

# **Program of the Seventy-Sixth Annual Meeting of the American Association of Physical Anthropologists**

to be held at  
**The Sheraton Society Hill Hotel**  
Philadelphia, Pennsylvania  
March 28 to March 31, 2007

## **AAPA Scientific Program Committee:**

Dennis H. O'Rourke  
Chair and Program Editor

Robert Anemone  
Heather Edgar  
Agustin Fuentes  
Christine Hanson  
Fredericka Kaestle  
John Kappelman  
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Edward Hagen, Computer Programming

## **Local Arrangements Committee:**

Theodore G. Schurr, chair

## Message from the Program Committee Chair

The seventy-sixth annual meeting of the AAPA will be held at the Sheraton Society Hill Hotel in Philadelphia, Pennsylvania. There will be 847 poster and podium presentations in 38 sessions, with over **1,750** participating authors. The program includes eight podium symposia and three poster symposia that span the breadth of our discipline. The program also includes the Fifth Annual Wiley-Liss Symposium; this year's symposium honors one of the giants of the field, W.W. Howells, with contributions from Prof. Howells' former students and distinguished members of the profession.

Even more than in past years, this year's program reflects the international nature of our meetings. Roughly 24% of the senior authors live outside the United States, representing 32 nations. The largest representation is from Canada (46 senior authors), the United Kingdom (41), Germany (20), France (12), Austria (12), Japan (7), the Czech Republic (6), and Australia and Switzerland (5 each). Our meeting also serves as an important avenue for presentation of student research; about 42% of all first authors are students.

This is the sixth year that we have used an online registration system for abstract submission and payment of registration fees. The entire meeting volume is again available at the AAPA website: <http://www.physanth.org>.

As is customary, we will meet in conjunction with a number of affiliated groups, including the American Association of Anthropological Genetics, the American Dermatoglyphics Association, the Dental Anthropology Association, the Human Biology Association (Wednesday and Thursday, March 28 – 29), the Paleopathology Association (Tuesday and Wednesday, March 27 – 28), and the Primate Biology and Behavior Interest Group. The Paleoanthropology Society is also meeting in conjunction with the AAPA meetings (Tuesday – Wednesday, March 27 – 28) at the University of Pennsylvania Museum.

In the following pages you will find a map of the Sheraton Society Hill Hotel and meeting rooms; a summary table of conference events; the daily conference schedule, including meetings of affiliated associations, editorial boards, workshops, and various business meetings; a detailed listing of AAPA poster and podium sessions; the abstracts of the presentations; and an index of the authors providing the session numbers and times of their presentations.

AAPA activities begin on Wednesday evening, March 28, with a session organized by the Career Development Committee. This year's discussion is entitled "The Good, the Bad, and the Ugly: The Keys to Giving Good Talks," presented by Mark Teaford (Johns Hopkins University) and Lorena Madrigal (University of South Florida). This event is followed by our annual welcoming reception. Poster and podium sessions begin Thursday morning and continue through Saturday afternoon.

The plenary session, scheduled for Thursday evening, is entitled "ethical Issues and Practices in Physical Anthropology: IRBs, IACUCs, and Fieldwork Issues. A Round-table Discussion with Audience Participation." Our annual luncheon on Friday features Alan Mann, Professor of Anthropology at Princeton, speaking on "Philadelphia: The Birthplace of American Physical Anthropology." As always, the annual business meeting of the association is on Friday evening. We conclude the annual meeting with a Student Awards Reception on Saturday afternoon following the conclusion of scientific sessions.

The AAPA Program, Local Arrangements, and Executive Committees cordially invite you to our seventy-sixth annual meeting. Welcome to Philadelphia, and we look forward to seeing you.

*Dennis H. O'Rourke*

*AAPA Vice President and  
Program Committee Chair*

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On the Cover:

