaeological framework inform on important questions of mortuary ritual practices and ethnic identity in prehistoric highland Andean societies.

This project was supported in part by the McClure scholarship for international study and the William M. Bass Endowment.

Quadruplegic paralysis and bone remodeling: A case study.

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Research has shown that bone turnover increases following prolonged periods of disuse. This acceleration is attributed to basic multicellular unit (BMU) activity for potential reduction of excess bone tissue. Previous studies have employed the rib as a control for systemic remodeling, yielding turnover rates indicative of biomechanical loading. Patterning of osteon size is also speculated to be related to activity levels. This

case study describes histomorphometric variation in the upper and lower limbs of a seventy-year old quadriplegic female having complete limb paralysis for her entire adult life. The goal of this research is to identify potential effects of biomechanical disuse on bone remodeling. Variables investigated include osteon population density (OPD), osteon area (On.Ar), Haversian canal area (H.Ar), osteon perimeter (On.Pm), Haversian canal perimeter (H.Pm), osteon circularity (On.Cr), and Haversian canal circularity (H.Cr). Although preliminary results demonstrate a high degree of uniformity in remodeling rates between long bones in relation to the rib, suggesting that the majority of bone turnover is attributable to systemic influences, there are some significant differences between bones with respect to OPD, areal and circularity measurements. These discrepancies are potentially indicative of intraskeletal variability.

Characterization of *TAS2R38* (phenylthiocarbamide) Haplotype Diversity in Altaian Populations from South-Central Siberia.

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Taste sensitivity to the bitter compound phenylthiocarbamide (PTC) has been observed to vary in every human population tested to date. Most of this variation is controlled by the segregation of two common alleles (PAV and AVI) at the *TAS2R38* locus on chromosome 7, which encode receptor variants with different ligand affinities. Although the PAV and AVI haplotypes are associated with the major taster and non-taster classic phenotypes, respectively, there are at least four other minor haplotypic forms that have been previously reported. The differential tasting abilities associated with these minor haplotypes has not been extensively studied. Currently, the tasting gene variation in northern Asian populations remains relatively unknown. To gain insights into the patterns of tasting abilities in this region, we analyzed variation at the *TAS2R38* locus in 379 individuals from indigenous Altaian populations in south-central Siberia. We used TaqMan assays to screen these samples for three informative SNPs within the *TAS2R38* gene that generate the major taster and non-taster phenotypes. Our data reveal a wide range of haplotypes in these populations, including ones that have not been previously reported. Comparisons with other populations show a large proportion of Altaian individuals possess taster alleles, which may reflect the effects of geographic isolation and adaptation in this region.

3D geometric morphometric analysis of the mandible of *Rudapithecus hungaricus* from the late Miocene of Rudabánya (Hungary).

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In 2006, a remarkably complete mandible of the 10 Ma fossil hominid *Rudapithecus hungaricus*, was recovered from Rudabánya, Hungary. This specimen preserves the body of the mandible in addition to the ramus on the right side, although the right gonial region is damaged. The completeness of the fossil provides a unique opportunity to describe the specimen quantitatively and examine the differences between *Rudapithecus* and extant primate mandibular morphology.
Here, we used a 3D geometric morphometrics approach to quantify these differences and to investigate the morphological affinities of *Rudapithecus* in a wide comparative sample of extant primates. 24 landmarks were chosen to capture the shape of the fossil specimen and digitized in the form of 3D coordinates on 98 specimens representing *Pan*, *Pongo*, *Hylobates*, *Symphalangus* and *Papio*. Generalized Procrustes analysis was used to superimpose the specimen landmark configurations and the fitted coordinates were analyzed using standard multivariate statistical techniques, including principal component analysis, canonical variates analysis and Procrustes distances. Mandibular shape differences along principal components were visualized, and the effect of size-related shape variation was explored. Preliminary results show *Rudapithecus hungaricus* clustering broadly with the apes, but sharing some morphological similarities with the gibbons. We discuss the implications of these findings for our understanding of primate cranio-mandibular evolution in the Miocene.
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Comparative analysis of 3-D measures of postcranial dimorphism in primates.

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The vagaries of the fossil record dictate that body size and size dimorphism for taxa are estimated using different skeletal elements. Postcranial measures are often considered preferable for estimating size and size dimorphism in the fossil record, with several studies recommending the use of dimensions that show isometric scaling. Still, few studies have evaluated patterns of postcranial dimorphism within and among species. Most analyses employ

simple linear dimensions, but new technology allows the easy acquisition of joint surface areas and diaphyseal cross-sectional areas, which should closely track body size and hence dimorphism. We present results from a comparative analysis of linear, surface area, and volumetric measures of femoral and tibial size in a series of apes and cercopithecoid monkeys.

High resolution, 3-D laser scans were gathered for the femur and tibia of hominoids and cercopithecoids. Scans were analyzed in Polyworks software, extracting standard linear dimensions, joint surface areas, mid-shaft cross-sectional areas, and bone volume. Body mass data were taken from museum records and literature sources. Data were analyzed using standard regression and correlation techniques.

While dimorphism across dimensions approximates size dimorphism, patterns of dimorphism vary strongly across taxa, and even between elements, in spite of pervasive isometric scaling. Joint surface area dimorphism is not more closely correlated with size dimorphism than standard linear dimensions. While no single measure provides a "best" estimate of size dimorphism, dimorphism estimates converge when averaged across measures, even using different combinations of variables, suggesting that taxa can be compared using multiple combinations of variables.

Cross-sectional geometry: The relationship between bending loads and the neutral axis.

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Cross-sectional geometry is often used to test hypotheses regarding the mechanical adaptation of long bones. However, the application of this method to infer habitual bending loads has been called into question. *In vivo* strain data show that the neutral axis of bending does not correspond to the maximum principle axis calculated from bone sections, suggesting that the inferred direction of habitual bending loads may not align with actual loads. However, it has also been suggested that extrapolations from strain data may not accurately reflect bending load orientation because the distribution of bone mass would deflect the neutral axis to a location where bone is not as strongly reinforced.

Using finite element analysis, the relationship between bending loads and the location of the neutral axis was investigated for 3D tubular models with various cross-sectional contours. Bending loads were applied perpendicular to the maximum principle axis. Following loading, the location of the neutral axis relative to the maximum principle axis was found to vary with cross-sectional contour. Neutral axes of models with asymmetric contours were rotated away from the maximum principle axis toward a region that was less reinforced. In other experiments, axial compression and torsional loads were applied in combination with bending loads. Symmetrical models exhibited particularly large deviations in neutral axis placement relative to bending loads, even if the torsional load was weak (e.g., 1/20th the bending load). The relationship between bending loads and the location of the neutral axis is complex and influenced by cross-sectional bone distribution.

Integration during ontogeny of the cranium of *Homo sapiens* and *Pan troglodytes*.

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Despite a plethora of work concerning morphological integration in hominids, little of this research has focused on integration patterns during ontogeny, choosing instead to quantify adult patterns of integration. An ontogenetic focus on studies of morphological integration is necessary, as an understanding of the ontogenetic integration of the cranium is required in order to ask insightful questions concerning changes in any system throughout evolution, particularly one as morphologically complex as the cranium.. The enormous morphological complexity of the cranium is likely why such a genetically uniform group as hominids possesses such widely diverse cranial forms. Quantification of the integration pattern during ontogeny should help explain how these diverse cranial morphologies arose and are maintained.

To this end, the integration pattern was quantified for a longitudinal human growth series and a cross-sectional chimpanzee series. Three hypotheses were tested: 1. Humans and chimpanzees possess identical integration patterns. 2. Humans and chimpanzees possess ontogenetically stable integration patterns. 3. The human integration pattern is heterochronic relative to the chimpanzee pattern.

Hypotheses 1 and 2 were falsified. Humans and chimpanzees show species-specific integration patterns, particularly in the face; humans are characterized by strong modularity while the more prognathic chimpanzee face is more integrated. Both groups, however, are integrated in the cranial vault, which is modularized from the cranial base. Ontogenetically, both species are characterized by dynamic integration patterns. Hypothesis 3 was not falsified. The human integration pattern never resembles the juvenile chimpanzee pattern; with respect to integration patterns, humans are not neotonous chimpanzees.

Daily energy expenditure in orangutans measured using doubly labeled water.

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How much energy do orangutans spend each day, and how does their daily energy budget compare to other animals? While numerous studies have modeled energy budgets in orangutans and other

primates, daily energy expenditure in apes has never been measured directly. In this study, we measured daily energy expenditure in healthy, active adult orangutans housed in large indoor-outdoor enclosures at the Great Ape Trust in Des Moines, IA. Total daily energy expenditure (kCal/day) was measured over a two-week period using the doubly labeled water method. Resting metabolic rate for these orangutans was measured using oxygen consumption and carbon dioxide production, and daily activity, including daily walking and climbing distance, was recorded. Intriguingly, despite activity levels similar to or greater than those of wild orangutans, daily energy expenditure in Great Ape Trust orangutans was substantially lower than seen in similarly sized mammals, and below that of sedentary humans. We discuss potential proximal and evolutionary causes for hypometabolism in orangutans, and examine the hypothesis that low daily energy expenditure is an evolved strategy for surviving during periods of extreme low food availability.

Effects of metabolic disorder on cerebellar development and morphology.

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Phenylketonuria (PKU) is a recessive genetic disorder resulting in an inability to utilize the amino acid phenylalanine. Previous studies have shown that the brains of individuals with PKU show specific dysmorphologies, including a decrease in overall size and white matter abnormalities relative to typically-developing individuals. Further, studies of animal models for PKU have shown cellular abnormalities in the cerebellum as well. We hypothesize that PKU has an effect on the development of the cerebellum, and will differ from that of typically-developing individuals.

To test our hypothesis, magnetic resonance images (MRIs) were acquired from 18 age-matched individuals (8 PKU, 10 typical) between 12-27 years of age. Volume measures of whole cerebellum, cerebellar gray matter, cerebellar white matter, and whole cerebrum were collected from the MRIs. Data were then compared between typically-developing individuals and individuals with PKU.

Results show that although cerebral volume is not reduced in PKU, there are trends for reduction in each of the cerebellar volume measures, though none are statistically significant. However, where typically-developing individuals show a tight correlation between cerebellar volume measures and cerebral volumes, individuals with PKU show markedly reduced correlations. These results suggest that the metabolic disorder resulting from PKU does not significantly affect brain size, but does affect the relationships among its component parts. This suggests a degree of developmental instability in the relationship between the cerebrum and cerebellum in the development of the brain in individuals with PKU. Future work will show whether these differences in structure are associated with behavioral changes. Work supported in part by the 2007 Thompson Center Undergraduate Research Opportunity Fund (KKP) and Scholar Funds Grant (SEC), and by the Department of Pathology & Anatomical Sciences.

Assessment of secular change in osteological aging methods.

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This research addresses whether older documented collections are appropriate reference samples to provide aging standards to apply to modern skeletal series. This issue is particularly important in forensic anthropological investigations, but also involves the broader issue of secular change in senescence. Several recent publications have documented secular change in both stature and cranial shape/size for American skeletal samples over the last century. Currently, it is unclear whether similar trends exist for aging methods based on commonly used regions for assessing age.

The pubic symphysis, auricular surface, sternal rib end, and cranial sutures were examined and phase values assigned for a sample of American blacks and whites from the Robert J. Terry (n=270), Hamann-Todd (n=276), William Bass Documented (n=156), and Maxwell Museum Documented (n=136) collections. Simple descriptive statistics, inaccuracy, bias, and intraobserver error rates were calculated. The Kappa statistic was used to test for agreement between older and newer scoring methods, older and more recent collections, and among sex-race groups. Bayesian analyses tested for differences between predicted and actual ages/phases.

The merits of this project include developing a method to reliably assess whether temporal trends exist in skeletal age estimation. By examining skeletal collections spanning 150 years, this project will advance knowledge and understanding of the impact of secular change on the applicability of age estimation methods based on 19th century reference samples to modern and/or archaeological specimens. Results will contribute to the understanding of the biology of aging and contextualize secular change in the study of human morphological variability.

Presenting human evolution at the Smithsonian: 'What does it mean to be human?'.

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Surveys by public media and scientific organizations (e.g., National Academy, NSF, AAAS) alike indicate that just over 50% of the U.S. adult population understands or accepts basic findings regarding human

evolution, significantly lower than in similar samples of Europeans (~70%). Data from a Smithsonian Institution study show that adult visitors to the National Museum of Natural History understand and/or accept the basic tenets of evolution (e.g., adaptation, cumulative change through time) at a rate of 85-95%, but with substantial falloff to 60% when those tenets are applied to humans. In an effort to advance public understanding of human origins, a new, permanent exhibition will open in November 2009 at the Smithsonian's National Museum of Natural History. The exhibition's overall message is that the defining qualities of *Homo sapiens* evolved over millions of years as early hominins adapted to diverse and dynamic environments. Displays will present fossils and artifacts (originals, casts, reproductions) from early hominin sites in Africa, Asia, and Europe that explain the major milestones in hominin adaptation in their environmental context. Interactive displays will encourage learning about how paleoanthropological evidence relates to research interpretations and dynamic aspects of evolutionary change. The exhibit will also highlight critical contributions from genetics and primate studies. The Smithsonian will simultaneously launch a human evolution education initiative that will rely on a network of scientists, educators, and organizations. This poster enables the scholarly community to examine our scientific treatments, methods of public outreach, and challenges of presenting human evolution on the U.S. National Mall.

New light on cranial bone adhering to matrix encasing Sts 5 ("Mrs Ples") from Sterkfontein, South Africa

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In 1947 Dr Robert Broom and John Robinson discovered the most complete cranium of *Australopithecus africanus*, nicknamed Mrs Ples (Sts 5), from the Sterkfontein Caves, South Africa. Unfortunately the skull (2.15 million years old) was broken into two pieces due to the fact that dynamite had been used by lime miners. Broom and Robinson used a hammer and chisel to extract the cranium from the surrounding matrix. In the process six pieces of breccias were removed, retaining the outermost layer of cranial bone (Sts 5, i – vi). Sts 5 (i) was preserved in a large block of breccia associated with occipito-parietal bone. Sts 5 (iii) retains a parietal fragment. The matrix has been prepared after careful dissolution in 5% acetic acid. Temporal lines and sutures have been exposed for the first time. The evidence currently available suggests that the temporal lines on the right and left sides did not meet at bregma, but were relatively close. It is probable that Mrs Ples may have developed a sagittal crest if the individual, a presumed male, had lived into adulthood. Sagittal and lambdoidal sutures are open. In addition, the third upper molar roots (revealed by CT scans) are open. These observations confirm the fact that Sts 5 represents an adolescent rather than an adult, as had been suggested by Robert Broom.

Pair bonding in socially monogamous primates: a comparative study of the white-cheeked gibbon (*Nomascus leucogenys*) and the white-faced saki (*Pithecia pithecia*).

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Primate social organization is highly variable and while most anthropoids live in large, fluid communities, some species organize into small, stable family units. These species are usually described as socially monogamous and exemplified by preferential mating patterns, close socio-spatial relationships, and joint infant care. But such characteristics differ between taxa and data are lacking in many species. We studied pair bonding in two poorly studied primates, the white-cheeked gibbon (*Nomascus leucogenys*) and the white-faced saki (*Pithecia pithecia*) at the San Antonio Zoo. Our primary goal was to examine sex differences in bonding behavior to determine whether males and females contribute equally to pair bond maintenance.
Systematic observations were conducted on one group of gibbons (N=3) and one group of saki monkeys (N=4) during five months for a total of 100 hrs. Data were collected on grooming, proximity, approach-retreat patterns, and paternal behavior. Results show considerable inter-sexual variation in bonding behavior and pair bond intensity. The gibbon pair mates spent more time in close proximity (25%) than the saki pair (3%), and engaged in much more mutual grooming (17% vs. 0.2%). Results also defied predictions based on research that suggests that males and females exhibit equal grooming effort and investment in the pair bond. In this study the female gibbon was responsible for much more grooming (98.4%) than the male (1.6%), while the male saki exhibited more grooming effort (92%) than the female (8%). Additional data are necessary to determine if results reported here reflect species typical differences in bonding behavior.

Residential mobility and dietary patterns at the prehistoric site of Gatas, southeastern Spain.

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This study examines residential mobility and paleodiet at the Argaric site of Gatas, located in Almeria Province, Spain, via biogeochemical analyses. The Argaric culture (ca. 2300-1600 B.C.) provides the first tangible evidence of social complexity in the

southeastern Iberian Peninsula. We explored social differentiation through possible differential access to food resources. We also tested the hypothesis that males were more mobile than females in their post-marital residence patterns, as suggested by earlier craniometric analysis and a matrilocality model. Strontium, oxygen and carbon isotope and trace element concentration analyses were performed on hydroxyapatite in human bone and enamel samples from eleven individuals buried in Gatas following established methodologies. Archaeological faunal samples of European rabbit (*Oryctolagus cuniculus*) were used to estimate the biologically available strontium at the site ($^{87}Sr/^{86}Sr$= 0.70953-0.71032). All individuals showed a local geographic origin, assuming that strontium was obtained through local food and water resources. Therefore, neither immigration nor higher male mobility was supported by the current data analyses. However, even though the strontium isotope analysis shows that the individuals did not come from the adjacent northern areas, movement from the south cannot be excluded due to the geochemical similarity of the regions. The paleodietary reconstruction revealed an overall similar diet and did not demonstrate differential access to food. Overall, the current study establishes a significant isotopic and elemental baseline for the reconstruction of residential mobility in southeastern Spain, and explores both migration and paleodiet in the Iberian Peninsula.
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Stable isotope and mtDNA evidence for geographic origins at the site of Vagnari (2nd- 4th centuries AD), Italy.

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Excavations at Vagnari have uncovered a large Imperial Roman estate and cemetery. Archaeological evidence suggests that the people buried there were likely servants or workers who lived, worked, and died on this estate. One question concerns the origins of these people; were they born locally, or did they migrate here from another part of the Roman Empire? Oxygen isotopes are used to investigate geographic origins because $\delta^{18}O$ values in bones and teeth reflect the source of ingested water, which in turn is largely determined by the $\delta^{18}O$ of local precipitation and varies with geographical location. We analyzed $\delta^{18}O$ in the enamel of 25 permanent 1st molars, which provides a record of the isotopic signal of water ingested at the time of formation (i.e., birth to ~3 years of age). The $\delta^{18}O$ values vary from -2.1 to -5.5‰, falling outside the expected $\delta^{18}O$ range for this region based on data from modern meteoric precipitation. We then extracted, amplified, and sequenced hypervariable region I of the mitochondrial DNA (mtDNA) from 10 individuals. Several samples were also cloned to verify sequence authenticity. Preliminary results show that the mtDNA signatures are diverse, indicating that few of the individuals were maternally related. However their origins, as determined by their haplogroups, cluster in similar geographical locales (e.g., W. Eurasia), but interestingly, the sample may also contain individuals from distant geographic regions (e.g., E. Asia). The combined isotopic and mtDNA analysis suggest a heterogeneous group who lived at Vagnari, some of whom came from outside of Italy.

The function of sexual swellings during pregnancy in chimpanzees.

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Like many other primates, female chimpanzees mate extensively during nonfertile periods, raising the question of the function of such mating. Mating occurs when females exhibit multiple cycles of anogenital swellings before each conception and for variable periods into pregnancy. Given that: sexual swellings are costly to produce, swollen females experience higher rates of male coercion and aggression and are surrounded by higher numbers of feeding competitors: the number of swelling cycles likely results from trade-offs between the costs and benefits of multiple mating. Here I examine variability in sexual swellings to evaluate four hypotheses about benefits of mating during pregnancy: extended mating 1) devalues each copulation, thus reducing male competition and coercion; confuses paternity so that males are 2) less likely to commit infanticide, or 3) more likely to invest in and protect the infant; 4) attracts males that protect the female from higher-ranking females. Sexual swellings of Kasekela community females at Gombe National Park, Tanzania have been recorded daily from 1972-2005. In 79 pregnancies resulting in live births to 32 females (13 natal, 16 immigrant, 3 unknown origin) the average day of last swelling in an estimated 229-day pregnancy was 96 (range 0-226). Younger females cycled significantly longer into pregnancy and immigrant females cycled significantly longer than natal females, controlling for age. Results provide preliminary support for hypotheses 2 and 4. Compared to natal females, young immigrant females are likely to be more vulnerable to infanticide by unrelated males and may be subject to more aggression from resident females.

Cortical bone topography and cross-sectional geometric properties of two Upper Paleolithic adult femoral shafts:

Cro-Magnon 1 and Chancelade (Western France).

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Structural morphology of the femur reflects habitual mechanical loads related to levels and patterns of physical activity, as well as adaptive changes during growth in locomotion modes and, likely, climate adaptation. Relative to recent-extant humans, the Neanderthal femur exhibits greater diaphyseal robusticity, which is consistent with higher mechanical load regimes. Notably, the adult Neanderthal shaft is reported to have greater resistance to medio-laterally-directed bending stresses, mainly on mid-diaphysis, in addition to a peculiar resistance to axial, antero-posterior, and torsional stresses. Conversely, the condition shown by the anatomically modern fossil human femur is still poorly reported.
By using techniques of (μ)CT-based 3D virtual modeling and quantitative analysis, we characterized the endostructural femoral morphology of two Upper Paleolithic adult skeletons: Cro-Magnon 1 (Gravettian) and Chancelade (Magdalenian).
Standardized cross-sectional geometric properties were measured at a series of regular intervals and compared with the evidence from a reference sample of 15 adult individuals. Cortical bone thickness was detailed between 20% and 80% of the biomechanical femoral length.
Chancelade's diaphysis is more robust than Cro-Magnon 1, with a greater resistance to axial, bending and torsional loads. As revealed by morphometric mapping, cortical bone topography in both fossil specimens traces the pattern shown by modern humans, with areas of relative increased thickness located medially (at 60-80%) and laterally, besides those surrounding the linea aspera. Nonetheless, values of cortical area (CA), polar section modulus (Zp), and polar second moment of area (J) in the Upper Paleolithic femurs systematically fall well above the modern human range of variation.

The effect of *Kitlg* on human skin pigmentation.

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Linkage mapping for pigmentary traits in stickleback fish has identified a genomic region surrounding the gene Kit ligand (*KITLG*), a growth factor and ligand for the KIT tyrosine kinase receptor. Investigation into populations of marine and fresh water sticklebacks suggests that regulatory changes at *KITLG* have spread via admixture. Admixture mapping in a sample of African Americans has demonstrated that *KITLG* also affects skin pigment variation between West Africans and Europeans. Patterns of variation across the gene, however, indicate that the protein-coding regions of KITLG do not show high levels of allele frequency difference. This work investigated polymorphisms near four signatures of selection found in the coding region (rs10858696), upstream (rs10732643), and in the untranslate region (rs4842625, rs642742) of *KITLG*. The skin melanin index (M) of these individuals was measured using reflectance spectroscopy and they were genotyped for a panel of AIMs facilitating fine-scale admixture mapping. The individual proportional ancestry was calculated and used to control for the confounding effects of ancestry when analyzing the relationship between each loci and M. While the SNPs in the UTR showed an effect on M individually (r^2 adj = 0.1649, $p < 0.0005$), a larger effect was found from analysis of the haplotypes of these four polymorphisms (r^2 adj = 0.1803, $p = 0.035$) suggesting that a polymorphism in LD with the studied polymorphisms may contribute to variation in skin pigmentation.

Does a woman's birth weight predict milk protein composition in adulthood?

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Recent work has highlighted natural variation in human milk composition and its immediate and long-term health impacts on offspring. A notable finding is that women consuming similar diets, and who have similar body composition and activity levels, can produce milk with different nutritional composition - including protein content. Is it possible that between-individual differences in milk protein content is influenced by differences in nutrition and growth during a mother's own gestation and infancy? Similar observations of an intergenerational influence on maternal-offspring nutrient transfer have been made for gestation, but little work has looked at associations during lactation, when a woman continues to provide a high level of nutritional investment in offspring. To investigate this question, we collected milk samples from 130 women followed longitudinally since their own gestations in 1983-84 from Cebu City, Philippines. Detailed health, anthropometric, and nutritional data were available at regular intervals on all women. Milk samples were collected between 6-10am, using mid-feed hand expression. Recall data on breastfeeding behaviors were also collected from all mothers. Infants were 343.4 ± 265.9 days old, women breastfed 7.9 ± 3.2 times/day. Infant age, current size, supplementation status, and maternal birth weight predicted breastfeeding frequency; infant age, size, and supplementation did not affect protein content of milk;

whereas maternal effects of birth weight and breastfeeding predicted greater protein content. This study is a first step in evaluating the potential intergenerational determinants of human milk composition and the health and biological impacts of this variation on nutrition of the next generation.

Automated conversion and haplotyping of human mitochondrial DNA sequences.

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Human mitochondrial DNA (mtDNA) sequence data are used extensively for the reconstruction of population history, the inference of migration, and forensic identification. By convention, human mtDNA data are summarized by their variable sites relative to a type sequence: the revised Cambridge Reference Sequence. It is an unfortunate fact that a significant amount of published human mitochondrial sequence data are only available as variable site listings in the primary literature, and do not have full sequence entries in a public database (e.g. GenBank). Therefore, when reanalyzing published data, it is often necessary to convert data available only as sequence to variable site listings or vice versa, depending on the needs of the analysis. To aid this task, I present software that I developed to automate the processes of (1) identifying variable sites in human mitochondrial DNA sequences, and (2) converting lists of variable sites into sequence data. In addition, haplogroup assignment is often useful, and generally performed manually, although there are now two web tools available to automate this process. The Genographic Haplogroup Prediction Tool identifies haplogroups from HVS-1 data using a nearest-neighbor matching method, while the Mitomaster Genome Analysis identifies haplogroups from partial to whole genome sequence data using a decision tree. In addition to these existing tools, I introduce a new haplotype identification tool that combines these approaches in a nearest-neighbor match of sequences generated from every node of the human mtDNA tree and examine the strengths and weaknesses of all three methods.

The Neanderthal face is not cold adapted.

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Since the first specimen was described, the paranasal sinuses of the Pleistocene fossil hominin *Homo neanderthalensis* have been described as large, extensive or even 'hyperpneumatized'. For the last forty years, this inferred condition has been interpreted as an adaptation to extreme cold, as some Neanderthals lived in Europe during glacial periods. Analysis of other primates and rodents, however, has shown that at least the maxillary sinus undergoes a significant *reduction* in volume in extreme cold, in both wild and laboratory conditions. Recent examination of Neanderthal crania by computed tomography (CT) allows detailed volumetric assessment of the paranasal sinuses in this hominin for the first time. Analysis of the Forbes Quarry (Gibraltar) Neanderthal reveals a degree of craniofacial pneumatization that is both commensurate with the size of the face and comparable in scale with that seen in temperate climate *H. sapiens*. This in turn implies that the facial morphology of *H. neanderthalensis*, often interpreted as a direct result of increased pneumatization, is not adapted to resist cold stress, and requires an alternative explanation.

Seasonal influences on the weaning process in Nicaraguan mantled howler monkeys (*Alouatta palliata*).

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Transitioning to dietary independence can be risky for mammalian juveniles. An extended mixed-feeding phase (juveniles continue nursing but also feed independently) may reduce energetic demands on the mother while still providing the juvenile with a source of nutrition. This research hypothesizes that mothers (i.e., the milk they provide) are "fallback foods" for juvenile mantled howler monkeys during periods of resource scarcity. This hypothesis predicts that, as resources become scarce during the dry season, howlers shift to fallback foods. Additionally, it is expected that juveniles are less efficient foragers than adults, that they continue nursing while resources are scarce, and that their mortality increases during food scarcity. Behavioral and ecological data to test this hypothesis were collected on Ometepe Island, Nicaragua, from August 2006 through August 2007. Results indicate a trend of reduced food availability (particularly of young leaves) during the dry season. Howlers shifted to a diet high in flowers but low in protein sources, such as young leaves. Juveniles foraged significantly less efficiently than adults, both by spending more time each day foraging and by being less successful foragers. Despite continued nursing during the dry season, juveniles experienced higher mortality than any other age/sex class. The evolution of an extended mixed-feeding phase enables juveniles to fall back to their mothers' milk during the scarce dry season. This research demonstrates environmental influences on life history parameters, including the pace of development and the level of maternal investment, and has implications for the importance of fallback foods in life history evolution.

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Variation in primate basal metabolism: explanations and ecological implications.

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Basal metabolic rates (BMR) vary across the Order Primates after body mass is taken into account, including the well documented hypometabolism characteristic of many strepsirhines. Previous researchers suggested this variation may be tied to dietary influences or activity patterns, however none of these fully account for the variation within Primates, or across other mammals. Here, we show that much of the variation in BMR (within primates and across mammals) is due to variation in total body muscle mass. We collected BMR and muscle mass data (n=50) from the literature (and in some cases, muscle mass from primate cadavers), and examined correlations between residuals of each variable from body mass. We found that taxa with relatively small muscle masses have relatively low BMRs. Residual variation in BMR and muscle mass are both positively correlated with latitude and negatively correlated with mean annual temperature within each taxon's range, suggesting that low BMRs are a response to thermoregulatory challenges. Thus, animals living in relatively cold climates have relatively high BMRs that are, at least in part, brought about by increases in muscle mass at a given body mass. These relationships remain significant at alpha = 0.05 after phylogeny is taken into account. Variation in BMR has important implications for ecology and life history in primates. For example, relatively high BMRs are associated with reduced population density and with increased newborn mass. These results suggest that BMR constrains some aspects of primate ecology and these constraints are likely tied to biogeography and thermoregulatory requirements.

Body condition as a potential indicator of body mass outliers in modern human populations.

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Estimates of overall body size in terms of stature are a standard component of anthropological analyses. Body mass is at least as relevant in the description of an individual, and a more meaningful descriptor of overall body size in ecological and physiological terms at the populational or species levels. While there are reliable estimation techniques with these goals in mind at the macro level, previous research using modern samples strongly suggests that their confidence intervals are too large for body mass interpretation at the individual level.

Accordingly, the recognition of individuals in the extremes of the distribution of body mass may be more relevant than providing individual central estimates. Body condition is a concept commonly used in zoology and ecology referring to the mass of an individual after correcting for structural body size, and is often used to detect deviations from estimated allometric body mass.

As a test of this concept in modern human males, transverse measurements of the humerus and femur are regressed on the maximum lengths of each bone, and the corresponding residuals are interpreted as indicators of body condition. These residuals were

then compared with the regression estimates for weight from the transverse measurements in another modern human sample, in order to assess their ability to detect relative weight outliers. In general, the residual method trended toward the expected classification, although it did not consistently indicate extreme body mass variation in all cases.

Human skeletal remains from the prehistoric site of Franjevac, Eastern Croatia.

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During the 2007 rescue excavations at the site of Franjevac in Slavonia, eastern Croatia the remains of prehistoric settlement containing various artefacts, animal and human remains have been found. On the basis of archaeological analysis of artefacts and radiocarbon dating to between 3340 and 2840 BC, the settlement is ascribed to Eneolithic Kostolac culture. Burials were found in three separate pits and belong to a total of six individuals. Pit 266 contained remains of an adult male aged between 20 and 35 years. Interestingly, the remains of two dogs were also found near the skeleton. Skeletal remains of an adult female aged between 35 and 50 years, and juvenile of between 5 and 10 years were found in pit 161. Pit 306 yielded remains of an adult male whose age could not be determined due to poor preservation, and skeletal parts of a juvenile younger than 5 years have been found. A series of radiocarbon dates directly on human bones yielded results of 2890-2830 BC (Beta 241651, Pit 266), 2900-2840 BC (Beta 241652, pit 161 female, and Beta 241653, pit 306, male), and 3090-3050 BC (Beta 233118, pit 161, juvenile). Among various skeletal pathologies, LEH, *cribra orbitalia*, periostitis, spondylolysis have been noted. As burials of Kostolac culture are quite rare and mostly found out-of-context, the analysis of human remains from Franjevac is a valuable addition to our understanding of the burial practices of central European Eneolithic.

Opposing extremes of jaw mechanics: *Australopithecus boisei* vs. *Homo neanderthalensis*.

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Two aspects of facial and mandibular anatomy grant *A. boisei* clear biomechanical benefits. One is linked to the anterior position of the masticatory muscles, primarily the masseter, and the other, to the elevated position of the mandibular condyle relative to the occlusal plane. The former provides a longer power arm, while the latter produces, among other benefits, a near uniform distribution of bite force along the postcanine teeth as well as an increased anterior component of bite force during the final stages of occlusion. These two anatomical aspects arguably result in a relatively small maximum gape.

Neandertals exhibit the opposite configuration: they "refrain" from displacing the masseter anteriorly, and the condyle is low relative to the occlusal plane (Rak and Hylander, 2003). The combination of these factors arguably results in a relatively large maximum gape.

We also suggest that in *A. boisei*, the small maximum gape (in which the occlusal planes are almost parallel) is linked to the retraction of the dental arcades (Rak, 1983) and hence, in relative terms, a lengthening of the mandible's power arm. In Neandertals, on the other hand, the large angle between the occlusal planes at maximum gape results in an increased molar gape when the M3 teeth are shifted forward. It turns out that the typical retromolar space in the Neandertal jaw is a by-product of this anterior shift. Why the Neandertal invested so much in a large gape is still an enigma.

Growth in African Pygmies tested from cranial morphology.

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The reduced body size of African Pygmies is usually interpreted as due to changes in growth hormone axis (GH/IGF-I) affecting growth rate. Since cranial morphogenesis follows similar developmental mechanisms than postcranial elements, cranial morphology was compared between African Pygmies and Bantu groups living in similar environment. We tested the hypothesis that Pygmies show different size and shape in skull than Bantu and that differences in shape are principally observed in structures highly sensitive to GH/IGF-I.

The 3D-configuration of landmarks was compared in samples of adult Bantu (n=144) and Pygmies (n=28) coming from central Africa with geometric morphometrics. Principal Component Analysis derived from the generalized Procrustes analysis, ANOVA and multivariate regression suggest that skull is smaller in Pygmies than in Bantu. Size-related shape variation (allometry) was explained by a reduced face relative to the neurocranium. Morphological differences are not observed in those areas mainly affected by GH/IGF-I axis, i.e. cranial base and muscle insertion areas. The shorter face in Pygmies may be developmentally connected with the smaller body size. However, results do not suggest that a GH/IGF-I deficiency is the main underlying factor affecting growth rates. Morphological differentiation probably resulted from changes in the tempo of growth between African Pygmies and Bantu.

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Hearths for the dead: The effects of secondary firing on human bone from northern Mesopotamia 2000-1600 BCE.

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Osteoarchaeological research at ancient Urkesh found evidence for warping, linear splitting, heightened brittleness, and discoloration of human bone, particularly of the skull. Combining archaeological context for these skeletons, one finds tannurs (ovens), hearths, or small fire pits immediately next to and sometimes over the body in primary context, suggesting the dead were exposed to secondary firing while still fleshed. This poster addresses some of these cases and reviews ancient textual sources alongside osteoarchaeological data to survey the practice of using hearths for the dead as part of the funerary ritual during the second millennium in the Khabur Valley of Syria.

Auditory sensitivity in the Lemuridae: A preliminary report.

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Acoustic cues or signals from predators, prey, conspecifics, and competitors are central to primate survival and reproduction. Yet the acoustic ecology of primates, or lemurs in particular, is hardly studied because the auditory sensitivity of most species is unknown. Prior to this study, auditory sensitivity estimates (audiograms) existed for six strepsirrhine taxa, including only three lemurid species (*Lemur catta, Eulemur fulvus, Eulemur macaco*). Here we report new data for *Lemur catta* as well as preliminary audiograms for five additional strepsirrhine taxa at the Duke Lemur Center. Audiograms were constructed using the brief tone-evoked auditory brainstem response method; acoustic signals ranging in frequency from 180 Hz to 64000 Hz were presented free-field, and acoustic shielding was placed around the testing area. The ABR-derived audiogram for *Lemur catta* resembles previously reported behaviorally-derived audiograms; the *Lemur catta* audiogram and a human audiogram recorded on-site serve as controls for comparison of ABR and behavioral thresholds in the other taxa. In general, the auditory sensitivity of the taxa tested in this study follow the strepsirhine pattern of relatively good high-frequency hearing. However, the position of the frequency-of-best-sensitivity and the position and breadth of the 5-dB or 10-dB bandwidth vary in a pattern that may be related to ecology. For example, the audiogram of the cathemeral *Eulemur mongoose* is consistent with the hypothesis that nocturnal primates tend to have particularly good high-frequency hearing.

We are grateful to the staff and veterinarians of the Duke Lemur Center and to the David and Lucile Packard Foundation.

Mating system and cost of pregnancy across neotropical primate taxa: a bioenergetic perspective.

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Although rare across the primate order as a whole, obligate paternal care, monogamy, and cooperative breeding systems are commonplace amongst Neotropical taxa. Given that these species display shorter inter-birth intervals and that many habitually twin, it has been postulated that obligate paternal care and complex mating systems, by facilitating sharing in the costs of infant care, make such physiologically expensive reproductive patterns possible. While the question of how cost of reproduction affects mating system has been studied previously, the search for meaningful results has been hampered by the inability to directly measure or calculate the cost of gestation, relying instead on heterogeneous types of data as proxies. Building on the work of Coelho (1960) and Rao (2006), a new bioenergetic model was developed that combines developmental, physiological, and ecological variables to present cost of gestation as a unified measure: percent increase in Daily Energy Expenditure (DEE).

This study used data from 24 species representing three of the four adaptive radiations. Data on activity patterns was taken exclusively from field studies while developmental data was taken from both captive and wild sources. It was shown that: 1) Variation in cost of gestation is substantial (9.2% to 26.2% increase in DEE). 2) Higher costs of gestation are correlated with species displaying paternal care ($r2=0.38$, $p<0.01$) and 3) with monogamous and cooperative breeding mating systems ($r2=0.83$, $p<0.01$). Finally, 4) Shorter interbirth interval and the presence of twinning were associated with increased cost of gestation.

Isostress analysis of maxillary canines in cercopithecoid monkeys.

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In their comparative assessment of primate canines, Plavcan and Ruff (*AJPA* 136:65-84) present a first-order approximation of canine structural properties using basal crown dimensions to model canines as prismatic beams. As they emphasize, accounting for the tapering of the crown as well as shape changes along an apical-basal axis provides a more realistic model for assessment of bending stress. We provide such an accounting and evaluate the hypothesis that the morphology of the cercopithecoid canine represents a structural "solution" for maintaining constant maximum bending stress under apical or distributed loading in a parasagittal plane. This "isostress" hypothesis is analogous with a design criterion of minimum mass for a given structural requirement.

Examining permanent maxillary

canines from males and females representing 8 West African cercopithecoid species, we reconstructed crown geometry from apex to base using micro-computed tomography. From reconstructed cross-sections we determined section moduli about a buccolingual centroidal axis. We assumed constant maximum bending stress at each cross section due to parasagittally directed loading. Using the determined section moduli, we solved for the internal bending moment at each section assuming a power function of the location along the apical-basal axis. We then differentiated the moment twice to determine the parasagittal loading.

We found that a variety of parasagittal loading regimes, from concentrated apical to uniformly distributed, yields cross-sectional variations close to those observed in actual canines. These results suggest that canines are not optimized for particular loading regimes, but effectively limit stress gradients associated with a range of behavior. Supported in part by NSF DUE 0511287 (AJR).

Invasion of gallery forests by introduced species (*Rattus rattus*) and possible interactions with endemic small mammals at the Beza Mahafaly Special Reserve, SW Madagascar.

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A number of species of small, nocturnal mammals inhabit the Special Reserve at Beza Mahafaly in southwest Madagascar. These include endemic primates, rodents, and tenrecs, as well as introduced rodents. The goal of our study was to determine possible negative impacts of the introduced species (in particular *Rattus rattus*) on the endemic small mammals. Six species of small mammals, totaling 395 individuals, were captured during a one-year period of intensive capture-recapture in the protected forest reserve (gallery and spiny) and the unprotected forest of Ihazoara. Rats were far more abundant in the gallery forest than in the dry, unprotected forest or in the spiny forest. They were three times as likely to be captured on the ground as in the trees, but they did climb trees. *Macrotarsomys bastardi* and *Eliurus myoxinus* were also found in the gallery forest (indeed only here) but in very low numbers (0.76% and 0.25% respectively of the total captures) and always on the ground. Mouse lemurs (*Microcebus griseorufus*) were abundant in all three forests, regardless of the presence of rats; they frequently descended to the ground and were as likely to enter traps on the ground as in the trees. *Echinops telfairi* was also abundant, but only in places not frequented by many rats. To determine possible negative impacts of rats on mouse lemurs, we compared their frequencies of external parasites in forests with high and low rat abundance. Tick frequency was highest in mouse lemurs inhabiting the gallery forests, where there were abundant rats.

Masticatory stress and the functional genomics of the TMJ articular disc in mammals.

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Tissue remodeling and modeling is induced by forces experienced during an organism's lifetime. However, our current understanding of the hierarchical network of such responses is largely restricted to the gross, cellular and protein levels. As elevated peak and/or cyclical loads underlie a cascade of adaptive tissue responses, unbiased analysis of the genetic underpinnings of functional changes in elements routinely subjected to significant loads may provide novel insight into the mechanobiology of complex joints.

We employed a rabbit-specific cDNA microarray approach to evaluate global changes in gene expression profiles using RNA isolated from TMJ articular discs of rabbits subjected to diet-induced variation in masticatory stresses. Rabbits exhibit a masticatory apparatus and feeding behaviors similar to primates, with many aspects of the responses of rabbit craniomandibular tissues to variation in loading environments already well characterized. Three rabbit cohorts were obtained as weanlings and raised on different diets until adult. Immediately following euthanasia, the articular disc was removed unilaterally, minced in RNALater and flash frozen. Disc tissue was mechanically disrupted, RNA was extracted using RNeasy Lipid Tissue MiniKit, and RNA quality determined via the BioRad Experion system. Samples were reverse-transcribed and hybridized to a rabbit-specific custom array containing probes representative of 8000 genes.

Variation in masticatory forces related to dietary properties is associated with changes in expression of genes related to connective tissue biomechanics including extracellular matrix synthesis and degradation, cell signaling and proliferation. This unbiased screening approach provides unique insights into the genetic bases of biomechanical variation in postnatal joint loading histories.

Glacial cycling, large mammal community composition, and trophic adaptations in the Western Cape, South Africa.

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Some of the earliest evidence for

modern human behavior has been recently recovered from the Western Cape Province, South Africa. A well-accepted hypothesis for the occupation of anatomically modern humans in the Western Cape both before and after the advent of modern behavior is that of a temporal and spatial shift of C_4 grasslands and the endemic C_3 shrubland vegetation found in the Western Cape today in response to glacial cycling. Specifically, it is conventionally held that glacial periods witnessed the expansion of grasslands associated with cooler global temperatures and decreased moisture. Evidence used to support this hypothesis has mainly been inferred from a pattern of increased numbers of grazers in the communities of large mammals recovered from glacial period archaeological and paleontological sites. Here, we test this hypothesis by analyzing the proportions of larger mammals belonging to three trophic categories from 115 levels of 15 Western Cape fossil assemblages sampling marine isotope stage (MIS) 6 to present to determine whether there is a change in composition in these communities that might reflect a shift in ecology and habitat. Our results indicate that trophic proportions did not significantly change over time, and thus the hypothesis for grassland expansions affecting the subsistence ecology of modern humans during the development of modern behavior is not supported. If ecological and population isolation during glacial periods such as MIS 6 were integral to catalyzing the development of modern behaviors, then a far more complex model than the simple one of grassland expansions is needed.

The use of computerized tomography in the analysis of sagittal suture fusion.

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The timing of cranial suture closure has long been a focus for osteological study, with methods emphasizing the visual inspection of the endo- and ectocranial surfaces to establish degree of suture closure. While many researchers still rely on visual inspection, few have attempted to use modern medical imaging to judge the closure of cranial sutures. This project evaluates the accuracy of computerized tomography (CT) in the evaluation of cranial suture closure. Tests of interobserver error for the determination of closure of the sagittal suture were conducted on a sample of scans of 54 crania from cadavers of known age, sex and population from the Raymond A. Dart Collection housed at the University of Witswatersrand School of Anatomical Sciences. Using the software Slicer v3.2, the sagittal suture of each scan was observed in a location corresponding to the four (S1, S2, S3, S4) segments of the sagittal suture, as described by Acsádi and Nemeskéri (1970) and Perizonius (1984). For each scan, four individuals manually adjusted the window/level and threshold in order to assess the density of bone in the areas of suture fusion. Each sagittal suture was coded for either closure or non-closure for the endocranial and ectocranial halves of the bone table. Our analysis shows that CT is a reliable tool for evaluating cranial suture closure and allow for the direct association of points of fusion of the endo- and ectocranial portions of the suture.

Comparison of heart rate monitor and accelerometer for measuring energy expenditure under field conditions.

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Life history models predict differential energy allocation patterns among growth, maintenance, and reproduction under varying ecological conditions. The assessment of energy expenditure is one important tool in quantifying energy allocation; activity is more immediately modifiable than endocrine or genetic factors. In a pilot project among subsistence agriculturalists in The Gambia, West Africa, we tested the efficacy of accelerometers against heart rate monitors for measuring energy expenditure in free-living Gambian women. While accelerometers are light, do not require contact with the skin, and may be programmed to start and stop at pre-determined times, they record movement rather than exertion. Both devices were calibrated to oxygen consumption, and individual regression lines for energy produced in Watts were computed. Women wore heart rate monitors and hip and arm accelerometers for approximately twelve hours, during which they were observed for two hours, and activity and intensity level were recorded.

Results indicate that, in this sample, an accelerometer worn on the hip is as effective as heart rate monitoring in measuring energy expenditure. Though activity counts spike more easily than heart rate, a rolling average of activity counts yields a qualitatively comparable energy expenditure curve to heart rate. Accelerometer activities recorded at the upper arm and the hip were generally concordant, but showed significant periods of divergence. Focal observations suggest that certain typical activities may be missed by one accelerometer location or the other. We conclude that differences in energy expenditure between individuals and between groups can be

obtained in field conditions using hip accelerometers.

Human mediated dispersal of the *Anopheles punctulatus* group in the Pacific.

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The distribution of the main vector for malaria in the Pacific, the *Anopheles punctulatus* group, reflects the time depth of human settlement in the region. Species diversity of *Anopheles punctulatus* is the greatest within Papua New Guinea (PNG), settled 40,000 years before present (ybp). Vanuatu, settled 3400 ybp, has only one *Anopheles punctulatus* species and is the limit of *Anopheles* and malaria in the Pacific. This species (*Anopheles farauti Laveran*) is saltwater tolerant, making it ideal for human mediated dispersal. Previous work has implicated humans as responsible for vector dispersal among islands in Vanuatu. To investigate how human movement has affected vector distribution across the Pacific, *Anopheles* larvae were collected from the Sepik region of PNG in 2001-2003 (n=163) and five islands of Vanuatu in 2004 (n=193). Species identification was determined using banding patterns of the internal transcribed spacer 2 (ITS2) region and a 493 base pair sequence of the ND4/ND5 mitochondrial region. Four *Anopheles punctulatus* species were found in PNG. However, 20/163 larvae do not match known *Anopheles punctulatus* banding patterns. The ND4/ND5 region reveals these larvae have deep branches and are separated from the four identified species by 47-153 mutations. PNG and Vanuatu *Anopheles farauti Laveran* sequences form distinct but closely related monophyletic clusters. Further investigation using ITS2 markers on the unidentified individuals, as well as larvae from Cambodia and Laos, is underway to determine if the larvae are undefined species or invasive species from Asia.

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The effects of the white-faced capuchin monkey (*Cebus capucinus)* on seed dispersal within a neotropical forest.

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Primate frugivores often are described as playing a fundamental role in maintaining tropical forest diversity as effective seed dispersers. This study assessed the impact of white-faced capuchins (*Cebus capucinus*) on seed dispersal and germination success in a neotropical rainforest in Costa Rica. Experimental and observational data were collected at La Suerte Biological Field Station, Costa Rica in 2007 and 2008 by measuring, activity, diet, number of intact seeds digested, and dispersal distance from the parent tree. A total of 39 fecal samples were collected, with seeds present in 82% (n=32). Within these fecal samples, there was an average of 36.5 seeds/sample, with an average length of 0.67cm and average girth of 0.40cm (n=75 seeds measured). Eight different types of seeds were found in the feces, with four positively identified as *Ficus* sp. (n=367), *Cecropia insignis* (n=360), *Psidium guajava* (n=29), and *Castilla elastica* (n=34). We conducted a germination experiment to compare ingested seeds (treatment) and non-ingested seeds taken directly from the fruit (control). Finally, distance from the parent tree was measured for *P. guajava* and *C. elastica.* Feces containing *P. guajava* seeds were up to 148 meters and an average of 74.06 meters from the parent tree; those containing *C. elastica* seeds were up to 90 meters and an average of 27.35 meters away. We conclude that *C. capucinus* are dispersing seeds away from parent trees, but results are inconclusive as to whether gut passage increases germination success and/or seedling survival. Given that passive dispersal of seeds away from these tree species is on average 50.71m, omnivorous primates like *C. capucinus* positively influence seedling survival and neotropical forest diversity.

The ontogeny of humeral torsion and locomotor behavior in African apes: implications for interpreting the hominoid fossil record.

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The humeral head of hominoids is medially oriented to articulate with a dorsally positioned scapula in a condition known as humeral torsion. The degree of humeral torsion is particularly high in adult African apes relative to other nonhuman hominoids. This difference has been functionally related to the excursion of the chimpanzee and gorilla forelimb in a parasagittal plane during terrestrial knuckle-walking. However, subadult African apes perform greater degrees of arboreal locomotion than adults, providing a unique test for the developmental plasticity of humeral torsion. Evidence from a previous study on wild-caught and captive orangutans has suggested that this trait may be responsive to the locomotor behaviors performed during an individual's lifetime. If so, humeral torsion has the potential to be a key indicator of locomotor behavior in the fossil record. This study examines whether the development of humeral torsion corresponds to

changes in locomotion by investigating the ontogeny of this trait in samples of *Pan troglodytes* and *Gorilla gorilla*, taxa in which differences in locomotor behavior between age groups is known. Four landmark points were taken with a Microscribe G2X to quantify humeral torsion. Mean values of this trait were compared between six age classes ranging from infants to adults. Results indicate that the degree of humeral torsion increases with age in chimpanzee and gorilla samples**,** corresponding with greater percentages of knuckle-walking. These results provide evidence that humeral torsion acts as a reliable marker of locomotion and can provide key insights into the positional behavior of extinct taxa.

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Oxygen isotopes as a biomarker for sickle cell disease.

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The origins of sickle cell disease (SCD) are well understood, as are its evolutionary pressures on humans and pathological presentation. However, because it has not been possible to identify SCD in archaeological contexts, its biocultural effects on past populations are unknown. It is possible that oxygen isotopes in bone apatite provide a biological marker for SCD in skeletal remains. Among living organisms, the heavier isotope ^{18}O is incorporated less readily in tissues than the lighter isotope ^{16}O. This discrepancy may be amplified by lower than normal oxygen saturation rates of individuals suffering from SCD, causing noticeable isotopic shifts. To test this hypothesis, $\delta^{18}O$ ratios were determined for transgenic mice expressing exclusively human SCD globins and healthy control mice. Mice were raised on similar diets in the same laboratory at the Albert Einstein College of Medicine of Yeshiva University. Results demonstrate that $\delta^{18}O$ values of SCD mice are significantly lower than those of control mice (-5.6‰ versus -4.5‰; $p < 0.0005$ in a two-tail *t*-Test). This discrepancy may be due to kinetic fractionation arising from low hemoglobin saturation rates and SCD-induced ischemia. Because the same conditions affect people with SCD, human bones may exhibit similar $\delta^{18}O$ depletion. If so, oxygen isotope ratios will be an archaeologically useful biomarker for SCD, making it possible to identify and explore its biocultural consequences for past populations. Knowing that SCD (and perhaps other anemias) reduces $\delta^{18}O$ ratios may facilitate differentiation between environmental and anemic causes of porotic hyperostosis and cribra orbitalia in archaeological samples.

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Geographic structure of global craniometric variation.

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Several studies have shown that global craniometric variation is geographically structured, as is also the case for classical genetic markers and DNA markers. This paper presents an analysis of residuals of craniometric distances from a geographically based model of population structure. W.W. Howells' global data set was used for these analyses, consisting of 57 craniometric measurements for 22 populations around the world, excluding Polynesia and Micronesia because of the relatively recent settlement of these regions. Phenotypic and geographic distances were derived between all pairs of populations. The correlation of the two matrices is moderate ($r = 0.38$, $P = 0.015$ using the Mantel test). Three-dimensional multidimensional scaling configurations were obtained for both distance matrices, and compared using Jackson's Procrustes rotation method (*Ecoscience* 2:297–303, 1995). This analysis revealed three populations that accounted for almost half of the residual sum of squares: Buriat, Greenland Eskimo, and Peru. The deviations of the Buriat and Greenland Eskimo appear to be related to climate, showing that long-term cranial adaptation to cold environments makes these populations appear more different from their geographic neighbors than expected under a neutral model. The Peruvian sample is more similar to other New World populations than expected based on geographic distance alone, likely reflecting the rapid movement of human populations through South America. Removing these three populations from the analysis results in a much larger correlation of phenotypic and geographic distance ($r = 0.62$, $P < 0.001$). Environmental influences obscure, but do not erase, geographic structure in craniometric variation.

Sexual dimorphism of antero-posterior deformation in prehistoric Mogollon crania from southern New Mexico.

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We examined a sample of prehistoric Mogollon crania from southern New Mexico to determine the extent of sexual dimorphism in this population. These crania exhibit obvious signs of artificial deformation most likely attributable to cradle-boarding. In this study we measured the cranial index and cranial capacity for this sample, which consists of seven skulls including three males and four females. We calculated the cranial index by multiplying maximum cranial breadth (euryon-euryon) by 100, and dividing that result by maximum cranial length (glabella-opisthocranion). We estimated cranial capacity by filling the crania with sesame seeds and measuring the volume in a graduated cylinder. These data from the Mogollon were compared with published data for

undeformed crania from Pecos Pueblo. Our results for the Mogollon sample reveal that the average male cranial index is 96% of the average value for the female crania. These results differ from the Pecos sample, where the average male cranial index is 92.9% that of female crania. The results concerning cranial capacity show the average capacity of females is 85.5% that of males for the Mogollon sample. For the Pecos sample, the average cranial capacity of females is 91.3% that of males. From these results we conclude that cradle-boarding diminishes the effects of sexual dimorphism by reducing the nuchal crest of the male cranium, thus minimizing its maximum length. There are several reasons why cradle-boarding might increase sexual dimorphism of cranial capacity, but determination of the particular cause in this instance requires additional research.

Preliminary craniometrical results on Canadian Amerindian inter-regional variation.

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By analysing morphological changes in a spatiotemporal perspective, craniometrics provide information on human variation as well as population history, complementary to other sources of data such as genetics, linguistics and archaeology. For Canadian Amerindian populations, little work of this kind has been done so far. Therefore, the present study attempts to explore Amerindian skull morphology from historic and prehistoric periods in 3 provinces across Canada.

The question addressed is: What are the main craniometrical changes through time and space? Skull variation was investigated between historic and prehistoric samples originating from three regions of Canada (Nunavut=63; Manitoba=14; British Columbia=30) using both 2D and 3D methods: 40 craniometrical measurements (collected with callipers) and 85 landmarks (collected with a digitizer) were analysed separately through multivariate analyses.

Preliminary results (PCA – Principal Component Analysis) show that there are morphological differences between the various groups especially in relation to the vault (breadth) and the face (nasal breadth, orbital height). Within a range of continuous variation, two extremes are observed: the Nunavut historic population (*circa* 19th century) (long narrow vault, narrow nose, small orbits) and the British Columbia prehistoric sample (short broad vault, broad nose, large orbits). Between these extremes (the first, more gracile and the second, more robust), the Manitoba prehistoric sample appears highly variable. Further comparisons on a worldwide scale could provide additional information on the relationship of these morphological changes with both geography and chronology, and the relative degree of gracilization, a process that seems also to have occurred through time within Amerindian populations.

Divergence in hominin upper limb anatomy in the early Pleistocene

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Adaptations for manual dexterity and tool use are key human adaptations, but a sparse fossil record has limited our understanding of the origin of human hand anatomy. Novel analyses of eastern and South African fossil assemblages show that modern humanlike thumb:finger length proportions, which are critical to precise opposition grips, were already present in *Australopithecus* taxa. However, *Australopithecus* retained a gracile thumb and an otherwise generally robust upper limb with pronounced muscle attachment sites. This study compares measurements of the hand and upper limb long bones of new and existing Plio-Pleistocene hominin fossils, modern humans, and great apes to test hypotheses about the pattern and timing of the appearance of a suite of human hand and upper limb characteristics. Bivariate and multivariate analyses show that KNM-WT 15000 possessed a relatively broad thumb metacarpal but otherwise gracile upper limb long bones. In contrast, newly discovered contemporaneous hominin fossils retain *Australopithecus*-like gracile thumb metacarpals and robust upper limb long bones with pronounced muscle attachment areas, and differ from known *Homo habilis* fossils (e.g., OH 62) in comparable respects, suggesting that they likely represent *Paranthropus boisei*. The robusticity of the *H. erectus* thumb supports hypotheses that it had a derived thumb musculature and was adapted to generate and resist greater forces associated with humanlike manual manipulation. These results demonstrate that sympatric early Pleistocene hominins had diverged in their upper limb anatomy, and add to anatomical and archeological evidence of the major transition from *Australopithecus* to *Homo*.

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Developmental basis of morphological integration of brain and skull in craniosynostosis.

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Apert syndrome is an autosomal dominant disorder characterized by multiple post cranial and cranial anomalies, including craniosynostosis. Two missense mutations in one of two adjacent amino acids, S252W and P253R of fibroblast growth factor receptor 2 (FGFR2) account for 99% of reported cases of Apert syndrome. FGFR and their ligands are known to play a critical role in the control of cell migration, proliferation, differentiation, and survival, affecting various cell lineages, but it is unknown how these mutations affect head development. We designed knock-in mice for each of the *FGFR2* point mutations, generating *Fgfr2*$^{+/S252W}$ and Fgfr2 $^{+/P253R}$ mouse models. We acquired micro-CT scans of skull and micro-MR images of brains of these mice at P0 and found that both the brain and skull were dysmorphic in both mouse models at birth. Neither mutation was associated with a particular pattern of craniosynostosis. Analysis of morphological integration between brain and skull indicated that the associations between loci on the cranial base and measures of the cerebrum varied according to which sutures were closed prematurely. The results of our morphological integration analyses are being used to identify locations for close investigation of proliferation, differentiation, and altered cell fate determination in developing cranial phenotypes while monitoring the various signaling networks that are responsible for development of the head. Supported in part by PHS grant R01 DE018500.

Coronoid process morphology and function in anthropoid primates.

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A key to explaining variation in primate craniofacial form is an understanding of how this variation is linked to the masticatory function of the skull. One anatomical region that has received little attention in this regard is the coronoid process of the mandible. Experimental research, conducted primarily on non-primate mammals, has demonstrated that the temporalis muscle has important effects on the morphology of the coronoid process. Recent research, however, has suggested that the orientation of the temporalis cannot explain variation in the configuration of the coronoid process in some primate groups. The current study tests the hypothesis that the morphology of the coronoid process in anthropoid primates is modulated by the orientation of the temporalis muscle.
Two-dimensional data describing the orientation of the temporalis muscle and the height and width of the coronoid process were collected from photographs on a sample of anthropoid primates (N=303). These data were used to calculate the following measures: (1) temporalis orientation (i.e., the angle formed between the estimated force vector of the temporalis muscle and the occlusal plane), (2) the height of the coronoid process relative to the height of the mandibular condyle, and (3) the width of the coronoid process relative to the height of the mandibular condyle. According to the functional model proposed, relative coronoid height and width should be positively correlated with temporalis orientation angle. Results provide support for the functional model and suggest that the orientation of the temporalis muscle is an important factor underlying coronoid process morphology in anthropoids.
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Changes in sex ratios, home range size, and diet in the black howler monkey (*Alouatta pigra*) at the Calakmul Biosphere Reserve, Mexico.

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The vast majority of studies of the black howler monkey (*Alouatta pigra*) have focused on populations within rapidly disappearing fragmented forests to further characterize the genus. In contrast, this presentation encompasses data from three study groups inhabiting the archaeological zone of the Calakmul Biosphere Reserve, an area currently free from fragmentation caused by human activity. Here we present data from representative samples of the wet seasons from 2001 to 2008 and a contrasting dry season sample. Based on this series of intensive non-invasive observations, we discuss sex ratios, range size, activity budgets, and dietary patterns of *A. pigra*. While sex ratios, number of individuals, and range sizes change within each of the study groups over time, the activity budgets and fruit consumption remain relatively constant. Results indicate all study groups consume a higher percentage of fruit compared with any other food type. Changes in the numbers of individuals per group directly affect changes in home range size. Changes in sex ratios appear to have no affect on range size, diet or activity budgets within each group.
This study shows that howlers are opportunistic foragers with fruit being the preferred food source. The implication of this study is a further understanding of inter- and intra-specific and inter- and intra-generic variability, and is

applicable to the evolution of primate social organization and the responses of a generalized primate to changing fragmented habitats.

Interpreting Hominin Variability: A Test of the Template Method

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The relationship between social behavior and sexual dimorphism is complex and cannot be assumed to be a matter of simple proxy. Nonetheless, accurate assessment of sexual dimorphism can aid our interpretations of important social and life history variables. Calculating hominin sexual dimorphism is complicated by the scarcity of suitable fossil material as well as differing taxonomic identifications. Recent attempts to move away from qualitative assessments of sexual dimorphism have included modeling approaches, which potentially increase sample size and statistical confidence in dimorphism estimates. However, the potentially significant effects of error or bias in these modeling techniques have yet to be thoroughly studied.
This study investigates potential sources of error in using the template method to model hominin populational variance. Post-cranial measurements were collected from more than 150 individual specimens representing 8 diverse human and non-human primate taxa. Small, medium, and large template individuals were assigned for each species and all skeletal measurements were translated into estimated femoral head diameter values using each template metric (following *Reno et al. 2003)*. The estimated values were bootstrapped 1000+ times and the resulting data were compared to the actual measured distributions. Our analysis indicates the template method is sensitive to biasing effects due to sample size, population composition, skeletal element choice, template choice, and even sexual dimorphism itself. Multiple templates were also applied to *A. afarensis* material and the results and limitations of that analysis will also be addressed.

Bayesian Approaches to Measuring Body Mass in Subadults from Kulubnarti, Grasshopper Pueblo, and Inamgaon.

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Compact bone properties are used in bioarchaeology to examine bone functional adaptations and infer locomotor or subsistence behaviors. In subadult samples, compact bone properties (J) can also be used to estimate body mass (R^2 = 0.958), which is useful for interpreting hominin phylogeny, life history, and stress (Cowgill, 2008; Robbins, 2008; Ruff, 2007). This poster examines the relationship between midshaft compact bone properties and the width of the femoral end in individuals with normal to low body mass for height. If the metaphyseal end is constrained by the necessity of joint congruence and midshaft parameters are more plastic and sensitive to body mass effects, then we hypothesize that the two sets of body mass estimates would be significantly different for individuals with low BMI. Using a maximum likelihood method for estimating body mass from the distal ends or from J, we compared results for three archaeological samples of individuals under the age of five years. Our results demonstrate a significant relationship ($r = 0.972$, $p < 0.001$) between both estimates and suggest preservation of the allometry between bone end and midshaft across the 'normal' BMI spectrum and below 95% CI. This close congruence between the articular and the midshaft parameters indicates either method can be used in body size analyses. Beyond that, it indicates strong allometric relationship among metaphyseal breadth and diaphyseal strength as they are primarily shaped early in ontogeny by pressures of bipedalism.

Influence of locomotion on the hominoid humeral trochlea.

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Studies comparing the humeral trochlea among hominoids have shown that articular shape varies relative to size and locomotor modes. However, orientation of the articular surface relative to the bone long axis was not documented in these analyses, despite evidence that articulations are generally oriented to better resist habitual loads. For example, predominantly arboreal species may be expected to present articulations that are oriented to resist loads generated by the strong superficial finger flexors that cross the elbow diagonally, while predominantly terrestrial species may present articulations that are oriented to resist load generated by ground reaction forces. This study explores the articular orientation of the distal humerus in extant large-bodied hominoids. Seven landmarks on the humeral shaft and distal surface of the trochlea were digitized in three dimensions in a sample of *Homo* and wild-shot *Gorilla, Pan,* and *Pongo*. From these landmarks, three angles were calculated reflecting the orientation of the medial and lateral flanges of the trochlea relative to each other and to the long axis of the diaphysis. Humans are significantly different from all other taxa in having a greater angle between both flanges. Relative to the diaphysis, the lateral flange is more distally oriented in *Homo* while the surface in apes is more vertically oriented. Medially, *Gorilla* have the more distally oriented flange, *Pan* and *Pongo* have the most vertically oriented and *Homo* are intermediate. These results suggest that locomotion, upper limb use, and possibly body size influences the orientation of the distal humerus in extant hominoids.

The history of European infectious diseases: skeletal evidence of tuberculosis, leprosy, and treponematosis.

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The broad spatial-temporal coverage of the 12,000+ European skeletons studied so far by Global History of Health Project members provides an unprecedented opportunity to study infectious diseases that have shaped European population history. Of the infectious diseases with a known pathogen cause that leave skeletal changes, tuberculosis, leprosy, and treponematosis, have been the most important in shaping the health-history of Europe.

Their differential diagnosis can be problematic and only small proportion of people will have bone changes, but the lesion characteristics and their distribution can be pathognomonic. Tuberculosis primarily produces lytic vertebral lesions and non-specific pleural-surface proliferative rib lesions. Depending on the immune response, leprosy is associated with distinct rounding and/or atrophy of the skull's rhinomaxillary region, and infection/resorption of hand and foot bones. The most important treponemal diseases in Europe were venereal and endemic syphilis. Both produce proliferative subperiosteal response, especially in the tibiae, but a characteristic of venereal syphilis can be cranial and rhinomaxillary lesions.

The project identified lesions suggestive of tuberculosis in 1.1% of individuals with observable vertebrae (n=6,563). Such lesions are more common during Classical Antiquity (CA) and the Early Middle Ages than during the High Middle Ages (HMA); rib lesions were more common in the Late Middle Ages and CA. Clear signs of leprosy (0.17% n=6,587) and treponemal disease (0.15% n=7,732) are uncommon in this sample. The leprosy cases (73%) mostly date to the Early and High Middle Ages. All of the probable treponemal disease cases are confined to the HMA or later.

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Parties in the rainforest: Subgroup size and composition of black-handed spider monkeys at a wet site in Costa Rica.

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In a fission-fusion social organization, subgroup size and composition reflect individual's attempts to optimize both their ecological and social opportunities. Such patterns may differ widely across different habitats that vary in resource ability, predation pressure, and social dynamics. Here, we present data on spider monkey (*Ateles geoffroyi ornatus)* subgroup

size at El Zota Biological Field Station, a lowland tropical wet site in northeastern Costa Rica. Of the 293 independent encounters, parties ranged in size from one to 10 individuals, and the mean number of independently locomoting individuals (ILI) per subgroup was 2.92 ± 0.10. Males and females ranged in parties that were not significantly different in size (males: 3.43 ± 0.28; females: 3.08 ± .0.11; T =1.374, df = 92, p = 0.25). Females with infants ranged in significantly larger parties than females without infants (female with infant ILI: 4.07 ± 0.28; female without infant ILI: 2.74 ± 0.10; T = 4.480, df = 73, p < 0.0001), a finding which differs from findings reported at other sites. Additionally, the mean party size found at El Zota is lower than figures reported for other sites across a variety of habitats. Furthermore, El Zota females are not more solitary than males and they do not range in significantly smaller parties, contrary to findings at other sites. We suggest that these patterns are a result of specific ecological and social conditions at El Zota, particularly regarding patch size, resource distribution, and threats to infants.

Quantitative genetic analysis of primate cranial morphology: Cayo Santiago and beyond.

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The evolution of cranial capacity is one of the hallmarks of primate and human evolution. Collections of crania of known individuals with known genealogical relationships are relatively rare. The collection of animals from the rhesus macaque population on Cayo Santiago is the primary such collection available with known maternity. A second collection of crania from the Southwest Foundation for Biomedical Research (SFBR) baboon colony has been recently prepared and curated providing a comparative sample of closely related primate species. Cranial capacity was measured in 500 Cayo macaques using mustard seed and a graduated cylinder and in 600 SFBR baboons using volume reconstructions of CT scans. Linear measurements were collected with a caliper in the Cayo macaques and calculated from 3D coordinates recorded from CT scans and a 3D digitizer in the SFBR baboons. The heritability of cranial capacity is relatively high in both papionin populations (0.60-0.70). Genetic correlations between cranial capacity and craniofacial measurements highlight the relationship between brain size and the size and shape of the cranial vault.

We acknowledge support from NSF grant BCS-0725068 and the Genomics of Cranial Morphology Project.

A human mandible BH-1 from the Pleistocene deposits of the Mala Balanica cave (Sićevo gorge, Serbia).

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The status of Neandertals as a species of *Homo* or a subspecies of *H. sapiens* dominates the scientific debate on human evolution in the European context. Recent introduction of several new species of *Homo* and renewed use of *H. heidelbergensis* implies a species status for Neandertals. The other view, which gives Neandertals a subspecific status, requires that both the Neandertals and the pre-Neandertals be included into archaic *sapiens* forms. In either case, multiple (at minimum two) migrations into Europe are required to account for either of the models. Reconstructing human evolution in the regional European context becomes inseparable from understanding the migrations of early hominins into the area and their later migratory movements into and out of Europe. The most likely corridor – the Southeastern Europe – has a limited Paleolithic research history and few fossil finds. In this context a recent find of a hominin mandible from the Mala Balanica cave described in this paper – the first substantially preserved fossil specimen in the Central Balkans recovered from an undisturbed context – has a potentially very important place in understanding human evolution in Europe.

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***In vivo* turnover rates in human buccal dental-microwear.**

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Differences in buccal dental-microwear among Pleistocene and Holocene hunter-gatherers, and agro-pastoral populations may provide an important clue to dietary and ecological adaptations that differentiate these groups. However, microwear patterns can also be the result of short-term variation in food availability and processing techniques. The microscopic *in vivo* effects of specific foods and changes in diet over time on the buccal enamel surface remain uncharacterized. The main purposes of this study were to record how short-term changes in the formation rate of buccal-microwear are related to mastication of an abrasive diet and

document long-term turnover in microwear.
Five high-resolution replicas were obtained from dental impressions taken on adult volunteers at ~7 day intervals, and one follow-up replica obtained 14-15 months later. Buccal enamel surface was examined with a SEM at 100X, and microstriation number and length were measured. During the experiment, volunteers maintained an *ad libitum* diet prior to the consumption of an induced abrasive diet based on gritty foods during ~7 days. Pre- and post-test microwear analyses were carried out in order to detect the effects of the changed diet.
Results indicate that individuals consuming an abrasive diet showed a higher frequency of new microwear features than when maintaining an *ad libitum* diet. In addition, long-term tests showed a turnover effect on buccal microwear, but no significant differences were found in microwear density. Our results show that abrasive diets accelerated the formation rate of buccal-microwear, which is a dynamic process with both cumulative and turnover effects during the individual´s life.

Primatology and evolutionary psychology: The importance of comparative and phylogenetic analyses in the study of human psychological adaptations.

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The field of evolutionary psychology seeks to identify human psychological adaptations – that is, brain mechanisms that were naturally selected for specific functions. One difficulty in this enterprise is the possibility that a learning mechanism designed for one purpose may interact with novel environments in such a way as to mimic special design for another purpose. Rigorous demonstration of adaptation thus requires not only phenotypic evidence for functional specificity, but also evidence that the trait in question is constructed by an inherited developmental process. Homology provides just such evidence. Homologous traits are by definition constructed by commonly inherited developmental mechanisms. Therefore, demonstration of homology for a trait argues for its construction by an inherited rather than an exapted developmental process.
Comparative research with nonhuman primates provides evidence for homology in many human psychological traits, thus arguing against the idea that such traits are the products of uniquely human culture. For example, phylogenetic continuity from nonhuman primates to humans in features of infant attachment to caregivers strongly suggests a developmental adaptation for survival. Likewise, hypotheses derived from comparative research with nonhuman primates and other animals have guided studies of human mate attraction and courtship behavior, demonstrating that important aspects of human mating psychology are regulated by neuroendocrine mechanisms similar to those occurring in nonhuman animals.

Schmorl's Nodes and the sexual division of labor in a Native American maize horticulturalist society.

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Although Schmorl's nodes (SN) are of unknown etiology, the frequency of their appearance in the spinal column can vary based on activity patterns and postures (Faccia et al, 2008). A sample of 45 individuals from a collection of Monongahelan Native American skeletal remains, ranging in age from 12 to 60+ years, was examined for the presence of SN. Differences in presence, location, and severity (total number of SN in an individual's spinal column) between males and females were investigated in order to help determine activity patterns and sexual divisions of labor within this maize horticulturalist society. No significant differences ($p<0.05$) in presence or severity of SN between males and females were observed. Males exhibited higher frequencies of SN overall and in thoracic and lumbar vertebrae, but these differences were not statistically significant. The results of this study indicate an even distribution of labor between the sexes in Monongahelan society.

Natural selection, random genetic drift, and the study of morphological variation.

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One of the most difficult challenges facing biological anthropological investigation is being able to separate out the effects of different forces of evolution on the distribution of among-population and among-species variation. Much of the theoretical and empirical work applying quantitative evolutionary methods to problems in biological anthropology has concentrated on detecting departures from neutral models. This is a product of the ease of specifying neutral expectations relative to models that include natural selection. There are, however, serious questions about the power and reliability of methods based on the neutral theory of phenotypic evolution.
I use computer simulation and analytical models that incorporate several patterns of directional and stabilizing selection of varying complexity to test the power of these approaches. The tests do have power to detect departures under certain circumstances. The

timescales over which comparisons are conducted, uncertainty in quantitative genetic parameters, patterns of integration, and the number of traits and groups used in an analysis affect the ability to detect departures from neutral expectations.
On balance, the results of empirical, simulation based, and analytical approaches show that deviations from neutrality can be detected in some circumstances, making neutral theory a useful approach to solving problems in biological anthropology. The dearth of well-specified selective hypotheses suggests a need for a synthesis of functional and evolutionary quantitative genetic theory and method to build more accurate selective models.

Carrying human babies: evolutionary costs and benefits.

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Whatever circumstances led to the evolution of bipedalism, one long-noted consequence of this mode of locomotion is that the hands are freed and available for manipulating the environment or transporting objects through the environment. Darwin proposed that early humans wielded tools or weapons, while Isaac, Lovejoy and others focused on the transport of food for sharing or provisioning. What has received less attention is that babies (both infants and older children) are one of the "items" most commonly carried by human mothers or other relatives. The successful carrying of babies was almost certainly a consistent selective pressure on all hominids irrespective of other environmental conditions. We examine the unique ways in which hominids carry their young and the implications of different carrying behaviors for energetics and locomotor biomechanics. Inevitably, changes in energetic cost and biomechanics due to carrying influence many aspects of human biology including: hominid life histories; duration of infant helplessness; length of time before weaning and composition of breast milk; inter-birth interval; whether crawling occurs as a universal stage in human development; hairlessness; and thermoregulatory strategies for mother and offspring. Carrying babies in one's arms or with the assistance of a sling or other device creates a cost/benefit trade-off. On the one hand, it enhances the survival of helpless infants or older children. On the other hand, it imposes a substantial, though potentially variable and sharable cost on adult care-givers. We argue for the centrality of infant carrying in the human adaptation.

Relative lumbosacral transverse process length in extant hominoids and australopithecines.

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Sts 14 (*Australopithecus africanus*) is the only early fossil hominid for which both lumbar transverse process (LTP) and sacral alar length can be accurately assessed. In addition to its long alae, Sts 14 was described by Robinson as having long LTPs for its body size. This claim, however, has not been quantified using comparative data. Here we investigated relative last rib, LTP, and alar length in a sample of living hominoids, *Macaca fascicularis*, and the australopithecine specimens Sts 14 and AL 288-1.
Our conclusions are three. First, the australopithecines have the relatively longest alae in our sample, and extremely long LTPs. This fact suggests that LTPs and alae might form a single developmental module, and that LTP length in australopithecines is a secondary effect (Type 2A) of increased sacral width. Second, humans have extremely short last ribs as compared to other hominoids and *Macaca*; *Gorilla* has the longest. These extreme phenotypes are related to the establishment of lordosis in the former and the need for truncal stiffening in the latter. Last, while the great apes have relatively short alae, *Hylobates* and *Macaca* alae are longer, indicating that australopithecines may have lengthened their alae from an ancestor not as extreme as the modern great apes. Moreover, *Gorilla* and *Pan* have shorter ultimate LTPs than *Pongo*, suggesting potential independent evolution of short lumbar spines in the great apes.

How sexually dimorphic is the human sacrum? Assessment of sex from the sacrum in a modern Portuguese population.

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Sex assessment is a key step in the analysis of skeletal remains. As the pelvis is the most sexually dimorphic structure of the human body, the pubic bone has received considerable attention from forensic anthropologists and bioarchaeologists, while the dimorphic sacrum has received considerably less attention. This study examined the usefulness of both morphological and metric sacral traits for sex assessment using 205 sacra of known-sex (102 males and 103 females, aged 18 to 94 years) from the Luís Lopes Collection, curated at the Bocage Museum, National Museum of National History, Lisbon, Portugal. Research has stressed the need for population-specific criteria for metrical methods as body proportions greatly differ between groups. A test of previously published metrical methods, including techniques applied to the pelvis (Kimura 1982; Steyn & İşcan 2008) showed that they were unsuitable for analysis of this Mediterranean population, highlighting the problems of using population-specific methods indiscriminately. Morphological

traits of the sacrum were found to reliably assess sex in most cases (62-85% correctly classified), and sacral shape was the single most dimorphic characteristic. With respect to metric traits, stepwise discriminant functions were developed for both complete and fragmented sacra, and resulting assignment accuracies ranged from 73-86.2%. Single measurements were not found to be useful for sex assessment, with accuracies of c.65%. Overall, this study demonstrated that morphological traits of the sacrum are less influenced by population-specificity, and are therefore preferable to metrical methods when assessing the sex of skeletal remains of unknown origin.

***In vivo* bone strain and finite-element modeling of the craniofacial haft in catarrhine primates**

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Hypotheses regarding global or overall deformation regimes in the primate skull remain untested in most taxa, in part because the in vivo bone strain data that provide the direct test of these hypotheses can only be gathered from restricted areas under strain gages. Well validated finite-element models provide a means of evaluating hypotheses regarding global deformation regimes because they not only allow extrapolation beyond the in vivo gage sites, but they also provide a picture of overall deformation. Here we compare in vivo bone strain data gathered from six sites on four *Macaca* individuals during mastication with strain data from the surface of a finite-element model of the skull of *Macaca* loaded using external forces estimate using measured muscle cross-sectional areas and masticatory EMG data. The global deformation regime of this validated macaque model is compared with the patterns of deformation of a finite-element model of *Pan* and with deformation patterns reported by Endo from his in vitro experiments on skulls of *Gorilla* and *Homo*. These comparisons reveal a common global craniofacial deformation regime among catarrhine primates, despite diversity in their craniofacial morphology. This suggests that diversity in catarrhine craniofacial skeletal morphology is not associated with variation in the manner in which the skeleton deforms during chewing. This variation must instead be due to selection on other aspects of cranial function, such as food ingestion, gape, vision, olfaction, or protection of soft tissue structures. Supported by National Science Foundation HOMINID grant 0725147.

Root growth during first molar eruption in extant great apes.

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Among primates, age at first molar (M1) emergence correlates with various life history attributes and can therefore be used to infer the life histories of fossil species. Because the M1 begins to form just prior to birth, for individuals that died during M1 eruption, age at M1 emergence can be determined by adding crown and root formation times calculated from the growth lines in enamel and dentin. However, such individuals are uncommon, so there is a need to know how much root to include using M1s that are past emergence and therefore have more fully formed roots. We determined the amount of root present at M1 emergence, and the degree of variation in this amount, both within and between species of extant great apes, using wild-shot infants in museum collections that were shot when the M1 was erupting. Our results, when combined with known root extension rates, suggest that intraspecific variation in the amount of root present at M1 emergence may be sufficiently low in terms of the time represented that useful estimates of age at M1 emergence can be made from teeth that have more fully formed roots. Our results also reveal that great apes species differ in the amount of root present at emergence, most likely related to differences in tooth size. Finally, we explore the extent to which differences in root growth during eruption contribute to variation in age at M1 emergence among extant great apes and humans.

Human Occlusion in past and Present. Edge-to-edge as physiologically adapted bite.

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Dentition, as mechanically stressed part of the orofacial system, is subject to physiological wear processes that affect the occlusal surface, the cutting-edge and the approximal contact points of teeth. The reasons are abrasive food particles, tooth contacts during chewing as well as erosion. Up until the Middle ages and even further on, both the decidous and the permanent dentition were, depending on age, subject to distinct hard tissue defects. These regularly led from normal overbite, which develops during dentition, to a pronounced edge-to-edge bite. In dentistry this known phenomenon is widely interpreted as a pathological adaptation. Due to specific subsistence conditions and dietary habits in food intake and preparation abrasive changes can be

found in the dentition of our ancestors, beginning with the history of humanity up until historic times. However, hardly in today's population. Abrasive food particles and erosion, are the main factors that cause wear in dental enamel.
We analyzed occlusal hard tissue changes that led to edge-to-edge-bite in chronologically scattered skeletal series from different regions in Germany. The sample consists of both males and females from varying age groups. The skulls were photographed in standardized positions and radiographically examined. The results show that dental wear is a natural, age-dependent process which does not lead to pathological changes. Crowding and contact surface caries can even widely be impeded through abrasion. Therefore dental wear is a natural process that has only been prevented by 'civilization' in the past two centuries. Edge-to-edge-bite is still the preferable occlusion in man.

Intraspecific variability in the nutritional contents of primate foods: implications for primate feeding ecology and ways forward.

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Faced with variations in food quality and quantity at diverse spatial and temporal scales, primates must adjust their diets to meet nutrient requirements. From our studies on gorillas and frugivorous monkeys we have demonstrated that there is a great amount of intraspecific variability in the nutritional content of primate foods. For example, by re-sampling the same species and part across the gorilla habitat, a commonly eaten leaf was shown to vary in protein from 17-36% and in lignin (indigestible fiber) from 2-18% depending on location and season. Similarly, a fruit frequently eaten by monkeys varied seasonally in fat content from 0.3-31%. These results suggest that habitat heterogeneity is not only affected by the abundance and distribution of plant species, but that a particular plant species does not always provide the same nutritional benefits. Consequently, to characterize the quality of primate diets, a large sampling effort needs to be employed, and many nutritional analyses are needed. One potential way of dealing with logistic problems created by this dramatic intraspecific variability is to adopt methods used in agriculture. For example, near infrared reflectance spectroscopy (NIRS) is a quick, inexpensive means of assessing nutritional chemistry. The general principle of NIRS is that chemical bonds of a food item are represented in a spectrum when the sample is irradiated with near infrared light. These spectra are calibrated against reference values (determined through traditional nutritional analysis) to develop regression equations, which can then be used to accurately estimate a variety of nutrients in the sample.

Assessing musculoskeletal markers characteristic of military activities: An analysis of sacrificial victims from Teotihuacan.

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Located in the northeast part of the Basin of Mexico, Teotihuacan underwent massive urban expansion during AD 200 and was becoming a political and religious center for the area. The sacrifice of 200-250 men and women at the Feathered Serpent Pyramid, most of who were dressed in military garb and buried with weapons, is thought to illustrate the growing importance of the military during this period. Mass sacrifice prompts questions concerning 1) the extent of Teotihuacan's influence in the Basin of Mexico, 2) their politics with foreign societies, and 3) the specific role of the military in internal and external affairs.
In attempting to answer these questions about early Teotihuacan, this pilot study analyzed skeletal material from four mass graves (26 individuals) to address the occupational identities of the sacrificial victims. It was hypothesized that the preliminary results of musculoskeletal marker (MSM) scoring would show a positive correlation between the individuals and military occupation. MSM were based on patterns of repetitive weapons training that would be expected of military members. The results showed that 41% of the total population sampled exceeded the average MSM measurements. Interestingly, 48% of the men exceeded average MSM measurements while only 25% of the women exceeded theirs. This analysis suggests the males, and not females, were more likely to have been involved in military occupational activities. Future studies investigating MSM in a larger Teotihuacan sample size could be conducted to elaborate on these findings and set a MSM baseline between classes in this particular population.

Qualitative and quantitative assessment of diagnostic MR and CT imaging in ancient mummies.

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Diagnostic imaging of ancient mummies is full of pitfalls, with magnetic resonance imaging (MRI) being one possible modality, lately feasible without prior historic sample rehydration (Rühli et al., JAMA, 2007). No comparative assessment of computed tomography (CT) and MRI has been hitherto done in historic bodies. The aim of this study was to explore qualitatively and quantitatively the diagnostic quality of both imaging modalities in

ancient mummies. Egyptian and Peruvian human and non-human mummies and mummified body parts (up to 1500 B.C.) were imaged by MR technique with up to three different pulse sequences (3D radial, single point imaging, 3D FLASH; clinical 1.5 and 3 Tesla field strength systems) offering an ultra-short echo time of as little as 70 µs. For spatial co-localisation high-resolution CT data sets were acquired either with a prototype volume CT system with flat panel detectors or a standard clinical multislice CT scanner. Qualitatively, MR shows different and sometimes even higher signal variations than CT, especially important for interpretation of mummification-related artifacts. MR sequence as well as MR field strength significantly influence image quality (e.g. bluring of edge structures). Quantitatively, a higher signal-to-noise ratio (44 out of 47 measures) but lower contrast-to-noise ratio (36 out 46) in MR in comparison to CT was found. Acquisition time by MRI can be high (some minutes to up to 9 hrs) and spatial resolution by CT is generally higher. Eventually, both complementary imaging modalities shall be merged for an improved diagnostic imaging of ancient mummies.

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Comparative prezygapophyseal shape variation in the nonhuman primate vertebral column.

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The zygapophyses are the spine's synovial interlocking joints that, together with intervertebral discs, permit and restrict movement in the vertebral column. Zygapophyseal orientation has been the principal focus of prior studies on the movements enabled by these joints. Results generally indicate that little variation exists among nonhuman primates that rely on different locomotor modes. Additional functional insight may be gained by analysis of zygapophyseal shape using three-dimensional landmark-based geometric morphometrics. Here, this approach is used to examine prezygapophyseal shape variation among *Papio, Pan, Gorilla, Hylobates* and *Pongo*. Nineteen landmarks were recorded on the prezygapophyses of the thoracolumbar vertebrae. Intrageneric and intergeneric generalized Procrustes and principal components analyses were performed to examine how prezygapophyseal shape changes in vertebral series of each taxon, and how shape varies across taxa. Results from intrageneric analyses indicate that the transition from thoracic to lumbar vertebrae is characterized by a gradual increase in prezygapophyseal facet curvature and sagittal orientation in the hominoids, while in *Papio* this transition is abrupt. Intergeneric analyses show that the prezygapophyses of quadrupedal/climbers exhibit greater sagittal orientation and curved facets with greater mediolateral breadth compared to suspensory/climbers that exhibit a more oblique orientation, and flatter facets with greater craniocaudal breadth. Allometry is detected for some vertebrae and for some taxa, indicating that prezygapophyseal shape may also be size-related. For example, *Gorilla* prezygapophyseal facets remain flatter throughout the vertebral series compared to the other hominoids. These results show that prezygapophyseal shape is related to locomotor behavior and, in some cases, increasing size.

The intrauterine environment as a life history precursor: perspectives from the callitrichine primates.

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The developmental programming paradigm frames the adaptive navigation of the intrauterine environment as not only critical to a successful pregnancy, but also as the trigger of physiological, immunological, and reproductive sequelae with far-reaching consequences across the life course. Growing evidence from epidemiological, clinical, and comparative studies has shown that both birth weight and placental characteristics, proxies of fetal responses to intrauterine environmental quality, are predictive of immune and metabolic function throughout the life course. Birth weight also plays a primary role in the cycle of life history phenomena, such as juvenile growth rate, age at sexual maturation, and fecundity. Species-specific life history characteristics may thus have deep roots in developmental processes during fetal life. My primary example comes from the Callitrichinae. The marmosets and tamarins are characterized as regularly producing twins, but this generalization obscures important energetically-driven flexibility in reproductive output, even within individual reproductive cycles. Demographic data, birth weights, and placental morphological analyses from captive marmosets will be used to build links between the intrauterine environment and adult reproductive characteristics. This approach may also help to shed light on the life history of the callimico, a callitrichine primate that is closely related to the marmoset but solely produces singletons. The aim of the talk is to suggest that energetic and ecologic parameters of fetal life may play an important role in the evolution of primate life histories.

Unlocking the Clavicle: Musculoskeletal Stress Markers (MSM) from Tell Abraq, United Arab Emirates (2300 B.C.).

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This study examines musculoskeletal markers (MSMs) and asymmetry of the complete adult clavicles (n=44, 30 rights, 14 lefts) recovered from a communal tomb at the Bronze Age site of Tell Abraq, located on the Arabian Gulf coast in the United Arab Emirates. Due to the disarticulation of the skeletons, only individual bones can be examined. Approximately 380 adults and children were interred in the tomb over a period of 200 years (2300-2100 B.C.). The site's inhabitants primarily engaged in a maritime economy and archaeological evidence shows that fishing and dugong hunting were prominent activities. The MSMs are scored using an ordinal system: 0=absent, 1=slight, 2=moderate, 3=strong, 4=severe. The almost equal robusticities of the right (.316) versus the left (.312) clavicles and the presence of stress lesions on the costal tuberosity (52.3% of the clavicles scored ≥2) suggest that some activities involving both arms, such as sailing, rowing, or fishnet casting, occurred. The robusticity of particular markers on the right clavicles, when compared to the left clavicles, suggest that some activities primarily involving the right or dominant arm, such as harpooning large sea mammals, also occurred. Moderate to pronounced attachments on the right clavicles (53.3%) versus the left (28.6%) demonstrate dominance of right arm activities. The human remains provide a direct correlation for involvement in maritime activities, which is important because so little is known about the human biology of Bronze Age people. This study demonstrates that the examination of skeletal remains can serve as an important supplement to archaeological investigations.

Locomotor effects on trabecular bone structure in the proximal femur and humerus of primates.

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The hypothesized relationship between locomotor loading and the three-dimensional structure of trabecular bone has gained increased attention in recent years. Interspecific analyses of trabecular bone structure in the proximal femur, however, have generally produced conflicting results with some studies suggesting a strong functional link and others finding no apparent functional signal. This study uses a sample of extant primates to investigate intraspecific and interspecific variation in trabecular bone architecture in the femur and humerus to evaluate the effects of locomotor behavioral differences across primate species. High-resolution x-ray computed tomography scans were collected from the proximal femur and humerus of fifteen primate species representing the full range of primate body masses and locomotor behaviors. Voxel sizes ranged from 0.01 to 0.06 mm on a side, depending on the size of the specimen. Spherical volumes of interest scaled relative to the size of the joint were defined within the femoral and humeral heads of each individual. The three-dimensional fabric structure of trabecular bone was quantified. Measured parameters included bone volume fraction, trabecular thickness, trabecular number, and anisotropy. In nearly all taxa, bone structure is more robust in the femur than the humerus with higher bone volume, higher trabecular number, and thicker trabeculae. Intraspecific variation was greatest in anisotopy measures and none of the parameters show a significant relationship to body mass. The results of this analysis suggest that differential limb usage during locomotion in primates is not reflected in trabecular bone of the femur and humerus. Research supported by NSF BCS-0617097.

The effects of suppressed estradiol on femoral cortical bone structure in growing female rats.

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Puberty is a critical time for skeletal development. Understanding factors that affect bone modeling is important because bone geometry affects bone strength and physical behavior patterns are often inferred from bone. Female athletes suffering from amenorrhea may not accrue bone at the expected rate, suggesting that adequate estrogen exposure is necessary to optimize bone modeling. The purpose of this study was to determine the effects of estradiol suppression post-puberty on cortical bone structure in adolescent female rats. At 23 days of age, 40 rats were randomly assigned into a baseline group (n=6) sacrificed on day 25, a baseline 65 group (n=10) sacrificed on day 65, an aged-match control group (n=15) sacrificed on day 90, and an experimental group (n=9) that received daily injections (2.5 mg/kg/dose) of a gonadotropin releasing hormone antagonist intraperitoneally (days 65 – 90). Rats received 2 calcein injections. Undecalcified cross sectional slices (50um) were processed for histomorphometric analyses. Decreased cortical bone area (8.24%), periosteal perimeter (2.01%), and mean cortical width (27.71%), and an increase in endocortical area(15.12%) and endocortical perimeter(11.70%) were found in experimental bones compared to control bones. Kinetic histomorphometry data illustrated trends in the experimental group towards an increased percent endocortical labeled surface(18.95%), increased mineral apposition rate(11.39%) and bone formation rate(32.5%), and a decreased percent periosteal labeled surface(36.87%), mineral apposition rate(21.19%) and bone formation rates(50.25%). Preliminary results indicate that suppressed estradiol levels post puberty affect modeling differently on the endocortical and periosteal femoral surfaces. Furthermore, a smaller periosteal surface may negatively affect bone strength later in development.

Interspecies orbit shape: An analysis of the morphological

differences of the aperture in hominoids.

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A geometric morphometric analysis was performed on the bony orbits of human (*Homo*), chimpanzee (*Pan*), gorilla (G*orilla*), orangutan (*Pongo*), and fossil hominoids *Sivapithecus indicus* and *Sahelanthropus tchadensis*. The data were tested for inter-species differences using both principle components analysis and an assessment of orbit indices. Distinct and significant patterns characterize each species: Orangutans exhibit a diagnostic "drooping" orbit. Gorillas have a rectangular orbit that is tilted on its axis at ectoconchion. Chimpanzees have similar orbits compared to gorillas, but their consensus shape is more oval. Humans possess a distinct trapezoidal shape which approaches quadrate proportions. The lateral-inferior drooping (LID) effect is most prominent in orangutans, as is shown by their most extreme principle component (PC). A functional hypothesis is put forth which suggests this 'drooping' shape may relate to flanges in mature orangutan males and older females. The conservative orbit shape of *Sahelanthropus tchadensis*, is consistent with it being the oldest hominin. Surprisingly, when compared to other great apes, *Sivapithecus indicus* is morphologically closer to the mean gorilla orbit shape than to the orangutan. The *Sivapithecus indicus* aperture has been a notable feature and often referred to as most similar to the orangutan of all the extant apes; this new evidence should be reinterpreted simply as a trait that is intermediate between gorilla and orangutan morphologies, as might be expected in a fossil that lies close to the point of divergence of these taxa.

Carbon and nitrogen isotope variation among five sympatric lemur species from Betampona Natural Reserve, Madagascar.

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Stable isotope analysis has proven to be a useful and reliable tool for identifying differences in diet and habitat use among primates and primate social groups. The present study employs this technique to explore differences in diet and habitat use among five sympatric lemur taxa (*Indri indri*, *Varecia variegata*, *Propithecus diadema diadema*, *Eulemur fulvus albifrons*, and *Avahi laniger*) from Betampona Natural Reserve (BNR), Madagascar and reports the first carbon and nitrogen isotope data for these species at BNR. BNR is one of the last remaining tracts of eastern lowland rainforest in Madagascar, and anthropogenic pressures have reduced the intact primary forest to just 50% of its original extent. Understanding the response of the lemur community to anthropogenic habitat alterations is essential for evaluating the viability of the lemur populations as well as informing conservation efforts. An indirect proxy for habitat use such as stable isotope analysis is particularly useful at BNR because the ruggedness of the terrain makes traditional behavioral and ecological methodologies difficult to implement. Carbon and nitrogen isotopes measured in hair are combined with habitat structural analysis and GIS to assess the degree to which isotopic variability conforms to patterns of heterogeneity in habitat structure and lemur habitat use. Results indicate patterning between isotopic variation and habitat use among the five taxa and among members of *Eulemur*. Furthermore, the results demonstrate the applicability of stable isotope analysis to the study of primate habitat use in rainforest environments that have undergone considerable anthropogenic alteration.

Systematic and functional significance of the KNM-ER 3228 os coxa.

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In spite of its 1.95 million year age KNM-ER 3228 is remarkably *Homo*-like showing only minor differences to modern humans and comparing favorably to fossils a million years younger (OH 28) . Its superoinferiorly short, anteroposteriorly wide and laterally directed iliac blades, reflect a short vertical distance from sacroiliac to hip joint, and hip joint stabilizers (gluteus maximus and medius m.) with a large x-section and a human-like line of action. An expansive postauricular attachment area for the erector spinae m., a large acetabular diameter, a large iliac tubercle and robust iliac pillar (albeit more anteriorly disposed than in humans), markedly developed sacroiliac ligament attachments, and a large comma-shaped auricular facet suggests powerful trunk extension and passive transmission of upper body weight by the pelvis to the lower limbs. A hyper-developed anteroinferior iliac spine, an acetabular lunate facet with an inferiorly directed articular gap, and a robust, mediolaterally wide and vertically short posterior ischial ramus with a posteriorly projecting and superiorly encroaching ischial tuberosity, reflect extension and powerful stabilization of an extended thigh. An apparently human-like ischial spine indicates development of a pelvic diaphragm and maintenance of visceral integrity in erect trunk postures. All these characters agree well with those of the slightly younger (~ 1.85-1.88 my) KNM-ER 1472 and 1481 femora, and suggest the KNM-ER 3228 individual had human-like locomotor capabilities --the earliest documented in the fossil record. Given its age and size, it probably corresponds to early *Homo* (*i.e.* KNM-ER 1470), but the possibility that it belongs to *Paranthropus* can not be discounted.

Influence of Orbit Size on Aspects of the Tarsier Postorbital Septum.

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Explanations invoking the complex mechanical effects of the enlarged orbital region in *Tarsius* have been extended to almost all areas of the skull including the conformation of the postorbital septum. A strong cline in the degree of relative orbital enlargement across 4 tarsier species groups documented in this study presents an unexploited opportunity to test such hypothesized scenarios. The goal here is to evaluate hypotheses concerning the impact of orbital hypertrophy on the size of specific components of the postorbital region including the frontal, alisphenoid, maxillary and zygomatic bones. The periorbital processes of the alisphenoid, maxilla, and zygomatic bone of *Tarsius* are perceived as functionally unrelated to orbital enlargement and therefore not expected to reflect increases in relative orbit size. The frontal flange, conversely, is almost always interpreted as a functional projection whose bracing role requires a positive morphometric association with increases in orbit size. These attributes were measured in an extensive sample of 4 tarsier species groups and analyzed with Systat 10 applying standard analysis of variance techniques (ANOVA, $P \leq 0.05$), correlation statistics (Pearson's product-moment correlations), partial correlations and reduced major axis regressions. In contrast to proposed functional interpretations, results indicate that variation in most linear parameters outlined above is better explained by overall body size than intrageneric differences in relative orbit size. Another unexpected finding is the small but discernible negative association between relative orbit size and width of the zygomatic periorbital segment.

Psychomorphometry: Towards a novel assessment of human facial form and function.

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Several disciplines share an interest in the evolutionary forces and constraints that shaped and continue to shape our minds, behaviors, and bodies. Traditionally, disciplines studying these processes address one domain at a time. The conceptionalizations and methodologies invoked often are conflicting and based on different explanatory rhetorics, hampering progress in one field from effective transfer to and adoption by the other. Topics at the intersection of anthropometry and psychometry, such as the impact of sexual selection on the hominin face, are a typical example. Yet, as the underlying (evolutionary) theory explicitly places facial form in the middle of a causal chain as *the* mediating variable between biological causes and psychological effects, a particularly convenient conceptual and analytic scenario arises: Modern morphometrics allow regressing shape both "backwards" on biology, and "forwards" on behavior/perception. These effects can be compared and evaluated as directions in the same morphospace. Such a translation permits us to study and relate the effects of biological processes on form to the perceptions of the same processes in one "psychomorphospace". As an example we present a geometric morphometrics analysis of facial photographs of 30 adult men from which we learn that the aspects of shape covarying with masculinity and dominance are aligned with those covarying with the 2D:4D ratio (a measure of prenatal testosterone) but not with the measure of current (salivary) testosterone, or perceived attractiveness. It follows that the part of male morphology that signals masculinity and dominance may be determined before birth.

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A new approach for age estimation by recruitment of the first metatarsal bone.

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In osteoarcheology, age-at-death estimation is important for reconstructing demographic structures, age-correlated frequencies of pathologies, health status and identification processes in forensic cases. Frequently the so-called "Combined Method" is taken for analysis; this approach includes the morphological changes at the *facies symphysialis* of the pubic bone, the degree of obliteration of the endocranial *sutures* as well as the structure of the cancellous bone tissue within the proximal end of the *humerus* and *femur*. Since the preservation of the epiphyses is often impaired by post-mortem destructions the reliability of the "Combined Method" decreases. Furthermore, we lack sophisticated methods to differentiate age-at-death in individuals older than 60 years.

Here we report the preliminary results of an ongoing study, where we used the potential of the first metatarsal bone for age estimation. This element is more often well preserved than the epiphyseal regions of the other long bones. The data of 200 first metatarsal bones of

contemporaries with known age (44-90 years) and sex were collected for examination. We used the non-destructive method of high-resolution computerized tomography with images generated on a 64-row-CT-scanner. We also were interested to shed light on potential effects of sexual dimorphism and laterality (footedness) on the trabecular pattern in regard to age-related changes.
Our results show a tendency towards an age-dependent gradual enlargement of the marrow space together with distinct alterations, i.e. hypointense areas within the subchondral cancellous bone. Furthermore, it seems that both, sex of the individual and footedness influence the overall morphology of the first metatarsal bone.

Evidence supporting two centers of population differentiation in East Asia: Siberia and SE Asia.

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In 1973 Schanfield and Gershowitz (1) hypothesized that there were two distinct centers of population differentiation in East Asia, one in the northeast and one in the southeast, that did not co-mingle until the Holocene. As of this date that hypothesis has not be extensively tested. To test that hypothesis data for 23 genetic markers systems (9 electrophoresis, 2 Ig Allotypes, 2 HLA, mtDNA, Y-SNP, 8 STRs) were collected on 4 Siberian populations (Altai (93), Evenki (266), Udehe (46) and Ket (33)) and 3 southeast Asian populations (SE Asians in US (102),, Indonesians (125), and Taiwan Aborigines (70)). F analysis was used to look at within region, and between region variation in allele frequencies for each locus (Fr, Fwr, Frt and Fst). Cluster analysis using Wards method on a Squared Euclidian distance matrix of PCA factor scores, with clusters tested using K means analysis were performed on the different sources of genetic data. Significant Frt values were detected for the GM allotypes (Frt=0.222), and HLA DQB1 (Frt=0.127) loci, Y DNA (Frt=0.079), KM (Frt=0.070), ESD (Frt=0.055), and mtDNA (Frt=0.052). Significant tree structures with no misclassification were seen for the Ig allotypes, DQB1 and YDNA, while single misclassifications were seen for DRB1 (Ket) and mtDNA (Udehe), The results of the F and tree analysis support two centers of differentiation in East Asian populations that must have occurred during the last glaciations. This data supports proposed centers of origin for source populations for the peopling of the new world and Pacific.

Abundance estimates and species diversity of the enigmatic nocturnal primates in the protected Rhoko forest, Cross River State, Nigeria.