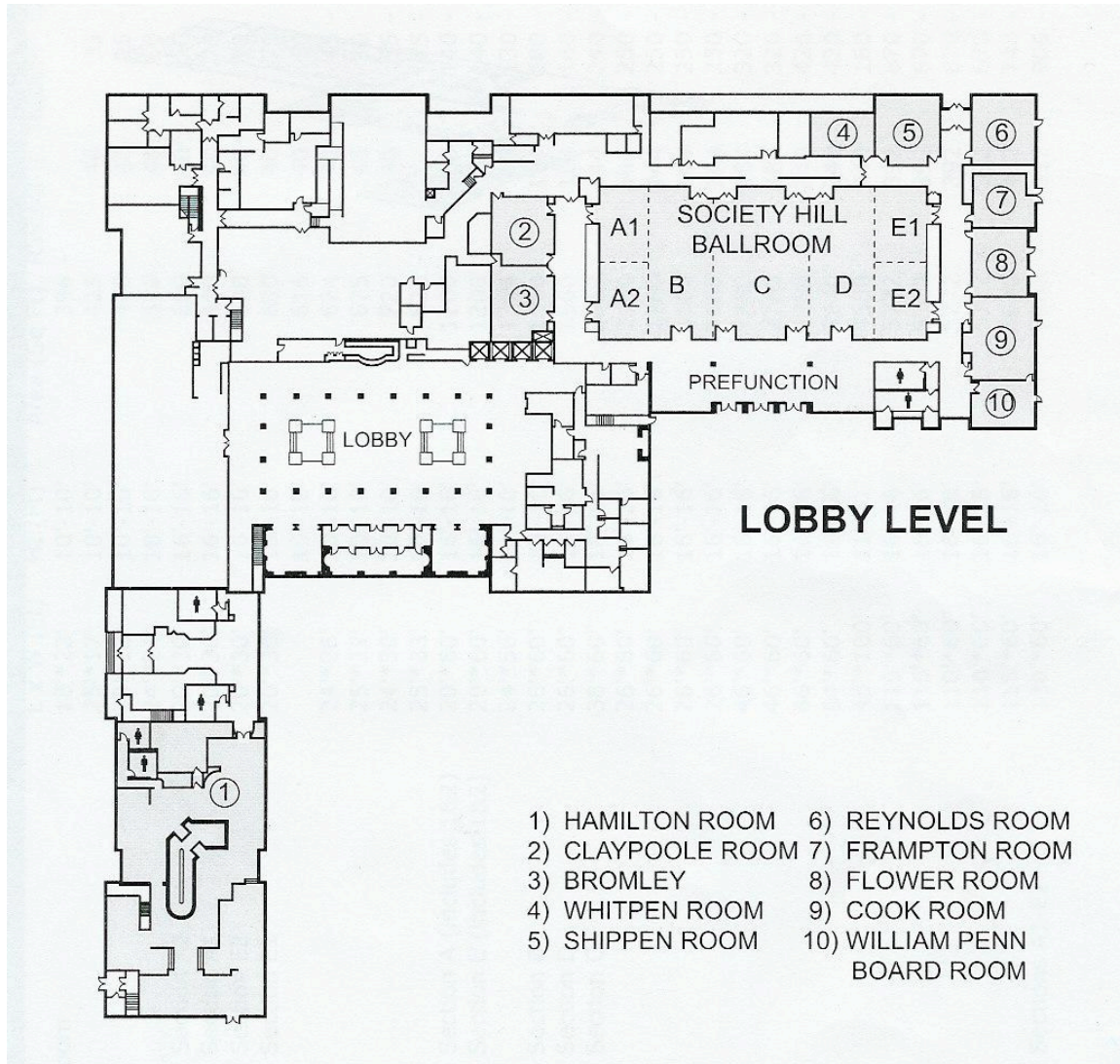
Supplement 42 was mailed the week of





# Sheraton Society Hill Hotel Floor Plan

All meeting rooms are located on the first floor of the hotel. The majority, including all the Ballrooms and smaller function rooms, are located immediately to the right of the elevators near the reception desk. The single room not located in this area of the hotel is the Hamilton Room, which is the site for most poster sessions and some exhibit areas. Another space for posters and some exhibitors is are the Bromley and Claypoole Rooms located near the Ballrooms.



## The Conference at a Glance

	Tues AM	Tues PM	Tues Evening	Wed AM	Wed PM	Wed Evening
<b>Ballroom A</b>	PPA Workshop			HBA Plenary Session		HBA Student Reception 6:30 - 8:00pm
<b>Ballroom B</b>			PPA Business Meeting 6:30 - 8:00pm			
<b>Ballroom C</b>						AAPA Reception 8:00 - 11:00pm
<b>Ballroom D</b>		PPA Podium Session		PPA Podium Session		
<b>Ballroom E</b>						
<b>Hamilton</b>					HBA Poster Session	
<b>Bromley/ Claypoole</b>				PPA Posters and Exhibitors		
<b>Wm. Penn Boardroom</b>			HBA Executive Committee Dinner 6:00 - 10:00pm	AAPA Executive Committee Meeting 8:00am - 6:00pm		
<b>Cook</b>	PPA Alternate Activity Room					AAPA Career Development 6:30 - 8:00pm
<b>Frampton</b>					AJPA Editorial Board Luncheon Noon - 2pm	
<b>Reynolds</b>				AJHB Editorial Board Breakfast 7:30 - 9:00am		
<b>Flower</b>	Speaker Ready	Speaker Ready		Speaker Ready	Speaker Ready	
<b>Shippen</b>	Press/Job Interview	Press/Job Interview		Press/Job Interview	Press/Job Interview	