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Despite their importance to understanding the origins of primates, few data are available regarding the behaviour and ecology of African strepsirhines. Indeed, even basic distribution data and population estimates are scanty, meaning that most species are currently listed by the IUCN as Data Deficient or Least Concern. Deforestation and hunting pressures make it increasingly important to gather accurate baseline data. To attempt to fill this gap, from June-August 2008, we carried out surveys on six sympatric species of nocturnal strepsirhines (*Arctocebus calabarensis, Perodicticus potto edwardsi, Galago demidovii, Galago thomasi, Euoticus pallidus,* and *Sciurocheirus alleni camerounensis*) by walking randomly selected transects in a 400 ha protected forest, in Southeast Nigeria. Rhoko Forest is jointly patrolled by the NGO CERCOPAN and the village of Iko Esai through a community-based conservation initiative. Using DISTANCE, we applied a hazard rate cosine model to 273 sightings. Analysis revealed detection probability of 0.69, effective strip width of 13.7, yielding 0.68 animals per ha. This is the first study to quantify the density of several of the study species. The angwantibo yielded lower numbers at 0.13 animals/ha (n=29). Vulnerable may be a more appropriate listing for the angwantibo and potto, as well as for the Northern needle-clawed bushbaby. Further work is needed to assess threat levels and provide updated ecological and behavorial data for all species.
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Effects of locomotion – Morphological differences in humeral cancellous bone of hominids and their relation to habitual loading conditions of the shoulder joint.

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The functional character of trabecular architecture among primates of diverse locomotor adaptations has been the subject of recent research. Several past studies have indicated a relationship between locomotor behavior, joint loading and trabecular architecture, especially for the hip joint. Regarding the investigation of early human locomotion, the hip joint can only indicate when bipedal behavior was first acquired. However, early

bipedalism was most likely also associated with some climbing behavior that must have had an effect on the shoulder girdle.
Here we present the first analysis of trabecular architecture in the humerus of hominids using high-resolution computed tomography data on *Pan troglodytes* (13), *Pongo pygmaeus* (16), and *Homo sapiens* (21). Preliminary findings indicate that each of these three taxa is characterized by distinct trabecular patterns in 3D morphometric analysis and by specific arrangements of trabecular elements. Thus, the effects of locomotor loads applied on the humerus in chimpanzees and orangutans during vertical climbing, arm-swinging, and suspensory behavior are in clear contrast to the relatively low humeral loading conditions in humans, which occur primarily in connection with manipulatory activities.
We show that the shoulder joint offers primary information about climbing vs non-climbing behavior, and we conclude that analysis of trabecular bone is crucial in understanding the evolution of fossil hominid locomotor behavior. The future study of fossil humans will help to elucidate the enigma of the beginning of bipedalism in humans.
This study was supported by the Max Planck Society.

Identifying the descendents of the Chaco Anasazi.

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Recently, a number of anthropologists and anthropological organizations, including the American Association of Physical Anthropologists and the Society for American Archaeology, have criticized the National Park Service's process for assigning cultural affiliation to the human remains from Chaco Canyon, located in the American Southwest. Specifically, the criticism stems directly from Chaco Culture National Historical Park's inclusion of the Navajo among the culturally affiliated tribes in its NAGPRA compliance process. Our purpose here is to identify the biological descendents of the Chaco Anasazi (ca. AD 850-1150) using multivariate analyses of various biological data sets, including cranial metric and non-metric data, anthropometric data taken on live individuals, mtDNA haplogroup frequencies, and dental non-metric data. We test the assumption that the Navajo, a non-Pueblo Indian group from Arizona, New Mexico, and Utah, are not affiliated biologically with the Chaco Anasazi. The results of our study revealed a complex pattern of biological relationships among prehistoric and present-day populations in the American Southwest. Analyses of several data sets, such as cranial indices and mtDNA haplotype frequencies, revealed a closer relationship between the Navajo and prehistoric Puebloan populations, including the Chaco Anasazi, than other present-day Pueblo Indian tribes such as the Hopi. We suggest, therefore, that contrary to the opinion of many anthropologists, the Navajo are affiliated biologically with the Chaco Anasazi and other prehistoric Puebloan groups.
This research was supported in part from by a grant to the first author by the Social Sciences and Humanities Research Council (SSHRC) of Canada.

Fiber type composition in the perivertebral muscles of small primates - Are primates different from other small mammals ?

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Comparative studies of the perivertebral musculature in small non-primate mammals such as tree-shrews or rats revealed some overall principles in the composition and distribution of muscles fiber types. Deep and short, mono- or multisegmental muscles consistently showed the highest percentage of slow, oxidative fibers implying a function as local stabilizers of the vertebral column. Superficial and larger, polysegmental muscles were predominantly composed of fast, glycolytic fibers suggesting they function to both globally stabilize and mobilize the spine. A deep, central oxidative region in the lumbar longissimus muscle appears to be a general feature and likely serves a proprioceptive function to control the postural equilibrium of the pelvic girdle and lumbar spine. In order to test whether these principles also apply to primates as well as to gain a better understanding of the functional morphology and the evolution of primate back muscles, the perivertebral musculature of two small primates (mouse lemur, brown lemur) was investigated three-dimensionally.
Immunohistochemical techniques were applied to differentiate muscle fiber types on serial cross-sections throughout the posterior thoracic and lumbar regions. The comparison to small non-primates shows that small primates are very similar in their fiber type distribution pattern and thus share the same overall principles in their back muscle organization. Because early representatives of primates were small to medium in body size and comparable in their body proportions and probably also locomotor parameters to the species investigated here, the described fiber type distribution is suggested to be representative of the ancestral condition in primates.
This study was supported by the Center of Interdisciplinary Prevention of Diseases related to Professional Activities funded by the Friedrich-Schiller-University Jena and the Berufsgenossenschaft Nahrungsmittel und Gaststätten Erfurt (Germany).

A landmark based approach to the study of the ear ossicles using ultra high resolution X-ray computed tomography data.

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Previous study of the ear ossicles in Primates has demonstrated that they vary on both functional and phylogenetic bases. Such studies, however, have generally employed two dimensional linear measurements rather than three dimensional data. The availability of ultra high resolution X-ray computed tomography (uhrCT) has made it possible to accurately image the ossicles so that broadly accepted methodologies for acquiring and studying morphometric data can be applied. Using uhrCT data also allows for the ossicular chain to be studied in anatomical position, so that it is possible to consider the spatial and size relationships of all three bones. One issue impeding the morphometric study of the ear ossicles is a lack of broadly recognized landmarks. Distinguishing landmarks on the ossicles is difficult in part because there are only two areas of articulaton in the ossicular chain, one of which (the malleus/incus articulation) has a complex three dimensional form. A measurement error study is presented demonstrating that a suite of 16 landmarks can be repeatably located on reconstructions of the ossicles from uhrCT data. Maximum likelihood estimates of measurement error showed that most landmarks were highly replicable, with an average CV for the interlandmark distances of less than 3%. The positions of these landmarks are chosen to reflect not only the overall shape of the bones in the chain and their relative positions, but also functional parameters. This study should provide a basis for further study of the smallest bones in the body in three dimensions.

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Scapula motion during walking in arboreal quadruped primates.

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Scapula movements during locomotion in five species of arboreal quadruped primates (*Microcebus murinus*, *Eulemur fulvus*, *Nycticebus pygmaeus*, *Saguinus oedipus*, and *Saimiri sciureus*) were investigated using uniplanar and biplanar high-speed cineradiography. The angular excursion of the shoulder blade of up to 50 degrees and the height of its instantaneous center of rotation assign to the scapula a predominant role in forelimb excursion. While the extent of scapula pro- and retraction in the primates investigated is similar to other claviculate mammals, the high degree of scapular tilting is not. Guided by the clavicle, the scapula moves along the thoracic wall and changes its position from parasagittal into dorsal during protraction and back into parasagittal position during retraction. In the strepsirhine primates and the tamarin, the humerus is unable to move outside the scapula plane. Seemingly, the glenohumeral joint is muscular stabilized against mediolateral excursion. Therefore, the humerus is abducted as long as the scapula moves outside the parasagittal plane. Only the squirrel monkey can actively adduct its upper arm against the scapula and thereby maintain parasagittal arm position throughout the contact phase. This "emancipation" of humeral excursions from scapula position probably requires a decoupling of muscular co-activity among stabilizing muscles, e.g. of anti-abductors and anti-adductors. Although the mechanical and neural mechanisms underlying the initial "emancipation" of the humerus are not identified yet, they are likely among the important initial steps towards the increasing role of glenohumeral motion during the evolution of primate locomotor diversity.

The people of the Xiongnu culture (3_{rd} century B.C. to 2_{nd} century A.D.): Insights into the biological diversity of the earliest Eurasian nomadic steppe empire.

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The prehistory of Mongolia has been characterized as a complex interaction of nomadic peoples throughout central Eurasia. Recent archaeological, genetic, and biological data support this theory. This study uses a quantitative genetic approach to examine these relationships by analyzing craniometric data to elucidate questions concerning the origins and diversity of one particular time period known as the Xiongnu. By 2200 BP, much of Inner Asia became integrated and began to develop large-scale nomadic polities. The Xiongnu were one of the earliest nomadic Eurasian steppe empires and were contemporaneous with the Qin and Han dynasties of China (2221 – 1800 BP). The Xiongnu were constructed from diverse political and economic traditions through the integrative process of distinct Inner Asian peoples. Centrally located in north central Mongolia, Xiongnu archaeological culture has been identified from Manchuria to Kazakhstan.

This presentation attempts to quantify Xiongnu biological diversity through the analyses of craniometric data within a population genetic model (Relethford-Blangero). Xiongnu

samples include various temporal and geographic contexts from excavations throughout Mongolia, in addition to the inclusion of several other geographic samples from Eurasia, East Asia, and North America for comparative purposes. Several multivariate analyses were performed to ascertain within-group and among-group variability to place the Xiongnu sample within a broader biological context. Our results demonstrate Xiongnu burials were similar biologically to other known Mongolian samples from several temporal periods. However, analyses also indicate higher within-group variability for the Xiongnu, which may reflect the elite status of peoples administering the polity of this incipient steppe empire.

The relationship between arm swinging behavior and postcranial morphology in *Ateles* and *Lagothrix*.

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Over the past decade it has become increasingly clear that several primates engage in arm-swinging as an important part of their locomotor repertoire without having highly specialized forelimbs or thoracic shape normally associated with this form of locomotion. This suggests that these features are not necessarily required for efficient hand-over-hand progression. Alternatively, there may be specific kinematic differences between the arm-swinging of specialists like gibbons and spider monkeys compared to other arm-swinging monkeys that exhibit compromise morphology accommodating multiple locomotor demands. By documenting these kinematic patterns we will be able to determine the relationships between locomotor behavior and postcranial morphology. We collected tri-planar videorecords of *Ateles fusciceps* and *Lagothrix lagothrichea* (an anatomically less specialized and less frequent arm-swinger than *Ateles)* arm-swinging underneath a raised horizontal pole. Whole-body rotations, lateral distance of the body relative to the pole and wrist, elbow, and arm-body angles were calculated. *Ateles* stayed directly below the pole and rotated completely keeping the body aligned with the pole while *Lagothrix* deviated laterally and rotated incompletely. Although the elbow joints of both animals exhibited similar range of extension, the wrist experience very different motions. *Lagothrix* experiences high values of flexion and extension as the animal deviated laterally with each handhold. *Ateles* experiences more consistently rotational patterns and the wrist is straight as the animal stays below the substrate. The controlled arm-swinging of *Ateles* favors mobile joints that are aligned in tension whereas the large lateral body movements of *Lagothrix* require more robust and highly stabilized forelimb joints.

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Genetic and linguistic coevolution in Native Latin America.

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The coevolution of genes and languages has been a subject of enduring interest among anthropologists, linguists, and geneticists. Progress has been limited in large part by the quality of the linguistic data available to researchers and by the methods used to reconstruct linguistic relationships. Dunn and colleagues (2005) recently suggested that structural linguistic data (i.e., aspects of sound systems and grammar) and innovative phylogenetic methods might overcome these limitations.

This study will employ structural linguistic data and Bayesian phylogenetic inference to examine the relationship between linguistic and genetic data collected from Native Latin Americans. The genetic data are comprised of the microsatellite markers typed for 18 South American populations by Wang and colleagues (2005). The structural linguistic data for these populations will be compiled from the literature. A maximum likelihood model-fitting method will be used to test the hypothesis that the linguistic tree estimated from the structural linguistic data corresponds to the genetic tree of the populations, and we will use coalescent-based simulation and matrix correlation tests to further compare the patterns of genetic and linguistic variation.

Physical and cognitive predictors of skills and expertise across the lifespan.

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Little is known about why humans have an extended juvenile development and long post-reproductive lifespan. Unlike most animals which live only as long as they can reproduce and take care of themselves, humans live past their reproductive years, experience significant declines in production, and often become dependent on support of others for their survival. Intergenerational contributions to skill development in younger kin could help explain past selection for longevity, but even less is known about development of older adult expertise in small-scale society. The distribution and ontogeny of everyday abilities, focusing on development of expertise and older adults' roles in the enculturation process are described among the Tsimane, a small-scale forager-horticulturalist group in the Bolivian Amazon. Investigation of the physical growth, cognitive experience, and reproductive investments moderating the ontogeny of skills and abilities, and the role of older adults as instructors, exemplars, and transmitters provides insight into past selection for longevity among humans. Results indicate that while

complex skills essential to survival can take decades to learn, development of expertise takes nearly a lifetime with most experts older than 40. Expertise is scheduled with strong skills mastered earlier, while difficult skills independent of strength, such as music, storytelling, and artifact manufacture come later. Intergenerational transmission of a cumulative traditional culture helps buffer mortality risks and has been made possible by extension of the human lifespan. Among Tsimane, older adults make important contributions to younger kin's skill development that likely affect fitness, helping explain "old age".
Support for this study kindly provided by National Science Foundation Doctoral Dissertation Improvement Grant Award #0612903.

An atlas of modern human cranial morphology constructed via non-rigid deformation analysis of high-resolution CT images.

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Comparative studies of skeletal morphology are only as good as the quality of the comparison sample. Comparisons made to a limited sample, or one that has unrecognized biases, can compromise the conclusions. A standardized atlas representing average morphology - and incorporating information about localized variation - is of obvious usefulness to the field. We present a method for constructing such an atlas using non-rigid deformation analysis of high-resolution CT images. The technique involves morphing CT images of crania into an arbitrarily selected target image. Distortion matrices that describe how each individual image differs from the target are then used to estimate the morphological average of all the images. The individual images are then remorphed into this average, and a new average is calculated. The process is repeated until subsequent iterations do not change. Variation at each point across the sample can be determined from this data, allowing for detailed global statistical analyses of the difference between an individual (e.g., a fossil) and the population average at each point. Beneficial qualities of this approach include: 1) additional specimens can easily be added, increasing the sample pool used to estimate the population average; 2) external and internal structures (e.g., endocranial surface) are automatically included; 3) sub-population comparisons can easily be made by appropriate subdivisions of the resulting distortion matrices. We demonstrate the technique with a pilot study of images of crania obtained from the Open Research Scan Archive at Penn, including 10 individuals each from Europe, India, Africa, and Asia.

Subsistence strategies of the early inhabitants of southernmost California.

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Some of the earliest New World sites are located in coastal southern California. Traditionally, we thought the earliest immigrants were big game hunters who traveled across the Bering land bridge, moved through today's Great Basin, then down through New Mexico and Arizona, and later into coastal regions where they began shellfish collection. A more recent hypothesis is that some groups of people traveled by boat directly down the coast.

Several sites near San Diego, CA, first excavated in the 1930's, are now known to be more than 9,000 years old. The sites present a unique opportunity to reconstruct diet and subsistence strategies at the threshold age for New World human occupation. Based largely on ethnographic evidence, they were originally thought to be similar to individuals living in the area at Spanish Contact. Those people collected plant foods (especially acorn), terrestrial mammals, and various mollusk species.

We extracted and analyzed bone collagen from several individuals from two different sites. Radiocarbon dates on human bone collagen and on shell demonstrate a range of occupation from 9,440 to 5,650 Cal BP. Bone collagen $\delta^{15}N$ values (14.2 to 21.3‰) are equivalent to or higher than those of recent marine mammal hunters and salmon fishing people. The $\delta^{13}C$ values (-16.6 to -12.1‰) overlap the salmon fishers; but are lower than one set of hunters. These results are consistent with an early marine adaptation with open ocean fishing and an early migration route into the New World. Support: Regents of the University of California.

Ranging patterns of hamadryas baboons: random walk analyses.

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The analysis of animal movement patterns via various forms of random walk is one of the fasting growing areas of research in the ecological sciences. In recent years advances in both theory and methodology have generated a substantial increase in the understanding of the spatial patterns produced during basic foraging activities and their underlying ecological correlates. The ability to quantify and compare movement patterns is essential to a thorough understanding of the animal's interaction with its environment, is vital in generic behavioural

modelling, and has profound implications for conservation initiatives. However, whilst recent research into Lévy walks and scale-free phenomena are encouraging, primates remain under-represented in this field.

The current study examines the ranging patterns of a band of hamadryas baboons (*Papio hamadryas*) at the Filoha outpost of Awash National Park, Ethiopia from March 2005 – February 2006. During all-day follows, the geographic center of the band was mapped every 15 minutes using a handheld GPS unit. Over 3,000 step lengths, turning angles and waiting times were documented across 105 complete follows spanning both wet and dry seasons. The data were subject to a comprehensive maximum likelihood distribution-fitting strategy involving model selection via the Akaike information criterion. Findings demonstrate that both step lengths and waiting times are power-law distributed, whilst turning angles are significantly biased towards zero. This suggests that resource patches are scale free in both distribution and size, and that the daily foraging round can be modelled as a correlated Lévy walk.

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Evolutionary processes underlying variation in early *Homo*.

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There is no doubt that the poorly defined and fragmentary Plio-Pliestocene early *Homo* fossil record represents a complicated lineage that is diverse morphologically, temporally and geographically. This large amount of variation has led to a number of studies (and debates) focused on determining the taxonomic relationships in early *Homo*. Yet despite this focus on variation, there remains no clear understanding of the evolutionary processes acting to produce this variation – i.e. the relative roles of genetic drift and selection. Previous studies have shown that genetic drift may account for facial diversity present during the early evolution of the genus *Homo* as well as the cranial variation between modern humans and Neanderthals. Here, we add to this body of work, by applying statistical tests developed from quantitative evolutionary theory to determine whether random genetic drift can explain the diverse craniodental morphology in early *Homo*. Our analyses are based on eight cranial measurements shared by eight specimens of early *Homo* from South Africa and Kenya, as well as published dental measurements from a number of early *Homo* specimens from South Africa, east Africa, Malawi and Georgia. Estimates of intra-specific variation are based on samples of three extant hominoid species. Our results suggest that genetic drift can explain much of the diversity seen in early *Homo* craniodental morphology. Tests that include specimens from Georgia and Malawi, however, show otherwise, suggesting that these hominins – which occupy temporal and geographic extremes of the early *Homo* hypodigm – display dental adaptations to distinctly different environments.

God and the *Stegosaurus*: presentations of creationism and evolution in American museums.

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Many Americans receive their first exposure to evolution while viewing natural history museum exhibits. Usurping the popularity of this educational forum, the Creation Museum in Petersburg, Kentucky promotes creationist explanations of natural phenomenon and markets itself as a legitimate alternative to natural history museums. Using the Creation Museum as a comparative "outlier" (i.e. the anti-evolution museum), evolution exhibits were evaluated at natural history museums that shared either local audience or national tourism significance with the Creation Museum. Natural history museums sharing locality with the Creation Museum include Cincinnati's Museum of Natural History and Science and the Behringer-Crawford Museum in Covington, Kentucky. Like the Creation Museum, New York's American Museum of Natural History, Washington, D.C.'s National Museum of Natural History, and Chicago's Field Museum draw destination tourists. Exhibits featuring the same "icon of evolution" (such as a depiction of *H. neanderthalensis*) were compared for their fidelity to evolutionary theory, pedagogical method, and context within the museum. Comparison of exhibits demonstrates that while the Creation Museum and natural history museums share visual elements, natural history museums generally adopt an inclusionary educational approach in terms of both exhibit material and audience. Within non-creationist venues, there is greater explicitness of evolution at national versus local museums, suggesting that presentations of evolution differ between scientific institutions. This study highlights the ongoing need for improved public understanding of evolution and the role of natural history museums in its consistent presentation and emphasis.

Stable isotope perspectives on diet at the Old Frankfort Cemetery.

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The stable carbon- and nitrogen-isotope ratios of collagen extracted from bone samples from 236 individuals from the Old Frankfort Cemetery (Kentucky) provides new

insights into community variations in diet and the origins of those who were buried there during the nineteenth century. The consistency in $\delta^{15}N$ values for adults suggests a very similar level of meat consumption across the population. On the other hand, variations in $\delta^{13}C$ values for adults provide evidence for possible in-migration, and also suggest that different segments of the population consumed different amounts of carbon derived from C3 and C4 plants. In general, most diets at Frankfort contained a high proportion of maize carbon, consumed directly through foods made from cornmeal and indirectly through corn-fed animals and their products (milk and eggs). Cane sugar may have also contributed to some diets.

The childhood $\delta^{15}N$ values show evidence for weaning around one year of age, consistent with general historic records from other parts of eastern North America at the about the same time period. However, some infants showed very little evidence of breastfeeding and were completely weaned before they were one year old. This could reflect maternal mortality or perhaps cultural ideas about infant nutrition. Variation in the youngest infant $\delta^{13}C$ values reflect variations in maternal diet and provide the strongest evidence for intra-community dietary variation between households.

This project was funded by the Kentucky Archaeological Survey with samples provided by the William S. Webb Museum of Anthropology, University of Kentucky.

Ranking food. Diet and social variation in early medieval populations from southwest Germany.

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While food constitutes a basic requirement for nutritional intake and physiological maintenance, diet denotes the regular consumption of foodstuffs and drinks as the customary selection from options available to an individual or a human community. Diet therefore refers to a behavioural category and should reflect opportunities for self expression and display. There is growing evidence that, through light stable isotope analysis, dietary reconstruction in past societies can be taken beyond the level of generic consumption patterns towards the identification of dietary differentiation within groups.

Social rank is an obvious signifier of differential access to resources and, by implication availability of foodstuffs more or less costly to produce or obtain. Carbon and nitrogen isotope ratios of human bone and associated faunal collagen samples (total N=118) from early medieval (6^{th}-8^{th} century AD) populations in south western Germany point to two different ways in which status, as reflected though grave inclusions and other funerary evidence, manifests itself in varying dietary options. At Kirchheim/Ries, nitrogen values suggest that males of pronounced social rank, buried next to their horses in a "nobles' cemetery", display higher levels of animal protein consumption than other well-off or ordinary compatriots. At Weingarten, the data show less variation in isotopic signals for individuals of elevated social standing, indicating choice of dietary breadth rather than differentiation through quantity. Both findings accord with strategies pursued to display social variation that are known from the ethnographic and historical record and will be discussed in the socio-ecological context of early medieval society.

***OPRM1* gene variation influences neuroendocrine function but not behavior in rhesus macaque (*Macaca mulatta*) mothers.**

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The endogenous opioid system modulates the physiological stress response and, at least in rodents, influences maternal behavior. In humans, a functional *OPRM1* gene variant (*OPRM1* A118G) confers a 3.5-fold increase in the receptor's affinity for beta-endorphin in vitro and is associated with attenuated hypothalamic-pituitary-adrenal (HPA) axis responses to stress A functionally similar variant (*OPRM1* C77G) in rhesus macaques also confers a 3-fold increase in beta-endorphin affinity. In this study, we tested whether rhesus macaque *OPRM1* genotype influences HPA axis function and maternal behavior in mothers during the postnatal period. Blood samples were collected from 58 primiparous and 75 multiparous mothers at postnatal days 7, 14, 21, 30, 60, 90, 120, and 150. Subjects were genotyped for *OPRM1* and the effects of genotype on adrenocorticotropic hormone (ACTH), cortisol, and maternal behavior were analyzed using repeated measures ANOVA. There was a main effect of genotype on cortisol in both primiparous and multiparous mothers; in both groups, carriers of the C77G allele had lower cortisol levels across the postnatal period. However, there were no effects of genotype on maternal behavior. Our findings are consistent with human studies that have demonstrated attenuated cortisol responses to stress among carriers of the *OPRM1* 118G allele, lending further support to the argument that the rhesus and human allelic variants are functionally similar. The lack of genotype effects on behavior suggests, however, that the endogenous opioid system does not play as significant a role in maternal behavior as it does in rodents.

Shrinkage: an age old problem.

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Documenting dental remains in the field is a problem in situations where the remains cannot be taken for further study. One must rely solely on notes, sketches and photographs. Making a mold of the teeth to form an exact cast for further analysis upon arrival home is ideal. However, most modeling compounds, for example Presidential Putty Soft, require that the epoxy be poured within one week of forming the mold. This is nearly impossible to do in the field. Additionally, the molding compounds require that the formed molds be kept at room temperature (~73˚ F), again posing a problem for most field conditions.

For this study, the above limitations of the molding compound, Presidential Putty Soft, were tested. What changes, if any, occur if the pour time is extended beyond the recommended one week, and what would happen to the molds if kept in extreme climates? Epoxy was poured into the same molds weekly for twelve weeks. Paired t-tests were used to test for significant differences. Preliminary results indicate that under room temperature conditions (~73˚ F); there were no significant differences in the size and shape of casts poured from the same molds between one and twelve weeks. This indicates that researchers would have adequate time to collect data over the course of a field season and return home to pour the epoxy without distorting the casts. Ongoing research is being conducted to study the effects of alternate climates on the molding compounds and the poured molds.

Basques in an Indo-European sea: a perspective from tooth crown morphology.

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Basques represent one of the few non-Indo-European populations in Europe. Ruhlen proposed a distant linguistic relationship between Basque and the Caucasian, Sino-Tibetan, and Na-Dene language families. Dentally, the first language family is distinctly European while populations of the latter two exhibit Sinodonty. Some authors suggest Basques are the descendents of Upper Paleolithic peoples of Western Europe. Genetically, they have a high frequency of the Rh allele (r) and a low frequency of blood group B. Such differences set the Basques apart from their neighbors, but they still group with Europeans in world genetic analyses, suggesting a common origin but one with some time depth.

Little is known of Basque tooth morphology and size. To partially remedy this situation, observations were made on 29 crown traits in modern Basque and Spanish samples. We did not find any noteworthy differences in crown trait frequencies between Basques and either Spaniards or Europeans in general. Basques exhibit no incisor winging and low frequencies of shoveling, double shoveling, 3-cusped upper second molars, cusp 5, and cusp 7. Compared to Europeans, they exhibit fewer cusp forms of Carabelli's trait and a higher frequency of deflecting wrinkle. The frequencies of four-cusped lower molars mirror almost exactly the frequencies of European populations. In a world-wide analysis, Basques cluster with Europeans although they separate at a higher level in the dendrogram. This does not, however, preclude a linkage between Basques and Upper Paleolithic groups who also exhibit the dental pattern that sets Europeans apart from other world populations.

Masticatory-system configuration and canine height in New and Old World monkeys.

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Previous research has demonstrated that catarrhine species with relatively tall canines are capable of wider gapes than those with relatively short canines. This study tests the hypothesis that differences among anthropoids in gape and canine height are reflected in the configuration of the masticatory system. Specifically, the masticatory muscles (masseter and temporalis) of species with relatively tall canines should (1) have reduced leverage (i.e., relatively short moment arms in comparison to bite-point moment arms) and/or (2) their origin and insertion sites should be positioned so as to reduce the distance that the muscle must stretch at a given degree of mandibular angular excursion (i.e., low stretch factors). To test these predictions, morphometric data collected from 279 male anthropoids, representing six platyrrhine and twelve cercopithecoid species, were analyzed using phylogenetic comparative methods.

For the masseter, muscle leverage is negatively correlated with canine height only in cercopithecoids. Notably, platyrrhines that specialize in processing hard objects with their anterior teeth have relatively tall canines and greater muscle leverage than closely related taxa. Masseter stretch factor is negatively correlated with canine height when the sample is considered as a whole, but the correlation is driven by the platyrrhines and is nonsignificant when these taxa are excluded. With respect to the temporalis, muscle leverage is not correlated with canine height, but the stretch factor for this muscle shows a weak relationship with canine height. These results indicate that some aspects of the masticatory system track canine height (and inferred gape), but the relationship is complex.

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Differential growth of the maxilla and mandible as an explanation for variation in mentum osseum size.

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The mentum osseum is considered a derived feature for *Homo sapiens* and has largely been explained as a biomechanical adaptation for masticatory force dissipation. Recent research (e.g., Dobson and Trinkaus, 2002), however, has suggested that the mentum osseum cannot be explained solely as a function of biomechanics. Additionally, Durand and Hunt (2008) found an inverse relationship between chin size and facial prognathism. Moreover, in a longitudinal growth study, Low (2008) found that mentum osseum size is ontogenetically tied to differential growth of a developmentally stable pogonion point and the dentoalveolar complex which is integrated with the maxilla through occlusal interlocking.

This study tests whether differential maxillary and mandibular growth can account for mentum osseum development in static adult comparisons. Following the occlusal interlocking model, we predict that mentum osseum size should be associated with the relative anterior-posterior placement of the maxilla and dentoalveolar complex. We tested this prediction in a mixed sex radiographic sample (n = 100) with Class I occlusion. On lateral cephalograms, the mentum osseum was quantified as the distance from B point (i.e., the deepest inflection point on the symphysis) to pogonion parallel to the Frankfurt Horizontal. As predicted, mentum osseum size in adults is associated with the anterior-posterior position of the dentoalveolar complex and maxilla. This suggests that mentum osseum development is, at least in part, a function of anterior maxillary growth reduction relative to the mandible, and may be part of a suite of features ultimately tied to facial size reduction in modern humans.

Dental microwear texture analysis of the Amarna workers.

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Akhenaten founded the capital city of Amarna during the 18th dynasty of Egypt to create a location from which to base his worship of the sun disc, the Aten. The occupants abandoned the city after approximately 15 years, relocating the tombs of elite citizens, but leaving the commoners' cemeteries. Initial skeletal analyses of those workers suggest widespread malnutrition; however, artistic portrayals indicate a city where all foods were available in abundance, and meat was a staple resource. This inconsistency has led to controversy concerning the diet of the Amarna workers, prompting the need for dietary reconstruction.

Here we apply dental microwear texture analysis to incisors and molars from the Amarna workers. A series of I^1s (n=14), M^2s and M_2s (n=25) were analyzed. Point clouds were generated from labial surfaces of incisors and "Phase II" (9, 10n, and x) molar facets for each individual using white-light confocal profilometry. Data were collected at a lateral sampling interval of 0.18 µm (resolution = 0.005 µm) over an area of 276 x 204 µm. Scale-sensitive fractal analysis attributes known to separate extant taxa with differing diets were then calculated.

Both incisors and molars evinced low complexity and high scale of maximum complexity, but differed in fill volume, with molars having considerably higher values than incisors. These results were compared with data from modern human groups with known diets. Both incisor and molar analyses indicate that meat was not a staple food at Amarna. Instead, texture attribute values suggest a diet reliant upon grain-based resources.

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A statistical test that two individuals are from the same randomly mating population.

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We describe a test of the null hypothesis that two individuals are unrelated members of the same randomly mating population. Our test is novel in that it does not require allele frequency or population membership information. Instead, our test works by comparing three estimates of population homozygosity. Two estimates are calculated as the proportion of homozygous sites within individuals, while the third estimate is calculated by comparing the allelic similarity between individuals.

Under the null hypothesis, all three estimates are consistent for the average number of homozygous sites between two copies of the genome. Thus, to test the null hypothesis, we use orthogonal contrasts from the three estimates to construct a chi square test statistic with two degrees of freedom. From an analysis of simulated data, we show that our test has the correct Type I error, and we examine its power under various alternatives. We apply our test to the genotype data of The International HapMap samples, and we demonstrate its ability to identify pairs who are inconsistent with the null hypothesis. As a result, our test has the potential to (1) improve inference in genome-wide association studies, (2) inform breeding programs for endangered

species; and (3) infer kinship in situations where only molecular data are available.
This research is supported by the Genome Science Training Grant (NIH T32HG00040) to N.M.S.

Dietary diversity and dental microwear variability in *Theropithecus gelada* and *Papio cynocephalus*.

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Dental microwear texture analysis has recently been proposed as a method with sufficient accuracy and precision to detect differences in dental microwear reflective of differences in dietary breadth. Accordingly, primate individuals and species with more narrowly focused diets are predicted to have less heterogeneous microwear textures and less variability in microwear textures between individuals. In particular, heterogeneity of area-scale fractal complexity ($HAsfc_{81\ cells}$) has been proposed as a microwear texture parameter to measure dietary variability.
Here we test this hypothesis on a sample of two cercopithecine species, *Theropithecus gelada* (N = 11) and *Papio cynocephalus* (N = 27). *Theropithecus gelada* relies on a more specialized diet (90% grass) while the diet of *Papio cynocephalus* is diverse ranging from fruits to leaves to animal prey. Thus, it is predicted that *Theropithecus gelada* molars would have less variable and less heterogeneous microwear textures compared to *Papio cynocephalus*.
Buccal wear facets were scanned using a white-light confocal profiler for all 38 specimens. Following published methodology, the heterogeneity parameter, $HAsfc_{81\ cells}$, was calculated for each specimen by comparing texture complexities of surfaces subdivided into 9 x 9 squares. Heterogeneity was significantly greater for *Papio cynocephalus* compared to *Theropithecus gelada* ($p = 0.005$, $\chi^2 = 12.1961$, Kruskal-Wallis test). Variability in heterogeneity between individuals was also significantly more for *Papio cynocephalus* ($p < 0.0001$, $F = 21.49$). These results support the hypothesis that broader or more diverse diets result in more variable microwear textures.
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Childhood obesity and the angle of the femoral neck: Relationship with slipped capital femoral epiphysis (SCFE) and adolescent tibia vara.

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The goal of this research is to determine the critical angle of knee alignment for healthy joint development and function in obese adolescents. Malalignment introduces abnormal strains on both the knee and hip joints. Excessive strains have been the suggested etiology for the most common orthopedic conditions in subadults. The conditions are comorbidities of obesity and are often correlated to knee malalignment. The conditions include slipped capital femoral epiphyses (SCFE) and Blount's disease. SCFE is a failure of the cartilaginous growth plate in the hip. This can lead to loss of blood supply at the joint and necrosis, requiring surgical pinning or hip replacement. In morbidly obese adolescents, the contra-lateral hip may subsequently fail. Adolescent Blount's disease is a progressive bowing of the tibia just below the knee, requiring surgical intervention. Both conditions, if untreated, lead to severe osteoarthritis and disability. The research involved the measurement of the angle of knee malalignment in existing radiographs of subjects diagnosed with one of the two orthopedic conditions. The radiographs used in this study are of patients of the Pediatric Surgery Department of the Knoxville Orthopedic Clinic. Forty-five male adolescent children are included in this study: 15 with SCFE, 15 with adolescent Blount's disease and 15 normal weight controls with no disease. At ten degrees of varus alignment, a liftoff occurs, leading to the acceleration of SCFE. As obese individuals cope with excessive loads, normal knee alignment is rare. In obese adolescents, malalignment could have deleterious consequences to normal bone and joint development.

Dental aging using multiple tooth wear indicators in conjunction with antemortem tooth loss.

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Teeth are one of the best means for aging skeletal remains, especially archaeological populations. This study presents a test case involving 98 individuals from the site of Hasanlu, Iran (17 subadults, 81 adults) and shows that aging methods using the dentition need to be expanded to include simultaneous evaluation of molar wear, molar crown height, exposure of secondary dentin, and antemortem tooth loss (AMTL). The Miles method was initially used to evaluate dental age in the Hasanlu collection because age estimates are derived by comparing wear rates within a population and are therefore less subject to reference sample bias. However, this technique seemed to underestimate the age of the Hasanlu skeletons, in part because wear was recorded using the scoring system presented in Buikstra and Ubelaker (1994) rather than basing observations on visual seriation. Although clear patterns of increasing wear are evident in the sample, calculating age using the wear scores alone proved challenging because the scoring system does not provide adequate evaluation of extreme wear. Dental aging encompasses multiple factors, much like the complex methods for skeletal aging, which rely on

evaluating several criteria. This example indicates that scoring AMTL, crown height, and secondary dentin exposure can improve dental aging based solely on wear. The non-parametric Spearman's rho coefficient indicates strong correlation between skeletal age and these dental markers and between the markers themselves. Focusing on a larger pattern of dental criteria will help to improve aging of adult individuals, especially those in the difficult upper age categories.

What are the distinctive features of human lactation biology and why should we care?

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This paper reviews recent theoretical and methodological advances in understanding the comparative biochemistry, behavioral ecology, and evolutionary biology of human milk, lactation, and complementary feeding. It aims to highlight briefly some recent advances in identifying the derived characteristics of human lactation biology and offer suggestions for an agenda for future comparative research by physical anthropologists.
We ask why does breastfeeding practice vary so markedly among individuals, between populations and across time? Evolutionary, anthropological and ethnographic comparisons can be used to develop a general conceptual framework to understand prehistoric, historic, and contemporary variation in human lactation and complementary feeding patterns. They suggest humans evolved an unusually flexible strategy for resolving tradeoffs between maternal costs of lactation and risk of poor infant outcomes. In modern environments this evolved flexibility creates potential for mismatch between optimal and actual feeding practices in many contemporary populations. Such mismatch can hamper efforts in improve maternal, neonatal and child health in the modern world or be reduced by modifying constraints on breastfeeding.
Discussion focuses on published findings, knowledge gaps, and recent innovations in theory and methods that throw light on questions about how human lactation biology varies and whether human lactation patterns are distinctive. Conclusions are that collection and integration of data on proximate mechanisms and ultimate explanations for variation in primate lactation is critical for developing a fuller understanding of the adaptive radiation in developmental programming, feeding, maternal investment, and life history.
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Craniofacial shape changes in *Pongo pygmaeus pygmaeus* – sexual dimorphism and bimaturism.

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The orangutan is one of the most dimorphic extant primate species. It shows, in contrast to African apes, an unusually long male developmental period and two adult male morphs (bimaturism). Males can arrest their development for a variable period but then rapidly develop into flanged, mature males. Investigating ontogenetic patterns of sexual dimorphism and bimaturism can help to clarify cranial shape variation in orangutans.
Our ontogenetic sample comprises 188 individuals and 71 three-dimensional craniofacial landmarks; four developmental stages were established according to status of dentition and sutures. This geometric morphometric study utilizes a Generalized Procrustes Analysis, form space Principal Component Analysis (PCA), and a quadratic regression in the subspace of the first three PCs to visualize ontogenetic trajectories.
The PCA shows sexual dimorphism in the first juvenile age-group but not in the
second. Male and female growth trajectories are almost parallel until convergence at the time when female growth ceases. At this stage most adult males with permanent dentition and an unfused basilar suture and mature females show very similar shapes. Then, with variable timing, adult males continue to grow, developing secondary sexual characteristics like flared zygomatics and a prolonged maxilla. The shape similarity of crested and uncrested mature males at the endpoint of the ontogenetic trajectory implies that cresting is not merely a function of size in orangutans. A precondition to develop into a mature male is maintaining an unfused basilar suture. Orangutan ontogeny is discussed as a consequence of the described sex-specific growth-trajectories.
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Environment influences bone elongation during a critical period of postnatal growth.

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Ambient temperature elicits permanent changes in extremity length after long-term heat or cold exposure in mammals, but it is unclear what mechanisms underlie these differences and in what pattern they emerge. This study tests the *a posteriori* hypothesis that adult limb length is subject to substantial modification during a brief but critical post-weaning time interval. Three-week old male CF-1 mice (N=28) were housed continuously at 7, 21, or 27C for

eight weeks in a previous investigation. Tails were measured weekly and lengths strongly correlated with long bones measured at endpoint. Analysis of tail growth curves revealed two distinct phases: an initial period of rapid temperature-sensitive growth in which elongation rate was directly impacted by ambient temperature; and a second phase in which rates were virtually identical among groups. Review of available literature reveals comparable reactions of skeletal growth in response to other environmental stressors such as activity, nutrition, and photoperiod. This supports the hypothesis that the postnatal skeleton is unusually responsive to external stimuli during a critical post-parturition window of heightened sensitivity. We are currently using *in vivo* multiphoton imaging to determine how these various environmental factors modulate vascular access to cartilaginous growth plates during this critical stage. Preliminary results demonstrate that growth plate vascular access is compromised by acute temperature changes, suggesting that initial vascular responses could potentiate at least part of the growth effect. Such studies are important for assessing environmental variables that may underlie skeletal variation among living and fossil primates.

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Results from early excavation at Tam Hang, Laos.

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This research presents the results of the first excavations at Tam Hang, a cave site located in the Southern Annamite Mountains of northeastern Laos. Tam Hang was excavated in the 1930s by the Geological Service of Indochina with significant paleoanthropological results, yielding a Middle Pleistocene human calvarium and a fragment of left temporal bone, representing one of only a handful of Middle Pleistocene sites in mainland Southeast Asia (Fromaget 1936, 1940). Additionally, past excavations at Tam Hang produced a sample of Late Pleistocene adults that included ten crania, six of which have relatively complete, associated skeletons (Demeter, 2000; Fromaget, 1936, 1940; Shackelford, 2005).

During October-November 2007, a French-American-Lao team returned to Tam Hang to resume excavation in the Pleistocene layers with the goal of clarifying and contextualizing the site within the prehistory of Southeast Asia. Faunal material collected during the 2007 field season from Middle Pleistocene layers of Tam Hang, including stegodon and orangutan, corroborate Fromaget's interpretation of the time period and identify a similarity between the fauna found at Tam Hang and that at other Middle Pleistocene sites where the arrival and dispersal of early humans in Southeast Asia have been demonstrated. Excavation in more recent layers outside the cave also resulted in substantial lithic remains that are inconsistent with any late Pleistocene or Hoabinhian type currently identified, suggesting that interpretations of Southeast Asian archaeology may reside outside the progressions seen in other parts of the world.

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Differences in cercopithecid communities in the African Plio-Pleistocene.

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Taxonomic differences between the cercopithecid species that occur at fossil sites in eastern and southern Africa during the Plio-Pleistocene have long been noted. Although only one species of colobine occurs in southern Africa, at least seven species of colobine occur in eastern Africa, whereas the number of cercopithecine species is relatively similar between the areas. These subfamilies make up different parts of the extant cercopithecid communities based on diet, body size, and substrate use. By using taxonomic uniformitarianism, the difference in subfamily make-up between eastern and southern African fossil sites may point to differences in the cercopithecid community ecology in these areas. To test the hypothesis that these communities are ecologically different, body mass, substrate use, and diet were reconstructed for taxa from four sites in southern Africa and six sites in eastern Africa spanning from 3.97 to 0.5 mya. These measures were used in a principal components analysis to examine differences between and among sites using niche breadth as a measure of species adaptation. The analysis showed that the southern African community lacked folivores but had many large frugivores, while the eastern African community had fewer frugivores but many folivores and had an overall greater diversity in adaptations. When viewed through time, cercopithecid adaptational separation in eastern Africa increased, but in the latest deposits the diversity of folivorous species was lost. These results imply that the community ecology of eastern and southern African cercopithecids differed in the Plio-Pleistocene, and that in eastern Africa the community ecology changed over time.

The effects of substrate size on quadrupedal locomotion in a small-bodied arboreal marsupial, *Petaurus breviceps* (sugar glider).

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Primates and arboreal marsupials are known to converge in their quadrupedal kinematics. The biomechanical advantages of these shared kinematic features are consistent with the view that primate quadrupedalism evolved in a small branch habitat. However, quadrupedal kinematic data are available for only a few arboreal marsupials, most of which are substantially larger than the presumed body size of the earliest primates. Because the challenge of a narrow branch has an inverse relationship with body size, small and large arboreal mammals may differ in their biomechanical response to small branches. This study tests for the effects of decreasing substrate diameter on quadrupedal kinematics in a small arboreal marsupial (the sugar glider, *Petaurus breviceps*), and compares the results to those reported for primates and other marsupials.
Four adult sugar gliders (average body mass 82g) were filmed at 100Hz walking across a flat surface or on horizontal poles of diameter 2.5, 1.0, and 0.5 cm (n=90 strides). 77% of all strides were lateral sequence/diagonal couplets gaits (25< limb phase <50), and 21% were diagonal sequence/diagonal couplets or trots (50≤limb phase<75). Like other arboreal marsupials, and in contrast to the terrestrial *Monodelphis*, limb phase increased on poles relative to the flat surface. However, sugar gliders used lower average limb phases than have been reported for other arboreal marsupials or primates, and used predominantly LSDC gaits even on the smallest pole. Results of this study highlight that mammals of different body sizes may use dissimilar, but equally successful strategies for navigating small branches.
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Energy pooling and implications for the unique traits of the human life history strategy.

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Compared to non-human primates, human life history is characterized by slow juvenile growth, late age at maturity, short interbirth intervals, and a decoupling of reproductive senescence and somatic senescence. Some of these traits represent a delay of reproductive effort while others represent an acceleration. To address this puzzle, we propose that humans in all three stages of the life span, pre-reproductives, adults of reproductive age, and post-reproductives, all contribute to a "pooled energy budget" (PEB) that is primarily utilized by the reproductively active female to carry out the energetically expensive tasks of gestation and lactation. Adults contribute to the pooled energy budget by providing food and care to children, thus freeing up the mother to provide more resources to a gestating fetus or a nursing infant and to resume postpartum ovulation more quickly. Pre-reproductives also contribute to the PEB. Older children, through participating in childcare and subsistence activities, can provide resources to partially meet their own energetic needs and to care for and provision younger siblings. The mother becomes the "final common pathway" through which energy flows in order to produce new offspring. While life history theory has traditionally considered growth, maintenance, and reproduction as the three main categories of energetic tradeoffs, we propose that energy allocated towards reproduction can be broken into two categories: direct and indirect reproductive effort. The contributions to the PEB made by both pre-reproductives and post-reproductives can be seen as indirect reproductive effort and can provide an explanation for slow childhood growth rates and menopause.

Bloodletting and bone: possible links between cultural practices and porotic hyperostosis.

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Bloodletting has been used as a therapy for a wide range of real and percieved ailments for centuries. Dating at least from Ancient Egyptian times, the practice was adopted by the Greeks and Romans, became widespread during the Middle Ages, and persisted until the turn of the 20th century. The amount of blood removed varied from approximately 20 ounces to several hundred ounces for "severe conditions," and blood was often removed several times over the course of a few days. Children, as well as adults, were often bled.
It is generally accepted within anthropology that one cause of porotic hyperostosis is iron deficiency secondary to poor quality diets. Other etiologies considered in the literature include specific infectious diseases, scurvy, parasites, and conditions of chronic blood loss. This paper explores a potential direct link between a particular cultural practice and the etiology of anemia, whereby the potential net loss of blood during a bloodletting session (or multiple sessions within a short time) places extraordinary demands on the hematopoietic system leading to porotic hyperostosis in children. Furthermore, recent work also suggests that bloodletting might be a causative factor in the development of osteoporosis in adults, indicating other possible links between cultural practices and skeletal pathologies. By focusing on specific criteria, we present a method for archival research into the biobehavioral identification of porotic hyperostosis and propose a theoretical etiological model that can be tested in future research on appropriate skeletal samples.

The influence of arboreality on longevity in mammals: A test of the evolutionary theory of aging.

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The evolutionary theory of aging predicts that organisms increase longevity by reducing extrinsic mortality rate, which exposes late-acting deleterious mutations to selection, ensuring that future generations will experience delayed senescence and longer maximal lifespans. At common body sizes, birds, bats, and gliding mammals possess longer maximal lifespans than non-volant, non-gliding mammals, presumably because of reduced predation. It has been suggested that arboreality has reduced extrinsic mortality in primates, thus slowing senescence and allowing for increased maximal lifespan. We test this hypothesis by analyzing a large dataset of lifespan records for 520 species of eutherian mammals, representing 15 orders. Species were organized according to recently published molecular phylogenies and analysis of covariance (ANCOVA) tests were conducted to determine whether regression lines for arboreal and terrestrial taxa are significantly different from each other in a given comparison. We show that, overall, arboreal mammals have significantly longer maximal lifespans than terrestrial mammals at common body sizes ($p<0.001$). This result holds true for every subclade of Eutheria in which comparable numbers of arboreal and terrestrial taxa exist. Because only humans have become fully terrestrial, a meaningful comparison among primates is not possible. However, when the remaining primates are assigned to arboreal and semi-arboreal categories, there is no significant difference between the two subgroups in terms of maximal lifespan. An arboreal evolutionary history may allow for increased longevity in all primates. Alternatively, primates may demonstrate a unique model of increased longevity independent of habitat type, perhaps in relation to increased brain size.

Were Levantine early modern *Homo sapiens* the marathoners of the Pleistocene?

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Recent studies have documented the correspondence between adolescent habitual activity patterns and upper and lower limb long bone diaphyseal strength properties in living humans (Shaw and Stock 2008a, Shaw and Stock 2008b). This paper compares the ratio of upper to lower limb torsional strength (humerus J:tibia J) among modern human varsity cross-country runners, swimmers, controls, Levantine anatomically modern *H. sapiens* (AMHS) (Skhul 4,5 Qafzeh 8,9) and Neandertals (Tabun 1, Spy 2, Amud 1, Shanidar 6). pQCT image derived cross-sectional diaphyseal strength properties were calculated for modern humans, while values for fossil hominins were obtained from the literature. Modern human runners show greater relative tibial strength than both swimmers and controls, while swimmers display greater relative humeral strength than runners and controls. In comparison, the upper to lower limb strength ratio of Neandertals and AMHS are more similar to runners than swimmers or controls. In general, the diaphyseal strength distribution of the AMHS are extreme, with greater tibial strength relative to humeral strength, than even modern human runners. These results suggest that both the Neandertals and AMHS included in this study were highly terrestrially mobile, and that early sapiens may have undertaken levels of mobility that were higher than modern human cross-country runners. Although preliminary, these analyses indicate that comparisons of prehistoric and fossil remains to modern human athletes may add to our understanding of prehistoric mobility patterns previously obtained through comparisons of remains alone.

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Microevolution of size, shape and timing changes in human pygmies.

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Recent debates have rekindled interest in the life history features of human pygmy groups, with one study (Migliano et al. 2007) suggesting that small body size is merely a correlate of early maturation and selection for rapid reproductive turnover. In this paper we use a comparative allometric and heterochronic approach to examine changes in size, shape and timing in various pygmy groups. Data comprise both published results and our own ongoing studies of body growth and skeletal proportions. Based on results in primates and other mammals, we conclude there is no necessary association of early maturation with small body size, and therefore little basis to conclude that there is no direct selection for reduced growth and body size in human pygmy populations. Analysis of adult skeletal limb proportions in African and Asian pygmy groups compared to African and non-African reference samples allowed us to test the null hypothesis of shape change resulting only via allometric truncation. Results revealed significant departures from simple allometric concordance, particularly in the East African pygmies, who converge on non-African proportions due to a significant reduction in length of the distal extremities. By contrast, proximal elements and within-limb comparisons follow a shared pattern in our samples. Overall, our analyses indicate that selection has clearly targeted both body size and body shape in the microevolution of the pygmy phenotype in various regions of the world. We discuss climatic adaptation and other hypotheses which may account for

these size, shape and timing changes in human pygmies.

Asian primate species richness correlates with rainfall using GIS modeling.

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We use GIS modeling to study the relationship between primate species richness (PSR) and rainfall. Our work was preceded by: Reed and Fleagle (1995), who found Asia to be anomalous because it showed no correlation in these variables, whereas they were found to correlate linearly in Africa, Madagascar, and the Neotropics; and Kay et al. (1997), who found non-linear relationships for Asia and the Neotropics. GIS modeling allows much denser sampling than previous studies, with the caveat that data are modeled rather than measured. In our results, first on southeast Asian primates (Srivathsan et al. 2008), and now extended to all Asian primates, we find a strong, positive, linear correlation between PSR and mean annual rainfall, and a strong, negative, linear correlation between PSR and seasonality/dry-months.
Separate analyses of biogeographic regions within Asia were performed for both variables. PSR is strongly influenced in Asia by powerful biogeographic effects, which can mask the overall relationship when examining limited data sets, or reveal more complex relationships when studied *in toto*. In the case of mean annual rainfall, we interpret the pattern of strong, weak, and insignificant relationships with PSR in the separate biogeographic regions to fit the predictions of Kay et al. of a bell-shaped curve, where plant productivity influences PSR. In the case of seasonality, breakpoint regression analysis reveals a breakpoint at approximately five dry-months, after which PSR is nearly constant. We interpret this as supporting the hypothesis by Reed and Fleagle that monsoonal climates place a cap on PSR.

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Classifying axial developmental defects in skeletal cases: Cranial or caudal?