**Monday Evening:** PPA Registration, Hotel Lobby, 5 7 pm.

### Key to Acronyms:

**AAAG** American Association of Anthropological Genetics  
**AAPA** American Association of Physical Anthropologists  
**ADA** American Dermatoglyphics Association  
**AJHB** *American Journal of Human Biology*  
**AJPA** *American Journal of Physical Anthropology*

**DAA** Dental Anthropology Association  
**HBA** Human Biology Association  
**JHE** *Journal of Human Evolution*  
**PPA** Paleopathology Association

## The Conference at a Glance (continued)

	Thurs AM	Thurs PM	Thurs Evening
<b>Ballroom A</b>	Skeletal Biology I. Variation and Adaptation, 8 - noon	Session 12. Primate & Human Brain Evolution, 1 - 2:45pm Session 13. Demography & Population History, 3:00 - 5pm	HBA Reception 7:30 - 10:30pm
<b>Ballroom B</b>	HBA Plenary Session		HBA Business Meeting 5 - 6pm; HBA Reception 7:30-10:30
<b>Ballroom C</b>	Session 6. Mid-Late Pleistocene Hominins, 8 - noon	Session 11. Fossil Primates and Early Hominins, 1 - 5pm	Wiley-Liss Reception 8:30 - 10:30pm
<b>Ballroom D</b>	Session 4. Paternal Care in Primates, 8 - noon	Session 10. Origins: The Genetic Evidence, 1 - 5pm	
<b>Ballroom E</b>	Session 7. Molecular Variation and Population Genetics, 8 - noon	Session 14. Skeletal Biology II. Paleopathology, 1 - 5pm	
<b>Hamilton</b>	Session 1. Functional and Evolutionary Morphology. 8 - noon. AAPA Exhibitors	Session 9. Primate Social Behavior and Ecology, 1 - 5pm. AAPA Exhibitors	
<b>Bromley</b>	Session 2. Dental Anthropology, 8 - noon Session 3. Biological Variation and Evolutionary Dynamics in Ancient Populations of the Americas, 8 - noon	Session 8. Personal Guides to Life in Antiquity: The Bioarchaeology of Individuals, 1 - 5pm	
<b>Claypoole</b>	AAPA Exhibitors		
<b>Wm. Penn Boardroom</b>			
<b>Cook</b>			Primate Biology & Behavior Interest Grp 7:45-8:45pm
<b>Frampton</b>			ADA Business Meeting 7:45-8:45pm
<b>Reynolds</b>		HBA Awards Luncheon 12-1:30pm	AAAG Business Meeting 7:45-8:45pm
<b>Flower</b>	Speaker Ready	Speaker Ready	
<b>Shippen</b>	Press/Job Interview	Press/Job Interview	DAA Business Meeting 7:45-8:45

## The Conference at a Glance (continued)

	Fri AM	Fri PM	Friday Evening	Sat AM	Sat PM
<b>Ballroom A</b>	Session 17. The Adaptable Phenotype and Biological Anthropology: Emerging Trends in the Study of Development, Genetics and Evolution, 8 - noon	Session 23. The Nature of the Earliest Asian Hominin Lifeways: The Current State of the Evidence, 1 - 5pm		Session 29. Principles of Primate Locomotion: How Unique is Primate Walking, Running and Ckimbing? 8 - noon	Session 36. Primate Behavior and Ecology, 1 - 5pm
<b>Ballroom B</b>					
<b>Ballroom C</b>	Session 18. What's New with Old Monkeys? Systematics, Phylogeny, and Paleobiology of fossil Cercopithecids, 8 - noon	Session 24. Reproductive Ecology, 1 - 5pm	AAPA Business Meeting 8-11	Session 31. Primate Behavior, Social Organization and Genetic Variation, 8 - noon	Session 38. Functional Anatomy and Locomotion, 1 - 5pm
<b>Ballroom D</b>	Session 19. Predation, Competition and Vocalizations in Primates, 8 - noon	Session 26. Human Genetic Variation, 1 - 5pm		Session 30. From the Shoulders of a Giant: Perspectivesw on the Legacy of William White howells (1908-2005), 8 - noon	Session 37. Diet, Health and Stature, 1 - 5pm
<b>Ballroom E</b>	Session 20. Anatomy, Ecology and Mastication, 8 - noon	Session 25. Anatomy and Functional Anatomy, 1 - 5pm		Session 32. Growth and Development, 8 - noon	Session 35. Recent Advances in Understanding Oral Pthology: Clinical, Evolutionary and Prehistoric Perspectives on Sex and Status Differences, 1 - 5pm
<b>Hamilton</b>	Session 15. Paleoanthropology, 8-noon AAPA Exhibitors	Session 21. Sketal Biology, 1 - 5pm AAPA Exhibitors		Session 27. Primate Biology: Morphology, Brain Evolution, Physiology and Reproduction., 8 - noon AAPA Exhibitors	Asession 33. Human Biology and Variation, 1 - 5pm AAPA Exhibitors
<b>Bromley</b>	Session 16. Paleopathology, 8 - noon	Session 22. Forensic Anthropology, 1 - 5pm		Session 28. Bioarchaeological Perspectives on Migration and Human Health in Ancient East Asia, 8 - noon	Session 34. Primate and Human Genetics, 1 - 5pm
<b>Claypoole</b>	AAPA Exhibitors			AAPA Exhibitors	
<b>Wm. Penn Boardroom</b>					
<b>Cook</b>			JHE Editorial Board Dinner	Teaching Outreach Program 8-12	
<b>Frampton</b>				AAPA ad hoc Committee on under represented groups, Noon - 1:00	Student Awards Committee Meeting 4-5
<b>Reynolds</b>				RHOI CAWG	
<b>Flower</b>	Speaker Ready	Speaker Ready		Speaker Ready	Speaker Ready
<b>Shippen</b>	Press/Job Interview	Press/Job Interview		Press/Job Interview	Press/Job Interview

## Conference Schedule

For a schedule of individual AAPA poster and podium presentations, see page 13.

### Tuesday, March 27, 2006

#### **Paleopathology Association**

- 8:00 am – 5:00 pm Registration. *Hotel Lobby.*
- 8:00 am – 12:00 pm Workshop. *Ballroom A.*
- 8:00 am – 12:00 pm Alternative Activity Room. *Cook.*
- 1:00 pm – 5:00 pm Podium Presentations. *Ballrooms D/E.*
- 6:30 pm – 8:00 pm Business Meeting. *Ballroom B.*

#### **Human Biology**

- 6:00 pm – 10:00 pm Executive Committee Meeting and Dinner. *Wm. Penn Boardroom*

### Wednesday, March 28, 2006

#### **American Association of Physical Anthropologists**

- 9:00 am – 5:00 pm Registration. *Hotel Lobby.*
- 8:00 am – 6:00 pm Executive Committee Meeting. *Wm. Penn Boardroom*
- 12:00 pm – 2:00 pm *American Journal of Physical Anthropology* Editorial Board Luncheon. *Frampton.*
- 6:30 pm – 7:45 pm Career Development Committee Discussion: “The good, the bad, and the ugly: The keys to giving good talks,” presented by Mark Teafor (Johns Hopkins University) and Lorena Madrigal (University of South Florida). *Cook.*
- 8:00pm – 11:00 pm Reception & Cash Bar. *Ballrooms C, D & E.*

#### **Paleopathology Association**

- 8:00 am – 10:00 pm Registration. *Hotel Lobby.*

8:00 am – 5:00 pm Podium Presentations. *Ballrooms D/E.*

8:00 am – 5:00 pm Poster Presentations and Exhibitors. *Bromley/Claypoole.*

### Human Biology Association

7:30 am – 9:00 am *American Journal of Human Biology* Editorial Board Breakfast. *Reynolds.*

8:00 am – 5:00 pm Registration. *Hotel Lobby.*

9:00 am – 12:30 pm Podium Session. *Ballrooms A/B.*

1:30 pm – 5:00 pm Poster Session. *Hamilton Room.*

5:00 pm – 6:00 pm Pearl Memorial Lecture. *Ballrooms A/B.*

5:00 pm – 7:00 pm Student Reception. *Ballroom A/B.*

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### Thursday, March 29, 2006

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### American Association of Physical Anthropologists

8:00 am – 8:00 pm Registration. *Hotel Lobby.*

8:00 am – 5:00 pm Posters and Exhibitors. *Hamilton, Bromley & Claypoole.*

8:00 am – 12:00 pm **Session 1. Functional and Evolutionary Morphology.** Contributed Posters. *Hamilton Room*

8:00 am – 12:00 pm **Session 2. Dental Anthropology.** Contributed Posters. *Bromley Room*

8:00 am – 12:00 pm **Session 3. Biological Variation and Evolutionary Dynamics in Ancient Populations of the Americas.** Poster Symposium. *Bromley Room.*

8:00 am – 12:00 pm **Session 4. Paternal Care in Primates.** Symposium. *Ballroom D.*

8:00 am – 12:00 pm **Session 5. Skeletal Biology I. Variation and Adaptation.** Contributed Papers. *Ballroom A.*

8:00 am – 12:00 pm **Session 6. Mid-Late Pleistocene Hominins.** Contributed Papers. *Ballroom C.*