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Axial developmental defects give insight into human development and allow inferences to be made about contributory health and environmental factors. This study analyzes the prevalence of different axial defects in a Florida Industrial sample in order to examine the accuracy of two contradictory definitions of cranial/caudal vertebral border shifting. Specifically, we hypothesized that theses two definitions—one based upon the shifting of a vertebral border and the other upon the shifting of vertebral characteristics —would lead to opposite defect classifications. Our Floridian Industrial sample consisted of 105 skeletal cases from the 1960s to the present. At least 30% of each individual was present, including the elements necessary to ensure accurate sex, age, ancestry, and stature estimates. The presence/absence of anomalies such as *spina bifida occulta*, *pars interarticularis* defects, cranial/caudal vertebral border shifting, irregular vertebral/rib segmentation, and sternal fusion defects, was recorded. We classified vertebral border defects using both definitions and compared the results using chi square analysis of variance. Fifteen individuals exhibited at least one type of border shifting (14.3%). Also common were *pars* defects (n = 15, 14.3%) and *spina bifida occulta* (n = 11, 10.5%), while most other defects occurred in less than 5% of the sample. The chi square analysis demonstrated that cranial/caudal classifications given by the two definitions were opposite and significantly different ($X^2 = 16.705$, df = 2, $p<0.001$). The definition based upon border movements resulted in a higher incidence of cranial defects (n = 11), which was consistent with the current literature.

Neighborhood mortality and the scarlet fever pandemic in 1875 Binghamton, New York.

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This study consists of a demographic and epidemiological analysis of mortality patterns observable within the 1875 State Census for the City of Binghamton, NY. Individual wards and election districts were examined in order to ascertain relationships between disease patterns and population density, ethnicity and socioeconomic status. Specific analysis was conducted regarding rates of death from scarlet fever and other infectious diseases between municipal divisions. Results showed that scarlet fever deaths were ubiquitous across municipal districts compared to other infectious diseases, such as tuberculosis and cholera, suggesting that demographic and socioeconomic factors were less significant determinants in mortality due to scarlet fever than for other infectious diseases. These results are consistent with previous historical epidemiological research on scarlet fever.
This study is an outgrowth of the Binghamton Neighborhood Project, a multidisciplinary microscale project designed to study quality of life factors in the City of Binghamton, NY.

Social tension and risky behaviors among male chimpanzees at Ngogo, Kibale, Uganda.

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Social tension is common in many group living primates, and is typically the result of competition

over resources, mates or social partners. Among chimpanzees social tension is common among males, and males use mediating behaviors, such as grooming to reduce tensions with conspecifics. Despite the abundance of research that has focused on social tension and mediating behaviors in chimpanzees, few studies have addressed whether or not social tension leads to other, risky, behaviors such as hunting or boundary patrols. I present data on social tensions and risky behaviors among male chimpanzees at Ngogo, Kibale National Park, Uganda that address this deficiency. The Ngogo community is unusually large, with over twenty-five adult and fifteen adolescent males. The number of males within the community provides for numerous opportunities for play throughout any given day. Data from over 300 instances of risky behavior (hunting and patrolling combined) indicate that social tension is a predictor for risky behaviors among male chimpanzees.

Inhibitory interneurons and the evolution of human frontal cortex.

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Inhibitory interneurons participate in local processing circuits, playing a central role in executive cognitive functions of the prefrontal cortex. Although humans differ from other primates in a number of cognitive domains, it is not currently known whether the interneuron system changed in the course of primate evolution leading to our species. In this study we examined the distribution of different interneuron subtypes in layer II/III of the frontal cortex in anthropoid primates as revealed by immunohistochemistry against calbindin, calretinin, and parvalbumin. Variance partitioning analysis of dorsolateral prefrontal cortex (area 9) from 23 anthropoid species demonstrated that total neuron density explained a greater amount of variance in the density of interneuron subtypes than phylogeny. In addition, human interneuron subtype densities were closely predicted by allometric scaling trends against total neuron density from the nonhuman sample based on species tip data and independent contrasts. We also examined variation in interneuron percentages among humans, chimpanzees, and macaques (n=6 each species) across regions of the frontal cortex (areas 4, 9, 32, and 44). A discriminant function analysis (DFA) of these data was able to accurately categorize 94.4% of cases to the correct species. Both the DFA and repeated-measures ANOVAs revealed that the greatest phyletic difference was a relatively large percentage of calbindin-containing interneurons in area 4 of chimpanzees as compared with macaques and humans. Our findings demonstrate that interneurons vary in their distribution within the frontal cortex of primates, however species differences do not clearly map to the evolution of human cognition.

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The genetics of morphology.

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Physical anthropology has long been largely devoted to detailing the structural morphology of extinct and extant primates, characterizing geographic as well as inter- and intraspecies morphological variation, and to exploring the functional influences on morphology. Less attention has been directed at elucidating the genetic underpinnings on trait variation despite the acknowledged implications for phylogenetic analyses. Current approaches investigating the genetics of morphological variation range from genetic epidemiological approaches to genetic manipulation of animal models. While the specific focus may range from understanding the evolution of morphologic features to characterizing the genetic etiology of common congenital deformities, any successful study will have broad applications across disciplines.

Our work has begun to elucidate the genetic architecture of complex craniofacial traits and measures of bone growth and bone health in both human and non-human primates. We have found significant genetic linkage (LOD > 3.0) for second metacarpal morphology in pre-pubertal children and cranial morphology in humans and baboons. We have also found strong evidence for genetic influences in knee and hand joint morphology, with heritabilities as high as 0.72. This work acts as an introduction to studies from the fields of development, evolution, and dysmorphology. Just as the historic paradigm shift from purely descriptive anatomy to functional anatomical inquiry had dramatic effects on the field, the potential shift to a more genetics-based understanding of morphology is expected to refine our understanding of the nature of morphologic change.

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The effect of variations in muscle positions in a complex

biomechanical model of a macaque skull.

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Biomechanical modelling is invaluable in functional anatomy, allowing the effects of forces and motions to be analysed through 3D computational simulations. In this study we developed a complex multibody dynamics (MD) model to study the cranial loading of *Macaca fascicularis* during biting. The model included the major muscles of mastication (temporalis, masseter, medial/lateral pterygoids) and incorporated muscle wrapping of the anterior and posterior temporalis. Unconstrained contact was defined at the temporo-mandibular joints during biting, with a feedback loop used to limit the anterior/posterior movement of the mandible through automatic muscle control.

The MD model calculates the bite force and joint forces produced by the applied muscle forces; however, the sensitivity of these forces to factors such as muscle position must be known to have confidence in the simulation and to understand its limitations. Thus, a range of bite positions and gape angles (canine to molar biting at gapes of 5° to 30°) was considered during the simulations. The analyses revealed that a shift in muscle position of just 5 mm could alter the bite forces by up to 20% (the skull had a postorbital length of 65 mm). The location of the temporalis muscle group had the greatest effect, while the position of the deep masseter was least important. These studies highlight the importance of accurate muscular representations when undertaking any modelling of skulls. The effect of these variations on the strain distributions in the macaque skull is now being investigated in a complementary finite element study.

This work is supported by BBSRC grants BBE0138051 and BBE014259.

Epiphyseal union in the medial clavicle: evidence for secular change in skeletal maturation.

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Accelerated maturation has been documented in the majority of western populations for nearly a century, primarily in terms of menarcheal onset. Because sexual and skeletal maturation are closely related, acceleration in pubertal onset is likely indicative of accelerated skeletal maturation. This phenomenon is of particular concern in a forensic context, wherein age estimates based on reference standards from populations that have undergone significant positive secular change may be overestimates.

This study documents epiphyseal union of the medial clavicle in the American population throughout the 20th century using three skeletal samples: the early 20th century Hamann-Todd Collection, the McKern and Stewart Korean War data, and the late 20th century McCormick Clavicle Collection. Transition analysis was used to derive statistically robust age ranges for fusion in each population.

Results indicate that the modern McCormick individuals begin fusion approximately 4.5 years earlier than the Hamann-Todd individuals. Likewise, the McCormick males begin fusion approximately 4 years earlier than the Korean War males. On the other hand, the Hamann-Todd and Korean War males differed significantly only in terms of final union, wherein the Korean War males completed union approximately 2 years before the Todd males.

These results underscore the importance of using modern standards to assess the age of modern individuals. As the American population continues to change, particularly with the current obesity epidemic, anthropologists will be charged with the task of evaluating how these changes in human biology affect our understanding of human skeletal variation.

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The genetics of normal variation in the mammalian dentition.

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Evolution occurs through the differential proliferation of normal variation in traits, but our understanding of genetic and developmental processes is based almost exclusively on the study of pathologic variation. Normal variation in teeth has been catalogued and shown to be heritable but its developmental origins remain unknown. Understanding these origins requires the use of analogy from an animal model where embryonic development can be manipulated. Here we show results of two methods for genetically dissecting normal dental variation in mice. First, genetic mapping in recombinant inbred mice detects associations between normal dental variation and regions of mouse chromosomes 11, 13, and 19. Two genes, *Glis3* and *Itga3*, with coding variation are identified as candidates. Additionally, potential regulatory variation is identified in several genes. However, traditional identification of candidate genes using published literature is shown to be biased. More than half of the genes in the mapping regions are found to be expressed in developing teeth using the GenePaint database. Second, transgenic alteration of the expression of the signaling factor *Bmp4* in developing teeth using the epithelium-specific enhancer of *Dlx2* shows that tooth development

is robust to over-expression of this important developmental molecule. Analysis of gene expression suggests that the buffering mechanism is complex and involves antagonists of BMP signaling, *ectodin* and *follistatin*. Studying normal variation is difficult because of the subtle genetic and developmental changes involved; however the methods presented are a first step in addressing this evolutionary vital subject and can be applied to traits beyond the dentition.

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Three-dimensional laser scan models of pubic bones as an age estimation tool for adult males.

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Current methods of age estimation from the pubic bone are generally effective at identifying youthful patterns in symphyseal surface morphology associated with a narrow range of chronological ages. However, since many of the qualitative traits used to characterize older patterns can be highly variable in expression, age estimates for these individuals tend to be less precise. Using a three-dimensional (3D) laser scanner to produce high resolution, digital models of pubic bones from male individuals of known age, we have focused on the problem of differentiating between the advanced phases (Phases 4, 5, and 6) of the Suchey-Brooks method. By analyzing pubic surface morphology with various 3D data analysis tools and techniques, we have quantified three aspects of the symphyseal surface that exhibit age-related changes in individuals over 40 - the symphyseal rim, symphyseal depression, and symphyseal lipping. The resulting morphometric data were explored for age-related correlations. The results highlight both the advantages and limitations of the use of a 3D model of the pubic bone as a tool for age estimations.

Genetics, selection, perception and the human face.

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The extensive variability in the human face is clear evidence for rapid evolution of the genes underlying facial morphology. Since Darwin's seminal work, 150 years ago there has been much speculation regarding how evolution has shaped the human face. Are these recently evolved facial traits more likely the result of natural selection, sexual selection or some of each? How can sexual selection be distinguished from natural selection? A number of tools are now available to anthropologists interested in the genetics of recently evolved traits including admixture mapping, observer-based studies, and screens for non-neutral genomic signatures. We will explore the application of these approaches presenting preliminary results on facial feature genetics and the evolutionary patterns in the genes determining variability in facial features as well as work on how particular facial feature traits are perceived by observers. Our results show that there are significant correlations between estimates of genetic ancestry and facial feature traits in both an African-American and Brazilian population sample and that observers can make good estimates of proportional ancestry when looking at a subjects face. In testing six candidate genes for significant effects on facial features, several demonstrate compelling effects on particular parts of the face using admixture mapping. Support in part from NIH (HG002154) and NIJ (2008-DN-BX-K125).

Mongoose lemur (*Eulemur mongoz*): Ecological requirements and conservation implications.

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Strepsirhine research is vital for our understanding of primate origins, however due to the loss of habitat, many species are threatened. More importantly, the threat level of many lemur species remains unevaluated or outdated. Mongoose lemurs (*Eulemur mongoz*) are naturally found only in the highly fragmented western dry deciduous forests of northwest Madagascar and are currently considered Vulnerable by the IUCN. Fragments throughout the species' range were surveyed for lemur densities using strip transects. Habitat sampling was conducted using point-quarter sampling to determine ecological requirements of the species. Correlations were found between *E. mongoz* densities and high humidity and canopy cover. Nested analysis predicted *E. mongoz* as the first lemur species present in the region to become extinct as fragment size decreases, and the nested rank of the fragments were significantly correlated with the size of the fragment. A dramatic decrease in *E. mongoz* density and available habitat was seen when compared to previous research. In one surveyed fragment, *E. mongoz* densities had declined 85% over the last 13 years. The exact distribution is not known for the species and densities are only known for a small part of their range, but the Vulnerable status of the species is likely no longer correct. This research implies that the species has specific ecological requirements and are more vulnerable to fragmentation than the other lemurs in the region. Therefore, the largest remaining fragments in the region should be of highest conservation priority.

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A life in the cane fields: osteological patterns of life time

activity among enslaved Africans from Newton Plantation, Barbados.

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A sugar boom ignited in the mid-17th century that contributed to the forced relocation of 1.6 million Africans to the Caribbean. At the center was Barbados: a tiny but key British colony receiving more than 350,000 enslaved laborers. Historical accounts reveal brutal gang labor on West Indian sugar plantations, culminating in high mortality and extremely poor quality of life relative to other New World economies. Yet the direct biological impacts of sugar production, particularly by age and sex, are not well understood. We present new skeletal evidence of activity-induced stressors from a large, historic Caribbean sugar plantation. Newton Plantation cemetery (ca. 1660-1820) was initially excavated in 1971-1973, producing a wealth of information, but postcrania were not retained for study. Subsequent excavations in 1997-1998 by Shuler and Pasquariello yielded 49 skeletons which were examined for systemic activity patterns, including degenerative joint disease, Schmorl's nodes, and enthesopathies. Adults display high rates of muscle cresting and tearing (76%) and joint modification (59%), but moderate vertebral herniation rates (25%). Activity stressors are more common in the females, although cresting and severe muscle tearing is more frequent for males in this sample. Upper appendicular skeletons are most impacted and axial skeletons show more mid-to-lower back modification, while neck modification is uncommon for both sexes. Tibial lesions in one male suggest infection from harvesting injuries. Finally, we explore osteological patterns at this site in conjunction with extensive published archival records to interpret lifetime activity patterns, including the unexpected findings for females in this sample.

Dietary intake and hot flash frequencies in Bangladeshi residents, Bangladeshi migrants, and European women in London.

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Much attention has been given to possible effects of phytoestrogen consumption on frequency and severity of hot flashes. This ongoing study was conducted to compare reproductive aging and symptom experience among Bangladesh immigrants living in London (n=143), neighbors of European origin (n=74) and Bangladeshis still living in Sylhet, Bangladesh (n=157). Hot flash frequencies during the preceding two weeks were investigated. A list of 30 culture-specific, phytoestrogenic foods was developed for Bangladeshis; many of the same foods (e.g., red lentils) are eaten by Bangladeshi neighbors as well. In exploratory analyses, hot flashes (yes/no) were examined in relation to frequency of consumption (4 categories, from never to daily) of each food.
There were few significant associations or trends. Migrant Bangladeshis who never consumed cabbage were significantly more likely to report hot flashes (75%) compared to women who ate cabbage occasionally (34%) or more than monthly (32%, $p<.05$). Foods were also grouped by factor analyses, and the sum of food frequency for each factor cluster was examined by t-test in relation to hot flash experience. Among women of European origin, those without hot flashes ate significantly more foods that clustered into Factor Two -- legumes (dried peas, red lentils, mung beans, broad beans, chick pea flour, garbanzo beans) and spices (ginger and turmeric) -- compared to women with hot flashes. The same was not true for Bangladeshis. It may be that some lignans (e.g., legumes) have a greater dampening effect on hot flash experience in one population than in another.
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The endocast of *Microsyops annectens* (Microsyopidae, Primates) and brain evolution in stem primates.

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Relatively large brain size is often cited as a distinguishing feature of Euprimates. Endocast data for stem primates ("plesiadapiforms") are needed to illuminate the evolutionary history of this characteristic. Until now relevant data have been limited to an endocast of *Ignacius* and partial endocasts of *Plesiadapis* and *Megadelphus*. We describe a new virtual endocast produced from an ultra high resolution X-ray computed tomography scan of a complete skull of the microsyopid plesiadapiform *Microsyops annectens* from the middle Eocene of Wyoming. Cranial capacity is estimated as 5.9 cubic centimeters, yielding an encephalization quotient (EQ) of 0.26-0.39 (Jerison's equation) or 0.35-0.57 (Eisenberg's equation), depending on the body mass estimate used. Even the lowest EQ estimate for *Microsyops* is higher than that of *Plesiadapis*; *Ignacius*' EQ lies within the range of estimates for *Microsyops*. As in the other plesiadapiforms, the olfactory bulbs of *Microsyops* are large, and the cerebrum does not extend onto the cerebellum or form a ventrally protruding temporal lobe,

suggesting less development of the visual sense than in extant euprimates, and a greater emphasis on olfaction. Unlike the endocasts of *Ignacius* and *Plesiadapis*, however, the caudal colliculi are not exposed rostral to the cerebellum, which could reflect some relative expansion of the cerebrum caudally. There are two well defined sulci (lateral and suprasylvian) in *Microsyops*, similar to the condition of *Megadelphus* and *Smilodectes*, but in contrast with the lissencephalic cerebrum of *Ignacius*. Variation amongst these plesiadapiforms may in part reflect ecological differences such as diet.

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Skull shapes, maps, and microscribes.

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With the increasing use of landmark-based geometric morphometrics in physical anthropology, raw data reliability has equally gained scrutiny. Most previous studies have emphasized measurement precision, especially when compared to calipers and other devices. The potential consequences for biological conclusions have been rarely examined. Here, we investigate patterns of intra- and interobserver error, and how they affect population variation as quantified by geometric morphometrics. A sample of 100 modern human crania, representing five geographically distinct populations, was digitized with a Microscribe 3DX. Three observers repeatedly recorded a series of type I-III landmarks. Crania remained in place during all measurements in order to test the repeatability of each landmark.

Intra- and interobserver precision across three observations was found to be similar, with respective ranges between 0.27-3.2mm and 0.56-4.74mm, the highest deviation being observed in type III landmarks, while type I landmarks yielded much smaller variances. PCA of Procrustes aligned specimens produced overall very similar patterns of between-population variation. Still, the degree of overlap/separation varied between observers and individual reruns. Moreover, Procrustes distances between populations, expectedly, varied in absolute terms, but also relatively, which was unexpected: populations that were closest in shape space in one analysis, were not necessarily so when digitized by other observers. On the other hand, our preliminary results indicate that population distances are relatively robust with respect to intra-observer variation. We caution that such sources of error need to be quantified systematically and taken into account in statistical analyses, before conclusions on patterns of shape variation are drawn.

Humeral and femoral cross-sectional shape of suspensory sloths and primates.

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Previous studies of cross-sectional geometry of long bone diaphyses have suggested that the ratio of the principal moments of area (Imax/Imin) reflects habitual locomotor behaviors. Among primates, ratios about principal axes (PMAs) of the humerus and femur appear to distinguish between those that are predominantly terrestrial from those that are arboreal. In particular, a PMA ratio close to 1.0 (i.e., more circular cross-section) has been shown to correlate with increased suspensory locomotion among African apes. Whether this pattern holds true for other suspensory primates (i.e., Asian apes) and other suspensory mammals (i.e., sloths) has yet to be investigated. Cross-sectional digital images at mid-shaft of the humerus and femur were obtained from two genera of suspensory sloths (*Bradypus, Choloepus*), five species of suspensory primates (*Hylobates lar, Hylobates syndactylus, Pongo pygmaeus, Pan paniscus, Pan troglodytes, Gorilla gorilla*), and a quadrupedal primate outgroup (*Papio cynocephalus*). Using MomentMacroJ v1.3 for ImageJ software, PMA ratios were calculated and compared between taxonomic and locomotor groups. As predicted, the humeri of suspensory primates and sloths were more circular than those of quadrupedal baboons. Contrary to prediction, PMA ratios of the femur do not successfully differentiate between groups. This pattern differs from previously published results for African ape comparisons. Whereas PMA ratios for the humerus are suitable for assessing suspensory behaviors, they appear not to be for the femur. Accordingly, we suggest that the inclusion of greater phylogenetic and functional diversity in comparative analyses of cross-sectional shape is necessary for inferring habitual locomotor behavior from long bones.

A female *Homo erectus* pelvis from Gona, Ethiopia.

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Homo erectus was the first of the ancient human ancestors discovered. Yet, more than one hundred years after its original announcement, significant aspects of its biology still remain poorly known. The recovery of a nearly complete 0.9-1.4 Ma *Homo erectus* female pelvis (BSN49/P27) from the Gona Paleoanthropological Research Project study area in the Afar State of Ethiopia allows a more accurate reconstruction of female body size, obstetric capacity, body form, and locomotor specializations than previously possible for this species. This fossil includes right and left os coxae, much of the sacrum and the last lumbar vertebra, which have allowed an anatomically reliable restoration of the complete pelvis.
This pelvis, which is transversely broad with laterally flaring ilia, is from a small-bodied individual with an estimated stature of 1.2-1.46 m – markedly shorter than the KNM-WT 15000 skeleton. Based on its morphology (wide greater sciatic notch and subpubic angle with a subpubic concavity, everted ischia, ventral arc, and preauricular sulcus), it is clearly a female pelvis indicating obstetric specializations were manifest in the Early Pleistocene resulting in a characteristically dimorphic pelvis. The obstetric dimensions are at or above those of many contemporary human populations and calculated maximum neonatal head dimensions are significantly greater than previous fossil-based estimates. This indicates that female pelvis size did not constrain secular trends in increasing brain size during the Early Pleistocene and that larger-brained and perhaps less altricial neonates characterized *Homo erectus*.

Patters of cranial integration in *Pan*, *Gorilla*, *Pongo* and *Homo*: similar or different?

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Morphological integration is an important factor that influences the evolutionary potential of the phenotype. Varying levels of developmental and functional processes can greatly affect and/or alter covariance structures among morphological elements. Integrative features of the mammalian cranium have been a particularly keen subject of investigation in experimental as well as osteometric studies.
Increasing application of methods such as 3D geometric morphometrics to analyze biological forms has further facilitated the study of phenotypic variation and covariation patterns in a variety of biological data. Among anthropological studies, several works have examined aspects of cranial integration in primates, but few have included comparisons of the entire cranium across great apes and modern humans.
Here, we conduct a comparative analysis of cranial integration patterns in *Pan*, *Gorilla*, *Pongo* and *Homo*. We hypothesize that closely related taxa have similar patterns of covariation among morphological units. Fifty-five 3D ectocranial landmarks were digitized on 357 adult individuals. Covariation patterns were compared among three *a priori* defined cranial regions: basicranium, face and vault. Statistical methods used in the study include generalized procrustes analysis to superimpose the specimen landmark configurations and 2Block partial-least squares, used to examine covariation patterns between different blocks. Our current results do not fully support our hypothesis of similar integration patterns among apes and humans, instead suggesting that covariance structures between the blocks may diverge among closely related species. These preliminary findings warrant further investigation into the role of phenotypic evolvability in the development and evolution of hominid cranial form.

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Intraspecific phylogeography of the Chacma baboon reveals evidence for behavioural adaptation to local habitats.

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The study of genetic variation within multiple populations of the same taxon can provide valuable insight into factors driving lineage diversification across space and time. Chacma baboons display a wide degree of regionally distributed physical and behavioral variation across their considerable geographic range. A recent study on chacma baboons (*Papio ursinus*) revealed an ancient diversification event within this lineage, correlating to climatic fluctuations across the Plio-Pleistocene. This study aims to understand underlying microevolutionary process by analysing mitochondrial haplotype diversity as it relates to the landscape and quantifying the level and directionality of gene flow among populations. Samples were collected from localities (N>30) in South Africa, Namibia, Botswana and Zambia, representing a diverse range of habitats and ecosystems in which chacma baboons occur. Network reconstruction of haplotype relationships reveals strong geographic structuring across the species range, while measures of gene flow are dominated by nearest-neighbour exchange. These results suggest that, despite being a generalist species, adaptation to local habitat may limit individual dispersal distances and consequently gene flow between populations of chacma baboons. While large scale climatic change and possible habitat shifts may account for deep divergences in the chacma lineage, ecosystem boundaries and behavioural

adaptation to local habitat are primary factors influencing population differentiation within chacma. From this perspective, the wide range of morphological diversity that has been well-documented within these baboons is most likely to be the product of neutral evolution.

Injuries in Classical ballerinas related to behavior and biomechanics.

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Ballet dancers are faced with the demands for a thin, trim body; a physique, which has been deemed as beautiful and acceptable in the world of dance while confronting the biomechanical demands, placed on their ankles and feet. Consequently, diet and nutrition are critical for maintaining the balance between body form and function. The goals of this project are to understand how behavior and diet can affect ballet dancer's state of health and how stress and fatigue contribute to poor health later in life.
Data specific to dietary recall, ethnographic survey of 44 dancers and 39 non-dancers are presented. In addition, dancers participated in a biomechanical assessment providing ground reaction forces and joint forces data for several ballet and non-ballet movements. X-ray's of pass injuries from dancers are also examined. The Fisher's Exact test were administered to the data as the relationships between body mass index, caloric intake, training, workload, to the frequency of dance injuries is examined. Our results demonstrated that there is a strong relationship between training (types and levels) to the frequency of injuries and workload (number of hours training) to the frequency of injuries. Poor training and long hours increase the likelihood of having an injury. Ultimately, our goal is to provide information to dance students and instructors to prevent chronic and acute dance injuries.

Testing an explanatory model for the variable presence of cusp 6 in *Pan* lower molars.

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Lower molars of species in the chimp/human clade (including fossil hominins) possess between four and seven cusps and this variability has been implicated in alpha taxonomy and phylogenetic systematics. What is known about the developmental basis of this plasticity — based primarily on experimental studies of rodent molars — suggests that cusp patterning is the result of morphodynamic process involving the iterative formation of enamel knots. Inherent to a 'patterning cascade mode of cusp development' (PCMCD) is the premise that small changes in the development of initial cusps can influence the presence and morphology of later-forming cusps.
In this study we test whether variation in cusp 6 (C6) presence in *Pan* lower first and second molars (N = 57) is consistent with predictions derived from a PCMCD model. Using microCT we imaged the enamel-dentine junction (EDJ) of lower molars and used geometric morphometrics to examine shape variation in the molar crown (in particular the size and spacing of the dentine horns) correlated with variation in C6.
Results indicate that C6 presence is consistent with predictions based on the PCMCD: larger molars exhibit a higher frequency of C6, the location and size of later-forming cusps (including C6) is more variable than earlier-forming cusps, and molars with relatively short hypoconids and hypoconulids exhibit a higher frequency of C6. These results have implications for the use of accessory cusp morphology in discrete trait analyses and demonstrate that the PCMCD is an appropriate model for interpreting cusp variation in *Pan* and, by extension, the chimp/human clade.
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Variation and secular trends in linear measurements of the mandible.

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Although secular trends for the cranium and the postcranial skeleton are often examined, such trends in the mandible are largely ignored. The aim of this study is twofold: first, to help characterize variation of the mandible using linear measurements and individuals of European and African American ancestries, and second, to investigate morphological change since the 1860s. Nine standard measurements for the mandible, along with palate length and breadth, were taken on 246 skulls from the Terry and Bass collections. Contemporary data from the Forensic Data Bank and forensic cases from the C.A. Pound Human Identification Laboratory supplemented information for African Americans.

Our results reveal that males are significantly larger than females in bigonial width and bicondylar breadth. African American individuals have thicker mandibular bodies than Europeans, regardless of sexual dimorphism. Measurements with significant differences for both sex and ancestry groups include: alveolar length and breadth, chin and body height, minimum and maximum ramus breadth, ramus height, and mandibular length. In most of these instances, European females are smallest, African American males are largest, and African American females are either slightly larger or not significantly different from European males. Secular trends for each measurement generally vary

between sex and ancestry groups. While secular changes in the mandible are complex and require further investigation, this study suggests that overall morphological differences between sex and ancestry groups observed in the rest of the skeleton hold true for the mandible, and that certain measurements may aid in sex and ancestry determination for unknown individuals.

Measuring human remains in the field: grid technique, total station, or MicroScirbe?

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Although the collection of 3D data during excavations of human remains provides essential evidence for the reconstruction of past funeral behavior and crime scenes, little is known about the process of the skeletal 3D data collection in the field. The goal of our research is to investigate accuracy, repeatability, and reproducibility between three approaches to measuring bones in the field: standard grid technique, total station, and MicroScribe 3D digitizer. Three groups of skeletal remains (perinatal [4 skeletons; n_{points}=62], infant and juvenile [3 skeletons; n_{points}=112], and adult skeletons [5 skeletons; n_{points}=131]) were measured by two observers repeatedly in the same day and between days. We compared inter- and intra-observer error, and inter-technical error using mean percentage difference (MD%), mean percentage absolute difference (MAD%), and limits of agreement (LA). The most reliable measurements were produced by MicroScribe 3D digitizer (MD% in majority of comparisons bellow 1 mm; range for MAD% between 1-2 mm). Similar results were obtained with the total station. However, the total station was very sensitive to minuscule deviations in initial set up and positioning the prism during measuring. When the total station is not used carefully, the MD% and MAD% is similar to the grid technique (MD%=3-5 mm; MAD%=3-7 mm). All the tree techniques were most reliable when perinatal skeletons were measured. This is a promising result, the accuracy is more critical for the graphic reconstruction of perinatal individuals than adult individuals. Further recommendations concerning measurement of skeletons in the field will be provided.

Changing faces: an examination of robust craniofacial features in *Macaca majori* and implications for the hominid fossil record.

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The Sardinian fossil old world monkey, *Macaca majori* exhibits a highly derived craniofacial morphology that, in certain respects, parallels that seen in australopithecines. An adult specimen preserving a relatively complete face (TY5199) exhibits a robust and laterally flaring zygomatic root and postorbital bar, broadened posterior palate and enlarged postcanine dentition and a distinctive supraorbital torus. The biomechanical relationships of these traits were assessed using a combination of geometric morphopmetrics (GMM) and finite element analysis (FEA). This method allowed for the examination of global robust morphology as well as isolated craniofacial characteristics. Results indicate that the *M. majori* face is, as a whole, more efficient at absorbing masticatory loads than that of *M. fascicularis*. However, the derived skeletal traits seen in *M. majori* do not result in universally lower strains in all aspects of the face. Rather, these traits may increase overall structural efficiency but elevate strains locally in some parts of the face. Furthermore, when isolated, some traits may have a negative effect on structural efficiency but a positive effect when present within a suite of characteristics. Thus, it is an oversimplification to state that the traits are straightforward stress-reducing adaptations. Our results are consistent with the hypothesis that these features are chewing adaptations, but the manner in which they are adaptive may be related to global rather than local decreases in strains. Insofar as the morphology of *M. majori* resembles that of early hominids, it is possible that this interpretation may apply equally well to our own ancestors.

Observing stress in captive Western Lowland Gorillas (*Gorilla gorilla gorilla*) through behavioral observations and fecal cortisol.

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Gorillas have recently been listed as critically endangered on the IUCN Red List, vulnerable to hunting and disease and historically difficult to maintain in captivity. Living conditions for captive gorillas have improved but recently a significant number of deaths among relatively young silverbacks have been linked to poor cardiac health. Stress has been suggested to be a possible contributing factor in these deaths. Captive gorillas are exposed to different stressors than those they would encounter in the wild, including restricted movement and opportunities for inter-group interaction or dispersal, noise associated with captive environments, human visitors and construction. Any of these stressors can lead to poor health and well-being in captive individuals. This study examines the potential chronic stressors faced by gorillas in captivity and explores relationships between captivity, stress behaviors and stress hormones among captive gorillas at

the San Francisco Zoo. Fecal and behavioral data were collected on 5 gorillas (1 silverback, 4 females) from June 30, 2007 to August 10, 2007. All gorillas showed a negative relationship between gorilla stress behavior and overall and peak cortisol levels (i.e. silverback: -0.699, $p<.036$; -.025, $p<.006$), though gorilla stress behaviors and stress hormones correlated with human activity and situations specific to captivity (i.e. silverback: Beta=.240, $p<.001$), such as construction, suggest that gorillas are sensitive to particular dimensions in the captive environment. This study suggests directions for individual zoos to explore in their efforts to monitor and alleviate potential stressors for the gorillas in their care.

Identifying selection and genetic drift in the landmark-based 3D cranial morphology of modern humans.

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In order to accurately interpret the patterns of cranial variation characterizing modern humans today, it is important consider how the impacts of microevolutionary forces have patterned that variation. Under a quantitative genetics framework, morphological variance/covariance (V/CV) is expected to be proportional within and between groups that are evolving primarily neutrally, whereas selection is expected to act to create divergent patterns of V/CVs among and within groups.
Landmarks capturing the three-dimensional morphology of the mandible, upper face, temporal bone, and basicranium were digitized from a large sample of 14 modern human populations. Following the approach of Lande (1979, 1980), within- and among-population variance/covariance (V/CV) matrices were compared for each anatomical region. Specifically, a Principal Components Analysis of each V/CV matrix was conducted. The resulting eigenvalues for the within- and among-population variances were compared using a least-squares regression. Significant deviations from a regression slope (β) of 1.0 were interpreted as evidence of selection, while slopes that did not significantly differ from 1.0 were taken as consistent with a null hypothesis of neutrality.
The regression slopes of the upper face, temporal bone, and basicranium were not significantly different from 1.0, suggesting a predominantly neutral mode of microevolution for these cranial regions. The slope of the mandibular data set, however, was significantly different from 1.0, suggesting that selection has acted to significantly alter its morphology. These findings are consistent with previous studies that have indicated that the morphology of the upper face, basicranium, and temporal bone reflects neutral genetic distances among modern human populations.
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Near-eruption proportional root lengths of the mandibular canine and premolars.

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Anthropologists have long employed dental staging techniques to assess dental maturity. Improved prediction of eruption timing may be possible by incorporating metric and proportional information from individual teeth. Beyond clinical utility, increased precision in detecting impending eruption allows better "retrodiction" of aspects of life history from skeletal and fossil individuals.
Panoramic films from 77 females (N=227) and 74 males (N=229) were rated for dental maturity using Demirjian staging. Total tooth length, and root length from root bifurcation to root apex, were measured for mandibular canines and premolars; alveolar eruption was recorded. A subsample of subjects with pre-eruption and post-eruption films within a 2-year time interval, for each of the 3 teeth considered separately, were targeted for additional analyses (N=46, canine; N=42, pm1; N=46, pm2).
Alveolar eruption usually occurs in Demirjian Stage F or Stage G. Roots will be moving into a parallel configuration. Dental age correlates marginally better than does chronological age with root lengths and percent root lengths (= (root length/total tooth length) x 100). Only for pre-eruption canines does maturational age correlate significantly with root length (r=0.30) and percent root length (r=0.32). Average midpoints and percentile data for percent root lengths suggest that the canine undergoes alveolar eruption with percent root lengths near 70; premolars erupt with percent root lengths closer to 65. Coefficients of variation in the immediate pre-eruption period are lower for percent root lengths than for chronological or dental age, demonstrating the value of percent root length for prediction.

Dental development in the Taï Forest chimpanzees reappraised.

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A recent study of tooth eruption in wild chimpanzees by Zihlman et al. (2004: PNAS 101: 10541-10543) finds "an unambiguous pattern of a slower growth rate in wild vs. captive chimpanzee populations" (p. 10541), a conclusion important for assessing growth and development in the hominin fossil record. The magnitude of the perceived delay led us to reassess the primary material, consisting of dental and skeletal remains of juvenile chimpanzees collected during a long-term study in the Taï Forest, Ivory Coast. We applied

radiographic imaging to reveal the developmental status of maxillary and mandibular teeth in an expanded sample of Taï Forest juvenile dentitions. We also assessed molar tooth formation histologically to confirm age at death in three individuals. Our results demonstrate that tooth formation stages in the Taï individuals largely overlap with captive standards. Molar crown formation times are variable, but are not consistently greater than times derived from captive individuals. Notably, Taï Female 3, illustrated in Zihlman et al. (2004: Fig. 1), was apparently misidentified during collection; histological study lowers her age of death, and thus eruption age, by almost 2 years. Restricting cases to Taï individuals of known or corrected birthdates, we find a greater degree of overlap in tooth eruption with captive standards than was previously reported, which is more consistent with data from a small number of wild chimpanzees from Gombe. While additional data are needed, our results suggest a high degree of overlap in dental development between captive and wild chimpanzees. Supported by the MPI-EVA.

Mandibular torus in the Greenlandic Norse.

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The Norse colonized Greenland from Iceland in A.D. 986. During their five hundred year occupancy of the island, the Greenlanders exhibited a number of temporal trends, including decreases in tooth, brain, and body size and an increase in third molar agenesis. The expression of palatine torus in the settlement period sample from Thjodhild's Church was similar to that of Danish Vikings and medieval Norwegians. Medieval Greenlanders, however, exhibited significantly elevated frequencies and expressions of this trait. Although palatine and mandibular tori are often linked and reported together, the temporal pattern for mandibular torus in Greenland differs completely from that for palatine torus. The settlement period Greenlanders exhibited the highest frequencies and greatest expressions of mandibular torus, far more than Danish Vikings, medieval Norwegians or even medieval Greenlanders. The environmental stresses that triggered the development of mandibular torus acted immediately on the earliest settlers but were delayed for palatine torus. This disjunction is not surprising given that correlation analysis shows there is no significant relationship between the expression of palatine torus and mandibular torus.

Growth and nutritional status in an indigenous lowland Ecuadorian population.

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Economic development has been linked to increases in a variety of negative health outcomes and to changes in patterns of growth. Studies have revealed that these health and life history shifts are not uniform across populations, yet this topic has attracted surprisingly little attention. Research is needed to clarify how factors such as the timing and intensity of market integration, cultural practices, and biological differences shape growth and health across populations. The Shuar are an indigenous Amazonian group that presently live across a wide range of circumstances from traditional forager-horticulturalists to professionals in urbanized communities. Our past work has shown that many Shuar children have height-for-age z-scores indicative of stunting, and that the extent of poor growth is considerably higher than among closely related groups, such as the Shiwiar and Achuar. In the present study, we investigate growth and nutritional status among Shuar children in a rural community in the southeastern Amazonian region of Ecuador with the following objectives: 1) to compare growth and nutritional status among the Shuar to international standards; 2) to assess lifestyle and dietary correlates of growth and nutritional status; and 3) to examine relationships among lifestyle, growth, and hemoglobin concentration. We collected anthropometric data and obtained hemoglobin concentrations for 149 Shuar children and adolescents (1-18 years old; 87 females, 62 males), as well as information on lifestyle, medical history, and diet. Our results document substantial variation in growth indicators and hemoglobin concentration by lifestyle and medical history, and reveal overall stunting prevalence of nearly 70%.
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Cross-sectional geometry of a warlike Samnite sample from the Alfedena necropolis (Iron Age, Italy).

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This paper reports the analysis of cross-sectional geometrical (CSG) properties of a Samnite group from the Alfedena necropolis (Abruzzo, Italy, 5-6 century B.C.). CSG properties based on periosteal contours are calculated for humeri, the femur, and the tibia (N=61). The Samnites were protohistoric Iron Age agropastoralists. They experienced population growth leading to small-scale conflicts in the attempt to maintain or expand control over resources. Previous research demonstrated a high incidence of perimortal blade

injuries on males, probably connected to warfare with neighboring communities.
CSG results are compared with the Ligurian Neolithic group from Arene Candide (Finale Ligure, Italy), in which subsistence was based primarily on pastoralism and secondarily on agriculture. Both groups lived in an extremely rugged terrain which may factor out the influence of terrain on hind limb CSG. Although both groups practiced pastoralism, some indication of decreased mobility on the Samnites is expected, given their greater reliance on agriculture. In the humerus, activities related to subsistence and warfare activities likely influenced male humeral bilateral asymmetry.
The results show substantial humeral bilateral asymmetry in Alfedena males (18.3%), suggesting preferential use of the dominant arm, possibly related to warfare activities. Lower limb results are consistent with reduced mobility relative to Neolithic Ligurians, with significantly lower femoral Ix/Iy, and both tibial J and Imax/Imin in both sexes. The correspondence of CSG results with known subsistence activities further support the use of this method for inferring past lifestyles.
Supported by the University of New Mexico.

Measuring selection and demographic sustainability in a 19th century population.

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When measuring selection in human populations, scientists often use methods that are not really "measuring" the effect of selection, that is differential survival and reproduction. In this paper I present an application of mathematical demographic techniques to the measurement of selection in a 19th century population from rural Scotland. The variable-r method is employed to measure the net reproduction in two segments of the population, those focused on agriculture and husbandry and those involved in non-agricultural work. The variable-r method allows for the estimation of the net reproduction rate (NRR), a combined measure of fertility and mortality measured at the population level, using only the distributions of births by age of mother and two evenly spaced age distributions. I hypothesize that because of beneficial effects at the household level for farm families, that they will also display a higher level of net reproduction than the non-farm segment of the population. Results indicate, that although fluctuations in the NRR exist over time, the agricultural segment of the population shows relatively higher levels of the NRR than the nonagricultural segment of the population. In this paper, I expand on this idea and suggest that by better balancing the current and future levels of reproduction, the agricultural population is more sustainable in this setting, suggesting a net selective advantage of this form of household economic specialization.

Permanent-tooth emergence among the Gullah of St. James Island (Outer Banks, South Carolina).

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We assessed the timing of permanent-tooth emergence among the Gullah, a group of African Americans living in South Carolina's Outer Banks. Data were collected from dental casts made in the mid-20th century, a period during which historical records suggest the Gullah experienced considerable economic, nutritional, and social stress. Because permanent-tooth eruption may be delayed under such conditions, we predicted that the Gullah would exhibit delayed emergence when compared to other children of African ancestry. Mean emergence ages for permanent teeth (except M3) were determined for 211 Gullah children and compared to those of children from five African regions and to African American children in the Midwestern U.S.
Emergence of maxillary and mandibular incisors and first molars was significantly delayed in Gullah boys. Gullah girls, however, showed no delay in incisors and little to no delay in first molars but did show significantly advanced emergence in maxillary second molars. Contrary to our hypothesis, Gullah children were significantly advanced compared to Nigerian children.
These findings suggest that environmental stress influenced the timing of permanent tooth emergence in the Gullah and that girls may have been less susceptible to environmental perturbations affecting development than boys. The significant delay of first molar eruption in Gullah boys suggests that the timing of first molar eruption is less constrained by ancestry than previously thought. Finally, advanced emergence of Gullah children compared to Nigerian children warrants further investigation as the ancestors of many African Americans, including the Gullah, may have come from this area.

Utah Lake skull cap: yet another Archaic burial?

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The Utah Lake skull cap was published in 1935 by geologist George H. Hansen (1896-1981) at the height of enthusiasm for finding Neandertal features in Paleoindians. He emphasized dolichocrany, vault thickness, and brow ridge development in his description. The skull was buried under nine inches of lake sediment, indicating to Hansen that it was from the Pleistocene and deposited during the time of Lake Bonneville. There is no obvious mineralization. The

skull was dismissed by T. D. Stewart due to a lack of context. We revisit this specimen, comparing the limited metric data available from this calotte with other ancient and recent Amerindian crania. When the skull is compared with the Howell's database, low-level probabilities (<0.15) of assignment to several African groups result, followed by Pacific and European groups. The Utah Lake is an old adult male that resembles other low-vaulted Amerindian crania in shape and supraorbital development. In the context of appropriate comparative material, the vault is not unusually thick. There are well-healed depression fractures on the outer table of the frontal, and the sagittal suture is both keeled and depressed, features remarked upon in other crania by Hrdlička. We report AMS dating and stable isotope analysis on this putative Paleoindian.

Food selection among individuals in a group of brown bearded capuchins (*Cebus libidinosus*) at Boa Vista, Piaui, Brazil.

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This cross sectional study relates food selection and the nutritional content of selected foods, to social status among adult male and female wild bearded capuchins (*Cebus libidinosus*) belonging to the same social group at the site of Boa Vista, Piaui, Brazil. We additionally conducted a more exclusive comparison of only females in order to assess the possible countervailing effects of reproductive state on food selection. We predicted that socially dominant individuals would have a diet that was more nutrient rich and lower in secondary compounds and that they would spend less time foraging. Lactating and pregnant females were predicted to select more nutrient rich and less toxic food. Behavioral data, and data on consumed foods, were collected on 6 individuals (3 male, 3 female). Individuals differed in rank and females also differed in reproductive state and reproductive history. Data on food nutrient content were compiled from the literature, from analyses conducted on collected palm fruits at the University of Sao Paulo, and by spectrometry in the field. The results reveal that dominant individuals consume the most calorically rich foods and that the consumption of secondary compounds was negligible for all except the least dominant female, which although fully adult has never given birth. We found that dominant female members of the group, regardless of reproductive state, had the most varied diet. These data suggest that social status either provides the opportunity to access a rich diet or that accessing a rich diet contributes to the attainment of high status. Research funded by a Summer Research Fellowship Award and equipment grant from the Kansas City University of Medicine and Biosciences.

Cranial variability in 19th century Tucson.

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Recent excavation of the Joint Courts Complex project in Tucson, Arizona uncovered a large historic cemetery in use between 1862 and 1881. During this period, Tucson's civilian population was predominantly Hispanic. However, the population also consisted of individuals of European and Native American ancestry, adding to the difficult task of assessing biological affinity. Because burial records cannot be associated with individuals, the purpose of this presentation is to employ craniometric data to assess the biological variation, affinity, and pattern of cemetery use represented by the individuals in the 'National Cemetery.'

A hierarchical cluster analysis, using 60 individuals with 18 variables in common, was utilized to assess intrasample variation. This approach revealed three main groups within the cemetery. To assess biological affinity, individuals were compared to multiple reference groups, including 19th century American Whites, indigenous Guatemalan Mayans, and US–Mexico border crossing fatalities. Biological distance was plotted against spatial distance to assess overall population homogeneity and cemetery use. Three distinct areas of the cemetery were noted: two areas of relatively high heterogeneity and a third area representing a relatively homogenous group of predominately Hispanic individuals. A discussion of these results within the bio-historical context of Tucson's National Cemetery will be presented.

Travel route analysis of fissioning Japanese macaque troops in Yakushima, Japan.

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Primatologists often record daily travel routes for the social groups under study. We analyze a data set of daily travel routes from the Yakushima study site of Japanese macaques (*Macaca fuscata yakui*) for a 10-month period in 1985-86. The data set covers three main study troops and other occasionally observed neighboring troops. The data period covers the fission of one of the main study troops, where the main and fission groups began to travel their own distinct routes each day. However, during the data period, the fission group had not yet established a distinct home range,

and the overall home ranges overlapped nearly completely among the main group and fission group. We also report on the distributions of daily first and last observation points, daily centroids, points at set intervals along routes, and the distance between travel routes of different troops within each day, compare various home range estimation methods, and analyze altitude, slope, slope direction, and cost-distance along each route to identify portions of routes with high or low estimated travel cost based on topography. Many techniques for home range analysis have emerged with improvements in geographical information systems (GIS). Ideally, a field study should be designed to utilize GIS, but GIS analysis often needs to be adapted to the data actually recorded by field researchers, especially in study sites with long histories, to take advantage of data revealing the ecological history of troop lineages.

Morphological disparity in the cranium and dentition of "prosimian" primates.

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The morphological disparity observed within biological groups has increasingly been used to inform analyses of adaptive radiation and other macroevolutionary processes in both extant and fossil organisms. In fossil mammals such analyses are limited to skeletal elements well represented in fossil deposits (e.g. the dentition). This limitation raises the question of whether morphological disparity in the dentition is representative of wider morphological differences between organisms.
This study addresses this question in "prosimian" primates by investigating matrix correlations between intertaxon distances derived from three functionally associated regions: the skull, mandible, and lower second molar. Linear and area measurements were taken on 25 strepsirrhine and one tarsier species, and converted to indices or Mosimann shape variables to reduce the impact of scale differences. Matrices of Euclidean intertaxon distances were evaluated for similarity via the Mantel test, revealing statistically significant correlations in all comparisons, though the correlation between the dental and mandibular distance matrices is only marginally significant at p=0.033.
Twenty of the strepsirrhine taxa for which a phylogenetic distance matrix could be constructed from recent literature were further subjected to Mantel tests of matrix correlations between morphological and phylogenetic distances. Only the skull distance matrix showed a significant correlation with phylogenetic distance. In addition, in three-way partial Mantel analyses with the phylogenetic distance matrix, correlations between regions remained significant in all comparisons. These results indicate that the morphological distances derived from one skeletal region are likely correlated with those from associated regions and that these correlations are largely independent of phylogenetic distance.

Growth in three environments: developmental canalization and positive allometry in wild, orchard-raiding and pet Sulawesi booted macaques, *Macaca ochreata*.

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The questions to be addressed in this paper are: Do various morphological traits differ in their degree of developmental canalization, and if so, which traits are the most highly canalized? Is differential canalization caused by differences in the intensity of stabilizing selection?
I analyzed overall body growth and relative growth (allometry) of body segments in free-ranging Sulawesi booted macaques, *Macaca ochreata sensu lato* (Cercopithecidae), including both wild-feeding and orchard-raiding populations. I supplemented my field data with published data on pet *M. ochreata* (T. Watanabe, Y. Hamada, B. Suryobroto, and M. Iwamoto. 1987. Kyoto University Overseas Research Report of Studies on Asian Non-Human Primates 6: 49-56) to create a sample spanning three environmental conditions with different dietary quality and activity levels.
Results suggest that relative growth of the trunk is faster under food-enhanced or activity-limited environmental conditions, though the differences seem to disappear by adulthood. The relative growth of limb segments, on the other hand, appears to be highly canalized, with no differences observed between animals from the three different environments. The femur, moreover, shows evidence of strongly positive allometry relative to the trunk and to the other limb segments, across all environments. Behavioral data that I collected on random transects in a primary-forest population show that *M. ochreata* engages in arboreal locomotion > 90% of the time, with terrestrial locomotion occurring rarely, and almost entirely during the dry season. The rapid and highly canalized growth of the femur is consistent with intense stabilizing selection upon arboreal leaping ability.
This research was supported by the L.S.B. Leakey Foundation, the National Science Foundation (award no. 0622545), and the U.S. Department of State (Fulbright Program).

Using 3D geometric morphometrics to describe sexual dimorphism in the human pelvis.

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Biological variation of hominid anatomy is extensively researched using three-dimensional techniques, yet fewer studies have applied these techniques to the hominid pelvis.

Three-dimensional methods facilitate the extraction and visualization of differences in the position of anatomical landmarks. To characterize sexual dimorphism, we employ this technique and expect that it will elucidate the primary regions of functionally and adaptively significant morphological differences.
Fourteen homologous landmarks were collected from 38 articulated pelves (19 Afro-Americans: 10 males, 9 females; 19 Euro-Americans: 10 females, 9 males) from the Hamann-Todd Osteological Collection at the Cleveland Museum of Natural History. Procrustes superimposed landmark data were subjected to multivariate statistical analyses including: 1) principle component analysis, and 2) thin plate spline visualizations and discriminant function analysis of the PC scores. These analyses indicate that 42.7% of the variation is explained by sexual dimorphism, while 11.5% is explained by racial difference.
Compared with males, females exhibit an anteroinferiorly positioned cristal tuberosity, superiorly positioned ASIS, and anteriorly located pubic symphysis and maximum breadth of the inlet that together contribute to the enlarged birth canal of the gynecoid pelvis. Similar patterns of sexual dimorphism occur within Afro-American and Euro-American populations. Thus, these results suggest that the primary difference between the sexes is due to the obstetric demands of birthing a large-brained neonate. This three-dimensional technique builds upon traditional linear morphometrics and explains spatially localized changes independent of size in morphology, rendering this technique appropriate for analyzing hominid fossils of unknown sexual and taxonomic affiliation.

Chimpanzee omnivory and the evolution of human life history.