8:00 am – 12:00 pm **Session 7. Molecular Variation and Population Genetics.** Contributed Papers. *Ballroom E.*

1:00 pm – 5:00 pm **Session 8. Personal Guides to Life in Antiquity: The Bioarchaeology of Individuals.** Poster Symposium. *Bromley Room.*

1:00 pm – 5:00 pm **Session 9. Primate Social Behavior & Ecology.** Contributed Posters. *Hamilton Room.*

- 1:00 pm – 5:00 pm     **Session 10. Origins: The Genetic Evidence.** Symposium (Co-Sponsored by AAAG). *Ballroom D.*
- 1:00 pm – 5:00 pm     **Session 11. Fossil Primates & Early Hominins.** Contributed Papers. *Ballroom C.*
- 1:00 pm – 2:45 pm     **Session 12. Primate & Human Brain Evolution.** Contributed Papers. *Ballroom A.*
- 3:00 pm – 5:00 pm     **Session 13. Demography & Population History.** Contributed Papers. *Ballroom A.*
- 1:00 pm – 5:00 pm     **Session 14. Skeletal Biology II. Paleopathology.** Contributed Papers. *Ballroom E.*
- 6:15 pm – 7:45 pm     **Plenary Session** – Ethical Issues and Practices in Biological Anthropology: IRBs, IACUCs, and Fieldwork Concerns. A Round-table discussion with audience participation.
- 8:30 pm – 10:30 pm     Wiley-Liss Reception. *Ballrooms C, D & E.*

### **Human Biology Association**

- 8:00 am – 5:00pm     Registration. *Hotel Lobby.*
- 8:00 am – 11:30 am     Plenary Session. *Ballroom B.*
- 12:00 pm – 1:30 pm     HBA Luncheon. *Reynolds.*
- 2:00 pm – 4:30 pm     Plenary Session (continued). *Ballroom B.*
- 5:30 pm – 6:30 pm     Business Meeting. *Ballroom B.*
- 7:30 pm – 10:30pm     Reception. *Ballrooms A/B.*

### **American Association of Anthropological Genetics**

- 7:45 pm – 8:45 pm     Business Meeting. *Reynolds.*

### **Dental Anthropology Association**

- 7:45 pm – 8:45 pm     Business Meeting. *Shippen.*

### **American Dermatoglyphics Association**

- 7:45 pm – 8:45 pm     Business Meeting. *Frampton.*

### **Primate Biology and Behavior Interest Group**

- 7:45 pm – 8:45 pm     Business Meeting. *Cook.*

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**Friday, March 30, 2006**


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**American Association of Physical Anthropologists**

- 8:00 am – 8:00 pm      Registration. *Hotel Lobby.*
- 8:00 am – 5:00 pm      Posters and Exhibitors. *Hamilton, Bromley & Claypoole.*
- 8:00 am – 12:00 pm    **Session 15. Paleoanthropology.** Contributed Posters. *Hamilton Room.*
- 8:00 am – 12:00 pm    **Session 16. Paleopathology.** Contributed Posters. *Bromley Room.*
- 8:00 am – 12:00 pm    **Session 17. The Adaptable Phenotype and Biological Anthropology: Emerging Trends in the Study of Development, Genetics and Evolution.** Symposium (cosponsored by HBA). *Ballrooms A/B.*
- 8:00 am – 12:00 pm    **Session 18. What's New with Old Monkeys? Systematics, Phylogeny, and Paleobiology of Fossil Cercopithecids.** Symposium. *Ballroom C.*
- 8:00 am – 12:00 pm    **Session 19. Predation, Competition and Vocalizations in Primates.** Contributed Papers. *Ballroom D.*
- 8:00 am – 12:00 pm    **Session 20. Anatomy, Ecology and Mastication.** Contributed Papers. *Ballroom E.*
- 12:00 pm – 2:00 pm    AAPA Luncheon. Location TBA  
Speaker: Alan Mann. "Philadelphia: The Birth Place of American Physical Anthropology."
- 1:00 pm – 5:00 pm      **Session 21. Skeletal Biology.** Contributed Posters. *Hamilton Room.*
- 1:00 pm – 5:00 pm      **Session 22. Forensic Anthropology.** Contributed Posters. *Bromley Room.*
- 1:00 pm – 5:00 pm      **Session 23. The Nature of the Earliest Asian Hominin Lifeways: The Current State of the Evidence.** Symposium. *Ballrooms A/B.*
- 1:00 pm – 5:00 pm      **Session 24. Reproductive Ecology.** Contributed Papers. *Ballroom C.*
- 1:00 pm – 5:00 pm      **Session 25. Anatomy and Functional Morphology.** Contributed Papers. *Ballroom E.*
- 1:00 pm – 5:00 pm      **Session 26. Human Genetic Variation.** Contributed Papers. *Ballroom D.*
- 8:00 pm – 11:00 pm    Business Meeting. *Ballroom C.*

Journal of Human Evolution Editorial Board Dinner. *Cook.*

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**Saturday, March 31, 2006**


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**American Association of Physical Anthropologists**



- 8:00 am – 12:00 pm Registration. *Hotel Lobby.*
- 8:00 am – 5:00 pm Posters and Exhibitors. *Hamilton, Bromley & Claypoole.*
- 8:00 am – 12:00 pm Teaching Outreach Program. *Cook.*  
This program is intended for local area teachers, but is open to AAPA members on an available-space basis. The program is as follows:
- Michael Park: "Using the Fossil Record in Teaching Human Evolution."  
Judith Corr: "Primate Clues to Human Behavior."  
K. Lindsay Eaves-Johnson and Nancy Tatarek: "Who are you?: Strategies for Presenting Forensic Anthropology and Human Variation in the Classroom."  
Pamela Ashmore and Barbara O'Connell: Human Skin Color Variation and Race."  
Martin K. Nichels: Organizer and Chair.
- 8:00 am – 12:00 pm **Session 27. Primate Biology: Morphology, Brain Evolution, Physiology and Reproduction.** Contributed Posters. *Hamilton Room.*
- 8:00 am – 12:00 pm **Session 28. Bioarchaeological Perspectives on Migration and Human Health in Ancient East Asia.** Poster Symposium. *Bromley Room.*
- 8:00 am – 12:00 pm **Session 29. Principles of Primate Locomotion: How Unique is Primate Walking, Running and Climbing?.** Symposium. *Ballrooms A/B.*
- 8:00 am – 12:00 pm **Session 30. From the Shoulders of a Giant: Perspectives on the Legacy of William White Howells (1908-2005).** (Fifth Annual Wiley-Liss Symposium) *Ballroom D.*
- 8:00 am – 12:00 pm **Session 31. Primate Behavior, Social Organization and Genetic Variation.** Contributed Papers. *Ballroom C.*
- 8:00 am – 12:00 pm **Session 32. Growth and Development.** Contributed Papers. *Ballroom E.*
- 1:00 pm – 5:00 pm **Session 33. Human Biology and Variation.** Contributed Posters. *Hamilton Room.*
- 1:00 pm – 5:00 pm **Session 34. Primate and Human Genetics.** Contributed Posters. *Bromley Room.*
- 1:00 pm – 5:00 pm **Session 35. Recent Advances in Understanding Oral Pathology: Clinical, Evolutionary and Prehistoric Perspectives on Sex and Status Differences.** Symposium. *Ballroom E.*
- 1:00 pm – 5:00 pm **Session 36. Primate Behavior and Ecology.** Contributed Papers. *Ballrooms A/B.*
- 1:00 pm – 5:00 pm **Session 37. Diet, Health and Stature.** Contributed Papers. *Ballroom D.*
- 1:00 pm – 5:00 pm **Session 38. Functional Anatomy and Locomotion.** Contributed Papers. *Ballroom C.*
- 4:00 pm – 5:00 pm Student Awards Committee Meeting. *Frampton.*
- 5:00 pm – 6:30 pm Student Awards Reception. *Cook.*

# AAPA Poster and Podium Presentation Schedule

*For a schedule of all conference events, see page 8*

## Session 1. Functional and Evolutionary Morphology. Contributed Posters. *Hamilton Room.*

Chair: ANNE M. BURROWS. Duquesne University.

8:00 – 8:30 am	Poster set-up.
8:30 – 10:00 am	Authors of even-numbered posters present for questions.
10:30 am – 12:00 pm	Authors of odd-numbered posters present for questions.
12:00 – 12:30 pm	Poster take-down.