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During the past few million years, the hominid lineage evolved at least two new major life history adaptations: a well-documented shift to a more omnivorous diet and an increased life expectancy. While patterns of aging in wild chimpanzees remain poorly documented, it is clear that they age on a trajectory quite different from that of modern humans, with a shorter life span and an earlier acceleration of the mortality rate. Reproductive senescence in females of both species also proceeds at markedly different rates.
This paper discusses the extent to which a shift to a more meat-based diet may be implicated in these human-ape life history differences. As critical as meat-eating may have become to Plio-Plesitocene hominid subsistence, the timing of the emergence of meat-eating and the modes of procurement remain unclear. I therefore first examine the explanations for hunting and meat-eating in wild chimpanzees. Several detailed field studies have proposed markedly different hypotheses to explain chimpanzee meat acquisition, and none appears to fully explanatory. The causes and effects of the shift to a more meat-base diet remain speculative; the well-documented negative health impacts of a diet containing meat makes these new traits less advantageous than they might appear. Finch and Stanford (2004) and others have proposed the evolution of meat-adaptive genes to offset or delay diseases brought on by a meat-rich diet, and I present evidence for this hypothesis.

Reconstruction of the Poliziano skull using geometric morphometrics methods for further application in forensic analysis.

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In this study, we apply previously described methodology of the 3D cranial reconstruction in Palaeoanthropology using methods of geometric morphometrics in order to recreate a complete cranium of the famous Italian humanist of the XVth century, Angelo Poliziano (1454-1494). The preserved portion of the Poliziano's skull contains fragments of the frontal bone, maxillae and a separate parietal bone. Some distortion is observed on the right side of the face. The general objective of the study was obtaining a complete skull for further plastic reconstruction of the face. In order to do so, CT san data were obtained for the Poliziano facial remains as well as for a complete skull belonging to a 37 year old Italian male that was used as a reference in the study. We have recreated missing data for the Poliziano skull and corrected for distortion and asymmetry in 3D. The correctness of the reconstruction has been validated by means of comparing it with a Poliziano miniature portrait by Theodor de Bry (1528-1598). We used the Manchester method for guidance in comparing between the skull and the picture of the fleshed face. A good fit between the portrait and the reconstructed skull has been obtained. As a result of this experiment, we conclude that geometric morphometric methods of the missing data reconstruction can be successfully applied in forensic purposes. Certain constraints and limitations are discussed.

Morphological integration of the Down Syndrome face.

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Down syndrome (DS) or trisomy 21 is the most common live-born human aneuploidy. Typical DS facial morphology encompasses a

wide range of variation, however many observers recognize a resemblance among genetically unrelated DS individuals. This suggests that trisomy 21 disrupts facial development similarly regardless of genetic background. To address this hypothesis we compared morphological integration (MI) patterns of immature DS faces (N=29) to those of non-DS siblings (N=30), aged 4-11 yrs. Coordinate data representing 20 anthropometric landmarks located on 3D digital photographic images were used to calculate linear distances (LDs) between landmarks. MIboot (Cole, 2002) was used to test for local differences in MI of facial features grouped using 30 ln transformed LDs into regions representing the mouth, nose, and eyes. 90% confidence intervals were calculated for each LD pair. Approximately 45% of the LD pairs were found to be significantly different between the two samples by confidence interval tests, indicating that DS faces are integrated differently than the faces of their unaffected siblings. The strongest correlation differences were seen between facial regions rather than within these regions. In particular, measures of philtrum length and height (mouth) are positively correlated with measures of nose length, interocular diameter, and biocular diameter in the DS sample but the same measures were negatively correlated in the sibling sample. Overall our analysis indicates that patterns of MI are significantly different in DS faces relative to the faces of non-DS siblings.

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Risk of dying from warfare-related trauma: Determining the impact of pre-existing conditions on victim selection.

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The Mississippian Orendorf cemetery and the later Bold Counselor Oneota cemetery at Norris Farms have some of the highest documented frequencies of warfare-related trauma in the Eastern Woodlands. While these findings suggest late prehistory was a tumultuous period in the Illinois Valley, trauma frequencies alone tells us little about the nature of warfare and its effect on community health. Previous work has shown that victims at both sites are predominantly adults of both sexes, in similar numbers. However, debilitating diseases or existing conditions such as dislocated joints may increase the risk of death from ambushes when a person cannot fight or flee as effectively as others. Milner et al. (1991) has suggested such a relationship for Norris Farms, while Steadman (2008) sees no link for Orendorf.

This analysis examines the demographic patterning and covariance of selected skeletal lesions, severe arthritis, and partly healed fractures among individuals in the Orendorf and Norris Farms cemeteries with and without evidence of having died violently. Odds ratios and likelihoods are generated for individuals with and without trauma having active infection, unhealed broken bones and poor joint mobility, including dislocated joints, at both sites. The results demonstrate whether the relative risk of dying of warfare-related injuries increases if an individual is already compromised by certain pre-existing conditions.

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Summary measurement of health and wellbeing: The health index.

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The health index is a descriptive and analytical tool that summarizes health at a site or locality on a scale from 0 (extremely poor health) to 100 (absence of lesions) by standardizing data on femur length, cribra orbitalia, porotic hyperostosis, linear enamel hypoplasias, oral health, periosteal reactions, osteoarthritis, and trauma. Based on information from approximately 12,000 individuals sites in northwest Europe were healthiest, with relatively few hypoplasias, longer femurs and little cribra orbitalia or porotic hyperostosis.

Ancient and pre-historic populations were least healthy, being short and laden with hypoplasias, tibial infections, cribra orbitalia, porotic hyperostosis, and considerable trauma. In our sample, sites in classical antiquity had the highest health index value. The index declined during the course of the Middle Ages as individuals became shorter, and had more trauma and worse oral health. Europeans scored about 10 health-index points (out of a 100) below sites in the Western Hemisphere, with the exceptions of sites located in Mesoamerica, where scores approximately equaled those in Europe. In general Europeans had more trauma and more tibial infections than Western Hemisphere populations.

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Ecomorphology of first phalanx reflects differing habitat adaptations among cephalophines.

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Hypotheses regarding hominin evolution can best be evaluated when environmental reconstructions of paleohabitats are available. Ecomorphology, particularly of bovids, has been used to make such reconstructions of paleohabitats. Bovid phalanges often are preserved at sites of interest and Degusta and Vrba reported in 2005 that the first bovid phalanx was useful when making habitat reconstructions. However, their study did not include the bush duiker, an open habitat adapted cephalophine bovid, and the effects of body mass on their model were unclear. The failure to include the bush duiker in this study omits data that would help resolve whether morphological differences among bovids result primarily from habitat specific adaptations or phylogeny. The failure to explicitly test for morphological differences independent of phylogeny has been one failing of bovid ecomorphology.

Here we test for morphological differences between bush duikers and other cephalophines that may be related to habitat use. A sample of 17 bush duiker and 56 forest-dwelling cephalophines was measured using published metrics. The geometric mean of non-length measurements was used to quantify body size.

The ratio of phalanx length to our general size metric differed significantly between bush duikers and forest-dwelling cephalophines ($p < 0.0001$, $\chi^2 = 28.4944$, Kruskal-Wallis test). This result supports the hypothesis that the bovid first phalanx varies with habitat and not only with phylogeny.

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Just how inefficient is human running?

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It has recently been suggested that endurance running may have been an important selective pressure leading to the emergence of modern human body proportions. Some have argued that the inefficiency of human running provides a counterargument to this perspective. Here we reevaluate the cost of human running and determine whether cost may be related to an individual's running experience. This becomes important in evaluating the cost of running in our ancestors who may have engaged in regular endurance running as a foraging strategy. We measured rates of oxygen consumption and carbon dioxide production in eighteen human subjects, between 18 and 30 years of age, while they ran on a treadmill at 2.68 ms^{-1}, on six separate occasions using a SensorMedics Vmax 29c automated respiratory gas analysis system. Average miles run per week was reported by each subject. For each individual, we also calculated the cost of locomotion predicted for a quadruped of the same mass using equation 9 in Taylor et al. (1982), based on data from 62 mammalian and avian species. Analysis of variance shows that energetic cost (LO_2/km) is significantly related to both mass ($p=.001$) and miles run per week ($p=0.021$). Regression analysis demonstrated that cost (LO_2/km) = 0.23(mass) -0.051 (miles run). Thus humans who run regularly may not be particularly inefficient.

New primate fossils from the late Oligocene Nsungwe Formation, Rukwa Rift Basin, Tanzania.

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The primate fossil record of early Cenozoic continental Africa is largely limited to specimens collected from localities above the equator, with the vast majority of Paleogene primate fossils recovered from the Jebel Qatrani Formation, Fayum Depression of Egypt. Temporally equivalent sub-Saharan faunas are uncommon, with no distinctive primate species yet described from below the equator. The rarity of Paleogene strata from much of continental Africa poses problems for understanding the geographical extent and evolutionary significance of faunas occupying the majority of that landmass, and provides obstacles for testing hypotheses regarding primate biogeographic history. East African sites have provided a wealth of Neogene fossil primates, and newly discovered Paleogene localities suggest that this region also holds keys for exploring issues deeper in paleoprimatological history. Here we describe new anthropoid and strepsirrhine primate material recovered from late Oligocene (~ 25 mya) deposits in the Nsungwe Formation of the Rukwa Rift Basin in southwestern Tanzania. Specimens were recovered from a rift-fill sequence of richly fossiliferous massive sandstones interpreted as fluvial discharge draining into a small lake system. Specimens referable to anthropoids include postcranial elements and an upper molar dentition reminiscent of early anthropoids from northern Africa and Oman. A strepsirrhine maxilla preserving M2-3 and part of the orbital margin constitutes the first Lorisiform primate recovered from the Paleogene of sub-Saharan Africa. Taken together, material from the Rukwa Rift represents a new window into primate evolutionary history at the close of the African Paleogene.

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How typical is the Spitalfields postcranial morphology? A comparative geometric morphometric study of the knee and elbow joints.

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The Spitalfields collection of human remains is widely used for comparative purposes, due to the number of individuals with known age at death. It is therefore empirical to know how typical its morphology is in relation to other, less documented samples.

This paper initially uses geometric morphometrics to assess inter-population variability in the human knee, using landmark measurements of the distal femur and proximal tibia in 387 and 370 individuals respectively, representing thirteen geographically distinct samples, including Spitalfields. It shows the shape of the knee joint to be highly population specific, and that the Spitalfields sample demonstrates a morphology which is very distinct from that of all other populations, particularly in the tibia. Ongoing research suggests that occupational stresses may be a causal factor, while high levels of atmospheric and ingested pollutants and incidence of infectious disease may also be influential. Further analyses are undertaken to determine whether this atypical morphology is carried through to other postcranial regions. Using six of the original thirteen populations, together with two further British samples, results from the knee are compared to those of the elbow joint. Preliminary results indicate that, although the Spitalfields knee remains distinct from the original five samples, its morphology appears relatively similar to the two additional British samples. Significantly, whilst the Spitalfields elbow shows little morphological distinction relative to the British samples neither does it show any undue separation in relation to the remaining samples.

The five skull trait sexing method and the benefits of Rasch analysis.

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Walker standardized the use of 5 anatomical skull traits that are subjectively assessed on a 5 point ordinal scale and include: glabella-supraorbital ridge (GS), orbital margin (OM), mastoid process (MP), mental eminence (ME), and the nuchal crest (NC) and produced predictive equations after assessing the traits on a series of 304 skulls of known age and sex from people of African American and European American ancestry from collections in the USA, and St. Bride's Church, London, England. The best equations with low sex biases *predicted better than equations based on ratio data* and were derived for the total but not sub-samples, disappointing, because little is known about population variation for sexual dimorphism. Rasch analyses (RAs) were used to create pictures of each sample's sex distributions along ratio scales that summarized *all* the ordinally coded data. The applications of the sexing method were also evaluated by RA. The ordinally coded skull data were converted by 4 separate Rasch analyses to ratio scales for the 4 samples. The distributions of the individuals are portrayed in accessible item-person maps that separate the sexes within each sample using the average total Rasch scores with accuracies minimally of 83%. Sex biases are low for all but the African Americans, and even most of the "outlier" individuals are classified correctly. The 5 levels for each trait are applied consistently. Thus, sexual dimorphism for 5 skull traits looks similar in expression among

these populations differing only in degree of overlap.

Are capuchins good models for the "grandmother" hypothesis?: What socio-spatial behavior of females with dependent infants can tells us.

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The "grandmother" hypothesis (GMH) has been advanced to explain the evolutionary origins of post-reproductive longevity in women and suggests that provisioning aid from maternal grandmothers increased reproductive fitness. The GMH also accounts for three additional life history traits: potential longevity, slow rate of development, and early weaning. Nonhuman primate species that share these life history traits and exhibit female philopatry provide promising models for testing the GMH. This study examines white-faced capuchins (*Cebus capucinus*) as one potential model taxon. Specifically, by examining the socio-spatial behavior of female capuchins, this research evaluates whether the social environment provides favorable conditions for the development of grandmothering behavior. A total of 29.5 hours of focal data were collected at the La Suerte Biological Field Station, Costa Rica; proximity and activity data were recorded in one-minute intervals. Two research questions were addressed: 1) do females with dependent infants (FI) spend a significant amount of time near other females? and 2) do these patterns differ for females without dependent infants (FNI)? The data collected indicate that FI spend a substantial amount of time near other females; however, this pattern was not shared by FNI and suggests that the presence of an infant was a driving force behind this difference. Differences were particularly pronounced during feeding, supporting expectations regarding the relationship of proximity to provisioning. Overall, the use of capuchins as models for grandmothering studies is supported, and suggestions for further research are provided.

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Ecogeographic variation in the ontogeny of hunter-gatherer physique and skeletal robusticity.

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The differing influences of biomechanical loading upon long bone robusticity, and ecological adaptation on human variation in physique, have been well established. Recent research has demonstrated a complex interaction between physique and limb biomechanics, which suggests that the influences of climatic adaptation and habitual activity upon long bone strength vary throughout the body (Stock, 2006). The current study expands upon previous work by investigating the pattern of postcranial variation among globally diverse hunter-gatherers throughout ontogeny. Variation in physique and diaphyseal robusticity of claviculae, humeri, ulnae, femora and tibiae is compared to a baseline of dental development. Populations used for comparison include late-Pleistocene and Holocene hunter-gatherers from East and North Africa, the Levant, the Danube, Siberia, the Great Lakes Region and the Canadian Arctic.

The results suggest that while somewhat weaker patterns of ecogeographic variation in physique are found among subadult skeletons than adults, the pattern of human variation is emphasized during the course of development. While there is a correspondence between climatic variation and subadult long bone robusticity, some patterns of variation cannot be explained by climatic adaptation and physique. In particular, developmental trajectories remain relatively homogenous throughout childhood, but vary more greatly during adolescence, leading to adult patterns of human variation between populations. While while both climatic and behavioral adaptation play a role in determining adult patterns of variation among hunter-gatherer populations, specific aspects of variation in long bone morphology, such as humeral bilateral asymmetry and femoral robusticity, are emphasized during adolescence and are best explained by behavioral factors.

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Recognizing population displacements and replacements in prehistory: A view from North Africa

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Bioanthropologists use skeletal data to reconstruct the historical global distribution of humans. One of the more critical and contentious issues is the inference that a complete population replacement has occurred which has importance for our understanding of human biological variation as well as issues of cultural patrimony. Despite the ubiquity of such analyses, problems exist with current methods because the degree of phenotypic change through time is dependent on demographic parameters, processes of selection, and changes in subsistence orientation which reflect the malleability of cranial form. How different do two populations need to be for continuity to be rejected?

In this paper the population history of northwestern African and central Saharan populations is discussed from the Late Pleistocene through Early Holocene. Craniometric data are used from nine chrono-spatial samples to address the relationship between temporally sequential populations in North Africa where long term changes in aridity prevented human occupation for several distinct intervals. R matrix analysis resolves several perceived population discontinuities based on analyses of lithic assemblages.

Population structure indicates a replacement of indigenous Aterian (early modern human) populations by makers of the Iberomaurusian industry ca 18kybp. Population continuity is suggested between the Iberomaurusian and Capsian horizons, and the analysis suggests the expansion of Late Pleistocene populations from the Maghreb into the Sahara as climate improved during the Holocene. Finally, a second population replacement is inferred during the Middle Holocene in the central Sahara coincident with the advent of pastoralism.

Introduction: Using comparative genomics to understand human evolution.

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Now that the human genome has been sequenced and with the completion of additional primate and mammalian genomes, the challenge is to elucidate the function of genes and non-coding elements and to understand the selective pressures that have influenced and characterized human and non-human primate evolution. Current avenues of research include studies to understand gene expression patterns among and within species, demographic effects on genome variation, and adaptation to the environment, including disease environments, in the human genome Here, I will briefly introduce some of these avenues of research that are discussed in this symposium and present a case study of a gene involved in morphological change in the dogs that may also be important in the primate lineage. For this case study, we have investigated RUNX2 sequences in Old World primates with different muzzle or snout lengths to see whether a correlation between DNA sequence repeat length and snout length found in dogs is also implicated in similar morphological changes in some primates. Morphological changes that have occurred in the primate lineage are of great interest since these can also be examined in the fossil record. Finally, I will consider some of the potential futures areas of research which may enhance our understanding of "what makes us human".

The impact of local selection on recent human evolution.

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Genetic, archaeological, and fossil evidence all point to a recent origin of modern humans in Africa, with dispersal across and out of Africa beginning around 60,000-80,000 ybp. This means that it was only relatively recently that modern humans were experiencing novel climates, environments, nutritional sources, parasites, diseases, etc., all of which in principle could lead to local adaptation via natural selection. However, there are very few examples known where it has been demonstrated conclusively that genetic variation at a particular locus has been altered in particular populations because the variation at that locus has a phenotypic effect that has in turn been influenced by natural selection. I shall discuss ongoing efforts at developing methods for detecting loci that show a genomic signature of local selection, and for further characterization of candidate genes.

Breaking symmetry in British archaeological populations.

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Asymmetry has been demonstrated to be a useful tool for osteological analysis as it detects disruptions in the developmental stability of osseous structures attributed to pathological processes, genetic predisposition, congenital abnormalities, environmental influences, or biomechanical stresses. It is important to distinguish between asymmetry that is part of normal population variation from that which is the result of individual developmental instability. The current study assesses levels of asymmetry through a database of 1344 adult skeletons from 11 archaeological populations spanning from the Anglo-Saxon to the Victorian periods. A comprehensive selection of 101 measurements from throughout the skeleton was chosen in order to evaluate differences in developmental stability and to reveal traits ideal for detecting fluctuating and directional asymmetries. Adults were found to have an average combined trait median directional asymmetry of 3.6%, with a 95% confidence interval of between -5.79 to 6.62% and an average median fluctuating asymmetry of 1.99%, with a confidence interval of 0 to 6.53%. However, it was discovered that asymmetry levels were trait specific and could vary between different regions of the same element. The highest variation was found in mastoid process height, with a 95% confidence interval of 0 to 31.8%, and the lowest was *os coxae* height at 0 to 1.7%. Therefore, comparisons of population or an individual's asymmetry based on combined trait median or mean asymmetry values will potentially either mask or inflate an abnormalities. Hence, it is essential that trait specific values are used for assessing the normality of any asymmetry score.

Facial biomechanics in *Australopithecus africanus:* implications for feeding ecology.

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The African Plio-Pleistocene hominins known as australopiths evolved a distinctive craniofacial morphology that includes large postcanine tooth crowns covered with thick enamel, mandibles with large, robust bodies, exaggerated markings for the masticatory muscles, and substantial bony buttressing of the face. A classic analysis of this morphology hypothesizes that loads applied to the premolars during feeding had a profound influence on the evolution of australopith craniofacial form. Here, we test this hypothesis using finite element analysis (FEA) in conjunction with comparative, imaging, and experimental methods. We find that the facial skeleton of *Australopithecus africanus* is well suited to withstand premolar loads. Specifically, the anterior pillar acts as a strut during premolar biting that transmits load in axial compression from the toothrow to the mid- and upper face. In contrast, the shell-like rostrum of *Macaca fascicularis* deforms in a more complex fashion due to a pronounced combination of twisting, bending and shear. The overall structural efficiency of the *A. africanus* face, as reflected by average strain energy density, is much greater than that of *M. fascicularis* during both premolar and molar loading, but this difference is accentuated during premolar bites. We infer that key aspects of australopith craniofacial morphology are likely to be related to the ingestion and initial preparation of large, mechanically protected food objects like large nuts and seeds. These foods may have broadened the diet of these hominins, possibly by being critical resources that australopiths relied on during periods when their preferred dietary items were in short supply.

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Dissimilarity fraction for metrical traits of human skull: comparison with genetic studies.

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The statement that pairs of individuals from different populations are often more genetically similar than pairs from the same ones is a widespread idea inside and outside the scientific community. Whiterspoon *et al*. (2007) proposed an index called “dissimilarity fraction” (ω) to access in a quantitative way the validity of the above statement for genetic systems. In this case, as the number of alleles increases ω decreases, therefore when enough sampling is available the above statement is false. In this study, we applied the same index on Howells database in order to establish whether or not that statement is valid when cranial morphology is concerned. While in genetic studies thousands of alleles are available, Howells database provides no more than 55 metrical traits, making the contribution of each variable very important. To cope with this peculiarity a bootstrap routine was developed for the calculus of ω. As long as enough samples are provided, the analysis of genetic data results in a null value of ω, however, our results show that cranial morphology reaches a mean asymptotically near 0.3 and therefore it is in accordance with the initial statement. Besides this, as it happens with genetic data, the results show that ω depends on the population, on the kind of data transformation and on the variables used in the analysis. Finally, assuming that cranial morphology is under an additive polygenetic model it is possible to state that it behaves as a neutral genetic system of no more than 20 alleles.

Internal bone structure in the human hind foot as an indicator of habitual compressive load during locomotion.

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The mineral density (estimated from radiodensity values of μCT images) of the subchondral bone of joints has been hypothesized to reflect patterns of habitual applied compressive load and thus to be potentially useful in behavioral reconstructions. In the human talocrural joint, a previous study reported two regular distribution patterns of subchondral radiodensity on the talar trochlea. However, a critical question is whether the regions of subchondral bone that display the highest radiodensity are those that actually withstood the greatest amount of compressive load in life. To address this question for the human talocrural and subtalar joints, patterns of subchondral radiodensity quantified from μCT

scans of distal tibiae, tali, and calcanei from the Hamann-Todd collection were compared with experimentally-determined patterns of joint articular contact and pressure during bipedal gait. As hypothesized, some specimens display radiodensity patterns consistent with articular contact areas during bipedal walking; for example, the talar trochlea displays higher radiodensity in the lateral to central regions. However other morphotypes are seen, for example having a region of high radiodensity on the medial side of the trochlea. These results indicate variation in the subchondral radiodensity patterns of the human hindfoot, possibly explained by age, body mass, and their effects on the congruency of the joints. Future studies will compare the variation of these patterns of subchondral radiodensity in the human hindfoot, as well as the architecture of the underlying trabecular bone, to that of other extant hominids to investigate the utility of these structures in inferring locomotor behavior in fossils. Supported by NSF-DDIG (BCS-1074079).

A new paleontological site in the Zhaotong Basin of Yunnan Province, China.

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Yunnan Province is renowned for its hominoid-bearing sites such as Lufeng and Yuanmou. We concentrated on Zhaotong Basin, an area in northern Yunnan that is known to be fossiliferous but where little research has been conducted. Zhaotong Basin is an "island" of Late Tertiary and Quaternary sediments within a complexly deformed and metamorphosed series of Paleozoic deposits belonging to the Yunnan-Guizhou-Hubei Fold Belt. The Late Tertiary deposits from the Zhaotong Basin were described as the Tuobuka Formation, but debate about the age of the vertebrate fossils has persisted because of the lack of a comprehensive stratigraphic survey of the area and the difficulty in applying biostratigraphic dating to what appears to be a strongly endemic biota. Fieldwork was started at Yongle, an open lignite mine in the Zhaotong Basin in the Fall of 2007. The strata at Yongle include layers of silts, conglomerates, and poorly compressed lignites. Vertebrate fossils are recovered from fine, dark-colored silts intercalated between layers of lignite. They include specimens of tapirids, rhinocerotids, cervids, bovids, proboscideans, carnivores, rodents, insectivores, primates, birds, reptiles, and fish. Of note are two primate specimens, a possible hylobatid phalanx and a colobine molar most similar to *Pygathrix*, as well as associated skeletons of two species of elephantids. The recovered fauna appears to be Pliocene in age. Yongle is potentially a site of great importance to the study of primate evolution as previous studies suggest that northern Yunnan may be near the site of origin for both modern gibbons and "odd-nosed" colobines.
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The use of q repeated-route system in three groups of Phayre's Leaf Monkeys (*Trachypithecus Phayrei*) in Thailand.

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The patchy distribution of primate foods in time and space poses a cognitive challenge to primates foragers. While increased ability to recall locations and phenological conditions may improve foraging success, behavioral strategies can reduce the need to store location and phenological information while increasing foraging success. One such strategy, the use of a repeated-route system for traveling among feeding patches, has been demonstrated in frugivorous primates (Di Fiore & Suarez, 2007). Here, I document route systems used by three groups of Phayre's leaf monkeys in the Phu Khieo Wildlife Sanctuary, Thailand. Each group was followed for about five days each month across a one-year period. During follows, researchers recorded UTM coordinates at the group center with a GPS unit at 30-minute intervals. Routes (n=177) were then transposed onto maps of the research site, using the program ArcMap 9.3. Overlaid travel paths were scored as "repeatedly-used" when segments of at least 100 meters were parallel, and lay within 50 meters of each other. Results show that for subsets of each group's home range, Phayre's leaf monkeys traveled along repeatedly used routes. Where routes can be documented, less than 40% of location points fall within 50 meters of travel routes. The use of particular route segments varies seasonally. Terrain does not strongly constrain the route system. The presence of a repeated route system in a folivorous primate suggests that folivorous primates may also adopt behavioral strategies to reduce cognitive foraging challenges. This project was supported by a grant to Drs. Andreas Koenig and Carolla Borries of Stony Brook University: NSF (BCS-0215542).

The expensive-tissue hypothesis and plant neurotoxins: Comparative analysis of metabolic hepatic enzymes indicates hominin diet shift.

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The expensive-tissue hypothesis predicts an energetic trade-off in gut size to allow the evolution and maintenance of the large human brain. Our presentation analyzes the

dietary changes predicted by the expensive-tissue hypothesis from a novel perspective. The wild plants consumed as foods by hominin ancestors were protected by a range of neurotoxic chemical offenses which "targeted" the nervous systems of predatory herbivores. In mammals, environmental chemicals are metabolized by defensive enzymes concentrated in the liver (particularly cytochrome P450). Using data from the *Entrez Protein* and *Ensembl Chimpanzee* databases, we describe a comparative analysis of genes and proteins that metabolize common plant neurotoxins.

Our analysis shows 1) a numerical reduction in genes dedicated to neurotoxin metabolism in *Homo* relative to generalist omnivores (*Rattus* and *Mus*), 2) an approximately-similar number of genes in closely-related specialized omnivores (*Pan*), and 3) a greater number of genes dedicated to neurotoxin metabolism in *Homo* relative to carnivores (*Canis*). We interpret these results as supporting the expensive-tissue hypothesis and indicating that a trade-off in gut size during encephalization in genus *Homo* was accompanied by a reduction in exposure to plant neurotoxins. This diet shift is consistent with detoxification of plant foods using cultural technologies and/or a greater dependence on meat eating.

The importance of the concept of culture to anthropology.

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The germs of racism began even before the Spanish Inquisition. Early in European history different peoples were thought of as either Pre-Adamites or as degenerates. Pre-Adamites were biologically fixed in their characteristics and could not be changed by living conditions or by education. Those who believed that "others" were degenerates assumed that these peoples were born of god but could be improved by changing their habits and environment, they could be missionized.

These ideas persisted until the time of Darwin and similar ideas persist even today. In the early 19th Century, the degenerate idea was given scientific justification through Lamarkianism. Pre-Adamite theory was reinforced by Mendelian genetics, Eugenics, and Social Darwinism. However, once Lamarkianism was disproven, there was no scientific theory left to explain the differences in peoples except biology and genetics. However, in 1911, Franz Boaz showed that skull shape could change in human immigrants by changing their environment and he developed the anthropological concept of culture. The idea that how and what humans thought mainly was related to their life history, education, and socialization was new to science. Human societies were not inferior or superior to one another but rather were different because of their different histories. I will discuss the importance of recognizing the concept of Culture within all fields of anthropology. As Clifford Geertz stated: "Without men no culture, certainly; but equally and more significantly, without culture no men." However, I will argue that without anthropology no culture, but, more significantly, without culture no anthropology.

Continuity and transformation during the terminal Middle Horizon (AD 950 – 1150): a bioarchaeological assessment of Tumilaca origins within the Moquegua Valley, Peru.

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While some archaeologists suggest that terminal Middle Horizon Tumilaca populations of the Moquegua Valley, Peru, represent direct descendants of earlier Chen Chen-style Tiwanaku colonists from the adjacent highlands, others have suggested that the Moquegua Valley Tumilaca were descended from earlier indigenous populations. We test these archaeological models by comparing hypothetical design matrices to dentally derived biodistance analyses using Tumilaca, Chen Chen-style, Tiwanaku, and other regional mortuary samples using 999 iterations of the partial Mantel test developed by Smouse et al. (1986). The generalized Mahalanobis' d^2 results for the nonmetric tooth cusp and root trait data indicate that the Tumilaca and Chen Chen-style mortuary samples are phenetically similar to one another suggesting that these populations likely share an ancestral-descendant relationship. The partial Mantel results for the highland origins model is positive and significant ($r = 0.49$, $p = 0.001$), while the comparisons for the local origins model produced negative and nonsignificant results ($r = -0.09$, $p = 0.732$). The broader implications of these results are discussed.

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Assessing the distribution and abundance of owl monkeys (*Aotus zonalis*) in Chagres National Park, Panama.

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Since its first scientific description in 1802 the taxonomy of *Aotus* has been debated and there are various arrangements on the number of species and subspecies. Although currently most classifications favor a more speciose arrangement than previously assumed, there is ambiguity on the status of many taxa. This taxonomic uncertainty may hamper conservation efforts,

necessitating the need to increase our understanding of both the taxonomic and population level status of many *Aotus* populations. The Panamanian owl monkey, tentatively identified as *Aotus zonalis,* is a case in point. With their forest habitat being destroyed at a rapid pace it is vital to find out more about this taxon to enable a correct IUCN Red listing and to ensure appropriate protection and management of the remaining populations. We conducted systematic surveys at Chagres National Park in central Panama, quantifying the abundance and distribution of *Aotus*. A total of 75.4 kilometers were walked along transects between 18:00-24:00 hrs and 04:00-06:00 hrs in three distinct forest ecosystems. A total of 33 individuals in 16 groups were observed, at two of three sites. Population density was measured in groups/km^2 and animals/km^2. Encounter rates and habitat characteristics of canopy cover and tree density/ha were found to be significantly different between sites. *Aotus zonalis* appears well-adapted to human disturbance and secondary forests at this site but population densities are low and careful management for conservation of the species is necessary. Clarification of their taxonomy will also aid in informing conservation status.

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Hamadryas baboons as an analog for social evolution in *Homo erectus*.

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Baboon behavior, adaptations and socioecology have long been recognized as providing an important comparative sample to elucidate the processes of human evolution. Hamadryas baboons in particular, *Papio hamadryas hamadryas*, may represent an even better analog than 'savanna' baboons for reconstructing social dynamics in early *Homo* groups because hamadryas display a combination of the male kin bonding that is thought to have characterized early hominins, the male-female pair-bonding that is thought to have developed at some point during human evolution, and the female bonding that underlies the grandmother hypothesis for the evolution of post-reproductive longevity in human females. *Homo erectus* has been argued to represent a transitional species in hominin evolution in that its larger body and brain size and more extensive ranging patterns increased the costs of reproduction for females, thereby providing a selective force leading to greater levels of sociality than in earlier hominins. The higher costs of reproduction faced by *Homo erectus* females, exacerbated by an increased reliance on difficult to acquire, nutrient-dense foods, are commonly thought to have been alleviated by a strengthening of male-female bonds (via male provisioning and the evolution of monogamy) or the assistance of older, post-reproductive females (via grandmothering). We present an alternative scenario of social evolution in *Homo erectus* that draws upon the patterns of social bonding and reproductive strategies found in hamadryas baboons. This new scenario of *Homo erectus* social evolution does not exclude either male provisioning or grandmothering, and thus integrates elements of previous models.

CT-based assessment of relative soft tissue alteration in different types of ancient mummy.

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Mummification of any type leads by definition to alteration of soft-tissue morphology. Hitherto, no research addressed mummification-type (e.g. artificial versus natural mummies) specific alteration of soft tissue shrinkage as assessed by computed tomography (CT). Our aim was to test whether soft-tissue alteration is specific for type of mummification. A total of 15 human mummies have been investigated by CT. Type of mummification included ancient Egyptian style, natural Peruvian mummies, Ice mummies (including the Iceman, South Tyrol Museum of Archeology, Bolzano, Italy, ca. 3,300 BC), bog bodies and a possible Asian mummy. As diagnostic gold-standard the CT cross-sectional data set of the visible human project ® was used. Soft-tissue shrinkage (area in number of voxels) was defined relative to area of bone. Measurements were taken at various anatomically defined locations (e.g. at mid-metacarpus 5 and at cervical vertebra 4). Ice mummies - independent of historic age - show the highest degree of preservation most likely due to water being frozen within tissues. Relative to the reference sample of Ice mummies (35 measures), all other types of mummies show significantly (at $p<0.05$) smaller relative area of preserved soft-tissue. Variation between different anatomical structures (e.g., upper lip versus mid-femur) is significant, unlike variation within one compartment (e.g. proximal versus distal humerus). Type of mummification determines significantly the degree of soft-tissue alteration, surprisingly mostly independent of overall historical age. These results highlight the unique morphological impact of taphonomy on soft-tissue preservation and is of particular interest also in tissue research and forensics.

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Predicting the oxygen consumption of individuals: Are

mechanical energy calculations enough?

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Assessing the energetic cost of locomotion is critical to evolutionary studies because energy used for locomotion is lost to reproduction. Some species can be directly studied in laboratory settings, but not all animals (especially extinct ones) are amenable to laboratory experimentation. Mechanical energy has been used to estimate metabolic energy, allowing for flexibility in predictions, but it has not been shown to predict metabolic requirements with great fidelity. Here we describe a subject-specific model of human walking to investigate the relationship between mechanical and metabolic energy.

We developed a mechanical model of human walking, which included rigid bodies representing thighs, legs and a pelvis/trunk. Kinematic, anthropometric, and volumetric oxygen consumption (VO_2) data were collect for 8 individuals who walked at three self-selected velocities. Kinematic and anthropometric data were used to parameterize the model and external and internal mechanical energy consumption was calculated for each individual. Mechanical energy as well as traditional predictor variables (body mass, velocity, leg length, resting metabolic rate (RMR)) were regressed against VO_2.

After stepwise variable selection, internal ($p < 0.001$) and external ($p = 0.002$) mechanical energy and RMR ($p < 0.001$) combined to explain 81% of the variation in VO_2 ($r^2 = 0.81$). Internal and external mechanical energy and RMR each showed a positive relationship with metabolic energy consumption if regressed alone ($r^2 = 0.37$, $r^2 = 0.14$, and $r^2=0.31$, respectively). Interestingly, in the combined model, while internal energy and standing RMR exhibited a positive relationship, external energy was negatively correlated with VO_2.

Hominin dental structure and development revealed non-destructively by multi-scale synchrotron imaging.

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Recent non-destructive X-ray synchrotron microtomographic studies have revealed internal tooth structure, including dental microstructure, with high fidelity. Anthropological applications include investigations of enamel thickness and root morphology in a number of human and primate fossils, as well as developmental features in fossil hominin enamel and dentine. One of the most powerful uses of this technique is the detection of the neonatal line, in addition to the incremental long-period line periodicity. The lack of these parameters in previous studies has led to broad estimations of developmental timing and age at death in other fossil hominins. Given the recent finding of a rapid developmental profile in a juvenile Belgian Neanderthal based on classical analysis, we applied synchrotron imaging techniques to increase the number of Neanderthal and early *Homo sapiens* juveniles available for study. The selected individuals were imaged at various resolutions in order to assess their dental developmental and to estimate their age at death based on incremental dental features. Here we present revised age at death estimates for a number of individuals, including the Le Moustier 2 and Engis 2 juveniles, which are younger than previous estimates based on modern human developmental standards. Synchrotron imaging allows accurate assessment of dental development in fossil hominins, leading to clearer resolution of the origins of modern human life history and resolution of the long-standing debate over developmental differences between Neanderthals and our own species.

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A little tail about sexual dimorphism of the human pelvis.

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The human vertebral column modally consists of four coccygeal ("tail") vertebrae. Fusion of the coccyx to the sacrum is considered a childbirth hazard. This study uses skeletons (Hamann-Todd and Terry Collections) of 130 females and 72 males to evaluate the effect of coccygeal fusion on pelvic size, and 413 females and 604 males to evaluate the relationship between coccygeal fusion and number of pre-sacral vertebrae. Museum records show the individuals were 20 to 49 years of age. Results show females and males are not significantly different from one another in the prevalence of coccygeal fusion; overall prevalence is 35%. Pelvimetric analysis shows that females with coccygeal fusion have a significantly shorter posterior sagittal diameter of the outlet than those without fusion. Females with coccygeal fusion are not significantly different from males without fusion in this diameter. Combined sample of females and males show that an extra pre-sacral vertebra is associated with a lower than expected prevalence of coccygeal fusion. Results are interpreted as follows. First, the high prevalence of coccygeal fusion suggests that the shortened posterior sagittal diameter of the outlet does not seriously compromise childbirth. Evolution of sexual dimorphism in sacral angulation (i.e., inclination of ventral axis of sacrum) ensures that females with coccygeal fusion have an obstetrically adequate pelvic outlet. Second, low prevalence of coccygeal fusion among individuals with an extra pre-sacral vertebra

suggests a homeotic transformation of the first coccygeal vertebra. Selection pertaining to this homeotic transformation is discussed.

Ontogenetic differences in giant bamboo consumption by *Hapalemur* (*Prolemur*) *simus*.

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In Ranomafana, Madagascar, *Hapalemur* (*Prolemur*) *simus* specializes on giant bamboo, *Cathariostachys madagascariensis*, as its dietary staple. Leaves, shoots, and culm pith are the major bamboo constituents the lemur consumes. Time involved in harvesting and eating these plant parts can differ greatly due to their inherent anatomical and mechanical attributes. Particularly, shoots and culm pith must be extracted from their protective vegetative layers before they can be ingested. Therefore, *H. simus* individuals that vary in maturation may exhibit age-specific feeding behavior that corresponds with their ability in extracting these food resources. I conducted focal animal observations (1996-2003) of 13 adult and 11 juvenile *H. simus* in Ranomafana and compared key aspects of giant bamboo consumption between the two age classes. Significant differences were found: 1) adults engage in more shoot and culm pith extractions than juveniles; 2) accordingly, juveniles spend less time harvesting and more time scavenging for scraps of these bamboo parts than adults; 3) adults feed on larger diameter shoots and culms than juveniles; and 4) adults are more efficient at breaking into shoots and culms than juveniles. Previous studies have shown that the mechanical properties of bamboo can influence the feeding behavior of *Hapalemur* species, and body size of the three species examined positively correlates with absolute maximum bite force. This study shows that the observed ontogenetic differences in feeding behavior of *H. simus* individuals may be similarly constrained by the mechanical properties of bamboo and the development of their masticatory apparatus.

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Lactation costs and benefits: contrasting primates with other mammalian taxa.

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The manner in which lactation acts as a cost to mothers and a benefit to infants is highly variable among mammalian taxa. By comparing primate lactation with other eutherian taxa, the extent to which specific features may, or may not, reflect adaptive patterns can be revealed. Such comparisons suggest the following: (1) milk composition is relatively conserved within orders and is driven by likelihood of frequent infant access to suckling. Groups with high access (e.g. carried primates, following ungulates) have relatively low density milk; (2) primates have relatively long periods of reliance on milk as the sole food source, given their precocial condition; (3) the period of infant "mixed feeding" – i.e. feeding on both milk and solid food – is highly variable among taxa, within taxa, and among individuals within a species. The mixed feeding period is likely quite sensitive to environmental cues and considerably complicates the empirical assessment of lactation costs; (4) a mother's investment in lactation may be balanced by other investments in infant growth, such as carrying (as seen in primates and edentates) and provisioning with solid food (as seen in some primates and carnivores). While these non-lactation investments are often made by the mother, they represent energetic burdens that can be shared with other group members in socially living species; (5) the role of suckling as an attachment behavior once its nutritional role is diminished or eliminated is highly developed in primates, creating both interesting fodder for study and complications regarding the assessment of lactation costs.

Jaw-muscle fiber architecture in great apes: a preliminary analysis of fiber length and physiologic cross-sectional area.

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Muscle fiber architecture is recognized as an important determinant of muscle function and performance, yet we know very little about the muscles that generate jaw movements and jaw forces in the great apes. We measured masseter fiber length (L_f) and computed physiologic cross-sectional area (PCSA) in a preliminary sample of *Pongo* (n=2), *Pan* (n=2) and *Gorilla* (n=2). Fiber length is proportional to a muscle's maximum excursion and, by extension, contraction velocity, while PCSA is proportional to a muscle's maximum force-generating capacity. Preliminary results demonstrate that L_f ranges between 17.0-22.9 mm for *Pongo*, 21.6-21.8 mm for *Pan*, and 41.8-63.5 mm for *Gorilla*. PCSA ranges between 17.6-18.8 cm^2 for *Pongo*, 9.6-22.8 cm^2 for *Pan*, and 35.1-39.0 cm^2 for *Gorilla*. Fiber length and PCSA are smallest in *Pan* and largest in *Gorilla*, suggesting a general scale effect. Relative to muscle length, fibers are longest in gorillas and shortest in orangutans. Gorillas and orangutans have larger PCSAs compared to chimpanzees relative to condyle-M_1 length, but the great apes have roughly similar PCSAs relative to jaw length. We

further compared masseter fiber architecture between the great apes and cercopithecoids (*Macaca* and *Papio*). Gorillas still have the relatively longest fibers. However, baboons have the greatest masseter PCSA relative to condyle-M_1, whereas cercopithecoids and apes show considerable overlap in masseter PCSA relative to jaw length. These preliminary results suggest that orangutans and gorillas have relatively greater maximum force-generating abilities compared to chimps during chewing.
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A reanalysis of the human cranium from the Scharbauer Site (41MD1), a Paleoindian locality near Midland, Texas.

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Recent research of Paleoindian remains from North and South America has revealed that the first human inhabitants had a cranial morphology somewhat distinct from recent populations of American Indians. The morphological characteristics of the Paleoindians reveal a craniometrically diverse founding population of the Americas. These findings have resulted in many questions regarding the number of migrations from Asia to the Americas and the biological relationships between early inhabitants of North and South America. Recently the author re-examined the human cranium from the Scharbauer site (41MD1), a Paleoindian locality near modern Midland, Texas. The fragmentary remains represent an adult female who lived 11,600±800 years Before Present. The cranial remains consist of a calotte and other small fragments. The state of preservation severely limits the number of measurements that may be observed. However, enough of the vault is present to collect at least 20 separate measurements. Comparison with published results of other Paleoindian female remains reveal that the basic shape of the Midland calotte is most similar to remains from Largoa Santa, Brazil. The analysis demonstrates that the craniometric pattern observed in South America was present in North America as well. This supports the hypothesis that the initial human colonization of the Americas was accomplished not by a single migration, but by multiple movements of small populations from the Old World to the New.

Lemur pregnancy in the wild: Noninvasive monitoring of reproductive function in Milne-Edwards' sifaka, *Propithecus edwardsi*, in Ranomafana National Park, Madagascar.

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We conducted this study to determine whether noninvasive techniques could be used to study ovarian function in wild *Propithecus edwardsi* females. To establish whether *P. edwardsi* ovarian steroid fecal metabolites characterize reproduction, we analyzed 71 fecal samples collected from four adults prior to and during gestation, from 9/07-5/08. We estimated conception dates by subtracting 179 days from birth. Three of four females delivered infants in May/June, 2008. We investigated patterns (duration and timing) of estradiol and progesterone excretion within each female. The three females who delivered infants displayed a slight but gradual increase in fecal estradiol 9-12 days post-estimated conception, which sharply increased in two females at days 49-55, similar to that observed in wild, pregnant *P. verreauxi* (increase ~day 7-15; surge ~day 42, Brockman 1994). The third pregnant female (3.5 years old) was primiparous and had lower estradiol levels (highest monthly means 4.3 and 5.6 times lower than other females) and did not spike as in the prime-aged (16, 17 year-old) females. This pattern resembled more closely that of the non-conceptive 5.5-year old. Estradiol elevations were followed by gradual and sustained progesterone elevations in all three gestating females at days 54, 53, and 43. The non-conceptive female displayed patterns of estradiol and progesterone excretion indicative of a normal primate ovarian cycle, with earlier and sustained progesterone elevations which decreased as progesterone climaxed in the other individuals. Progesterone levels appear most informative for determining pregnancy in this species whereas estradiol may also show age related changes in response to pregnancy.
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A comparative analysis of minicolumns in association versus primary motor, sensory and visual cortex in apes and humans.

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Minicolumns are vertical aggregates of cells traversing layers II through VI of the cortex. We measured mean spacing distance (MSD) and grey level index (GLI) of minicolumns in five regions of human and ape cortex: frontal pole, Broca's area, primary motor, somatosensory, and visual cortex. Our sample included thirteen complete series of histologically processed brains from six hominoid species: humans, bonobos, chimpanzees, gorillas, orangutans, and gibbons.
Our results indicate that there are differences both within humans between the frontal lobe and sensory cortices, and also between humans and apes with regards to

the frontal lobe regions. In humans, MSD was greatest in the two frontal lobe regions, and the average MSD for these regions did not overlap with the average MSD found in the three primary sensory cortices. In contrast, in all of the ape specimens, average MSD in the frontal lobe regions overlapped with the MSD seen in other regions. MSD was larger in both the frontal pole and Broca's area in humans than in the great apes ($p = 0.037$ and $=0.034$, respectively). However, the region with the greatest average MSD in all ape specimens was M1; in humans, the frontal pole had the most widely spaced minicolumns, followed by Broca's area. Unsurprisingly, GLI, which measures neuronal density, followed an opposite pattern in all regions. Our results suggest that humans have more space for connections between neurons in frontal lobe regions compared with other areas of the human brain, and also compared to the ape frontal lobe.

Ecomorphology and adaptation among foragers from Hokkaido Island, Japan.

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This study reconstructs ecomorphology among prehistoric foragers from Hokkaido, Japan (6000-1400 BP). The Hokkaido climate is differentiated from other Japanese islands by freezing winters with sea-ice accumulation. Given this climatic diversity, it was predicted that increased body size relative to limb length and reduced distal relative to proximal limb lengths would typify Jomon period foragers from Hokkaido (HKJ) compared to Honshu (HSJ). Similar limb proportions with groups from colder environments including Ainu people were also predicted for the HKJ. Relative limb length and body size were compared between the HKJ and HSJ using RMA regression and "Quick-Test" methods. Cluster and principal components analysis were employed to understand similarities between the HKJ and groups from different ecogeographic regions.
No significant differences in relative body size or limb lengths were observed between the HKJ and HSJ. HKJ limb proportions were similar to groups from warmer environments and differed from Ainu people. HSJ foragers retained cold-derived body size in association with Pleistocene migrations from Northeast Asia, but evolved relatively elongated distal appendages following colonization of the climatically mild Japanese Islands (ca. 35,000 BP). Hokkaido was, however, only occupied for approximately 6,000 years by Jomon cultures. It is, therefore, likely that the HKJ arrived in Hokkaido with body sizes that were pre-adapted to colder environments, but did not experience relative limb length changes in association with the brief colonization of this region. Differences between the HKJ and Ainu samples are related to gene flow between Okhotsk foragers from Siberia and local Jomon (Satsumon) cultures.
This study was funded by the Wenner-Gren Foundation for Anthropological Research and the Japan Society for the Promotion of Science.

Scaling relationships in the anthropoid temporomandibular joint.

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Many aspects of variation in the masticatory apparatus have been linked to changes in body size. It is largely unclear, however, how aspects of temporomandibular joint (TMJ) size and shape scale with body size or other biomechanically relevant variables. The scaling of condylar width, height, and area were previously examined by Smith et al. (1983) and Bouvier (1986a,b), with slightly conflicting results. No comparable scaling analyses have been conducted for the glenoid fossa.
To assess scaling in the TMJ and to provide a framework for future analyses of TMJ variation across primates, geometric morphometric methods were used to describe TMJ shape across size classes of samples from 48 anthropoid species. Linear measurements of the TMJ (e.g., glenoid and condylar length and width) were also calculated and regressed against body mass, cranial centroid size, and mandibular length. In platyrrhines and cercopithecoids, all TMJ variables tended to scale isometrically, whereas in hominoids glenoid and condyle width scaled with strong positive allometry, and preglenoid plane length scaled with negative allometry. These findings were consistent with Smith et al. and Bouvier's results, and indicate that the slight positive allometry found by Smith et al. is due to several unique scaling relationships found only in hominoids.
These results indicate that the TMJ variables studied here have different scaling patterns depending upon the taxonomic group being examined. These patterns have specific biomechanical implications regarding the role of the TMJ in mastication, and particularly in regard to dietary and phylogenetic variation among anthropoid primates.
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The history of growth disruption in European children: evidence from hypoplastic teeth.

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To explore temporal-spatial variation in growth disruptions in European children, we recorded the severity of linear enamel hypoplasia (LEH) in 5,784 individuals studied as part of the Global History of Health Project. LEH is a deficiency in enamel development (amelogenesis) caused by pathological stress associated with infectious disease, parasitic infestations, malnutrition, and various combinations of such environmental factors. Because LEH persists in the teeth of adults, it provides an excellent nonspecific index of levels of childhood developmental stress.
Lesions on the incisors and canines were recorded as present only if linear grooves could clearly be seen with the naked eye using the following system: 1) no linear enamel hypoplasia, 2) one hypoplastic line present, 3) two or more hypoplastic lines present. Teeth were scored as "unobservable" if more than 50% of the crown height has been lost owing to wear, or other causes.
These data reveal higher rates of LEH in men than in women (x^2=7.2, p=0.007) and a highly significant positive correlation between LEH and porotic hyperostosis (x^2=80.2, p <0.0001). Strong correlations do not exist between levels of population aggregation (rural vs. city life) or historical period. Ecological analysis reveals low LEH rates among people living in environments with low ordinal primary productivity scores (x^2=71.8, p=0.000). The prevalence of LEH is also significantly greater (x^2=26.4, p<0.0001) among the people living in Northern Europe than it is in Southern Europe. Chronological analysis does not reveal any clear temporal trends in the prevalence of LEH.
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New discoveries from Kromdraai, South Africa, relating to the type specimen of *Paranthropus robustus*, TM 1517.

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The type specimen of *Paranthropus robustus* (TM 1517), discovered by Gert Terblanche in 1938 at Kromdraai B in the Cradle of Humankind World Heritage Site, South Africa, was described by Robert Broom. It includes a partial cranium, hemi-mandible, right distal humerus and talus. More recently, a left humerus shaft and molar fragment (probably representing the same individual) have been found in the course of systematic excavation, after trace element analyses were undertaken on breccia to identify the probable locality of TM 1517. Palaeomagnetic analyses of Kromdraai B breccias, together with associated fauna, provide a minimum date of 1.95 million years (the beginning of the Olduvai Event) for the type specimen of *P. robustus*. As at Olduvai, both *Homo* and *Paranthropus* are represented at Kromdraai. Stone artefacts are associated with Oldowan technology.

Upper limb asymmetry in the archaic Windover population from Florida.

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Prehistoric humans demonstrate species-wide bilateral asymmetry in the length and diaphyseal breadth of their upper limbs, with the majority having a bias towards right side dominance. These differences in size (primarily the breadths) have been attributed to direct usage and differential activity levels that result in mechanically driven bone growth

and remodeling (Auerbach and Ruff 2006; Lazenby 2002; Steele 2000; Schultz 1937). This study examines the 8,000 year old Windover skeletal population from Florida to determine the differences between males and females in their expression of bilateral asymmetry using several upper limb elements. A preliminary comparison of humeral morphology found that males tend to have a relatively higher correlation between different measures of asymmetry with a bias for the right side in comparison to females. Although this result suggests a division of labor based on gender roles, the nature of the actions producing these asymmetries still needs to be carefully examined in terms of both subsistence activities and other habituation arm usages. The analysis of the entire upper limb, including hand elements, from a single population will make deciphering the impact of these different activities more feasible.