1. **The functional significance of the lumbar Transverse processes of *Homo neanderthalensis*.** E. BEEN.
2. **Microanatomical comparison of the orbicularis oris muscle between chimpanzees and humans: implications for the evolution of speech.** A.M. BURROWS, C.R. ROGERS, M.P. MOONEY, S.M. WEINBERG, B.M. WALLER, L.A. PARR, C.J. BONAR, F.W.B. DELEYIANNIS, M.I. SIEGEL, M.L. MARAZITA.
3. **Hand morphology, hand preference and laterality.** L.A. CASHMORE AND S.R. ZAKRZEWSKI.
4. **Cranial expansion of the thorax in hominoids.** L.K. CHAN.
5. **Humeral retroversion revisited: a functional and ontogenetic model for populational variation.** L.W. COWGILL.
6. **Patterns of geographic variation in hands and feet of *Pan* and *Gorilla*.** R.S. JABBOUR.
7. **Scaling patterns and the functional morphology of primate pelvis shape.** K.L. LEWTON AND M.A. SPENCER.
8. **Lower limb bone remodeling in a Neolithic sample from Liguria (Italy).** D. MARCHI.
9. **Cranial vault thickness as a taxonomic indicator.** H.E. MARSH.
10. **A three-dimensional shape comparison of AL129-1a and modern human distal femora.** B.C. MERKL, A.D. SYLVESTER AND M.R. MAHFOUZ.
11. **Body mass estimation from human femoral midshaft cross-sectional area.** M.K. MOORE, E.A. FATAH, M.R. MAHFOUZ.
12. **High throughput morphometrics and the developmental basis for facial length in mice** T.E. PARSONS, E. KRISTENSEN, S.K. BOYD, B. HALLGRÍMSSON.
13. **Prediction of long bone cross-sectional geometrical properties from external dimensions.** O. M. PEARSON, T. R. PETERSEN AND F. E. GRINE.
14. **Curved beam model of mandibular symphyseal bending including heterogeneous elasticity.** A.J. RAPOFF, R.B. BUCINELL, W.S. MCGRAW AND D.J. DAEGLING.
15. **Locomotion-related trabecular architectures in long bones of primates.** H. SCHERF.
16. **Sex differences in cranial form assessed via non-rigid deformation analysis of high-resolution CT images.** P. T. SCHOENEMANN, J. MONGE, B. B. AVANTS, D. GLOTZER, J. C. GEE.
17. **Geometric morphometric analysis of mangabey suborbital morphology.** M. SINGLETON.
18. **Bipedal apes and humans: how do they compare and what can we learn from it?** E.E. VEREECKE, K. D'AOÛT, P. AERTS AND R.H. CROMPTON.
19. **Intraspecific Shape Variance in the Primate Scapula: The Role of Stabilizing Selection.** N.M. YOUNG.
20. **Explaining primate gaits: a carnivoran test case.** M. CARTMILL, D. SCHMITT, A. HARTSTONE-ROSE, P. LEMELIN.
21. **An analysis of the geographic patterning of limb segment length variability using the dynamic sum segment method.** M. DEMBO, A. CROSS AND M. COLLARD.
22. **Enthesis bilateral asymmetry in humans and African apes.** M.S.M. DRAPEAU.
23. **Functional morphology of the primate cochlea.** A.D. GOSELIN-ILDARI AND E.C. KIRK.
24. **The functional morphology of the bifid cervical spinous process.** T.M. GREINER.
25. **The effect of ecology on the muscle and skeletal anatomy of two macaques.** L.E. JOHNSON.

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**Thursday Morning – March 29, 2007**