The effect of bias skeletal recovery on bioarchaeological interpretations: a case study from the Southeast.

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Although modern methods of skeletal recovery have evolved in response to the population oriented goals of bioarchaeology, the fact remains that much of the available material was collected during a period with questionable research objectives. Stewart (1969) recognized deliberate selection of pathological specimens in an Illinois series and notes how rarely this type of information is communicated to researchers. Since bioarchaeological interpretations rely on representative skeletal samples, it is of value to consider different approaches to these issues. The Oliver site (22CO503) in northwest Mississippi is unique in that two widely time-separated excavations were completed at the site: the first in 1900 by Charles Peabody (~25% of exposed burials were collected), and a more recent project in 1990 by the Mississippi Department of Archives and History (all uncovered material was collected). Comparing the osteological material shows the rate of traumatic injury differs considerably between samples (28% versus 15%); the rate of porotic hyperostosis is significantly higher (X^2=3.75, p=.05) in the 1990 sample; and the1900 sample is overwhelmingly comprised of individuals 17-40 years old, whereas the 1990 sample has a much higher representation of sub-adults aged 2-10 years.
Results suggest the presence of several recovery related biases in the 1900 sample. While this has some unavoidable implications, there are approaches that can still provide useful data. For example, instead of focusing on overall rates of trauma, exploring intragroup patterns by sex avoids issues related to selective recovery. Suggestions presented may be applicable when dealing with skeletal material collected in similar contexts.

Baby death and baby teeth: analysis of dental defects in the deciduous dentition from Tell Abraq (2300 B.C.).

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The disarticulated and commingled remains from an Umm an-Nar tomb at the Bronze Age site of Tell Abraq (2300 B.C.) contain 18 perinatals, infants, and children (MNI based on upper right deciduous canine). This tooth was chosen for study since its crown development spans the third trimester of fetal development through birth to c. 11 months of age and so it provides an opportunity to examine infant health from a developmental perspective. Fifty-seven canines were available for analysis. For the upper right deciduous canine, 5.6 % presented with hypoplastic pits, 61.6% show defects likely caused by fluorosis, and 33.3% showed no defects. Of these individuals, 38.9% were aged birth to 3 years and 61.1% aged 3 to 6 years of age. Four teeth show defects that occurred in utero, 11 formed around birth and within the first year of life, and for 3 the whole crown was affected. Forty percent of upper left canines (n=15) had hypoplastic pits, 73.3% displayed fluorosis defects, 13.3% had no defects. The lower canines show a similar pattern of fluorosis and hypoplastic pitting. Ground water in the Arabian Peninsula has relatively high levels of fluoride, and many of the defects have the classic opacities and defects associated with fluorosis. Based on long bones, there were approximately 30 neonate and newborns interred in this tomb, an unusually high number suggesting high infant mortality. The deciduous defects provide additional insight into the possible reasons for newborn and infant death.

Grooming for tolerance? Behavioural interchange in wild tufted capuchin monkeys (*Cebus apella nigritus*).

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A focus on the proximate mechanisms underlying reciprocity has recently been prompted by the hypothesis that cognitive abilities can constrain reciprocation in primates. Indeed, constraints in the ability to memorize a large number of interactions or to connect a given action to a subsequent reaction over long time periods have been suggested to strongly limit the possibility of reciprocation in non-

human animals. As a consequence, reciprocity has been hypothesized to necessarily occur only over short intervals of time. This study aims at testing whether or not reciprocation in primates is based exclusively on short-term interactions by analyzing the temporal frame of behavioral interchange. Data on grooming and co-feeding on contestable resources (as a measure of tolerance) were collected in a wild group of tufted capuchin monkeys (*Cebus apella nigritus*) in Iguazú National Park, Argentina both in natural contexts and during supplemental feeding on suspended platforms. A total of 222 feeding platform experiments and 697 hours of observations in natural contexts were conducted. Across the entire data set, allogrooming between two individuals was positively correlated with their tolerated co-feeding in the experimental feeding contexts even when maternal kinship was controlled for. However, grooming had no short-term (within two hours) effect on the level of tolerated co-feeding. These results suggest that short-term interactions do not constrain a subject's willingness to tolerate group members. Long-term affiliative relationships seem to have a more important role in explaining the reciprocal exchange of social services such as grooming and tolerance. Funding provided by the University "La Sapienza", Rome, Italy.

Phylogeographic variation of ASPM is determined by IL-10?

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Several genes have been related to encephalization based on pathological conditions, and one of these genes, ASPM, has been investigated by multiple groups trying to understand its influence on human brain evolution. The ASPM gene is found on chromosome 1 and is relatively near the IL-10 gene. IL-10 plays a major role as primary negative regulator of inflammatory and immune responses. It has been established that mutations in the promoter region of IL-10 determine different relative levels of expression and that relatively low levels of expression of IL-10 are associated with numerous diseases, particularly of autoimmune type, suggesting IL-10 is under ongoing selection. Furthermore, IL-10 appears to be one of those indispensable genes, playing roles in multiple pathways and with no "understudy." Though the two genes are not immediately adjacent to one another, combinations of linked ASPM and IL-10 haplotypes are likely population-specific or common to regions. We have generated data for IL-10 expression variants from the same set of samples used by Mekel-Bobrov et al. (2005) to determine the worldwide distribution of ASPM variation. Based on preliminary PHASE results, it appears that the higher expression IL-10 haplotype is linked to the derived ASPM haplotype, and the lower expression IL-10 haplotype is linked to particular ancestral ASPM haplotypes. Contrary to previously published analyses of ASPM, claiming the derived ASPM haplotype was under selection, we propose that it was selection for the linked higher expression IL-10 allele that has driven the geographic distribution of the derived ASPM haplotype.

The genetic basis of phenotypic variation in Africa: Evidence for local adaptation.

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Africa contains the greatest levels of human genetic variation and is the source of the worldwide range expansion of all modern humans in the past 100,000 years. Analyses of genome-wide markers genotyped in diverse Africans indicate that African populations also have high levels of genetic substructure. Because of differences in diet, climate, and exposure to pathogens, ethnically and geographically distinct populations are likely to have experienced distinct selection pressures, resulting in local genetic adaptations. We currently know little about how changes at the genetic level correlate with phenotypic changes and adaptation to novel environments during recent human evolutionary history.

In order to address these issues we have collected data on genotypic and phenotypic variation for a number of normal variable traits, including lactase persistence and bitter taste perception, in >50 populations from Western and Eastern Africa. We have sequenced candidate loci that may play a role in phenotypic diversity and have identified novel polymorphisms associated with these traits. We use a number methods based on observed levels of intra- and inter-species genetic variation to characterize signatures of natural selection. Our results help shed light on the genetic bases of adaptation to changes in diet and on historical migration events within Africa.

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From coprolites to ancient human microbiomes.

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The Human Microbiome Project is an effort to elucidate the genetic identity of several hundred microorganisms that live in the human body and their influence upon human development, immunity, nutrition, and disease

predisposition. Advances in new DNA sequencing technologies, like massively parallel pyrosequencing, better known as 454 technology, allow us to retrieve information from a microorganism community without the need to isolate and grow the microbes. The goal of the present work was to adapt this technology to retrieve the microbiome information from pre-Columbian human coprolites (paleofeces) from the Americas. This genomic information allows us to compare ancient gut microbial communities to modern gut communities. Prior to pyrosequencing, we determined that our samples reflected separate individuals; we confirmed abundance and quality of DNA extracts; we confirmed the presence of species characteristic of the human gut. While within a controlled laboratory environment, we generated DNA libraries using tags that allow us to keep track of external contamination during later processes of pyrosequencing. Our 454 run was successful, with little evidence for contamination. After a phylogenetic and functional analysis of the genetic information retrieved, we found similar profiles as those observed for modern human microbiomes. However, we found more similarities between the ancient profiles than between ancient and modern profiles. We postulate this pattern is attributed to a distinct pre-Columbian biogeography.

Does Environmental Unpredictability Drive Lemur Life Histories?

C.J. Toborowsky, W.A. Barr, R.J. Lewis. Department of Anthropology, University of Texas at Austin.

Many authors have suggested that Madagascar's unpredictable climate, e.g. high occurrences of cyclones and droughts, causes a unique suite of traits in the lemur radiation. However, few researchers have quantified Madagascar's predictability. Environmental unpredictability is expected to result in "fast" life histories in mammals. This study tested the hypotheses that 1) Madagascar's climate is unusually unpredictable, and 2) life history traits vary in lemurs according to the degree of environmental unpredictability. We predicted that 1) Madagascar's climate is less predictable than other primate habitats, 2) the seasonally dry habitats of Madagascar are less predictable than the aseasonal wet habitats, and 3) life history traits correlate with climatic predictability. Climatic predictability was measured by monthly and yearly variation. Our results demonstrated that Madagascar's climate is less predictable than continental Africa ($P = 0.025$), and that the dry and wet habitats of Madagascar did not differ. We found no significant relationship between predictability and lemur life history traits. We found more variation in life history traits than expected based on body mass in predictable habitats, but in unpredictable habitats, life histories were tightly constrained by body mass. Contrary to expectations that unpredictability correlates with "fast" life histories, some lemur life history traits were significantly "slower" than in similarly-sized primates in the more predictable African habitats. This deviation from expectations suggests that a "slow" life history may be adaptive in unpredictable environments, or that environmental unpredictability is not as strong a selective pressure driving lemur life history patterns as previously thought.

Contribution to New Forest Growth by *A. palliata* in a Fragment of Dry Tropical Forest.

A. Toole. University of Missouri-St. Louis.

Research has shown that howler monkeys can be efficient seed dispersers. A preliminary study was conducted in June/July 2008 in a fragment of dry tropical forest on the Isla de Ometepe, Nicaragua to assess the potential contribution of *A. palliata* to seedling density and new forest growth. Using random 12 m^2 transects, I compared woody and herbaceous seedlings under 10 central activity trees to 10 control trees in which howlers were not active. Central activity trees were defined as trees in which monkeys were observed feeding and resting during the day rather than traveling through. Two-tailed independent sample t-tests were used to assess differences in new seedling growth between activity trees and control trees. There was a statistically significant difference (0.027 p-value) in the total number of seedlings between the groups, with activity trees having on average 96 more seedlings beneath them than control trees. There was also statistical significance (0.000 p-value) between the numbers of woody seedlings, with the activity trees having more. These results suggest that *A. palliata* may be important contributors to the variety and density of regenerating forests. Follow-up research is needed to examine biodiversity and to determine the effect of other seed-dispersing animals.

Piercing the body: Labret use and identity in prehistoric Chile.

C. Torres-Rouff. Department of Anthropology, Colorado College.

Contextualized bioarchaeological analyses of a small set of human remains from the Chilean *norte chico* site of El Torín are used to explore the relationship between labret use and identity. Excavation of 11 funerary mounds at this Formative Period site (0-800 AD) yielded the remains of 37 individuals, four of whom were interred with labrets. Data were collected on the presence of this ornament and its effects on the dentition. Labret use is discussed in light of demographic information, body use data, traumatic injury, burial style, and grave goods.
This analysis demonstrated that the individuals with labrets were all middle adult males with skeletal evidence of use. Three of these males had five traumatic injuries, a significantly higher rate than in the remaining adult population. These four individuals were grouped in two burial mounds with five other

individuals, yet only one object was found between the two tombs. Despite the widespread use of body adornments, the individuals with labrets had no other ornamentation. The men who wore labrets at El Torín did so often enough and for a long enough time to produce noticeable effects on their teeth and mandibles, and possibly reused the object itself. I argue that the labret denoted a social class that reflected achieved standing and, more specifically, underscored a particular sort of masculinity. While consistent with earlier readings that tied labret use to maleness, this contextualized approach takes into account the multiplicity of socially acquired identities and provides a glimpse into individual lives.

Infant carrying and prewalking locomotor development: proximate and evolutionary perspectives.

D.P. Tracer. Department of Anthropology, University of Colorado Denver.

Failure to crawl is considered in much of the child development literature to be symptomatic of a disruption in normal neurological progression and associated with a roster of deleterious sequelae. Using data from 113 Papua New Guinean mother-infant pairs observed for a total 483 hours of focal follows, I show that the high degree of infant carrying in this population canalizes the course of development such that children never crawl but instead universally go through a phase that involves upright scooting prior to walking. Indices of infants' nutritional status, but not the lack of crawling, are most strongly associated with further locomotor and cognitive development.

Using comparative data from other foraging populations and our closest primate relatives, I suggest that a high degree of infant carrying was likely normative throughout our evolutionary history. Carrying is an adaptive parental strategy that made infants less susceptible to predation and also lessened transmission of parasites to offspring by curtailing oral to ground contact. Thus crawling was likely not a universal stage of prewalking locomotor development during our evolutionary history but represents a recent innovation associated with newer housing and levels of hygiene that allow parents to put infants down without fear of predation or parasite transmission.

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A re-evaluation of the traditional interpretation of British Prehistoric non-formal funerary and depositional practices.

J. T. Tracey. Archaeology Department, University of Reading.

This poster presents the results of a re-assessment of funerary and depositional accounts of human remains from a British Prehistoric Settlement *c.* 800 BC originally excavated during the 1970s. This settlement exhibited wide-ranging types of human skeletal assemblages; complete and partial inhumations, commingled and mixed (both human and faunal) assemblages. Typical of the period the archaeologists' method was based on anthropological and ethnographic studies from outside the British Isles, with suggestions that excarnation and secondary burial rites were common practices during the British Iron Age.

In light of subsequent research in forensic taphonomy and osteoarchaeology these human remains recently underwent a more detailed osteological analysis to determine whether this funerary interpretation still stands. Preservation issues, surface modifications, age, skeletal representation, and depositional contexts types were examined to determine whether skeletal variation, patterning or rite could be observed.

Results suggest that there was a radical change in the treatment of the dead between *c.* 800 BC and *c.* 400 BC from fragmentation of the corpse, to keeping the body whole and the inclusion of non-adults in the burial record. Finally, mixed assemblages traditionally considered 'special' deposits may have been a common, structured and active practice, running in parallel to the complete, partial and commingled assemblages.

Shape analysis of human midfacial morphology.

W.R Trask, J.T Hefner. Statistical Research, Inc.

Cranial morphology is a valuable indicator for both sex assessment and group affiliation in human skeletal remains. As technology advances, methods must also advance and seek to reassess the variation typically thought to exist between sexes and among groups. This paper examines three-dimensional morphometric variability in the human midfacial skeleton.

Eighteen landmarks were chosen based on their ability to characterize both the shape of the orbit, as well as illustrate the changes and variation of the bones that compose the midface. The samples used in this study include a series of American White and American Black male and female crania from several collections, as well as a collection of 19th-century Hispanic male and female crania recovered from a historic period cemetery in Tucson, Arizona. Three dimensional coordinate data for each cranium were collected and analyzed using standard geometric morphometric methods to assess between and within group differences. A MANOVA using 999 randomizations of group membership produced significant differences ($p<0.05$). A relative warp analysis of a thin plate spline (TPS) revealed major differences in shape variations, including a rounder orbit and higher zygoma in females than males, as well as a posterior movement of the maxilla and inferio-lateral nasal aperture in females. Additionally, significant differences were observed among Hispanics, Whites, and Blacks in the study groups and a discriminant function analysis of the first four principal components had

significantly high cross-validated classification accuracies. These results add to and improve upon the quantification and understanding of midfacial morphology and human cranial shape.

The mysterious genitalia of female strepsirhines: explaining variability in female genital morphology.

K. Treatman-Clark. Johns Hopkins University.

In contrast to male strepsirhines, which exhibit relatively consistent genital morphologies within a family, female strepsirhines often exhibit strikingly different morphology of the vagina and clitoris within the same family, and even among congeners (Treatman-Clark, 2008). Many hypotheses were ventured to explain the genital variability observed in lemuriforms, including male mimicry, variations in social and mating systems, variations in urine marking behavior, and disease avoidance.
Measurements of the genitalia and descriptions of genital shape were collected for nineteen lemuriform taxa and three lorisiform taxa at the Duke Primate Center and Ranomafana National Park. PICs and linear regression were used to test for associations between continuous variables, such as clitoris length and penis length, while Chi square tests were used to test for associations between ranked and categorical variables.
The non-significant association between clitoris length and penis length indicates that male mimicry alone is not enough to explain variation in clitoris length ($r = .317$, $d.f. = 22$, $p = .108$). Different aspects of the genitalia are associated with different social or mating variables. Anestrus vaginal closure is more common in dispersed taxa ($\chi^2 = 8.06$, $p = .005$), while clitoral elongation is associated with gregariousness ($\chi^2 = 6.67$, $p = .036$), more frequent copulation during behavioral estrus ($\chi^2 = 5.92$, $p = .05$), and female dominance ($\chi^2 = 6.67$, $p = .036$). It appears that multiple selective pressures have acted on the genitalia of female strepsirhines. Social and mating behavior have ultimately played an important role in shaping female genital morphology, but more work is necessary to elucidate the proximate causes of genital variation.

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Inferred body proportions of a southern European Neandertal, Palomas 92.

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European Neandertal body proportions have been based on specimens from last glacial cold ecozones, and the absence of more southern European skeletons has made ecogeographical variation within the European Neandertals difficult to assess. The 2005 discovery of a partial Neandertal skeleton in the Sima de las Palomas in southeastern Spain (Palomas 92), from early oxygen isotope stage 3, permits a preliminary assessment of Neandertal ecogeographical variation.
It is possible to estimate femoral length and femoral head diameter, plus mid-proximal diaphyseal cross-sectional parameters, for Palomas 92. Based on these data, it is one of the smallest Neandertals known. Mid-proximal polar second moment of area versus femoral length times estimated body mass (from the femoral head diameter) provides a level of robusticity in the middle of the Late Pleistocene range of variation, but comparison of the polar second moment of area to femoral length alone aligns it with the Neandertals, suggesting stocky body proportions. This inference is supported by its femoral head diameter (reflecting body mass) to femur length (reflecting stature) proportion, which places Palomas 92 with more northern Neandertals, at the top of the Middle Upper Paleolithic range and separate from linear Middle Paleolithic modern humans. Palomas 92 therefore combines a normal level of femoral diaphyseal robusticity with the stocky body proportions of other European Neandertals despite its more southern and warmer milieu.

Molecular clocks in lemuroid primates.

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Although the molecular clock hypothesis posits that the rate of molecular change in species scales to absolute time, there is evidence that molecular clocks vary among taxa. These rate differences are hypothesized to correlate with certain species attributes, such as generation length and body size. Some of the strongest evidence for variable molecular clocks comes from the primates, e.g. the 'hominoid slowdown.' Here, we examine rates of molecular change in Lemuroid primates and test whether body size or age at first reproduction (a proxy for generation time) explain patterns of rate variation better than a null model where the molecular clock is independent of these factors. To examine these models, we utilized the recent molecular dataset of Horvath et al (2008) and other available data from Genbank. This study examined 4 pairs of lemur sister taxa, potentially resolving issues of phylogenetic independence and fluctuating body size and generation length changes over time. Our analysis does not support a model where body weight or age at first reproduction strongly correlates with rates of molecular evolution, though the role of body size is nearly significant. This result suggests that molecular clocks are relatively constant in lemuroids, despite differences in

body size and generation time. Alternatively, our proxy for generation length may be flawed, or, that too few data exist to fully test these two alternatives against the null hypothesis.

Astragalar proximal facet shape: Differences in articular morphology among closely related hominoid taxa.

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The talo-crural joint in primates can be considered to consist of three elements, proximal presentation, distal presentation, and the joint articulation. Prior examination of the proximal element (tibia) using geometric morphometric techniques revealed that this proximal platform is highly conserved within taxa, but mass and substrate use influence both presentation and articular morphology. The current study uses the same techniques to explore proximal talar/astragalar articular shape in three closely related hominoid taxa.
Astragali from 30 specimens from three hominoid species, *Homo sapiens, Gorilla gorilla,* and *Pan troglodytes* formed the study group. Laser scans were performed using a portable Minolta 910 LSS and edited in Geomagic. Thirty landmarks were placed on the scans using Landmark Editor software. Landmark configurations were then superimposed using Morphologika 2.0 and statistically analyzed in SAS using principal component analysis and multivariate regression to examine the differences in shape and their relation to factors such as mass and substrate use. Thin plate splines with wire frame deformation, and exemplar surface warp techniques provided visualization of the facet morphology.
Results demonstrated marked clustering of astragalar shape by taxon. Larger taxa showed increased trochlear mediolateral diameter and rectangular shape. Arboreal platforms have greater trochlear angulation and lateral facet concavity, but in terrestrial taxa depth of the midtrochlear groove and lateral facet concavity decreases, and the medial facet is anteriorly displaced. The proximal astragular articular morphology may provide adaptive flexibility among the taxa examined to the requirements of substrate use within the constraints imposed by mass and proximal platform morphology.
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Diet versus locale: isotopic support for causal roles in pathological conditions at Machu Picchu, Peru.

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The analysis of pathological conditions in human skeletal remains has a long tradition in biological anthropology, revealing key patterns of malnutrition, stress and disease in antiquity. However, the majority of pathological conditions are limited in their interpretive significance because they are of nonspecific etiologies. Even those indicative of more specific conditions, such as anemia or microbial infection, may have multiple causal factors. This can limit the interpretation and comparison of the distribution of pathological conditions within and between populations.
This study seeks to differentiate dietary and environmental causal factors of common pathological conditions through multi-isotopic and osteological analyses of the skeletal population from the site of Machu Picchu, Peru (N=74). Previously-reported isotopic results from this population have identified substantial immigration and wide variation in early-life residence, which may indicate considerable variation in the stressors precipitating childhood pathological conditions. Therefore, scored dental and cranial pathology data, markers of early-life stressors, were statistically analyzed against carbon ($\delta^{13}C$) and nitrogen ($\delta^{15}N$) isotopic data from tooth enamel and dentin, which represent dietary isotopic signatures from early in life. They were then compared to strontium ($^{87}Sr/^{86}Sr$), oxygen ($\delta^{18}O$) and lead ($^{20n}Pb/^{204}Pb$) isotopic data in tooth enamel, markers of region of origin early in life. Statistically significant relationships were found between several conditions and specific isotopic parameters. In particular, results for several conditions suggest that early-life environment, rather than diet, is etiologically important in their formation. These results present new avenues for more accurately interpreting pathological conditions in archaeological populations.
This study was funded by the National Science Foundation (BCS-0615409) and the Department of Anthropology at Emory University.

Fragile spines on Cayo Santiago: bone mineral density, trabecular morphology and the potential forexploring the genetics of osteoporosis in rhesus monkeys.

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Osteoporosis, a well-documented disorder among rhesus monkeys (*Macaca mulatta*) on Cayo Santiago PR, disproportionately afflicts more females than males. Like their human counterparts, female rhesus monkeys experience age-related decline in bone mineral density (BMD) and increased fracture risk. DEXA, the standard for defining osteoporosis, only assesses bone quantity, not quality of trabecular bone architecture, which is also implicated in fracture susceptibility. Using micro-CT this study explored which aspects of trabecular bone architecture most highly correlated with BMD and, more importantly, which more accurately predict potential fracture

risk. Micro-CT of the last lumbar vertebral body from 36 female free-ranging rhesus macaques (5.4 to 23.7 years) from Cayo Santiago revealed that areal BMD (g/cm^2) measured by DEXA was significantly correlated (r=0.80) with the micro-CT volumetric value (mg/cm^3). This in turn showed high positive correlation with trabecular thickness, bone volume ratio, more plates than rods, and less bone surface area per bone volume. Age, connectivity and directionality of bone architecture as well as trabecular number and separation were not strongly correlated with bone density, although the latter two were correlated with each other. This insight into trabecular structure suggests potential for more accurate assessment of osteoporotic status including relative fracture risk. Matrilineal affiliations of rhesus monkeys on Cayo Santiago are known and previous studies indicated low bone mineral density and osteoporosis may be more prevalent in certain matrilines suggesting an exciting opportunity to explore the genetics of this disorder in rhesus monkeys.

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A comparison of estimated age-at-death distributions using bioarchaeological and forensic methods.

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The goal of this research is to compare bioarchaeological and forensic perspectives of age-at-death estimation by examining age distributions resulting from each methodology.

Age-at-death estimation in bioarchaeological samples usually affords the advantage of seriation of the skeletal remains of a population as a part of the method. This is assumed to improve the performance of age estimation methods as one generates a sample-specific morphological chronology. However, in most forensic situations there is only a single set of remains so seriation is not possible and thus an age-at-death estimate must be generated entirely based on data acquired from independent reference samples.

A known age skeletal sample of White and Black males (n=63) from the Hamann-Todd Collection was scored on two different occasions. The skeletal elements examined to estimate age were the cranium and a single innominate of each individual. The first scoring assumed a bioarchaeological context where all the innominates were ordered from youngest to oldest based on morphological changes of the auricular surface and pubic symphysis, the crania were then used to refine the seriation order. In the forensic scenario the cranium, pubic symphysis and auricular surface were scored with common methods used in forensic anthropology and three point estimates were generated for each individual. After completion of both aging sessions the age distributions from each scenario were compared to the actual age distribution of the sample and to each other. Results suggest that common error trends occur in both the forensic and bioarchaeological aging methodologies.

Diet and craniofacial variation in three west African colobine species.

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Previous research has shown that primates with diets requiring greater masticatory forces tend to exhibit increased facial retraction, vertically deeper faces and more anteriorly-placed masseter muscle attachments. We compared the crania of three sympatric colobine species to test the effect of dietary differences on craniofacial form. If a phenotype favoring increased facial retraction provides a mechanical advantage for durophagy, then we expect (1) those areas of the cranium associated with the process of mastication to be most important for discriminating between species and (2) a more durophagous primate to show the phenotype described. *Procolobus badius*, *Colobus polykomos* and *Procolobus verus* are sympatric species inhabiting the Tai Forest of Côte d'Ivoire that differ substantially in diet. *C. polykomos* exploits tough seeds, *P. badius* feeds on fruits as well as leaves and *P. verus* feeds primarily on young leaves. For each specimen (n=52), 12 measurements were taken on the maxillo-facial complex.

Discriminant functions were calculated using forward stepwise methodology and assessed by a leave-one-out hit-rate estimate comparison. All functions were significant at $p < 0.05$. Measurements most important for discrimination were malar subtense, malar length, bimaxillary subtense, and basion-prostion length (at 92.6 – 99.7%). *C. polykomos* does not show the typical phenotypic pattern for an obdurate feeder. However, the features most clearly separating taxa are those that relate to increased bite force and diet. This result is likely due to the complex nature of mastication and the difficulty of capturing this complexity with 2-D linear modeling.

Testosterone, aging, and seasonality among Toba men of northern Argentina.

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Originally hunter-gatherers, the Toba of northern Argentina now exhibit a range of subsistence practices. Their environment, diet, and physical activity patterns are considerably seasonal. With the purpose of examining seasonal and age-related changes in testosterone (T) levels, we collected morning and evening saliva samples and anthropometric measures from 153 men ages 12 to 83, in each of three distinct seasons. Data from a subset

of n=48 men were used for repeated measures analyses. Mean body mass index (BMI) was 24.1± 3.3 kg/m^2 and no statistically significant seasonal differences in body mass were found. Salivary T concentration fell within the range of those found in other non-industrialized populations. No statistically significant associations were found between overall T levels and age (r = -0.16, p=.28), height (r = 0.04, p=.78), or BMI (r = -0.08, p=.59). Circadian variation was non significant as well ($t_{(47)}$=0.99, p=.32). T levels showed a seasonal pattern, peaking during the hot, rainy season (140 vs 180 pmol/L, cold vs hot season, $t_{(46)}$=3.36, p=.002). Previous demographic and reproductive ecology studies indicated that conceptions and ovarian hormone levels peak during this season as well. Younger men seem to be contributing more to the seasonal difference (age x season interaction effects). We will discuss biosocial effects on T levels, including physical and sexual activity levels across seasons, which appear to support the hypothesis that T regulates energy allocation towards mating effort.

Spatial correlates of capuchin-dispersed seed and seedling survival, germination and growth.

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White-faced capuchin monkeys (*Cebus capucinus*) are effective primary seed dispersers. Here, we examine the effect of spatial patterns of seed dispersal and neighborhood characteristics on seed and seedling survival and growth. During focal follows on 17 habituated capuchin monkeys in Santa Rosa National Park, Costa Rica, we recorded the distance from parent trees for all capuchin defecations containing seeds . We returned seeds of the 5 most commonly passed plant species to up to 10 defecation locations (hereafter plots). At each plot we placed 4 piles of 10 seeds each, and between 4 and 6 conspecific lab-raised seedlings. We measured neighborhood characteristics, and the distance to the nearest fruiting conspecific (NFC) tree and parent tree. Over the course of 7-months of study we monitored plots weekly, recording germination or death, growth and seedling damage. We conducted stepwise regressions to analyze the effect of distance and neighborhood characteristics on plots. Both seed survival and duration of survival was significantly affected by the distance to NFC trees for all 5 species. Three of the 5 species also showed increased seedling survival and growth as an effect of increased distance to NFC trees. Other neighborhood and distance effects were found, but were limited, and not consistent in the direction of their effect.
These results provide empirical support for a revised version of the seed escape hypothesis: the distance to any fruiting conspecific, and not only the parent, is the most critical variable in the survival and growth of capuchin-dispersed seeds.
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Reduced adult mortality and the expansion of the human bio-cultural niche in the Late Pleistocene.

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Caspari & Lee (2004) identified a possible signal for changes in adult mortality at various intervals throughout the Pleistocene by examining the ratio of old to young adults at different stages of human evolutionary history. The increase in adult survivorship they observe is especially pronounced in the Late Pleistocene. While paleodemographic reconstructions are fraught with difficulties, this research provides a potential avenue to connect the varying theoretical and research perspectives of paleoanthropologists, archaeologists and geneticists. Here, stochastic demographic models are generated to show the results produced by Caspari & Lee are potentially consistent with stable population theory. These Late Pleistocene demographic changes are then examined with reference to the archaeological and genetic record as a means of cross-validating the aforementioned conclusions. The results provide additional support for the idea that the evolution of Late Pleistocene humans is characterized by an expansion in both the environments compatible for sustained human occupation and the ways in which human cultures might develop within those environments.

Social and hormonal mechanisms underlying male reproductive strategies in black howler monkeys (*Alouatta pigra*).

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We investigated the social and hormonal mechanisms underlying male reproductive strategies in two multimale-multifemale groups of black howler monkeys (*Alouatta pigra*) during a 14-month study in

Palenque National Park, Mexico. Eleven changes in male group membership permitted us to examine the relationship between male social interactions and fecal testosterone and cortisol levels during socially stable (N = 5) and unstable (N = 4) periods. We analyzed a total of 343 fecal samples collected from 14 males at 4.0 ± 2.9 days intervals. No dominance ranks could be discerned among males, but during stable periods one male had significantly closer spatial associations with the resident females than the other males. These "central" males had significantly higher testosterone and cortisol levels compared to "non-central" males, and achieved higher mating success during four of the five stable periods when at least one female was sexually active. During unstable periods, incoming males had significantly higher testosterone and cortisol levels compared to males that remained in the group. Our findings suggest that despite the absence of overt male-male aggression, black howler males compete for group membership and mating opportunities, and that their mating strategies are more consistent with the tug-of-war model of reproductive skew than with the concession model.

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Correlates of urinary catecholamine excretion rates differ depending upon the situation of measurement in young working women.

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Several studies have shown that more acute rather than chronic factors contribute to the between-individual variation in catecholamines, suggesting that different factors are likely to affect catecholamine levels at different times. The purpose of this study was to compare physiological and psychosocial correlates of urinary epinephrine (E) and norepinephrine (NE) excretion rates measured at work (W) (from 11AM-3PM), home (H) (from approx. 6PM to 10PM) and during sleep (S) (from approx. 10 PM to 6 AM) in a sample of 134 women who were employed in secretarial and technical positions at a major medical center in NYC (age = 34.5 ± 9.8 years). Stepwise regression analysis was used to evaluate the correlates of the catcholamine excretion rates. The results show that denial ($p<.036$) was predictive of E ($p < .036$) at W, perceived stress was predictive of E ($p < .019$) during S, but there were no psychological predictors of Epi at H. Daily coffee intake predicted E ($p < .002$) and NE ($p < .001$) at W, as well as NE during S ($p <.024$). E excretion at W, H and S were also associated with greater body mass ($p<.05$). Finally, a family history of hypertension ($p<.05$) also had a marked effect on E and NE excretion during S ($p<.05$). These results support earlier findings that subjective feelings of stress and denial are associated with variation in catecholamine excretion among women. They also show that the correlates of catecholamine excretion differ depending upon the situation.

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Energy inputs, not skill learning, determine age at maturity in orangutans and other primates

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The Skill Learning hypothesis states that the time it takes to learn the skills essential for success in the adult niche determines a species' maturation time. We tested this prediction in a long-term study of the development of diet composition and feeding skills in a cohort of infant and juvenile Bornean orangutans (*Pongo pygmaeus wurmbii*) at Tuanan field station in Central Kalimantan, Borneo. By weaning around age 6, infants had virtually identical diets to their mothers ('what'), processed their foods in the same way, and a few years later also ate them at the same rates ('how'). Range use competence ('when and where'), though more difficult to examine, was also reached well before age at first reproduction (estimated 15 years). Field studies on other species showed a similar pattern.

We also conducted a complementary comparative analysis of mammalian maturation time in relation to brain size. If brain size is correlated with the average number of skills, brain size should predict age at first reproduction. While this was true for precocial mammals, it was not for altricial ones. Moreover, energy throughput, as indexed by basal metabolic rate, also significantly affected age at maturity. Both studies thus support a model in which development time is set by tradeoffs with somatic growth imposed by brain size and the aversion of ecological risks, rather than the time it takes to learn specific skills. To explain the evolution of human life history, we may need to examine alternatives to the Embodied Capital hypothesis.

Seasonality and brain size: What's the link?

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It has been well established that having a large brain can be beneficial; it enhances food acquisition, spatial orientation and social skills. However, little attention has been given to the costs large brains bring about. Brain tissue is energetically very expensive and needs a constant energy supply. To achieve a more complete view of brain size

evolution it is important to take these costs into account as well as the benefits.
Primates living in highly seasonal or unpredictable habitats are likely to suffer from periodic energy shortages. Therefore we predict that primates living in more seasonal habitats have smaller brains than primates living in less seasonal habitats.
Rainfall is a proxy for plant productivity and insect prevalence, and thus rainfall seasonality represents seasonality in food availability. We used different rainfall seasonality measurements – mean vector length (*r*), coefficient of variation (CV) and number of dry months – and conducted a comparative analysis to analyse the influence of seasonality on brain sizes of Lorisiformes and Lemuriformes (N=38 species). Prosimians are of particular interest, because previous studies have not found a clear relationship between brain size and life history, group size or gut size. We found a significant negative correlation between rainfall seasonality and brain size for *r* and CV, but not for number of dry months (taking both body mass and phylogenetic relatedness into account). These results indicate that highly seasonal habitats might act as an energetic constraint on brain size even in relatively small-brained primates.
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Ontogeny of play in captive spider monkeys.

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The reason for the amount of time devoted to play by juvenile primates with a presumably constrained time budget is an evolutionary question that requires resolution. This study analyzes the development of play behaviors among a group of captive spider monkeys, *Ateles geoffroyi robustus*. The group is housed at the John Ball Zoo in Grand Rapids, Michigan (total *n* = 12). The spider monkeys are kept in an indoor enclosure during the winter months and an outdoor enclosure during the summer months; data are collected during all seasons. Both cross-sectional and longitudinal data are collected through focal observations spanning more than three years. The juveniles in the study (*n* = 5) are coded for age group category at the time of observation. These categories include Infant 1 and 2, Juvenile 1 and 2, and Subadult. Types of play behavior are locomotor play, object play, and social play. This investigation shows a clear difference among the types of play that dominate the time budget of the different age classes. Results are compared to similar studies of other social animals in the discussion of the evolutionary implications of this differentiation.

Social and ecological factors associated with temporary reproductive collapse in cooperatively breeding red variegated lemurs (*Varecia rubra*) on the Masoala Peninsula, Madagascar.

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A study of *Varecia rubra* in the Masoala National Park was undertaken in the aftermath of a severe cyclone season. Post-cyclone reproductive failure in this lemur appeared to be a broad phenomenon in the affected region, preceded by diminished plant productivity. Communal reproductive failure offered a natural experiment to examine whether alloparenting is linked to the capacity for *V. rubra* to disperse into subgroups of variable size within their fission-fusion social system. Subgroup size, dynamics, and ranging increased in the absence of infants during the time period when young are normally born. Ranging (distances traveled, forest area used, overlap of individual female home ranges) showed sharp increased, similar to what was observed in a 'normal' year when young were produced and plant productivity had not been curtailed by cyclone activity. Thus the primary proximate causal factor initiating increases in subgroup size, dynamics, and ranging appears to be climatic, specifically, the onset of the hot dry season which 'normally' brings diverse and abundant resources (Vasey, 2002). These findings hone one of key question posed about cooperative plural breeders from "Why live and breed in a social group?" to "Why *only* breed together?" A viable strategy for a plural breeder with extremely high reproductive costs involving litters of non-clinging young living in tropical rainforests where natural catastrophes affect their resource base unpredictably is to modulate energetically costly care according to variation in the resource base, communally deferring reproduction in some years, banking on high population growth rates in other years to recover. This research was sponsored by the Oregon Zoo Future for Wildlife Program, Primate Conservation Inc., and Portland State University.

Effects of habitat light intensity on the evolution of mammalian visual anatomy: implications for primate ecology and evolution.

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Many aspects of mammalian visual anatomy vary with activity pattern, reflecting the divergent selective pressures imposed by high light and low light visual environments. Recent work has focused on identifying activity pattern effects on primate visual morphology in relation to primate evolutionary questions. However, ambient light intensity also differs substantially with foliage density (e.g., by habitat type/canopy level). The goal of this project was to explore the effects of between- and within-habitat variation in ambient light intensity on mammalian visual anatomy. Data on relative cornea size (cornea diameter/eye length), activity

pattern, and habitat ("open," "woodland," or "forest") were collected from the literature for 137 mammals. Using an index which corrects for ordinal differences in relative cornea size (RCI), we tested whether RCI varies between habitat types within activity patterns. Habitat type had a significant effect on mammal relative cornea size, although this effect was mediated by activity pattern. While diurnal mammals differed significantly in RCI between habitat types (χ=6.65, p=0.036), we found no effect of habitat type in nocturnal or cathemeral groups. Within-order comparisons also supported this result, suggesting that nocturnally-active species may experience selection to maximize visual sensitivity across habitats. Within pairs of primate congeners inhabiting different forest strata, relative cornea size was also found to generally respond to light intensity variation. The results of our study indicate that, in addition to activity pattern, other ecological factors (habitat type, canopy level) have influenced primate and mammalian visual evolution.
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Straight to the bone: identifying cutmarks on human bone.

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Identifying anthropogenic cutmarks on skeletal remains carries important implications for documenting past human activity, such as violent acts, brutal dismemberment, or disarticulation as a mortuary practice. However, distinguishing between peri-mortem anthropogenic cutmarks and natural or other damage can be difficult due to ambiguous signatures left by humans and non-humans. Previous studies have characterized butchering marks according to tool type and have demonstrated how mammalian chewing and excavation damage can be incorrectly interpreted as prehistoric cutmarks (Walker and Long 1977; Milner et al. 2000). The present study aims to contribute to this research by refining diagnostic criteria for anthropogenic cutmarks through analysis of a large sample of human postcranial remains from the Late Intermediate Period (AD 1000-1400) Monqachayoc sector at the site of Huari, Peru.
Through gross observation of cutmarks on commingled postcrania (n=457), this study systematically characterizes cutmarks according to groove depth, shape, coloration, and location (particularly as the latter relates to which tendons and muscles were cut). This study also describes and presents images of ambiguous marks, and compares their locations on the bones to known anthropogenic cutmarks as an additional diagnostic. The Monqachayoc sample provides a rich data set to document cutmark variation, as the majority of long bones and os coxae exhibit cutmarks: 73% of the total sample (n=457), ranging from 53% of left humeri (n=38) to 95% of right ulnae (n=65). This study represents the first phase in a larger investigation of cutmark morphology and the purposes behind the dismemberment of these ancient Andean bodies.
This research was supported by a Vanderbilt Discovery Grant and Vanderbilt Center for Americas Grant to Tung, and a Mellon Mays Undergraduate Fellowship (Stanford University) to Velasco.

Assessing the human stress response in paradise.

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The human stress reaction is critical to life, but in excess has the ability to inflict major damage. Previous studies have identified high levels of stress hormones and stress related diseases in western populations, but questions remain as to whether this is true for developing countries. To gain insight into the range, costs, and limits of human adaptation, environmental and social stresses encountered by humans in Papua New Guinea (PNG) are examined. Populations in PNG were chosen since they live in ecological and social conditions which provide a better proxy for the environment of evolutionary adaptedness.

Sixty-six individuals from three villages in New Ireland provided salivary samples and conducted a range of questionnaires. The aim was to compare perceived, observed, and biologically measured stress reactions. The adrenal steroid, cortisol, can be considered the workhorse of the stress response, it shows a good correlation with plasma cortisol and was hence used as a diagnostic tool. The results of our analyses are consistent with the null hypothesis that, despite economic impoverishment and widespread cultural change, PNG inhabitants are able to negotiate daily stressors (more) efficiently because the stressor aetiology and context in which stressors are experienced is more akin to the conditions in which the human stress response evolved. However, even in remote PNG, location has a significant effect on stress levels; cortisol levels are significantly higher in urban surroundings. Unlike studies conducted in developed countries, this study found no association between individuals suffering from abuse and altered cortisol levels.

Endocranial growth and development during postnatal ontogeny in chimpanzees (*Pan troglodytes*).

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Geometric morphometric studies have extensively described the ontogeny of the external cranium of *Pan troglodytes*. However, almost nothing is known about endocranial shape changes. The aim of this study is to focus on the size (growth) and shape (development) changes that occur in the internal

cranium from infancy to adulthood. Geometric morphometric analyses of the common chimpanzee's endocranium were performed. Percentage of the adult mean size was used to characterize differences in growth patterns and percentage of the adult mean shape was used to quantify patterns of development. Both analyses were done at different dental ages and for both adult sexes. Our studies point out four major growth allometries that act throughout chimpanzees' endocranium maturation: the lowering of the internal euryon, the distal migration of the foramen magnum, the changing position of the cribriform plate, and the proportional elongation and extension of the endocranial base. Analyzing the entire endocranium, size and shape dimorphism was not found. It is possible to suggest that rates of endocranial growth show a slight attenuation when going through the sexual maturation period (M2 eruption), and similar and higher rates before and after, but in general they show similar results than other studies reviewed; and rates of endocranial development seem to maintain a constant pace with acceleration in the last stage.

In situ analyses of partial human skeletal remains: Four key elements.

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The upper portion of a single skeleton was exposed during an initial exploration of a walled cemetery site on Isla San Lucas (CR). The cemetery is associated with the penal colony that operated on the island between 1873 and 1991. Our sampling methods and time constraints did not permit excavation of the entire skeleton. Therefore, we examined the remains *in situ* to assess four key variables: age, sex, stature, and racial affinity. Because the cemetery was associated with a penal colony, we expected the skeleton to be an adult male. We predicted that the stature would fall within the limits of modern human populations. Ancestry was likely Hispanic, Amerindian, or a mixture. Anthropometric and visual methods were used to quantify dentition, anatomical markers, and osteometric dimensions. We calculated the age at death as ~ 39 years (range 26.9-51.1 yrs, S.D.=+/- 12.1). Square mandible shape, the presence of brow ridges, and robust mastoid processes present in the skull indicate it was male. Stature was calculated based on the length of the humerus (29 cm R; 28.7 cm L). These findings suggest that he was quite short, 162.86-153.50 cm. However this stature is well within the normal range for adult males prior to 1920. Ancestral affinities were analyzed with 12 variables using FORDISC 3. This software yielded a non-Anglo, non-African ancestry, from Mesoamerica, likely Guatemala. Our results show that it is possible to derive valuable data from bones without removing them from the burial site.

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Bioarcheology of the Late Upper Paleolithic burial Villabruna 1 (Val Cismon, Italy).

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The Late Upper Paleolithic burial Villabruna 1 was discovered in 1988 in Val Cismon, Belluno, Italy. The burial was directly dated to approximately14,000 yBP and included a well preserved skeleton accompanied by grave goods and covered with painted stones. This study aimed at analyzing the biological characteristics of the skeleton in the context of European Upper Paleolithic populations. The remains were studied through anthropometric, microscopic, radiologic, chemical and biomechanical techniques and the data elaborated by means of bivariate and multivariate statistical analyses.

Our results show the remains belonged to a young adult male about 25 years old, characterized by relatively tall stature for the time period and body proportions retaining warm climate adaptations similar to those of recent North-African populations. Craniofacial morphology multivariate analysis indicates striking similarities between Villabruna and geographically and chronologically nearby specimens, suggesting genetic affinity among the last hunter and gatherers from the alpine region. Dental wear and microwear indicate the anterior dentition was involved in non-alimentary activities. Stable isotope analysis points to a mainly terrestrial diet rich in animal proteins. Long bones cross-sectional geometry shows high overall robusticity and marked humeral asymmetry consistent with throwing-based hunting techniques. Femoral biomechanical properties show high resistance to bending and compressive forces, likely resulted from the combined effect of mobile lifestyle and mountainous terrain. Paleopathological analysis revealed remodelled porotic hyperostosis, tibial periostitis and ossification anomalies such as lumbar spondylolysis and bilateral bipartite acromion.

Compliant feet in bipedalism: can elastic recoil contribute to propulsion?

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The human foot is specialised for terrestrial bipedalism, generating propulsion by means of a windlass mechanism, turning the foot into a rigid lever at push-off, and by storage and release of elastic energy in the plantar aponeurosis. Unlike

humans, gibbons lack a longitudinal arch and have a poorly developed plantar aponeurosis. Yet, they regularly engage in bipedalism, running bipedally atop large branches or on the ground. The question then arises: can arboreally-adapted compliant feet also contribute to propulsion generation in bipedalism?
To investigate this, we have integrated force (AMTI) and plantar pressure (RsScan) recordings with high-speed footage (250Hz, RedLake) and detailed foot anatomy. Data was collected in the Wild Animal Park of Planckendael, and included spontaneous bipedal bouts of an adult white-handed gibbon (*Hylobates lar*). A four-linked segment model of the foot was used to analyse the 2D motion of the internal foot joints. Integration with force and pressure data allowed us to compute the external joint moments, power and work.
We found that during the first 70-80% of stance, negative external work is performed at the foot joints, potentially loading plantarflexor tendons and ligaments with elastic energy. This is followed by concentric contraction of the plantarflexors during late stance, generating propulsion for push-off, possibly via elastic recoil. Our results indicate that though the compliant gibbon foot is less mechanically effective for push-off than a rigid arched foot, it can contribute to propulsion generation in bipedalism via stretch and recoil of the plantarflexor tendons and plantar ligaments.

The Aurignacian human remains from La Quina-Aval (Charente, France).

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The scarcity, poor preservation and questionable association of human remains from Aurignacian contexts has led some authors to question the taxonomic affiliation of the makers of the early phases of this technocomplex. At the site of La Quina-Aval (Charente, France), two main excavations conducted between 1905 and 1972 yielded Châtelperronian and Aurignacian assemblages, as well as several human remains. New excavations from 1994 to 1998 allowed reevaluation of the stratigraphy, chronology and archeology and confirmed the presence of Early Aurignacien and Châtelperronian. The exact number of La Quina-Aval human remains, their inventory and detailed description have never been published, and some listed specimens are now missing. According to the publications, excavations reports and handwritten notes, 13 human remains were found in this site. We have been able to locate seven of these remains, among which one tooth is doubtfully associated with the Aurignacian and two post-cranial remains are likely not human. The four others, two immature mandibles and two permanent premolars (upper and lower) are securely associated to the Early Aurignacian. The maxillary premolar is undiagnostic, but the mandibular premolar and molars present none of the apparently derived Neandertal features. The Quina-Aval 4 mandible has a distinctly projecting mentum osseum and a narrow anterior dental arcade, both of which align it with early modern humans. The La Quina-Aval remains therefore support the interpretation that modern humans produced the Early Aurignacian technocomplex in western Europe.

Using comparative primate population genetics in understanding infectious disease resistance.

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In this "post-genomic" age, analyses of human and chimpanzee genomes have enabled us a glimpse into the past evolutionary events that have shaped our respective phenotypes. Nonetheless, to what extent the identification of the genes involved in the adaptive divergence of our common ancestors over 4 million years ago are relevant to modern human evolution is unknown. For example, infectious disease is believed to have been one of the strongest selective pressures in the emergence of modern humans, and thus, it is of interest to characterize its recent impact at the genomic level. In doing so, human population genetic analyses of polymorphism in frequency and magnitude across ethnically diverse groups have furthered this endeavor by revealing population-specific variants and recent positive selection at genes involved in immune response. However, we lack complimentary analyses at the population level in other primates to determine whether these patterns in humans are genetically unique. Here, in a large sampling of unrelated wild-born individuals of the western Africa chimpanzee, *Pan troglodytes verus*, we present comparative population genetic analyses with humans in examining patterns of polymorphism, site frequency distributions, and linkage disequilibrium to distinguish between demographic and adaptive signatures of variation. Using this comparative approach, we demonstrate how humans and chimpanzees have become genetically differentiated even in their recent history with respect to genes involved in infectious diseases such as malaria and HIV/SIV.

Juvenile burial from the Eneolithic site of Josipovac – Gravinjak, Croatia.

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During rescue excavations in 2007 at the site of Josipovac–Gravinjak in Slavonia, eastern Croatia, a prehistoric settlement of the Baden culture was discovered. On the floor of one of the pit houses there was a burial of a small child. A series of fifteen C^{14} dates from the site place the settlement in the period approximately from 3500 to 2780 BC, while direct dating of a skeleton yielded a date of 3490-3110 cal BC (Beta 241675). The skeleton was buried in a left lateral flexed position, oriented north/south. The cranium, including the mandible, and most of the postcranial skeleton were preserved. Tooth crown formation was consistent with that of a child 7.5-8.5 years of age, while the skeletal maturity suggests somewhat younger age (4.5 - 6 years of age). The most prominent pathology was dislocation of the right radius, resulting in exostosis on the posterior proximal radius, and periostitis along side the bone shaft. Exostosis is also present on the right ulna, inferior to the coronoid process. Radiographs of the distal arm elements did not reveal any fracture. Other pathological changes included linear enamel hypoplasia (LEH) on the upper permanent incisors and canines and lower permanent 1st incisors, and endocranial lesions on the frontal, parietal and right temporal bones.

Digestive efficiency and its effects on primate biomass across continents.

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Primate assemblages differ in marked ways among the four main regions (Asian, Africa, Madagascar, and America). Previous attempts to explain differences among Neotropical primates and their Old World counterparts have focused on phenology and historical factors such as ecological niche space and seasonality. Lambert (1998) suggested that some of these differences in patterns of resource use may instead be explained by digestive physiology. Both Milton (1981, 1984, 1986) and Lambert (1998) have emphasized the importance of gut physiology in understanding primate feeding strategies and behavior. Here we examine gut physiology, specifically gut transit time (GTT), to explain differences in several morphological, dietary, and behavioral traits among Neotropical and Old World arboreal primates. Controlling for body weight, we found that Neotropical monkeys have shorter gut transit times compared to Old World monkeys ($p=0.0003$). We propose that shorter gut transit times are a morphological constraint of New World primates that leads to a need for higher quality diets and thus may help explain smaller group sizes, low apparent productivity, larger home ranges, the lack of folivorous monkeys, and the relatively high number of fission-fussion species in the Neotropics. We found that species with a shorter GTT require larger foraging areas, controlling for diet and group size. We suggest that differences in body mass, diet, home range size and overlap, day journey length, and foraging group size can all be explained by a combination of physiological constraints combined with patterns of phenology. Finally, we expand our analyses to include lemurs and apes.

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Some new aspects of the shoulder architecture within the genus *Homo*.

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The morphology of human clavicles can be estimated by projecting them on two perpendicular planes in order to assess the shapes of their cranial and dorsal primary curvatures. In cranial view, no differences in curvature appear within the genus Homo, which means, that the different species had similar arms elevation capacity, especially in protraction. On the contrary, in dorsal view two clavicles morphologies could be defined. The first one is characterized by two curvatures in dorsal view and is found in all Homo species, but not in modern human and Upper Palaeolithic remains. The two latter display clavicle morphologies, in dorsal view, characterized by either one curvature, or two slightly pronounced ones.

As comparisons with Apes show it, clavicles displaying two pronounced curvatures in dorsal view are associated with scapula sitting high on the thorax in regard to modern human. However, shoulder with high scapula on the thorax displays two different kinds of architectures: (i) shoulder with short clavicles associated to scapulas sitting more laterally than those of modern human. This group includes earlier *Homo* like *Homo habilis* and *Homo ergaster* and (ii) shoulder with long clavicles associated to scapulas sitting more dorsally on the thorax, like those of modern human. This group includes *Homo antecessor* and Neanderthals. In other words, within the genus *Homo*, three shoulders architectures would have existed. Evolution of the shoulder complex is far more complex than previously thought and the arrival of modern bipedalism was not associated to modern shoulder.

Sexing of the human innominate using non-metric traits and statistical analysis.

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The human innominate is frequently used in both forensic anthropology and in bioarchaeological settings to

estimate sex. The innominate appears to have the most useful non-metric information for sexing and interobserver errors using measurements of the innominate have been notoriously high because of poorly defined landmarks. Because of this, the innominate is the subject of numerous non-metric studies for sexing, most notably the traits of Phenice (1969): the ventral arc, the subpubic concavity, and the medial aspect of the ischio-pubic ramus. Many studies have since confirmed the utility of Phenice's traits, though the traits were often analyzed singly. The goal of this study is to investigate all three of Phenice's characteristics in a statistical framework similar to Walker's (2008) study using observations from the cranium and mandible. A sample of 173 adult, left innominates of known ancestry and sex from the Hamann-Todd collection were scored based on Phenice's three traits. Each trait was scored on a scale of one to five adapted from Phenice's illustrations and descriptions for males and females. New intermediate configurations, descriptions, and illustrations were created by the authors. The scores were analyzed using linear discriminant analysis, kernel probability density and k nearest neighbor analyses. Using all three traits, the linear discriminant function for sex provided a mean cross-validated correct classification rate of 93%, with the other statistical analyses providing similar results. The degree of expression of the ventral arc proved to be the single best trait at separating males and females.

Comparative functional morphology and bilateral asymmetry of the clavicle in the Regourdou (Neanderthal) and Chancelade (late Upper Paleolithic) adult skeletons (Western France): a high-resolution endostructural analysis.

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The human upper limb robusticity shows a pattern of decline through the Pleistocene, indicating reduction in levels of habitual manipulative loading. As shown by structural changes at the humeral shaft and by a generalized decrease in bilateral asymmetry of the arm skeleton as a whole, this trend accelerated since the late Upper Paleolithic to recent times, likely in relationship to changes occurred in subsistence strategies, technology, social organization, and life-style.
In order to detect the polarity and amount of the functionally-related changes recorded by the clavicle, by means of techniques of 2-3D virtual modeling and quantitative analysis of their high-resolution (SR)microtomographic record, we comparatively assessed the endostructural organization and degree of bilateral asymmetry of the clavicle in a Neanderthal and a late Upper Paleolithic adult skeleton: Regourdou and Chancelade (Western France).
While in Regourdou both clavicles are in excellent preservation conditions, the Chancelade's left one misses its sternal end. Body sized standardized cross-sectional properties were measured at different sites along the shafts and the results compared to the microtomographic-based evidence from two modern adult individuals.
The late Upper Paleolithic individual, whose odonto-skeletal age at death is likely older than that estimated for Regourdou, shows a relatively greater degree of resistance to axial loads, antero-posterior bending, and distal torsion. Compared to the Neanderthal and modern human figures, Chancelade's clavicle exhibits thicker cortex and a narrower cavity. Conversely, while in both fossil skeletons the right side is dominant, asymmetry for cortical bone volume is much higher in the Neanderthal individual.

Investigating the relative neutrality of individual bones in the modern human cranium.

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Recent studies have demonstrated that the shape of the human temporal bone is particularly strongly correlated with neutral genetic expectation, when compared against other cranial regions, such as the vault, face, and basicranium. In turn, this has led to suggestions that the temporal bone is particularly reliable in analyses of primate phylogeny and human population history. While several reasons have been suggested to explain the temporal bone's strong fit with neutral expectation, the temporal bone has not systematically been compared against other individual cranial bones, defined using the same biological criteria. Therefore, it is currently unknown whether the shapes of all cranial bones possess reliable information regarding neutral genetic evolution, or whether the temporal bone is unique in this respect. This paper determines the relative neutrality of individual human cranial bones by correlating population affinity matrices generated using neutral genetic and 3D craniometric data. The results demonstrate that while the temporal bone shows the absolute strongest correlation with neutral genetic data compared with all other bones, it is not statistically differentiated from the sphenoid, frontal and parietal bones in this regard. Potential reasons for the temporal bone's consistently strong fit with neutral expectation, such as its contribution to the architecture of the basicranium, are also examined. The results suggest that future phylogenetic and taxonomic studies would benefit from considering the shape of the entire cranium minus those regions (e.g. occipital) that deviate most from neutrality.

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Digit identity is independent of digit position: What gene expression tells us about the individuality of morphological characters?

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Some of the most puzzling aspects of morphological evolution are the homologies of digits in various tetrapod lineages. The best known instance of this problem is the homology of avian digits in the wing. Birds have three definite digits that are clearly identified as digits 1, 2, and 3 based on phylogenetic and morphological evidence. However, there is also convincing embryological data that shows that these digits develop from digit positions 2, 3 and 4, i.e. digit anlagen that normally develop into digits 2, 3 and 4.This problem is not limited to birds, but has also been described in a parallel literature on a less well known system, the skinks of the genus *Chalcides*. Many species of this genus reduce the number of digits, most of them to three. The bird and skink literatures contains a similar controversy, where embryologists claim that these digits are digits 2, 3 and 4 while the morphological evidence supports the identification of these digits as digits 1, 2, and 3. In this talk I will present evidence that in both cases, the birds and the skinks, the embryological and the morphological patterns are best explained by the assumption of a digit identity frame shift occurred during the evolution of these groups. That means that in the derived three digit states of birds and three toed skinks, digits 1, 2, and 3 develop in positions 2, 3, and 4. Key evidence supporting this conclusion comes from the comparison of HoxD gene expression, which shows that the inferred shift in digit identity is associated with a parallel shift in HoxD gene expression. These genes are known for their role in digit identity determination. In addition we show that a digit identity shift can be experimentally induced by manipulating the Sonic hedgehog signaling in the chick wing. We thus conclude that the morphological identity of a character, at least in the case of digits, is tied to the expression of character identity genes rather than to its embryological origin.

Victims of the Shimabara Rebellion in 1638 excavated from the Hara Castle site, Japan.

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In 1637, Japanese peasants, mostly Christians, formed a revolt called the Shimabara Rebellion, which was then crushed by Tokugawa Shogunate forces in April 1638, at Hara Castle, Kyushu in the western part of Japan. Historical records describe the killing of more than 30,000 rebels including women and children during a major siege by Tokugawa Shogunate soldiers (Samurai) on April 12, 1638. Many fragmentary human skeletal remains and their accessories (crosses) were unearthed from the main castle area of Hara Castle site between 1998-2003. To date, we have been able to distinguish 72 adult males, 16 adult females and 14 immature individuals. Unhealed cut marks considered to be Japanese sword wounds were noted in two crania, one left humerus, one left hip bone, 11 right femora, and two left femora not only in the male remains but also in those of females and immature individuals, suggesting that they were also killed in situ at the same time. The results of radiocarbon dating of the human bones undertaken by the fourth author (MY) corresponded to that time period. This is the first evidence from interdisciplinary analyses of archaeological human skeletal remains confirming pre-Modern historical records in Japan.

Historical patterns of traumatic injury and violence in Europe.

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[12]University of Coimbra, [13]University of Szeged, [14]Archaeological Service, CAD Douai France, [15]State University of New York, College at Oneonta, [16]University of Sheffield, [17]28th Ephorate of Byzantine Antiquities, [18]University of Bradford, [19]University of Birmingham, [20]University of Basel, [21]University of Bern, [22]University of Rome, [23]Independent Osteoarchaeological Consultant, Ireland, [24]Nicolaus Copernicus University, [25]Stockholm University, [26]University of Athens, [27]Western Michigan University, [28]American School of Classical Studies at Athens, [29]Latvian University, [30]Arizona State University, [31]University of Oslo, [32]York Osteoarchaeology Limited, [33]Natural History Museum, Basel, Switzerland, [34]AOC Archaeology, [35]University of Exeter, [36]University of Chicago, [37]Université de Caen Basse-Normandie, [38]Syracuse University, [39]National Academy of Sciences Ukraine, [40]Western University, Pomona, [41]University of Leiden, [42]University of Arkansas, [43]Universitat Autònoma de Barcelona, [44]Department of Archaeology, City of Dordrecht, The Netherlands, [45]"Francisc J. Rainer" Anthropological Research Center, [46]University of York, [47]University College London.

Traumatic injury data from the skeletons of 10,975 Europeans studied by Global History of Health Project members provide a unique opportunity to study the socioeconomic correlates of skeletal injuries in a historically well-documented human population. The much higher (x^2=104.6, $p < 0.0001$) injury rates of males (19.4%) relative to those of females (10.6%) is consistent with modern clinical data. Injury rates vary significantly through time. During Classical Antiquity and the Early Middle Ages injury rates were relatively low with 9-11% of the individuals exhibiting them. During the High Middle Ages, injury rates rise to nearly 15% and then decline again during the Late Middle Ages, especially among women. Logistic regression controlling for age at death and sex effects shows that both this High Middle Ages increase (z=8.0, $p<0.0001$) and the later decline (z=8.0, $p<0.0001$) in injuries are highly statistically significant. Analysis of injury locations shows that the Late Middle Ages saw a marked increase in head trauma; this is an area of the body frequently targeted during interpersonal violence. Of interest in this regard is the exceedingly low nasal fracture rate (0.13%) among Medieval Europeans. This contrasts starkly with the high rates of nasal fractures (>25%) seen in the skeletons modern people of European and African American ancestry who lived during the early 20th century. Such differences point strongly to the key role that cultural factors play in structuring patterns of interpersonal violence in human populations.

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Physical measurements as health indicators in Latino children of Springfield, Missouri: a pilot study.

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Physical measurements serving as indicators of health and nutrition were recorded for a group of immigrant Latino children in Springfield, Missouri. I predicted that these indicators would prove similar to those of Latinos in other parts of the country, for whom obesity-related illness occurs at increasingly high rates. A particular concern is the rising rate of type 2 diabetes in children.

This pilot study allowed for assessment of feasibility and need for a diabetes and obesity prevention program for local Latino children. Collection of this baseline information was the first phase of a larger applied project involving nutrition and exercise education for this group. Growth and development will be tracked over the course of a year, and informational materials provided to parents.

Twenty girls and boys, children of Mexican immigrants, between the ages of two and eleven were measured for waist circumference, weight, and height. Waist circumference has high predictive value for diabetes risk, and the latter two measurements allow for body mass index (BMI) calculation. Of the twenty children, over half were overweight or at risk for becoming overweight according to their BMI; mean percentile for BMI was 85. The mean percentile for waist circumference was 73, which is in an unhealthy weight range. These sobering results for a small subset of Latino children in the Midwest are concordant with results of other studies of U.S. Latinos, and highlight the vital need for intervention in the form of a health education program.

Comprehension of tool properties by orangutans (*Pongo* spp.): rigidity and flexibility.

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Comprehension of tool properties regarding rigidity and flexibility was explored in orangutans (*Pongo* spp.) through an extension of Povinelli, Reaux, and Theall's (2000) Flimsy-Tool problem. Captive orangutans (n = 3) were presented with three pairs of tools to solve a problem in which a reward was placed out of reach inside a transparent box. Solving the problem required selection of a rigid tool to open the box to access the reward. Each pair of tools contained one tool with rigid properties (functional tool to solve the problem) and one tool with flimsy properties (non-functional). Unlike the chimpanzees of Povinelli et al.'s work, the orangutans choose the functional, rigid tools significantly more often than the non-functional, flimsy tools to solve the problem. Moreover, the orangutans demonstrated this within the first

test session, suggesting they had a comprehension of the properties of rigidity and flexibility and were able to apply this knowledge to the present task. The results of the present study demonstrate that orangutans can recognize relevant tool properties, supporting the hypothesis that they have causal understanding regarding tools.

Analysis of variation in masseter and temporalis EMGs during mastication in primates and treeshrews.

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We analyzed EMG data from the masseter and temporalis muscles during mastication from 14 primate and 1 treeshrew species to assess functional and phylogenetic information in patterns of neuromuscular variation. All data were collected from 8 similar electrode locations within the muscles of each species and analyzed using the same methods. We examined the variance components for relative peak EMG activity and timing of peak EMG. We used an unbalanced nested ANOVA design across successive hierarchical factors from "chewing cycle" through "species".
Results show markedly different variance components among species, suggesting that these muscles have evolved as distinct functional units. The balancing-side deep masseter exhibits the most variation among species. The working-side anterior temporalis, by contrast, shows little variation. Primates appear to have a conserved pattern of producing vertical jaw movements and force with the working-side anterior temporalis while varying the activity pattern of the balancing-side deep masseter to produce transverse jaw movements and force. Furthermore, a significant proportion of the variance is linked to food properties and how these properties change throughout a chewing sequence suggesting that efforts be made to standardize foods given to research subjects.
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Reproductive costs for everyone: How female frontal loads impact mobility.

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Energetic costs of reproduction for human females are extensive and include costs of gestation and lactation, as well as costs of carrying. Carrying an offspring does not merely increase the cost of locomotion, but also has the potential to impact the speed at which locomotion is occurring. We have previously shown that when women carry frontal loads of 8% and 16% of their body mass (loads such as those found during pregnancy and the first months of a newborn's life), the speed at which energetic optimality occurs is significantly slower than when they walk unloaded. This potentially has an impact on other people in their group: if one woman is walking loaded, and another is walking unloaded, either one or both will not be walking at her optimum. Because velocity has changed, so has the amount of time it will take a loaded female to go the same distance. The question thus becomes, what is more likely from an energetic standpoint, that an unloaded female slows down to walk with a loaded female or that a loaded female speeds up? Two pieces of data suggest the former. Firstly, data from 20 women's loaded and unloaded optimal walking curves suggest that unloaded walking curves are significantly ($p<0.001$) less acute than loaded women. This means that unloaded women can slow down and walk with loaded women at very little reduction in cost. Secondly, women preferred to walk at speeds slower than their optima ($p<0.005$), suggesting longer travel times for groups carrying loads.
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Antemortem fracture patterns in two Florida Archaic skeletal samples: Bay West (8CR200) and Windover (8BR248).

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Prehistoric warfare is most often identified through the evaluation of multiple lines of bioarchaeological evidence, including the remnants of fortifications, mass burials, and artistic depictions of war, weaponry, and fracture patterns on the human remains. Yet, the identification of the bioarchaeological evidence of warfare and its subsequent interpretation has been controversial. With this project, our intention was to dispel some of the controversy by presenting skeletal data from the Archaic Hunter-gatherer sites of Bay West and Windover.
The main goal of this project was to analyze antemortem and perimortem fracture frequency and pattern in order to determine whether the patterned injuries were more consistent with accidental injury (e.g., falls) or intentional injury. Specifically we compared the overall pattern of antemortem fractures both among individuals and as pooled data. The frequency of fracture between theses two samples was significantly different

(x2=67.692; P=<0.001); although both evidenced low fracture rates (5%) with fractures to the thorax predominating. Of interest, is that the Windover sample's third most prevalent area of trauma was the skull (11%) where depressed cranial and orbit blow-out fractures were present. While low incidence of fracture within the samples is in keeping with the Southeastern Archaic Hunter-gatherer expectation that little or no warfare existed, the Windover sample had several crushing cranial fractures believed to be consistent with interpersonal violence.

The context of spider monkey whinnies: Party composition and activity.

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Animals living in complex societies employ contact calls to maintain spatial coherence. These vocalizations are particularly important in fission-fusion societies in which group members may frequently be out of visual range of others. For spider monkeys the whinny vocalization has been described as both a contact call and a food call. Spider monkeys utilize whinnies during feeding, as well as other activities such as resting and traveling. Here, we test the specific context of whinnies, including party composition and activities associated with frequent whinnying, among black-handed spider monkeys (*Ateles geoffroyi ornatus*). Results are based on approximately 10 hours of focal animal sampling during July 2008 at El Zota Biological Field Station, a wet forest located in northeastern Costa Rica. Spider monkeys did not whinny more frequently during a particular activity. However, significantly more whinnies were observed while spider monkeys were solitary than in mixed company (including with multiple adults and/or juveniles), with young offspring, or in all adult female parties (n = 16, χ^2 value =30.815, *df* = 18, p=0.030). These results indicate that spider monkey whinnies may be particularly important for maintaining communicative contact with community group that are out of visual range. Furthermore, these results support the function of the whinny vocalization as a contact call rather than as a food call. Whinnies are likely essential for promoting relationships within spider monkey societies composed generally of amorphous social groups.

Ontogeny of sex difference in skull biomechanics of Rhesus macaques from Cayo Santiago.

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Studies on biomechanics of skulls have been reshaping our understanding of primate and human evolution. However, little is known on how skull biomechanics in male and female primates are different due to sexual dimorphism. In addition, it is unclear whether this sex difference will generate different patterns of adaptation and evolution in different sexes of primates. Several factors influencing structural properties of skulls, including growth of craniofacial skeletons, sutural fusion, and functional tooth eruption, were investigated in Rhesus macaques (*Macaca mulatta*) from a unique skeletal collection from Cayo Santiago Island, Puerto Rico, with known age and sex. Results demonstrated that females had a longer ontogeny in the facial area, had smaller facial skeletons with more patent sutures than in males, yet the premolars in females reached the occlusal level at an earlier stage than in males. These findings indicated that the ontogeny of sex differences in the biomechanics of Rhesus macaque skulls was generated through different skeletal and dental maturation patterns. These sex differences in structural properties could be modeled using Finite Element Analyses to assess the sex difference in skull mechanics in the future. It is worth noting that there was a significant sex difference in survival rates at comparable developmental stages, suggesting a complicated scenario in the relationship among morphology, function, survival, and evolution. Supported by National Science Foundation HOMINID grants 0725183.

Three dimensional anatomy of the anthropoid bony pelvis.

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The pelvis should be informative about the biology and locomotion of any animal because it reflects torso shape and overall body plan, plus hip joint postures and function. It is now widely recognized that changes in overall torso structure and body plan have been key innovations in hominoid evolution. Also, hip joint function varies among anthropoids. While isolated features of hipbones have been shown to reflect locomotor adaptations, no study has assessed pelvic form in 3D to test these hypotheses, or to evaluate features were not possible to assess previously.

Pelves were articulated and landmark data collected from a large sample of anthropoids. Data were analyzed using geometric morphometrics to evaluate overall shape differences, and Euclidean distance matrix analysis and bivariate methods to localize shape changes among taxa.

Data from all methods yielded broadly similar results, and support the hypothesis that locomotor groups can be separated on the basis of pelvic anatomy. As expected, iliac size and orientation were the most significant aspect of variation, and separate hominoids from cercopithecids, with atelines in between. However, other key features vary among taxa and reflect positional adaptations, including ischial length orientation, position of the pelvis relative to the sacrum, and symphyseal dimensions. Data from this analysis support previous

hypotheses about form-function relations in the pelvis, and identify novel aspects of pelvic functional anatomy that provide an appropriate context in which to evaluate aspects pelvic anatomy in fossil anthropoids.

Dental attrition patterns in two late prehistoric skeletal collections from the Estremadura region of Portugal: comparisons and results.

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The archaeological record suggests that the Middle Neolithic through Early Bronze Age (c.4000-1500 BC) of the Portuguese Estremadura was a time of substantial social, economic, and political change – with dynamic cycling in population density, social stratification, and interregional interaction. However, information about the biological effects of these changes is limited. This poster details the results of a comparative study of dental attrition from two collective burial sites from the Portuguese Estremadura. The earlier site, Feteira II (Lourinhã), is a natural cave site dating to the Middle-Late Neolithic (c. 3600-2900 BC). The second site, Bolóres (Torres Vedras), is a rock shelter burial site located 16km SE of Feteira II whose collective burials have been dated to the Late Neolithic-Early Bronze Age (c.2800-1800). The aim of this study was to ascertain if there are qualitative or quantitative differences in dental wear between the two collections which would reflect dietary or behavioral changes across these time periods. More than 1600 teeth (MNI 93) were examined as part of this project. The results of this study show that the nature and degree of dental attrition remain consistent throughout the burials in these two sites. This suggests that large-scale dietary change was not associated with the social transformations of the Middle Neolithic-Early Bronze Age. In both collections, extensive lingual wear on the anterior maxillary incisors was common which may reflect the continuation of specific masticatory or paramasticatory activities over time in this region.

Infant feeding practices in Holocene Siberian hunter-gatherers: an intra-long bone analysis of stable nitrogen isotope ratios.

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Weaning is a physiologically stressful period and many infants in prehistoric cemeteries died during the weaning stage. Stable nitrogen isotope ($\delta^{15}N$) analysis permits a reconstruction of nursing and weaning practices in past populations, as nursing infants have elevated $\delta^{15}N$ ratios relative to infants who have been weaned. Intra-individual sampling, from different mineralized tissues or between different parts of the same anatomical element, has been found to be useful in assessing the diachronic dietary history of individuals. Three segments of long bone from 49 subadults (birth to 10 years) from three Holocene hunter-gatherer cemeteries (Shamanka II, Lokomotiv and Ust'-Ida I) from southwestern Siberia are analyzed for $\delta^{15}N$. By contrasting $\delta^{15}N$ values from the metaphyseal area of a growing long bone, which contains the most recently deposited bone, to $\delta^{15}N$ values from the diaphysis, which contains older bone, it is possible to determine the breastfeeding/weaning status of individual subadults. In the later cemetery of Ust'-Ida I the expected pattern of infant death during weaning was found; however, in the earlier cemeteries of Shamanka II and Lokomotiv the intra-long bone $\delta^{15}N$ pattern for weaning was found in only 31% of infants, while 56% have a pattern indicative of nursing (the data is inconclusive in 13% of infants). Overall, the use of an intra-long bone sampling strategy for $\delta^{15}N$ permits an enhanced evaluation of the feeding status of subadults. Therefore, the impact of differing infant feeding practices upon the health of subadults from sub-arctic/boreal forest environments can be better understood.

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Normality is relative: a populational approach to vertebral deformity in archaeological populations.

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The shape of a normal vertebra differs significantly by population, sex, and age. Thus, defining what is normal within each population is essential in order to form a more sophisticated understanding of both pathological and healthy vertebrae. A populational profile of a healthy vertebra allows for the isolation of abnormal vertebrae as representative of a pathological condition. Additionally, it reveals differences in the vertebral shapes in the upper, mid, and lower thoracic, which reflect the varying mechanical stress experienced in each section. Such stresses are determined by biological variance as well as cultural practices, including the division of labor along sex and age boundaries.

This study examines normal variation in the thoracic centrum heights of thirty-three adult individuals from the prehistoric Grantham site in northern Ohio. Disparities in vertebral shape along the thoracic portion of the vertebral column and consistent distinctions between normality in sex and age groups were recorded. Differences in type and degree of mechanical stress at Grantham compared to what modern individuals experience resulted in a discrepancy between normality in the Grantham population compared to modern samples. If descriptions of the modern thoracic vertebrae were used as a baseline for the Grantham

sample, the estimates of abnormal individuals at Grantham would be unnecessarily amplified. Such results demonstrate that a populational survey of normality is essential in understanding how biological tendencies and cultural practices have shaped human bodies.

Linearity and strength of male chimpanzee dominance hierarchies at Ngogo, Kibale National Park, Uganda.

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Male chimpanzees typically strive for high dominance ranks, which can bring reproductive payoffs. However, few quantitative analyses of dominance hierarchy linearity and strength exist, and how alliances influence these has not been formally analyzed.
We used data on agonistic interactions among male chimpanzees in an unusually large community with 22 to 30 adult males to analyze the linearity and strength of male dominance hierarchies over a 12-year period and the effects of coalitions on dominance hierarchies. Contrary to reports from other sites that males can only be grouped into rank classes in large communities, matrix permutation tests of the outcome of dyadic agonistic interactions (performed using MatMan) yielded highly significant linearity in each of 12 annual hierarchies, with only a few males having tied ranks and only a few circularities in rankings ($p < 0.001$ in all cases). Randomization tests of hierarchy steepness also produced significant results ($P < 0.001$ in all cases), consistent with description of male chimpanzee dominance style as despotic.
While coalitions might minimize power differentials and reduce hierarchy linearity and steepness, analysis of matrices that also included polyadic interactions also showed significant linearity and significantly steep hierarchies. Including data on coalitions changed some relative ranks, but the resulting hierarchies closely matched those based on dyadic interactions. Coalitions had only limited effect on hierarchy linearity and strength because most coalitions were "conservative" and reinforced rank differentials; few involved coalition partners who were lower ranking than their targets and thus stood to reverse rank with those targets.

Developmental and Ecogeographic Limb Variation Among the Subadults of Three Native American Populations.

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Evolution teaches us that skeletal development is both a tenuous and predictive period of final adult form. To better understand the basis of human variation it is imperative to focus on the developmental period. In physical anthropology, analyses of juvenile skeletal remains are a vital analytical tool but are underrepresented due to a lack of documented samples and small sample size. Similar studies of human variation often focus on analyzing skeletal differences through the environmentally-focused, complementary "rules" set by Bergmann (1847) and Allen (1877). The present study assesses ecogeographic variation of the subadult limb among three distinct Native American populations.
This research analyzes six postcranial elements (humeri, ulnae, radii, femora, tibiae, fibulae) drawn from three distinct Native North American populations: Native Alaskan (n=52), South Dakota Arikara (n=76), and New Mexico Puebloan (n=44). These populations are temporally conserved and share a common evolutionary history. All material is housed at the National Museum of Natural History, Smithsonian Institution and the Maxwell Museum of Anthropology, University of New Mexico.
Compared to limb variation among eco-geographically distinct adult populations (Waxenbaum & Falsetti 2008), the subadult segments display statistically significant ($p<0.0001$) deviation by population among the limb (upper vs. lower) instead of by segment (proximal vs. distal) with a large portion of the variation accounted for by the lower limb. An isolated analysis of the pubescent period presents limb variation comparable to those appreciated among adults. This investigation demonstrates that subadults share similar variation by population which preempt patterning along geographic boundaries and climatic conditions.

The paradox of human cranial variation.

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Cranial variation in humans presents a paradox. On one hand, differences among human populations are as large as those among non-human primate subspecies or sometimes even species. On the other hand, human among-population variation is small relative to the total amount of variation, about 5-15%, matching results from presumably neutral DNA polymorphisms. DNA-polymorphism studies further show that human populations tend to differ little genetically from one another relative to non-human primate populations. Why do humans appear to be cranially diverse, when looked at one way, but cranially homogeneous from another perspective? When in the course of human evolution did humans begin to differ from non-human primates in the relationship between their cranial and genetic diversity?
To address these questions, I present statistical analyses of human, non-human primate, and fossil hominin cranial variation. The results show that the human vs. non-human primate dichotomy goes back at least as far as the last common ancestor of Neandertals and modern humans. It seems that

resolving the paradox of human cranial variation lies in thinking of non-human primates as cranially limited rather than human populations as cranially diverse. In other words, cranial evolution in non-human primates has been constrained, whereas these restrictions have been relaxed in humans and Neandertals. This relaxation implies a shift in human evolution when stabilizing natural selection became less of a barrier and genetic drift increased in importance in shaping human cranial variation.

A flexible new program for computer-aided footprint analysis: demonstration, discussion and application.

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"Toe Indexer" is a macro program for ImageJ, a flexible image analysis program that can run user-written macros within it, thereby extending and refining its functionality. It is produced and maintained by the NIH and is distributed for free, as are a number of macros written by researchers in a variety of fields.
The macro, "Toe Indexer," allows easy measurement of footprints and calculation of toe index, as defined by Webb et al. (Anthropologie, 2006). The new techniques establish a longitudinal axis of the footprint, which is required for many other measurements, and define a functionally meaningful point from which to measure toe length. Toe length is divided by foot length to give toe index, a parameter which appears to be useful in ontogenetic studies and has been used to compare the Laetoli footprints with those of more modern hominins. Because the structure of "Toe Indexer" is fairly straightforward and the written code is well 'commented,' it is easy to make minor alterations. Furthermore, brief instructions for each step are printed in a "Log" window as the user proceeds, as are intermediate results of the various measurements and calculations. This output can be customized by adding and deleting various calculations and their associated "print" commands.
"Toe Indexer" has been used in a study of a fairly large ontogenetic (mixed cross-sectional) collection of footprints, about 300 total. Preliminary results of this research suggest a general trend towards decreasing toe index with increasing age, but individual variation may confound efforts to use toe index as an age marker.

Arthritic lipping of limb bone joint surface areas among 19th century Midwestern workers.

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Nineteenth century skeletal remains from Midwestern workers are predicted to show arthritic changes to the limb bone joint surfaces as a function of age and sex. To test these expectations, mating joint pairs of the shoulder, elbow and knee of 44 males and 24 females from Second Catholic, Lincoln Park, Cross, Longview, and Kaskaskia cemeteries in Missouri and Illinois were scored for degree of lipping on a five point scale. The joint surface areas of the proximal ulna exhibits the greatest frequency of lipping, followed by the distal humerus and distal femur, whereas the proximal humerus and proximal tibia exhibit the least frequent occurrence of lipping. Mann-Whitney U tests show that males and females differ in lipping profiles only for the right proximal humerus and the left proximal ulna. All articular surfaces associated with the knee, regardless of side, show a significant relationship with age, demonstrated by p values derived from linear regression. Joint surfaces of the elbow and shoulder show no significant relationship with age, suggesting these effects are primarily manifested on the weight bearing articular surfaces of knee. Linear regressions conducted separately for males strengthen the association between age and lipping of knee joints. The relationship between age and lipping of the knee joints is weaker for females. From these results, we may suggest that occupational stress in the 19th century Midwest most often manifested in the elbow, but that males and some females exhibited age-related arthritic changes in the knee as a function of age.

Mandibular shape changes in modern humans and *chimpanzees* during fetal and early postnatal development.

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We explore shape-allometry of human and chimp mandibles throughout prenatal and early postnatal life using a dense 3D surface representation based on CT scans to describe developmental similarities/differences
quantitatively. The sample consists of 66 *Homo* and 25 *Pan* specimens, ranging in age from fetus to dental stages 1 and 2 (DS1, DS2: between birth and prior to eruption of the first permanent molar).
We digitized 415 (semi)landmarks on each specimen and converted these to shape-variables by Procrustes superimposition. Allometric shape changes are compared by regressing shape on the logarithm of centroid size in Procrustes-shape-space.
Human and chimp mandibular shapes diverge very early in prenatal life. In humans, the geometry of the chin and mental fossae are already established by gestational month 5. These traits emerge at the same time as lateral and forward displacements of the basilar unit and displacements in the opposite direction of the anterior and lateral portions of the alveolar unit are occurring. Chimps also show a bulbous mental region (though not T-like) and bi-lateral anterior grooves, but these

disappear before birth. In both species, changes in the alveolar mandibular unit are dominated by the developing teeth. The basilar unit, however, exhibits quite different paths where humans feature more pronounced shape changes compared to chimps. Both start with a V-shape in fetal life but the changes in antero-posterior and lateral dimensions are quite distinct, leading to different U-shapes at DS1 and DS2. We discuss that the human chin emerges from developmental constraints different from mastication.

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Semliki chimpanzees do eat insects.

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Wild chimpanzees (*Pan troglodytes schweinfurthii*) at Toro-Semliki Wildlife Reserve, Uganda, have been preliminarily reported to eat no insects (Hunt and McGrew, 2002), which would make them the only chimpanzee population studied in the long-term not to do so. Here we report that not only do the Semliki apes eat insects, but also that they are among the most insectivorous of chimpanzee populations. Over a 6-month period (May-November, 2008) that included both wet and dry seasons, we tracked and observed chimpanzees, monitored insect nests, transected for insect availability and collected chimpanzee fecal samples. Twelve colonies of *Oecophylla longinoda* (weaver ants), 11 hives of *Apis mellifera* (honey bees), and 13 mounds of *Macrotermes* spp. (the largest of the fungus-growing termites) were monitored on average every two days. Five strip-transects totalling 2.5 km were cut, in a representative sample of vegetation types used by the apes. Insects were found in over half of chimpanzee fecal samples, with the highest frequency being of weaver ants. Predation on honey bees was second-most common, and included stick use to extract honey. Termite-eating was not recorded, although *Macrotermes* mounds were common and were fishable by chimpanzee fishing-probe techniques. Eating of army ants (*Dorylus* spp.) was absent, but these prey were rarely encountered, by comparison with wetter sites elsewhere in Africa. Insectivory is a chimpanzee universal.

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Bone health in African Americans from enslavement through reconstruction.

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The Africans and African Americans enslaved in the United States left few written accounts of their lives. Bioarchaeological skeletal analysis can help describe the lived histories of these marginalized individuals. Skeletal remains from historical African American cemeteries in New York City, Philadelphia, and Arkansas have been analyzed using bone histomorphometry to reconstruct some of the physical experiences these individuals endured. This presentation provides a discussion of historical African American health and nutritional status, as seen through the analysis of the enslaved Africans and African Americans interred at the New York African Burial Ground (1646-1790), freedmen from two First African Baptist Church cemeteries in downtown Philadelphia (1810-1843), and free Blacks from the Cedar Grove Baptist Church Cemetery, Arkansas (1878-1930). Paleodemographic data reveal the shortest life expectancies among the enslaved, and paleopathological studies demonstrate high prevalences of disease among all populations. The enslaved individuals had by far the most cortical bone mass but smallest measures of bone turnover when compared with the other study populations and published literature. The emancipated Philadelphians were achieving less peak bone mass, and the free Blacks in Arkansas exhibited the most resorptive spaces where existing bone had not been replaced. Osteoarthrtis, enthosopathies, periostitis, and linear enamel hypoplasia correlate most significantly with the patterns of bone turnover observed, and these patterns are described by age category and sex. Finally, the disease and histology patterns observed are considered in light of each population's social, political, and economic context. Osteobiographies of select individuals are included.

Calibrated Expert Inference and the construction of unbiased paleodemographic mortality profiles.

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Calibrated Expert Inference (CEI) – a new approach for constructing mortality profiles from skeletons – is based on one age-indicator and a new statistical technique. Notable features include the calibration of age indicators against the ages of known-age skeletons, and the generation of individual ages-at-death after the mortality schedule is estimated for the study population. Thus, CEI addresses well-known problems with existing paleodemographic procedures.

Initial age estimates are based on impressionistic (expert) assessments of age, expressed as an interval reflecting uncertainty about the skeleton. These assessments rely on many morphological characteristics distributed throughout the skeleton. Repeated blind tests by multiple osteologists using 19th and 20th century known-age skeletons have shown there is high consistency among observers, as well as high repeatability within

single observers. Initial osteological assessments, the single age indicators, are calibrated against known-age skeletons, *ca*. 350 individuals from the Coimbra Collection, Portugal. By using a non-parametric regression technique, which allows for interval-censored data, we do not have to rely on linearity between the indicator and actual age, nor on heteroscedastic error distributions. The population mortality pattern is estimated through a maximum-likelihood procedure using the calibrated age-indicator; therefore, the resulting age-at-death profile is not susceptible to age-mimicry. By using interval-width information in the calibration procedure, uncertainty in skeletal age estimates directly enters into final estimate confidence statements. The initial osteological age assessment is non-invasive and quick, so throughput is high making CEI suitable for the large skeletal samples needed for paleodemographic studies.

The implications of demographic changes on the craniofacial morphology of the modern Portuguese.

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Significant changes in craniofacial morphology of modern people have been documented in several worldwide populations. Changes in demographic parameters have occurred in parallel with these phenotypic changes. The demographic changes are characterized by a substantial decrease in childhood and infant mortality and a subsequent increase in adult longevity and have been termed the "modern demographic transition". This study uses an identified sample of 500 Portuguese individuals with birth dates ranging from 1800-1950 to explore the relationship between several demographic parameters and changes in craniofacial morphology. From historic records of the Lisbon population, demographic parameters are calculated using a Siler model. The hazard rates for 0-1 years, 1-5 years, 5-20 years, and overall mortality are the parameters used. The relationship between these mortality parameters and the principal components extracted from a geometric morphometrics analysis of three-dimensional cranial landmarks are examined. This analysis is used to examine whether the cranial morphology is significantly related to the pattern of change in specific mortality parameters. The results of the analysis suggest that changes in cranial morphology are significantly related to changes in the juvenile hazard rate. Studies on the modern demographic transition have shown that juvenile mortality is the first and most significant demographic parameter to be affected by changes in environmental conditions. The environmental conditions that affected the substantial decrease in juvenile mortality may also have had a significant impact of changes in craniofacial morphology, due to changing growth patterns that occur as a result of reduced stress during this period of development.

Cranial muscle markers: A preliminary examination of size, sex, and age effects.

E. Weiss. San Jose State University.

Most muscle marker research consists of post-cranial analyses, but some researchers examine crania to reconstruct activities. Regardless of bones examined, anthropologists know the complexities surrounding muscle marker development. Here, four posterior cranial muscle markers are analyzed to determine whether they are useful in reconstructing activities by examining effects (e.g., size) that hinder reconstructions. Additionally, upper limb muscle markers and humeral cross-sectional robusticity variables are correlated with cranial muscle markers to determine if robust individuals are generally robust.

Cranial muscle markers of 65 prehistoric California Amerinds are scored using a five-point observer rating scale. Body mass is calculated from femoral head size; maximum cranial length and breadth are measured with a spreading caliper; and age and sex are determined through standard procedures. Upper limb muscle markers are scored on seven sites using two dimensions within a seven-point scale. Cross-sectional properties are calculated from biplanar humeral radiographs. Aggregates are created for cranial muscle markers, upper limb muscle markers, and cross-sectional robusticity.

Cranial muscle markers correlate with cranial length, $r = 0.25$; upper limb muscle markers, $r = 0.22$; and, cross-sectional robusticity, $r = 0.30$; $ps < 0.05$. Cranial muscle marker scores increase in those with longer crania, greater upper limb muscle markers, and greater cross-sectional robusticity. Cranial and upper limb muscle markers, cross-sectional robusticity, and cranial length differ between sexes (Mann-Whitney = 31.00 - 307.50, $ps < 0.01$). Results imply individuals with well-developed cranial muscle markers have overall greater robusticity and sex differences are not completely related to activities.

Natural selection: its meaning, its anthropology, and how it works.

K.M Weiss and B.W. Lambert. Penn State University.

It is easier to refer to natural selection than to see how it actually works. Simple scenarios are easier to invoke than to prove. Evidence of selection is manifest across the human genome, in coding as well as noncoding regions, most of whose function is not known. The evidence is statistical and often problematic. There is genomic signature of selection occurring differentially in the human lineage compared to other primates, but overall patterns are easier to infer

than gene-specific selection. However, many if not most approaches use data that focus attention on selection since our emergence from Africa, often searching for regionally different adaptations. The classic instance is malarial resistance, and even this very strong, recent selection has left complex results. More typically, selective differences as high 1% seem to be unusual. If selection is a tolerant process, and the genetic architecture it works on is complex, selection can be so slow as to be undetectable at any given time. This has implications for our intuitive sense of selection, and our interpretation of current phenotypic variation, with its important potential societal consequences. This is especially true of regional adaptations, where the samples chosen for analysis can easily be given racial or even racist interpretations. Humans have come through complex demographic histories for which flexible forward computer simulation may be a valuable tool to reinforce, alter, or temper ideas about particular aspects of human adaptation, or even to reveal unsuspected paths to adaptive change.

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Maternal physiological guidance of offspring developmental trajectory: transgenerational adaptation to novel niches.

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Due to their high risk of mortality, colonising animals tend to have rapid growth rates and small adult size. Such fast life histories aid adaptation to rapidly changing environments. Humans, increasingly described as 'colonising apes', contradict these trends. As in many species, human offspring can adapt to local conditions through early-life plasticity. However, given the role of the mother in meeting the offspring's nutritional requirements during pregnancy and lactation, offspring adapt not to the external environment itself, but to maternal phenotype. Mothers with high phenotypic quality (somatic capital) can buffer their offspring against both short-term ecological perturbations, and severe systematic stresses. Mothers with poor phenotypic quality also buffer their offspring against short-term perturbations, but may be obliged to transmit more fundamental stress. This scenario represents the guiding of offspring development by matrilineal quality, and different matrilines within a common environment may guide their offspring along different trajectories, according to their own characteristics. This is interpreted as a fitness-maximising strategy, whereby mothers do best by tailoring the size of their offspring to their capacity to provision them both prior to and after weaning. Evidence from both prehistoric and historic anthropometric data provides support for this hypothesis of varying matrilineal capital transmission. The adaptation of human offspring to maternal phenotype, rather than the external environment, results in non-genetic transgenerational correlations in phenotypic quality. As plasticity is lost during the life-course, older individuals can use culture to mitigate ecological perturbations, and may transmit cultural capital alongside somatic capital to the next generation.

Evidence of reduced mobility in a Missouri Woodland Period adolescent male.

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Morphological features of the femur are commonly used by physical anthropologists to reconstruct mobility levels. We examine morphological features of the femur associated with reduced mobility and immobility, and argue that reduced ambulatory ability or recent immobility provides a parsimonious explanation for the femur morphology of an adolescent Woodland period male from central Missouri. We compare femur midshaft and subtrochanteric dimensions and functional angles (inclination, torsion, and bicondylar) to other Missouri Woodland males and modern individuals known to have reduced ambulatory ability. Individuals with long-term reduced mobility have diminished muscular stress and weight bearing on the lower limb bones. Depending on the age of the individual when ambulatory problems arose, normal ontogenetic changes in femoral angles often do not transpire and wasting of the femoral shaft cortical bone occurs. Such wasting is reflected in bone strength and mediolateral diaphyseal dimensions. Individuals with reduced ambulatory ability associated with cerebral palsy, for example, are often more than two standard deviations below the mean in the mediolateral midshaft dimension, but do not differ significantly from normal in anteroposterior diaphyseal dimensions, head diameter, or bone length. The young Woodland male from Missouri is within the normal range for femur length, head diameter, and diaphyseal AP diameter, but has high angles of inclination and torsion, as well as midshaft and subtrochanteric ML dimensions more than two standard deviations below the mean. It is possible that this individual suffered from some sort of disorder that caused long-term mobility problems.

Juvenile growth in the medieval English cemetery population of Hereford Cathedral Close.

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The English medieval cemetery from Hereford Cathedral Close is noteworthy for its large sample size (ca. 1100 individuals), its three plague pits (188 individuals), and the large number of juveniles present (310). Juvenile growth was assessed in this population as a general indicator of child health and nutritional status. In theory, differences in attained long bone length for dental age can be equated with differences in growth, and thus differences in health and nutrition. Growth curves were plotted based on long bone length and dental development and compared to growth standards derived from a modern American population, an historic Canadian population, a proto-historic North American Native population, a medieval English population, and a 6-7th C German population. Additionally, a skeletal growth profile for the Hereford juvenile femora as a percentage of attained mean adult femur length was constructed and compared to the historic and modern data. A temporal trend can be seen in the differences in growth between the various juvenile groups and is most likely related to the secular increase in juvenile stature. When compared to modern standards, the Hereford juveniles were short for their ages, a condition commonly ascribed to a reduced standard of nutrition and heath. However, when growth was plotted as a percentage of attained mean adult size, it could be seen that the Hereford children were following a normal growth trajectory that would result in their achieving what would be for them, a normal adult stature.

Tooth development models predict Carabelli cusp variation: interaction effects and epigenetic mechanisms.

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The Jernvall and Salazar-Ciudad model of tooth morphogenesis accounts for the development of tooth shape, including the appearance of new cusps, based on a small number of developmental parameters. Initiation and placement of presumptive cusp tips, epithelial and mesenchymal growth, and root formation all affect tooth shape. The model predicts covariation among morphological variables, such as tooth size, intercusp distances, and cusp size. We investigated the model's predictions for covariation of Carabelli cusp with tooth size and intercusp distances: Carabelli should be large in teeth with small intercusp distances relative to tooth size. We also investigated left-right asymmetry in Carabelli size within individuals, providing a new opportunity to isolate non-genetic sources of morphological variation. The sample consists of 40 M[1] antimeric pairs with Carabelli cusps in a dental cast sample of Ohio orthodontic patients. We recorded various measures of tooth size and inter-cusp distances with a Hirox digital microscope.
Tooth size per se has no bearing on Carabelli size in the sample overall (but see below for asymmetry). Intercusp distance, however, covaries with Carabelli size such that Carabellis are largest in teeth with small intercusp distances relative to tooth size, as predicted. In teeth with relatively large intercusp distances, Carabelli cusps may be large or small, though more frequently they are small. Surprisingly, left/right differences in Carabelli size covary more strongly with asymmetry in tooth size than with asymmetry in other parameters. This last result suggests that differences in tooth size may influence Carabelli size primarily through epigenetic mechanisms.

Intestinal parasites of Zambian baboons.

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We collected 118 fecal samples in 10% formalin from baboons along a north-south transect in the Kafue River basin in west-central

Zambia, The transect spans the transition zone between the "Kinda" subspecies of the yellow baboon (*Papio cynocephalus kindae*), in the north, and the chacma baboon subspecies *Papio ursinus griseipes*, in the south.
This is the first record of intestinal parasites in Zambian baboons. Ten helminth and two protozoan parasite taxa were recovered using formalin-ether sedimentation. Parasite intensity, prevalence, species richness, and multiple species infection were examined and compared. The parasite taxa are the same as have been reported for baboon populations elsewhere. "Kinda" baboons were found to have significantly higher intensities and prevalence of both *Physaloptera* sp. and *Streptopharagus* sp., higher parasite species richness, and more individuals harboring multiple helminth species infections. The high frequency of spirurids indirectly implicates arthropods as of possibly greater significance in the "Kinda" diet than in the diet of grayfooted chacmas in this region.
Two species of schistosomes recovered from both baboon subspecies are known to be infective to humans, and are thus of possible zoonotic interest.
This research was supported by grants from the Leakey Foundation and National Geographic Society to JP-C and CJJ.

The monkey who cried wolf: tufted capuchin monkeys use

anti-predator calls to usurp resources from conspecifics.

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Observations of tactical deception in animals are rare, making systematic studies of such behaviors difficult. For example, the "deceptive" use of alarm calls in competitive feeding situations has thus far been observed only anecdotally in non-human primates. It is therefore unclear if primates, like some birds, use alarm calls to usurp food resources and, if so, what conditions elicit such behavior. To address these questions, tufted capuchin monkeys (*Cebus apella nigritus*) in northeastern Argentina were observed during experimental feeding contexts. If capuchins do use alarm calls "deceptively" to usurp food resources, it was predicted that individuals that do not have priority of access to resources (subordinates) would be more likely to call in the absence of potential predators than those that do have priority of access (dominants), and that alarm calls would be more frequent when resources are more clumped (and therefore more contestable). Data were collected using continuous and instantaneous focal sampling during experiments wherein fruit pieces were distributed across one to six platforms suspended from tree branches. During 45 hours of experimental observation, focal animals produced alarm calls with no apparent eliciting stimulus on 25 occasions. Results indicate that subordinate individuals produced these false alarm calls more often than dominants, and that the alarms were more common when food was distributed across fewer platforms. These results support the hypothesis that alarm calls are used to usurp resources, but further study is necessary to determine if this is intentional on the part of the caller.
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Tethered and terminal load: female travel at pregnancy's end.

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Pregnancy imposes considerable modifications in the structure and function of the female body to allow for development and parturition of the fetus. Many of these changes, including weight gain, ligamentous laxity and shape alterations in body segments contribute to the characteristic gait associated with the pregnant human female. The dynamic coupling of pelvic and thoracic rotations during walking gait may be constrained during pregnancy by the presence of the fetal body as well as increased moments of inertia imposed by maternal weight gain. Both hold the potential to reduce stride length and impact gait efficiency during pregnancy.
Eighteen healthy women were kinematically and anthropometrically examined at six stages of pregnancy from first trimester and term to determine amplitude of pelvic rotation and stride length at self-selected walking speeds, and abdominal girth and bi-iliac spine breadth associated with fetal growth. Results of repeated measures ANOVA indicate effects of girth on pelvic rotation significantly reducing amplitude (F 20.03, $P <$ 0.0001), in correlation with fetal load. Intra-individual standard deviation increased toward term. Anthropometric variables increased significantly from early pregnancy to term ($P < 0.01$ for each), but stride length did not significantly differ. Although conventional parameters of bipedal locomotor performance suggest that pregnant gait is remarkably unchanged from non-pregnant gait, minor mechanistic differences may underlie the similarities.
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Architecture of life history events in vervet monkeys (*Cercopithecus aethiops*).

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This paper examines the hormonal architecture of adolescent growth and puberty in a nonhuman primate. Comparative studies of primate ontogeny are revealing diverse patterns of postnatal growth. Insights into the underlying mechanisms can be gained from investigation of within-species variation in the tempo of life history. We test the hypothesis that population-level variation in the growth, metabolic, and gonadal axes are associated with variation in the timing of adolescent growth and reproduction. Data are drawn from morphometric measurements and radioimmunoassays of sera from wild vervet monkeys in four distinct populations in Kenya, East Africa. Cross-sectional profiles of hormonal and growth data from juveniles are compared between sexes and across populations differing in adult body size and habitat quality.
Two hormones linked to pubertal onset, IGF-I and leptin, vary with age in juveniles. Leptin increases significantly with age in juvenile females but declines with age in juvenile males where it is not associated with changes in gonadal steroids or growth. In contrast, IGF-I increases significantly over the first four years of life in both males and females and is correlated with increasing levels of estradiol. Trunk length is significantly correlated with estradiol and IGF-I in both males and females. Both males and females have higher IGF-I in sites with higher rainfall, but estradiol is higher in females from drier habitats, reflecting the earlier reproductive maturation of these females. These analyses demonstrate similarities with human hormonal profiles of

adolescence and suggest that life history trade-offs are embodied in patterns of hormonal interactions.
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Geographic variation in orangutan calls: implications for the evolution of language?

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How the complex open-endedness of human spoken language (here human speech) evolved from non-open ended communication systems in non-human species is still an unresolved and hotly debated issue. At present, there are two major, non-exclusive hypotheses for the evolution of human speech. The first suggests that human speech has evolved as an extension of vocal communication in non-human primates. The second hypothesis argues that human spoken language evolved from the gestural communication as seen in great apes. However, at present both hypotheses face difficulties explaining the evolution of human speech. Recent studies on orangutans (*Pongo* sp.) indicate that there is substantial variation among wild populations, but also between wild and captive populations in the sounds and vocalizations they produce. Importantly, many of the sounds and vocalizations that differ between populations are made in similar behavioral contexts. In addition, experiments show that orangutans have the capacity to spontaneously learn new sounds. We argue that geographic variation in orangutan sounds and vocalizations provides evidence for features that provide a plausible platform for the evolution for certain aspects of human speech, especially because it strongly implies arbitrary (i.e. symbolic) meaning. The fact that orangutans can also learn new sounds in experiments indicates a larger than hitherto appreciated flexibility in their sound learning capacities. We argue that this capacity to learn sounds and the arbitrariness of sounds and vocalizations in wild and captive orangutans might have provided a scaffold to the enormous flexibility in vocal learning and arbitrary use of words in human speech.

Seeds as a fallback resource for East African *Cercocebus*.

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The hypothesis that fallback foods drive adaptations for processing such diet items is tested in two species of *Cercocebus* mangabeys exhibiting craniomuscular and dental features predicted to be related to processing hard-object foods. Feeding and phenological sampling data are analyzed for one habituated group each of the Tana River mangabey *C. galeritus* and the Sanje mangabey *C. sanjei*: monthly/bimonthly 3-day follows in 2000-01 and 2005-06, 11,120 feeding records; 5-day monthly follows in 2004, 5614 feeding records; respectively. Both mangabey species consume fruit preferentially, in positive correlation with availability. Both also rely on seeds/nuts as fallback foods, consumed in negative correlation with fruit consumption and availability. Seeds are consumed by both mangabeys during all months and regularly contributed >50% of the diet for *C. galeritus*; *C. sanjei's* monthly consumption varied from 1-71%. The Tana River mangabey switches to a diet of dry seeds (which have lain on the forest floor for a prolonged time and are devoid of fruit pulp) known to have high crushing resistance scores. *C. sanjei* exhibits strong reliance on hard, dried *Parinari* nuts collected from the leaf litter or dug from the ground. Variable feeding strategies related to fruit and/or seed consumption (e.g., consumption of soft nutritious seeds within hard pericarp unripe fruits) are also considered in relation to the fallback designation. While these data suggest that dried seeds may more characteristically constitute 'staple' rather than 'filler' fallback foods for these mangabeys, relative reliance on seeds may differ between the species and their respective habitats.
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Sex Differences in Mantled Howler Monkey (*Alouatta palliata)* Feeding Diversity in Two Dry Tropical Forest Fragments.

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Female primates adapt their diets to compensate for increased energy requirements during pregnancy and lactation. They meet their needs by consuming higher quality foods or by spending greater amounts of time feeding. It was hypothesized that the adult female mantled howler monkeys (*Alouatta palliata*) might exploit a wider variety of plant species than males in order to compensate for their increased nutritional demands. Research was conducted at Ometepe Biological Research Station in two dry tropical forest fragments in Nicaragua. Approximately 50 hours of data were collected from June 26-July 10, 2008. The study population consisted of adult *Alouatta palliata* living in two distinct groups on Ometepe Island. Continuous focal animal sampling was used to assess activity and plants consumed. A Chi-square statistical analysis was conducted comparing plant species exploited by males and females. Results indicated that females did not feed from a significantly greater variety of plant species than males (X^2=5.13, p=0.40). However,

analysis of activity durations in this study found that females did spend longer feeding than males. Female monkeys in these two groups may meet their energetic needs instead by increasing the rate of and the overall time spent feeding. Results also differ from groups living in contiguous forests, which may shed light on how mantled howlers adapt to living in forest fragments. Future studies should assess not only the plant species exploited, but also feeding durations and nutritional analyses of the plant foods between monkeys living in contiguous and fragmented forests.

Wrist and upper limb kinematics of amateur knappers during stone tool production.

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Modern human's command of technology is a hallmark of humanity. Stone tool production represents the earliest archaeological expression of this behavior. Past studies have linked aspects of upper limb morphology with the ability to produce stone tools. However we currently lack the quantitative data on upper limb motions needed to evaluate the mechanical context of tool production. This study investigates upper limb joint kinematics, focusing on the wrist joint, during two types of knapping: flake production and retouch. Data were captured from 4 amateur knappers using a VICON motion analysis system (50 Hz). Knapping conditions were kept constant: separate hammerstones were used for flake production (0.928 kg) and retouch (0.389 kg), and the type, mass, and dimensions of the cores were initially similar.
Results show that knappers utilized ~8-26% and ~13-19% of their flexion/extension and abduction/adduction wrist motion ranges during flake production, respectively. During retouch, ~14-24% and ~4-23% were utilized, respectively. More efficient knappers maintained similar wrist motion ranges between the knapping types, whereas ranges significantly varied among more inefficient knappers. Temporally, however, wrist movements were remarkably similar across all efficiency levels—in virtually all cases (99%), maximum wrist extension occurred within 0.2 seconds after down-swing initiation and extension release occurred ~0.02 second prior to strike. This sequence sets up wrist posture in preparation for hammer-strike and induces a wrist flick to further accelerate the hammerstone towards the nodule immediately before impact. These findings suggest that wrist movements are critical to knapping and may be altered as knapping skills increase.
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A morphometric analysis of the middle face in SK 847 and STW 53 in comparison to the maxillae of *Paranthropus*, *Australopithecus* and early *Homo*.

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The evolution of *Homo* in South Africa may be represented by SK847, often attributed to *Homo erectus*, and STW53, referred to *Homo habilis*, or *Homo* sp. Indet. The maxillary region of these two individuals is well preserved, allowing for a morphometric analysis of the middle face to be brought to bear on the affinity of these two fossils to *Homo*. Here we investigate Euclidean distances from three-dimensional coordinates specific to the maxillae of SK847, STW53 and other Hominini specimens from Plio-Pleistocene Africa, including *Paranthropus robustus*, *P. boisei*, *Australopithecus africanus*, *Homo habilis* and *Homo erectus* (*H. ergaster*). Canonical scores of interlandmark distances shared among fifteen fossils easily distinguish the taxa. SK847 is associated with KNM-ER3733 and KNM-WT15000, while STW53 groups with KNM-ER1813, KNM-ER1805, STS71 and STS5. When distances are scaled to the geometric mean, the resemblance of STW53 to *Homo habilis* is reduced, although SK847 remains most similar to *H. erectus* individuals. In a cluster analysis of raw interlandmark distances, STW53 is grouped with KNM-ER1813 and SK52, while SK847 is linked with STS5 and STS71. For scaled distances, STW53 clusters with STS71, and SK847 is associated with KNM-ER 1813 and KNM-ER 406. SK847 and STW53 differ greatly in maxillary size and shape. These results suggest that the resemblance between the palate of STW53 and other *Homo* material might be driven in large part by similarities in size. Indeed, if both SK847 and STW53 are attributable to early *Homo* then considerable morphological overlap exists among the lower faces of Plio-Pleistocene Hominini.

Presentation and heritability of skeletal dyplasia of the hand in the Jirel ethnic group of eastern Nepal.

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The Jirel population of eastern Nepal participates in a number of genetic epidemiological studies, including the Jiri Growth Study and the Jiri Helminth Project. Hand-wrist radiographs have been collected for 2,130 related children and adults and have been examined as part of the Jiri BDA3 Study which aims to explore the genetic architecture of the common brachydactyly, BDA3. In the course of this investigation, two other types of brachydactyly (BDD and BDE) and other isolated skeletal dysplasia were identified. The prevalence of the primary anomalies are: BDA3 (7.37%), BDD (3.60%), and BDE (0.39%). BDD and BDE are combined (3.99%) because they have some phenotypic overlap and may represent a single anomaly with differential expression. Overall, 10.66% of the population has some sort of skeletal dysplasia (BDX) of the hand. We used variance-components methods implemented in SOLAR to estimate the heritability of each anomaly. The additive genetic heritability of each trait was highly statistically significant: BDA3 $h^2 \pm SE = 0.67 \pm 0.13$; BDD $h^2 \pm SE = 0.70 \pm 0.13$; BDE $h^2 \pm SE = 1.00$ (converged at upper bound); BDD/E SE = 0.78 ± 0.11; and BDX $h^2 \pm SE = 0.63 \pm 0.09$. These types of skeletal dysplasia have not been studied in a population of this size characterized by a large extended pedigree structure. Understanding the genetic component of presentation of skeletal dysplasia of the hand provides valuable insight into the mechanisms that contribute to limb and digit development. Supported by NIH grants F32HD053206, R01HD40377, R01AI37091, R01AI44406, and R37MH59490.

Differential mortality in the 19th century Johnstown and Sheffield Floods: A study of age and gender.

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The 1889 flood in Johnstown, Pennsylvania and the 1864 flood in Sheffield, England were some of the worst U.S. and U.K disasters of the nineteenth century. Despite their geographic separation, these floods share many characteristics, allowing for mortality comparisons between the two disasters. The mechanism of disaster was the same, a dam break, with roughly equivalent volumes of water displaced. They are also alike in terms of time period and regional economy. Differential mortality is seen in both floods when examining age and gender victim profiles. The overall mortality profile of the Johnstown victims resembles a catastrophic mortality curve, and individuals under fifteen years constitute a majority of the victims. Conversely, the majority of Sheffield victims are adults, by more than 24%, and their mortality profile is more similar to an attritional mortality curve. Johnstown's female victims outnumber male victims by over 15%. In contrast, there are 17% more male victims than female victims in the Sheffield Flood. In natural disasters, like floods, women and children are more likely to die than men. The Johnstown Flood emphasizes this fact, but the Sheffield Flood shows that community composition can greatly affect the resulting mortality curve. This disparity may reflect differences in terrain and the course of the floodwaters, the time of day when the flood struck, as well as underlying demographic factors like population size and community composition. The complexity of these two disasters shows the importance of considering social, cultural, economic, and biological factors when discussing human vulnerability to historical and modern disasters.

Modularity in the hominoid vertebral column: Implications for the evolution of orthogrady.

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Natural selection favors the coinheritance of functionally and developmentally related traits, selecting for the genetic integration of such traits. Hierarchical investigations of morphological integration can reveal modules, or sets of traits that are highly internally integrated and relatively autonomous in their interactions with other sets of traits. Modularity allows evolutionary forces to act on traits within one module without causing correlated responses on traits in other modules. Since the vertebral column is a naturally hierarchical structure, it is an ideal region for testing hypotheses of modularity. Hominoid primates are orthograde and possess unique morphological structures of the vertebral column related to this posture. Several hypotheses are proposed to explain modularity in the hominoid vertebral column, including separate autonomous regions, cervical autonomy, thoraco-lumbar modularity, lumbo-sacral modularity, and pre-sacral modularity.

Linear morphological distances were measured on select cervical, thoracic, lumbar, and sacral vertebrae of *Hylobates lar* (n=56) and *Homo sapiens* (n=60). Hypothesis matrices were constructed and tested against the observed correlation matrix for each species using matrix correlations and Mantel tests. Results indicate that gibbon and human correlation structures are significantly correlated ($r=0.571$, $p<0.001$) and share similar patterns of integration. Of the hypotheses tested, thoraco-lumbar modularity best explains correlation patterns in the observed matrices in both species ($r=0.131$, $p<0.01$). These results suggest that either 1) patterns of integration are homologous in gibbons and humans and are therefore primitive for hominoids or 2) gibbons and humans have converged on similar patterns of integration due to functional demands related to orthogrady.

An inter and intra-cemetery craniometric assessment of biological distance and social organization of the Middle Woodland Ray and Gibson sites.

C.A. Willis and J.E. Buikstra.

Population genetics and Biological distance studies have been a substantial tool for recreating prehistoric biological interactions in West-Central Illinois, however, these studies have been model free approaches, and have not included non-Hopewellian data. This analysis focuses on Middle Woodland inter and intra cemetery biological variation based upon cranial metric data. In this study, cranial measurements from 61 individuals from the Ray and Gibson sites are analyzed to shed light on the population interactions of the Lower Illinois River Valley. Using the methods of Relethford and Blangero ([1990] Hum Biol *62*:5-25) external gene flow, minimum genetic distances, and observed and expected phenotypic variances were calculated. Results indicate that the inhabitants of the Ray site experienced less external gene flow than the inhabitants of the Gibson site. The post-marital residence pattern at the Ray site was matrilocal, in direct contrast to the expected pattern, and that of the Gibson site. Also the cemetery at the Ray site represents three distinct genetic populations. Here we examine alternative models related to time and origins to explain these differences.

Developmental origin of covariation between traits.

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In 1984 we analyzed the relationship between metric and nonmetric traits in the crania of rhesus macaques from Cayo Santiago using functional cranial analysis, which posits that the form of skeletal tissues are dependent upon the related soft tissue organs and spaces. We found that the relationship between cranial metric and nonmetric traits is explicable in terms of a common developmental pathway shared by the two types of traits and proposed that nonmetric traits have an underlying continuous distribution, their expression reflecting a threshold model. Though the genetic basis for both types of traits have been established in this population, the question remains, what are the developmental processes by which variation in these two types of traits is produced? Here we compare the covariation of traits among individuals with the covariation of fluctuating asymmetries in traits following Klingenberg et al. (2003). We reanalyze the Cayo datasets that have been expanded in terms of the number of animals and the cranial measures analyzed, to further refine the nature of developmental processes that affect variation in these traits. Our hypothesis, that nonmetric traits located within a functional cranial component share developmental history with the osseous elements of the component, is partially supported by our work. However, inconsistencies in our results also suggests that developmental processes contribute differentially to variation at different levels, providing support for separation of developmental processes for the two types of traits. Funded in part by NSF-BCS0725227, NSF-BCS0523637.

Modeling death in late prehistoric west-central Illinois.

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The central Illinois River valley was the setting for significant changes in cultural practices, subsistence strategies and settlement patterns during the Late Woodland, Mississippian and Oneota periods (AD 400 to AD 1450). While some researchers point to the proportion of infants and juveniles in cemetery samples and conclude that fertility increased in the region, others suggest health declined, citing the lower mean age-at-death and increased prevalence of non-specific indicators of stress. Given recent advancements in age estimation and paleodemoraphy, the current analysis utilizes two maximum-likelihood aging methods to explore the variability in mortality patterns over time in skeletal samples from Dickson Mounds (n = 915), the Morton Complex (n = 209), Orendorf (n = 268), and Norris Farms (n = 296).

Results of the hazard models and survival curves are significantly different from life tables previously published for the region and more closely approximate mortality patterns observed in extant ethnographic analogs. Individual estimates of age-at-death and the cumulative hazard functions indicate people were frequently living longer than previously estimated. While the proportional increase in infant and juvenile remains in the current cemetery samples suggest increased fertility over time, stages of population growth were offset by a high risk of death for women during their early fertile years. These findings support the notion that a high-pressure system of fertility and mortality existed amongst late prehistoric populations of the Midwest.

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Natural selection for birth weight at high altitude: Is small good or bad?

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Fetal growth is slowed at high altitude (HA) and preeclampsia more common. Populations of multi-generational residence at HA show a decrease in fetal growth at high altitude, but the decrease is less than that seen in relative newcomers to HA. There is debate as to whether decreased birth weight at HA has been selected for or against. Previously, direct tests of the genetic adaptations in pregnancy to HA have been unavailable. We explored the relationship between genes that show evidence of natural selection and their effect on phenotype by 1) identifying hypoxia-related gene regions that showed evidence of natural selection through the analysis of genome-wide SNP microarray data, and 2) searching for association between genotypes at candidate loci, circulating gene product (protein) levels, uterine artery (UA) blood flow and other pregnancy phenotypes at HA. In 50 multi-generational HA Andeans compared to low-altitude control populations (Amerindians and Han Chinese), five hypoxia-related gene regions showed differential expression of alleles in Andeans. In 55 multi-generational HA pregnant Andeans, CDH1 gene region SNP genotypes were associated with UA blood flow. Soluble CDH (sCDH1) correlated with CDH1 genotype and also with UA blood flow. Additionally, AMPKa1 genotype was strongly associated with gestational age at birth and ARNT2 was associated with birth weight. In all cases, alleles more frequently found in Andeans were positively associated with UA blood flow, gestational age at birth, or birth weight, suggesting evolution at HA may have selected for increased birth weight, as opposed to "small-but-healthy" babies, in adapted populations.

Biomechanical changes in the ankle and foot during flexed hip and knee walking and its implications for interpreting the hominin fossil record.

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The relatively stiff walking gait of modern humans minimizes the muscular work done to move the lower limbs and the center of mass. Nonhuman primates, and perhaps our earliest ancestors, may have used a form of bipedalism involving flexed hip and knee posture. Previous studies have examined loading and energetic costs of these "compliant" walking gaits. This study is the first to explore the effects of increased hip and knee flexion on the dorsiflexion of the ankle and the toe clearance in adult humans. These data are relevant to understanding differences in distal tibia orientation and foot length between apes, early hominins, and modern humans. 3D kinematics were collected while subjects walked normally and with a flexed hip and knee along a 90ft. trackway. When walking compliantly, our subjects demonstrated an average increase in dorsiflexion of 16^{o} during stance phase and 13^{o} during swing phase, as well as reduced toe clearance compared to normal walking. Increased dorsiflexion requires more muscular effort to stabilize the ankle throughout the stride, and will change the nature of forces across the ankle. The decreased foot clearance during compliant gait suggests that the changes at the hip, knee, and ankle were still not enough to bring about the same foot clearance as normal walking. This, in combination with the fact that some early hominins had unusually long feet and particularly long toes, suggests that they would have had to use other mechanisms such as toe flexion to clear the substrate. NIH AR50245.

[Inter]Facing age: a test of the ADBOU age estimation software in a forensic context.

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The estimation of skeletal age-at-death with some statistical certainty is essential to any forensic assessment of unknown skeletal remains, serving as key evidence in making an identification. The accurate assessment of age for cases of medico-legal significance is frequently confounded by other biological variables and the often fragmentary state of available elements. The multiple-trait, component scoring approach of Transition Analysis has been shown to be a promising alternative to traditional methods when dealing with individual, unknown, and often incomplete cases. Moreover, the recent release of the ADBOU age estimation software has significantly improved the ease with which the statistical procedures can be implemented, age estimates calculated, and graphical displays of the results obtained. This project tests the efficacy of the ADBOU program in producing age estimates for a mixed-sex, multiple ancestry sample of 50 now positively identified modern American forensic skeletal cases drawn from the William M. Bass Forensic and Donated Skeletal Collections (University of Tennessee, Knoxville). Emphasis is placed upon the user's negotiation between the internal parameters of the software and the remains under analysis, including, for example, the choice of available prior distributions, the effect of "misidentifying" or not "knowing" sex and/or ancestry, and the combination and quantity of morphological characteristics assessed.

Principles of growth perception: does the human face processing pathway generalize to cars?.

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In a study combining physical anthropology and evolutionary psychology, human perceptual processing of facial maturation is cast in a somewhat broader context. The standard methods of geometric morphometrics (GMM)—landmarks, semilandmarks, and thin-plate splines—find a strong signal for chronological age, the same one familiar from earlier studies of soft-tissue anthropometrics. The signal is strong, honest, and arguably fitness-related; and furthermore it is accessible subjectively (we estimate age just by glancing, without reasoning explicitly). But it is not obvious what general perceptual machinery is involved in this subjective assessment.

We explored the neuropsychological substrate of image-based age assessment by a study of a metacognitive task. 77 subjects in two countries (Austria and Ethiopia) were asked a "nonsense" question about the "stage of maturity" of the standardized views 46 fronts of automobiles, a form with the same general structure as that of a human face.

In both samples we find the same shape patterns for increasing attributed age in cars as for actual age of growing human faces. In many ways, the transformation grids look the same. Relative sizes of the neurocranium and the windshield decrease in both "species"; eyes and headlights both become more slit-like, noses and grilles both become taller and larger, lips and air-intakes become wider. Thus in this GMM version the best single factor for attributed age applies as well to cars as to facial growth. We wonder whether it would apply as well to body growth.

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The history of European oral health: evidence from dental caries, dental abscesses. antemortem tooth loss.

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Oral health data derived from the teeth and jaws of the sample of over 12,000 burials recorded so far by History of Health in Europe Project members are an important source of information on both diet and overall health. The most accessible dental health indices are those derived from observations of carious lesions and antemortem tooth loss. Tooth decay and tooth loss have linkages to dietary, economic and lifestyle changes. Especially relevant in this regard are the increases in dental caries rates associated with the shift from hunting and gathering to agriculture and the further increase in caries rate associated with the introduction of large quantities of sugar to the European diet as a result of an expansion of international trading relationships during the Late Medieval and Modern periods.

We recorded the following oral health related variables for each burial: total number of erupted tooth positions observed, total number of erupted permanent teeth observed, total number of permanent teeth with carious lesions, total number of teeth lost premortem, and total number of abscesses observed. Statistical

analyses indicate that overall, European women had a higher proportion of teeth with carious lesions than did men (x^2= 11.5, p=0.0007). The proportion of carious teeth in the dentitions of people decreased significantly (x^2= 6.9, p=0.009) between Classical Antiquity and the Early Middle Ages and then increased significantly between the Early and High Middle Ages (x^2= 4.99, p= 0.02) and especially between the High and Late Middle Ages (x^2= 7.2, p=0.007).

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The life in lines – Chronology of stress markers in the enamel microstructure and the possible association of pathological changes in bone in a child from the late Neolithic in Syria

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During the excavations in 2006 at the middle to late Halaf period (mid 6th millenium B.C.) site Tell Tawila in Northeastern Syria a single shaft grave of a child was discovered in the settlement area. The development of the dentition and of the skeleton indicate an age at death of 6 to 8 years. The developmental schedule of the preserved teeth covered the entire life of the individual. By microscopical analysis of incremental markers of enamel (Retzius lines and prism cross striations) in longitudinal ground sections a record of the chronology of development and of stress events impairing the secretory stage of amelogenesis was obtained. In the early postnatal development aberrations in enamel microstructure were present as less pronounced linear enamel hypoplasias (LEH) or as Wilson bands (WB) only. With an onset two years before death a stress event lasting for more than three month could be documented by the formation of pronounced LEHs in the respective tooth portions. The incremental pattern of the enamel formed afterwards remained accentuated with the expression of additional WBs in specific intervals. This indicates the prolonged presence of developmental stress of varying intensity. Vestiges of pathological changes of bone in different stages of organization from several skeletal regions were further analyzed microscopically. This enables a discussion of the possible correlation of bone lesions to the chronology of stress markers in enamel microstructure and offers the potential to give a detailed patho-biography of an individual even from a distant past.

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Specific metabolic correlates of obesity as indicated in a cross-sectional population study.

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Overweight is considered a major burden in public health in developed countries. Underlying etiologies are enigmatic and metabolic causes have been suggested to various extent before. The aim of this study was to analyze links of major blood parameters to individual body mass index (BMI) in an entire cohort of young males, in order to suggest an underlying metabolic cause of obesity. Anthropometric (height, weight) and metabolic data (total cholesterol, alanine transaminase, creatinin, fasting and postprandial glucose, blood cell counts, haemoglobin, etc.) of Swiss conscripts (n_{total}= 64,599; 18-20yrs old, 2005 and 2006 census) were examined by regression analysis. Swiss Armed Forces recruiting is mandatory, thus the group studied reflects more than 80% of a year`s male Swiss citizen birth cohort. Individual body mass index ranged from 17 kg/m^2 (1st percentile) to 36 kg/m^2 (99th percentile) with an average of 23 kg/m^2. Alanine transaminase (r^2=0.10) and total cholesterol (r^2=0.08) increase significantly with higher BMI as do erythrocyte counts (r^2=0.02). All other parameters investigated explain individually 1% or less of total variation. Our findings show a liver-associated metabolic correlation with individual BMI. Surprisingly, glucose values do not correlate with BMI significantly, thus suggesting a specific metabolic co-etiology of individual overweight. Further research for subgroups of BMI distribution as well as possible cofounding psychological and socio-economic factors is encouraged.

Paleoanthropology and cultural anthropology: could and should the twain meet?

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If a visitor from outer space was to visit a 4-field Anthropology Department, she might wonder why biological and cultural anthropology had been assembled under the same ‘tent”. Both have an interest in humanity; one in its evolutionary history and its biologically based behavior, and the other in its “non-biological” behavior. But beyond that communality, they seem poles apart. One strives for objectivity and repeatable observations, whereas the other is deeply suspicious of the scientific method, and seems to encourage subjectivity. One tries to translate as much as it can into numbers, the other has a phobia about quantitative methods. One operates within the paradigm of Darwinian evolution, the other treats Darwinian explanations with deep suspicion and as prime examples of the hegemony of science. And as for their vocabularies, once you move beyond prepositions, articles,

and common verbs, there is scarcely any overlap. Is the above just an ill-informed and/or mischievous parody, or do the two fields of anthropology really have so little in common? Is there anything that biological anthropology in general, and paleoanthropology in particular, can learn from cultural anthropology? This presentation will consider the areas of potential intellectual overlap between cultural anthropology and paleoanthropology and suggest the means by which the twain might co-exist profitably, even if they do not actually meet.

The importance of protein and fiber in Delacour's langur food choice.

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Despite impressive adaptations for leaf-eating, colobines eat selectively. While colobines can digest mature leaves, data suggest they prefer young leaves that are high in protein, low in fiber, and low in lignin and condensed tannins. The importance of protein and fiber as an indicator for folivorous primate food choice has been repeatedly documented. While the importance of the protein-to-fiber ratio has been documented for the African and Asian colobines, this question has yet to be evaluated for the highly endangered limestone langurs of Southeast Asia. The limestone langurs are a monophyletic group of six species found almost exclusively on limestone karst habitat in northern Vietnam, eastern Laos, and southern China.
I collected >370 hours of behavioral data on four groups of *Trachypithecus delacouri* at Van Long Nature Reserve, Vietnam over 14 consecutive months from June 2007-July 2008. Both eaten and non-eaten leaves were collected immediately following observation, dried, and analyzed for crude protein, NDF, tannins, total phenolics, ash, and water content at several institutions in Hanoi. Results show that *Trachypithecus delacouri* feed selectivity for plant species and parts. Eaten leaves have a significantly higher protein-to-fiber ratios versus non-eaten leaves (p=0.00038). Young leaves were eaten more than double mature leaves (55% vs. 20%), yet eaten young leaves were significantly higher in NDF than eaten mature leaves (p= 0.01525). These results are discussed in the context of energy return from different types of fiber for foregut-fermenting primates, as well as in the context of the distinct edaphic conditions of this limestone habitat.
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Bioarchaeological evidence of interpersonal violence in a prehistoric skeletal sample from the Middle Cumberland Region of Tennessee.

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The skeletal sample from the Averbuch site (40Dv60), a Mississippian village site (A.D. 1350-1450) located in the Middle Cumberland region (MCR) of Tennessee, was examined for evidence of interpersonal trauma. The Middle Cumberland culture, a local variant of the Mississippian culture, consisted of several autonomous towns of comparable size. Artifact assemblages suggest that there was continual contact among the local populations. The presence of palisades, skeletal evidence of trophy taking, and pictographic representations of warfare suggest that intergroup violence did affect populations in the region, yet few studies focused primarily on the topic of warfare in the MCR. For this study, individuals from the Averbuch skeletal assemblage were assessed for the presence of violent trauma, including cutmarks associated with scalping, evidence of decapitation or dismemberment, cranial blunt force trauma, and projectile point injuries. The sample consisted of 177 adult individuals with relatively complete crania. Of the 177 individuals examined, 9.6% showed evidence of interpersonal trauma (6% of females, 11% of males). Approximately two percent of adults (1% of females and 3% of males) in the sample showed evidence of interpersonal violence consistent with intergroup violence (i.e. scalping, inflicted projectile point, or sharp force trauma), whereas almost seven percent (4% of females, 7% of males) showed evidence of non-lethal cranial blunt force trauma. The higher proportion of healed cranial blunt force trauma to scalping is similar to rates seen in east Tennessee, which has been attributed to codified intragroup violence.
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Dominance rank and reproductive success in male chimpanzees (*Pan troglodytes schweinfurthii*).

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Access to fertile females determines male reproductive success in many species. Presumably a dominance hierarchy reflects male competitive ability and determines mating access, and the priority of access model predicts how males gain access to females based on their dominance rank, the number of male competitors, and the number of simultaneously receptive females. Testing the model has been difficult in the wild due to the challenge of establishing paternity, especially in promiscuous mating systems, and results have varied across species and populations. In this study, we determined paternity for 34 chimpanzees born during a 22 year period at Gombe National Park, Tanzania, and compared the

patterns of paternity to the predictions of the priority of access model. We found that male reproductive success was generally predicted by the model in this system (r_s = 0.56, p = 0.03), characterized by fission-fusion social grouping, promiscuous mating, and alternative male strategies. But strikingly, low-ranking males had greater success than predicted by the model. They sired offspring with younger, less-desirable females (p = 0.04) and used the consortship mating strategy more than high-ranking males (p = 0.01). Inbreeding avoidance of high-ranking male relatives did not explain low-ranking male success (r_s = 0.54, p = 0.034), despite approximately 50% of Gombe chimpanzee females remaining in their natal community. Thus while rank and the priority of access model are important predictors of male chimpanzee reproductive success, male mate choice and alternative mating strategies allow low-ranking males to bypass their queue in line.

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The brain morphology of Homo Liujiang cranium fossil by 3-D CT.

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The Liujiang cranium is the most complete and well-preserved late Pleistocene human fossils ever unearthed in south China. Because the endocranial cavity is filled with hard stone matrix, earlier studies are only restricted to the exterior morphological of the specimen with the traditional methods. In order to get more information for the phyletic evaluation of the Liujiang cranium, the high-resolution industrial CT was used to scan the fossil, and the 3-D brain image was reconstructed. Compared with the endocasts of the human fossils (Hexian, ZKD, KNM-WT 15000, Sm 3, Kabwe, Brunn 3, Predomost) and modern Chinese, most morphological features of the Liujiang brain are in common with modern humans, including a round brain shape, bulged and wide frontal lobes, an enlarged brain height, a full orbital margin and long parietal lobes. A few differences exist between Liujiang and the modern Chinese in our sample, including a strong posterior projection of the occipital lobes, and a reduction cerebellar lobe. The measurement of the virtual endocast shows that the endocranial capacity of Liujiang is 1567 cc, which is in the range of Late *Homo sapiens* and much beyond the mean of modern humans. The brain morphology of Liujiang is more close to the Late *Homo sapiens*.

Postcranial ontogeny in captive sifaka (*Propithecus verreauxi*).

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The extended juvenile period in primates is associated with several fitness consequences, but few studies have addressed how primate life history is shaped by locomotor design. While staying small may benefit nourishment of juvenile primates, small body size has implications for locomotor energetics and risks. Juvenile sifaka are under particular ecological pressure to keep up with adults and successfully compete for resources in a highly seasonal environment. Postcranially, they develop very slowly yet have to engage in mechanically risky forms of locomotion (e.g. leaping). We conducted a longitudinal study of postcranial growth in sifaka during the early stages of development to address how and to what extent juvenile sifaka attain locomotor equivalence with adult sifaka during their periods of smallest body size and independent movement. Limb segments and body weights were measured on six sifaka at the Duke Lemur Center every two-four weeks until age 2.5. Body weight exhibits its highest rate of growth during the first year of life in sifaka. Trunk, thigh, leg, and tail length exhibit positive allometry (RMA slopes = 0.41, 0.40, 0.38, 0.46, respectively), while arm, forearm, foot and hand growth are isometric during the first year. We predict that young animals will exhibit larger hindlimb angular excursions than adults during leaping and will use their tails more than adults to assist the arms with angular rotation and deceleration prior to landing. These and possible behavioral changes (e.g. more leaps per sequence, substrate choice) may allow sifaka to maintain locomotor equivalence throughout the life cycle. Supported by the Jeffress Memorial Trust.

Interannual comparison of food toughness in the diets of a wild *Lemur catta* population in Beza Mahafaly special reserve, Madagascar.

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Fluctuations in mechanical dietary properties can reflect differences in underlying food composition. A study of lemur diets conducted over 13 months in 1999-2000 established a baseline for food properties for which additional data are needed in an environment as seasonal as the dry forest of southwestern Madagascar. In this study, we compare data on food toughness collected in 1999-2000 and June

2008. The major questions we ask are: 1) is same-month (June) food toughness similar between the two sampling periods? and 2) how similar is dietary composition (plant species and parts)?
We followed collared ring-tailed lemurs, noted plant species and parts consumed, and tested individual plant parts with a portable mechanical tester. Dietary toughness in the same month between years was not significantly different, though 1999 sample sizes were small. However, when compared to adjacent dry season months in 1999, food toughness in 2008 was significantly higher, perhaps related to 2008 being a drought year. Of 19 total plants eaten, 3 were common in the same month in different years. However, most of the plants in 2008 were also eaten in dry season months in 1999. Mature leaves and unripe fruit were the most common parts eaten. In 1999-2000, mature leaf consumption was highest in June and unripe fruit in May-August. These patterns indicate that the plant parts eaten in 2008 are representative for the dry season in this area. A cyclone/flood in 2005 silted over the reserve, and common plants in a later year are evidence of forest recovery.
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Subspecific variation in prenatal craniofacial growth pattern in the Japanese macaque (*Macaca fuscata*).

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Many studies on the postnatal craniofacial ontogeny in primates have suggested that interspecific craniofacial shape variations are established during the fetal period. However, few studies have examined the prenatal craniofacial growth pattern diversity in primates. In this study, we cross-sectionally analyzed the prenatal ontogenetic shape changes in crania of two subspecies of Japanese macaque to explore whether they share a common trajectory.
We used a total of 17 fetal specimens of Japanese macaque subspecies (8 *Macaca fuscata fuscata* and 9 *Macaca fuscata yakui*) housed at the Japan Monkey Centre. Each specimen underwent computed tomography scanning, and 68 landmark coordinates were digitized on the internal and external surfaces of the crania. We adopted a geometric morphometrics technique and principal component analysis to three-dimensionally investigate cranial ontogenetic shape changes.
Our results showed that craniofacial shape variations between these two subspecies exist during the fetal period, though they generally share a common size-related ontogenetic pattern presented by the first principal component (PC1). Clear cranial shape differences, such as the height of neurocranium and the shape of the orbit and occipital bone, accounted by the PC2 and PC3, respectively, were found to be already present by the middle period of the fetal life. Our results suggested that the divergence of primate craniofacial ontogenetic trajectories may occur at the very early stage of the fetal period even between closely related taxa. In our ongoing research, we are continuing these analyses using additional specimens in order to confirm this result.

Ethnohistory, stable isotopes and high latitude hunter-gatherer diet.

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Carbon, nitrogen, and strontium stable isotopic data from human remains offer the potential of testing hypotheses concerning the validity of ethnohistoric accounts of hunter-gatherer diets and assessing the degree of dietary change that intervened between initial EuroAmerican contact and ethnographic descriptions of dietary regimes. Survival of high latitude hunter-gatherers into the 19th and 20th centuries offers a particularly strong data set for this purpose. Here analyses of stable isotopes are examined from three late prehistoric contexts: in Argentine Tierra del Fuego; in coastal Maine; and on Kodiak Island and eastern Aleutian Islands, Alaska.
Stable carbon and nitrogen isotopic data from Tierra del Fuego generally confirm the hypothesis that Yahgan and Selk'nam populations were highly dependent on marine and terrestrial resources, respectively, although human remains attributable to some poorly known Yahgan groups seem to have been more dependent on terrestrial resources. Similarly, the poorly known Haush appear to have been largely dependent on maritime resources. On the Maine coast, stable carbon, nitrogen, and strontium isotopes suggest localization of some island populations, a conclusion at variance with ethnohistoric models of riverine transhumance. On Kodiak Island, stable carbon and nitrogen isotopes suggest a greater degree of use of terrestrial resources than is reported ethnographically, while eastern Aleutian groups reveal the greatest marine carnivory reported in the extant literature.
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From the cradle to the grave: A stable isotopic examination of infant and child diet in a Virginia slave population.

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Nineteenth-century African-American slave childhood quality of life has been described as exceedingly poor (Rathbun and Steckel 2002). Although inadequate diet undoubtedly played

a role, little is known about childhood and infant diets in slave populations. Examination of weaning age from enamel hypoplasias indicates relatively late weaning in a slave population from Barbados (Corrucini et al., 1985), but there are conflicting reports from U.S. slave narratives on the continuation of breastfeeding upon the mother's return to work in the fields (Schwartz 2006, 2000). Reports concerning childhood diet are even scarcer; however, some indicate that the diet consisted almost entirely of corn and fat (Kiple and Kiple, 1977). The goal of this paper is to document, through stable isotopic analysis, childhood diet of a Virginia slave population. The Robinson cemetery is an African-American slave cemetery that was located on the Woodstock Plantation in Henrico County, Virginia. Stable isotopic examination of adult diet from this site indicates that it was primarily composed of C4 plants and C4 fed animals, likely corn and pig or cow (Yoder et al., 2008). Subadult diets are investigated in this study using stable isotope ratios of nitrogen and carbon from the bone collagen and apatite of seven children from the Robinson site. These are some of the first stable isotopic reconstructions of slave diet and, when supplemented with bioarchaeological and ethnohistoric data, add to our understanding of the adequacy of slave childhood diet and contribute to our knowledge of diet throughout the lives of these individuals.

Locomotor adaptations of the humerus of *Mesopithecus pentelicus* and *M.* cf. *delsoni* from Greece.

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Mesopithecus is a highly diversified late Miocene-upper Pliocene Eurasian colobine genus that bears strong phylogenetic affinities to Asian colobines. Therefore, reconstructing the paleobiology of its different forms that span the Turolian is important in elucidating colobine evolutionary history. Herein, we compare the morphology of two humeri of *Mesopithecus* cf. *delsoni* (Vathylakos-early Turolian and Perivolaki-early middle Turolian) and 11 humeri of *M. pentelicus* (Pikermi-late middle Turolian) from Greece, with that of 112 recent Asian and African colobines, by means of univariate and multivariate analyses of 27 linear measurements.

Both forms were similar in most proximal humeral features (humeral head, tuberosities, shaft length) resembling African arboreal colobines, and in some characters of the distal humerus (trochlea, capitulum), reminiscent of semi-terrestrial *Semnopithecus* and *Trachypithecus*. However, they differed in distal articular surface morphology and medial condyle form, where *Mesopithecus* cf. *delsoni* appeared to be more similar to semi-terrestrial forms, while *M. pentelicus* to arboreal *Presbytis*. Additionally, when all linear measurements were considered, *M.* cf *delsoni* was placed close to *Trachypithecus* and was repeatedly classified as *Trachypithecus* in the Principal Components and Discriminant Functions Analyses, respectively. In contrast, *M. pentelicus* was set apart from the other colobines in the PCA and was hardly classified as *Presbytis* and *Trachypithecus* in the DFA.

These results imply proximal and distal humeral morphology associated with less terrestrial quadrupedal activities in *M. pentelicus*, compared to the relatively restricted mobility of the distal humerus in *M.* cf. *delsoni,* suggesting more terrestrial habits.

The implications of cross-cultural variation in fluctuating asymmetry for its use as a measure of early-life exposure to stress.

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Recent studies suggest that fluctuating asymmetry (FA) can be used to assess early-life exposure to environmental insults. FA may be an invaluable measure for assessing causes of biological variation in past and current human populations. Little is known about geographic, ecological, subsistence, or sex-related variation in FA among humans. Although our understanding of the mechanisms underlying developmental stability remain limited, the observed variation of FA with other phenotypes related to fitness and health make the cross-cultural study of FA important for evaluating its utility for assessing the nature, causes, and implications of human biological variation.

This study compares FA variation between three groups- the Aché of Paraguay and the Hadza of Tanzania, two foraging populations, and contemporary U.S. college students. Given that the two traditional groups experience greater environmental stress during development than the U.S. group, we predict that they will exhibit higher FA than the U.S. sample. Our findings show that the Aché and Hadza experience similar levels of FA, which are much higher than those observed in the U.S. population. These results are in agreement with the idea that foraging populations experience greater developmental noise than their industrialized counterparts, and that FA is an effective measure of developmental exposure to environmental stress. Further research is needed to explore cross-cultural

and sex-related variation in FA and to assess how exposures to environmental insults manifest at various points during the life course. This research was funded by the Wilhelm Rosenblatt Foundation at the Institute of Medicine, University of New Mexico.

Ontogenetic allometry of limb bone strength in capuchin monkeys (*Cebus albifrons* and *Cebus apella*): implications for locomotor development and life history.

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Previous ontogenetic studies of non-primate mammals have found that limb bone cross-sectional dimensions scale with negative allometry during growth. Augmented cross-sectional dimensions increase bone strength, permitting young individuals to maintain adequate safety factors despite skeletal immaturity. To test whether similar scaling trends characterize primate growth, we measured humeral and femoral lengths and cortical diameters at midshaft in a longitudinal radiographic sample of capuchin monkeys (*Cebus albifrons* and *C. apella*, N=14 and 3) spanning the first 5 years of life. Raw measurements were used to calculate polar section modulus (Z_P), a measure of average bending strength. Ontogenetic changes in limb bone safety factors (SF) were estimated as Z_P divided by the product of body mass and bone length (a proxy for bending moments).
Humeral Z_P scaled to body mass with negative allometry across species. Femoral Z_P, by contrast, scaled with slight positive allometry in *C. albifrons* and negative allometry in *C. apella*. Nevertheless, because humeral and femoral lengths scaled with strong positive allometry in both species, estimated humeral and femoral SF declined rapidly with age. In both species, humeral SF reached a lower asymptote at approximately 9 months and femoral SF reached asymptote at approximately 6 months of age. These ages correspond closely with the mean ages of weaning and locomotor independence, respectively. These data indicate that 1) limb bone strength in capuchin monkeys generally declines with age, as observed in other mammals, and 2) the achievement of adult-like limb bone properties may be closely associated with important life history events.
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Social stratification of height in postfamine Ireland (1860-1910).

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Data from 4900 males and 1430 females (Harvard Anthropological Survey of Ireland, 1934-1936) were used to examine the social stratification of height in postfamine Ireland. Social variables measured include: occupation, migration, education, siblings, birthplace, and occupations of father and mother's father. Those variables that demonstrated a significant influence on terminal adult height were included in further examinations of the effects of socioeconomic status on secular trend. Significant differences in the height of Irish males were found by occupation ($F = 23.53$, $p < 0.001$), education ($F = 75.97$, $p < 0.001$), socioeconomic status of father ($F = 56.89$, $p < 0.001$) and maternal grandfather ($F = 38.00$, $p < 0.001$). Males employed in agriculture, or whose fathers or grandfathers were so employed, were significantly taller than other males. Among females, only occupation ($F = 15.47$, $p < 0.001$) and grandfather's SES ($F = 10.82$, $p < 0.001$) had a significant impact on height. Women in white-collar positions or those whose grandfathers were farmers were taller than women working in blue-collar jobs or granddaughters of blue-collar men, respectively. Correlations were also calculated between height and various economic indices, and an inverse correlation was found between the British Cost of Living Index and male heights ($r = -0.035$, $p < 0.05$). Our results suggest that proximity to resources, not only of the subject but also of their parents and grandparents, plays an important role in the overall nutritional status reflected in terminal adult height.
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The effects of digitigrade cheiridial postures on speed and gait in infant baboons.

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While digitigrade foot and hand (cheiridial) postures are common among mammals, they are rare within primates. This rare occurrence of digitigrady in primates suggests an adaptive reason for its use in terrestrial monkeys. On the other hand, the lack of digitigrady within primates as a whole suggests that unique aspects of primate locomotor behavior preclude its overall effectiveness and deter its use. For example, in mammals, the proposed function of digitigrady is to increase effective limb length (ELL) thereby increasing stride length and velocity. However, an increased ELL may increase the potential for limb interference during the distinctive diagonal sequence diagonal couplets primate walking gait, in which a hindlimb touches down before the ipsilateral forelimb lifts off. This study sought to gain insight into the function of primate digitigrady by testing two hypotheses, 1) digitigrady in a terrestrial primate increases velocity and 2) primate digitigrady is preferred during lateral couplets

rather than diagonal couplets walking gaits. Longitudinal kinematic data were collected on four infant baboons as they aged from 2-9 months, and again at 2-3 years. Cheridial postures, dimensionless velocity, and gait number were calculated for 514 symmetrical walking strides. Contrary to predictions, digitigrady was not correlated with dimensionless velocity. Digitigrady in the foot and hand occurred during lateral and diagonal couplets gaits, suggesting that digitigrade postures are neither influenced by, nor preclude any particular gait type. More information on other limb kinematics is needed in order to understand how infant baboons counteract the effects of an increased ELL during digitigrady.
Supported by a National Science Foundation Graduate Research Fellowship.

Hormones and dominance rank in a large captive group of bonobos (Pan *paniscus*).

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Associations between dominance status, agonistic and affiliative behaviors and hormones (primarily testosterone and cortisol) have been sought in many different species, including common and pygmy chimpanzees. Given the dearth of studies on bonobo behavioral endocrinology, we sought to further clarify any relationships between dominance rank and hormones in the world's largest single captive population of bonobos. Nine adult female, seven adult male, one juvenile male and four juvenile female animals were sampled February-March 2007 at the Milwaukee County Zoo, Wisconsin. Multiple samples were collected (first morning voids) off of clean cage floors, samples were pooled and stored frozen until analysis. Cortisol, testosterone, vasopressin and oxytocin were all measured via enzyme immunoassay. Dominance rank was determined via 300 hours of observation where all acts of aggression and antagonism were documented. When combined as a group (males and females) for analyses, there were significant direct relationships between dominance rank and the hormones vasopressin (r^2=.294, p=.028) and oxytocin (r^2=.324, p=.027). Dominance rank was not significantly associated with testosterone or cortisol for the group. Further research is required to better understand the hormonal correlates with behavior in these animals.
This project was supported, in part, by the Department of Anthropology, University of Wisconsin-Milwaukee.

Null mutations in human and mouse orthologs frequently result in different phenotypes: Implications for human evolution.

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One-to-one orthologous genes of relatively closely related species are widely assumed to have similar functions and cause similar phenotypes when deleted from the genome. Although this assumption is the foundation of comparative genomics and the basis for the use of model organisms to study human biology and disease, its validity is known only from anecdotes rather than from systematic examination. Comparing documented phenotypes of null mutations in humans and mice, we find that >20% of human essential genes have nonessential mouse orthologs. These changes of gene essentiality appear to be associated with adaptive evolution at the protein-sequence, but not gene-expression, level. Proteins localized to the vacuole, a cellular compartment for waste management, are highly enriched among essentiality-changing genes. It is probable that the evolution of the prolonged life history in humans required enhanced waste management for proper cellular function until the time of reproduction, which rendered these vacuole proteins essential and generated selective pressures for their improvement. If our gene sample represents the entire genome, our results would mean frequent changes of phenotypic effects of one-to-one orthologous genes even between relatively closely related species, a possibility that should be considered in comparative genomic studies and in making cross-species inferences of gene function and phenotypic effect.

Classification of Hylobatidae: what does anatomy contribute?

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Gibbons have long been recognized as a uniform group: small body size, little sexual dimorphism, and long forelimbs, with siamangs (*Symphalangus)* as an outgroup. AH Schultz's (1944) classic study based on a sample of 107 wild Thai lar gibbons *(Hylobates lar entelloides)* provided skeletal data that served to define the hylobatids. Since then, data on geography, pelage, vocalizations, chromosomes, and DNA have demonstrated that the Hylobatidae are far more diverse than

acknowledged historically. Four taxonomic genera are recognized, each with a different chromosome number: *Hoolock* (hoolock) (38), *Hylobates* (44), *Nomascus* (crested gibbons) (52), and *Symphalangus* (50). Few anatomical data exist on this family.

This study tests the hypothesis that each genus has a distinct pattern of body and limb proportions. The sample of 12 ranges from 1 to 7 individuals per genus. Dissections on whole animals reveal that the adult *Hoolock* has limb proportions that are light relative to body mass with forelimbs slightly heavier than hind limbs (16.5% and 16%), a pattern that differs from the other three genera. *Hylobates* (e.g. *lar, moloch, agilis, pileatus*; n=7) have heavy limbs overall, with forelimbs lighter than hind limbs (ave. 19.1%, 20.3%). *Nomascus* limbs are lighter than *Hylobates* but are similar in having lighter forelimbs to hind limbs. Siamangs are distinguished from other hylobatids in having forelimbs that are 2% - 3% heavier than hind limbs. These anatomical patterns are consistent with the current taxonomic division into four genera and contribute to the discussion of diversity of the hylobatids.

New findings on life and death of the Tyrolean Iceman.

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In 1991 a 5300-year-old glacier mummy was found in the Alps, near the border between Austria and Italy. A recent re-examination of thoracic CT scans of the Tyrolean Iceman, also known as "Ötzi", provided evidence for an intravital arrow injury, which strongly suggested that the Iceman had died from a lethal assault. Additionally, several injuries on his right hand, back and face, have led to the assumption that the Iceman could have been involved in a violent conflict before his death. We performed a re-examination of the mummy and his equipment in order to gain new information on the last days of his life and his death. This included a detailed morphological and radiological analysis of the Iceman's body, nanotechnological investigations of the skin wounds and a forensic inspection of his equipment and clothing. For the new nanotechnological approach we applied high resolution atomic force microscopy (AFM) on small tissues samples of the Iceman's wounds. The belongings of the mummy were scanned with a forensic light source and areas with probable bloodspots were then further tested chemically for the presence of hemoglobin. The paleopathological investigations revealed a severe head trauma which may have contributed to the Iceman's death. The use of the AFM allowed for the first time the detection of red blood cells in the tissue samples of the Iceman. Finally, the forensic study provided evidence of blood traces at his coat and grass mat, which probably originate from the arrow wound at his back.

Longevity in wild mouse lemurs: old but not mousy.

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In earlier work by King et al., 2005, the ages of individual wild-caught sifakas were reliably estimated on the basis of tooth wear. Here we report a similar method for estimating the ages of small-bodied (40g) brown mouse lemurs (*Microcebus rufus*) at Ranomafana National Park, Madagascar. Using field-collected dental molds of identified individuals captured in successive years, we established that tooth wear proceeds at a predictable rate in wild mouse lemurs. We found that tooth wear can accurately be quantified by a series of linear measurements taken from high quality stereo microscope photographs of dental impressions. These measurements provide an indirect measure of the amount of wear-exposed dentine on the occlusal surface of the mandibular second molar. This method has the advantage of being simple enough to be used in the field allowing for on-site age estimates. We estimated the ages of 75 individuals in both disturbed and undisturbed forests, and found a mean age of 43 months (3.6 years) and a maximum of 8 years. Thus we set the minimum estimated lifespan of wild brown mouse lemurs at 8 years, but suspect that individuals sometimes live beyond that age, and certainly well beyond the lifespan of similarly sized mice. These preliminary estimates compare favorably with the longevity of mouse lemurs in captivity where individuals frequently live in excess of ten years. Therefore, as in larger lemurs, lifespan observed in captivity may reflect the actual longevity of mouse lemurs in the wild. Research was funded by NSF-BCS 721233.

Sex, society & syphilis: an investigation of social identity-mediated patterns of acquired syphilis in early modern England (1500-1850).

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This study presents the preliminary results of a macroscopic osteological evaluation of early modern English skeletons bearing evidence of venereal syphilis. Based on inferences from the historical record, it was hypothesized that several aspects of early modern English social identity, such as socioeconomic status, may have impacted experiences of infection with syphilis, including the duration and severity of infection. Individuals derived from early modern

archaeological sites (1500-1850) and pathological collections in England (N=86) with suggestive and diagnostic evidence of syphilis were examined for multiple skeletal stress indicators and co-existing cranial and post-cranial conditions and pathologies; dental and post-cranial metric data was also collected. In preparation for a more extensive analysis, general aspects of social identity were estimated via contextual archaeological and historical data from published and unpublished reports. Results from a preliminary analysis of a subset of individuals (N=37) indicates that the presence of sex- and socioeconomic status-mediated patterns in the severity and duration of syphilitic lesions. Low socioeconomic status individuals are more likely to manifest severe lesions than those of high or mid-level socioeconomic status (p=0.18, Fishers' exact test), while females are more likely to manifest mild skeletal lesions than males. Results have implications for understanding the otherwise historically undocumented relationship between social inequality and a highly stigmatized disease in a dynamic social, political, and economic context. These and future results will help to elucidate the political economy of health, illness, disability and disease in early modern England.

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Trends in lumbar vertebral body and lamina osteophytes.

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Numerous studies have developed scoring systems for lumbar vertebral body osteophytes, mainly defining the categories with pictures. Some studies have examined the presence of lamina osteophytes, but analysis of general trends in development have been ignored. This study aims to verbally define a body scoring system and develop a similarly defined lamina scoring system. This inquiry is a preliminary study in a series, investigating the relationship between degenerative and morphological changes with age. Left and right superior and inferior margins were scored for each lumbar level body and lamina in order to detect differences due to vertebral loading. These eight scores were taken on 76 individuals of Caucasian ancestry from the Bass Collection.

Results reveal that degenerative changes of the body generally increase in severity with age while the lamina evinces no age trend. On average, all female body scores were higher than males. Female lamina scored higher than males for both surfaces on the left, while males, scored higher than females on the right. Female bodies exhibited the highest scores on the superior surface at L3 and L4 and on the inferior surface at L1 and L2. Female lamina demonstrated more degenerative changes at L1 and L2 on the superior margins and at L1 and L5 on the inferior margins. No clear patterns emerged for males. These results show that female degenerative changes follow a pattern that is most likely load-bearing related while male results are inconclusive. Additional investigation with morphological data may help to further elucidate these relationships.