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26. **Trabecular orientation in the calvaria of perinatal rabbits with familial coronal suture synostosis.** M.E. KOVACIK, J.C. REED, T.E. BARBANO, K.A. QUINLIN, M.I. SIEGEL AND M.P. MOONEY.
27. **Geometric similarity in primates as assessed from long bone lengths.** P.A. KRAMER, M.C. MENDENALL AND A.D. SYLVESTER.
28. **Form and anatomical incongruity of the glenohumeral joint in primates.** C. KRAUSE, M.S. FISCHER AND M. SCHMIDT.
29. **Trabecular, articular and cortical asymmetry in the human second metacarpal.** R.A. LAZENBY, D.M.L COOPER, S. ANGUS AND B. HALLGRÍMSSON.
30. **Structural signature of bipedal training in the tibial plateau of a Japanese macaque.** A. MAZURIER, M. NAKATSUKASA, L. BONDIOLI, L. ROOK AND R. MACCHIARELLI.
31. **Walking and leg length: Are modern humans geometrically similar?** M.C. MENDENALL, A.D. SYLVESTER AND P.A. KRAMER.
32. **Functional convergence of the haplorhine postorbital septum and strigiform postorbital process.** R.A. MENEGAZ AND E.C. KIRK.
33. **Comparative histology of the mandibular condylar cartilage in gouging and non-gouging platyrrhines.** A.L. MORK, W.E. HORTON AND C.J. VINYARD.
34. **Modulation of mastication to variation in food material properties in *Cebus capucinus*.** C.F. ROSS AND D.A. REED.
35. **Kinematics and proportions of the three-segmented limb: How are small primates different from other small mammals?** M. SCHMIDT.
36. ***In vitro* study of shock absorption in simulated intervertebral disks and the implications for bipedal distance running.** J.E. SCOTT AND J.D. POLK.
37. **Fill in the blanks: trabecular bone and the biomechanical consequences of having paranasal sinuses.** A.L. SMITH, D.S. STRAIT, J. CHALK, B.W. WRIGHT, Q. WANG, P.C. DECHOW, B.G. RICHMOND, C.F. ROSS AND M.A. SPENCER.
38. **Compensatory scaling within the feeding complex of haplorhine primates.** M.A. SPENCER, C. SCHREIN AND L. COPES.
39. **The Problem of Assessing Landmark Error in Geometric Morphometrics: Methods and Modifications.** N. VON CRAMON-TAUBADEL, B.C. FRAZIER AND M.M. LAHR.
40. **Postcranial features of *Cacajao*, with comparisons to *Chiropotes* and *Pithecia*.** S.E. WALKER AND L.C. DAVIS.
41. **Mechanical correlates of sexual dimorphism in the jaw muscles and bones of baboons.** C. E. WALL, J. G. M. PERRY, M. BRIGGS AND F. SCHACHAT.
42. **Crossing the lines: Suture biomechanics in the primate craniofacial skeleton examined using finite element analysis.** Q. WANG, D.S. STRAIT, A.L. SMITH, J. CHALK, B.W. WRIGHT, P.C. DECHOW, B.G. RICHMOND, C.F. ROSS AND M.A. SPENCER.
43. **Measuring footprints: refining the methods.** D. WEBB, D.V. BERNARDO AND T. HERMENEGILDO.
44. **A telemetry system for studying jaw-muscle activity in free-ranging primates: pilot data from howling monkeys (*Alouatta palliata*) at La Pacifica, Costa Rica.** S.H. WILLIAMS, C.J. VINYARD, K.E. GLANDER, M.F. TEAFORD, M. DEFFENBAUGH AND C.L. THOMPSON.
45. **Long bone articular and diaphyseal structure in douc langurs: evidence of suspensory adaptations.** K.A. WRIGHT, C.B. RUFF, N.J. STEVENS, H.H. COVERT, AND T. NADLER.
46. **Assessing how experimental and surgical manipulations during *in vivo* laboratory research influence chewing speed in tufted capuchins (*Cebus apella*).** C.L. THOMPSON, E.M. JACKSON, C.D. STIMPSON AND C.J. VINYARD.
47. **Locomotor ecology of three sympatric lemur species in Mantadia National Park, Madagascar.** M.L. BLANCHARD, S. DAY AND R.H. CROMPTON.
48. **Evolutionary convergence of tail structure in prehensile- and nonprehensile-tailed primates and procyonids.** J.M. ORGAN.

**Session 2. Dental Anthropology. Contributed Posters. Bromley Room.**

Chair: BRIAN HEMPHILL. California State University, Bakersfield.

8:00 – 8:30 am	Poster set-up.
8:30 – 10:00 am	Authors of even-numbered posters present for questions.
10:30 am – 12:00 pm	Authors of odd-numbered posters present for questions.
12:00 – 12:30 pm	Poster take-down.

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**Thursday Morning – March 29, 2007**


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1. **A multivariate analysis for sex determination from deciduous, morphometric tooth traits** C.J. ADLER AND D. DONLON.
2. **Dental health, diet, and social variation in Late Prehistoric Eastern Tennessee.** T.K. BETSINGER AND M.O. SMITH.
3. **Population level differences in overall linear enamel hypoplasia frequency, sexual dimorphism and lesion location in the permanent dentition: inferences on the adaptive significance of three development models in the Yucatan Peninsula.** F.D. GURRI.
4. **Diachronic change (or lack thereof) in molar size of early inhabitants of the Texas Gulf Coastal Plain.** M.S. TAYLOR.
5. **Dental developmental patterns in Neandertals: A high-resolution 3D analysis.** P. BAYLE, J. BRAGA, A. MAZURIER, J. RADOVCI AND R. MACCHIARELLI.
6. **Dental variation in Holocene Khoesan populations.** W. BLACK, R.R. ACKERMANN AND J. SEALY.
7. **Oxygen isotope analysis of human tooth enamel carbonate: Implications for climatological and environmental research.** E.N. CHAMBERS, J.K. MCKEE, D. GUATELLI-STEINBERG AND J.S. KRIGBAUM.
8. **Neanderthals and the Inuit of Igloolik: A comparative tooth wear study.** A.F. CLEMENT.
9. **Non-carious cervical tooth lesions (NCTL) from the early Neolithic site of Mehrgarh.** A. COPPA, L. BONDIOLI, D.W. FRAYER, R. MACCHIARELLI, A. NAVA AND G. TARTAGLIA.
10. **Quantification of inter-observer error in 3D dental tissue measurements.** R.N.M. FEENEY AND A.J. OLEJNICZAK.
11. **Dental pathology of the Jemez region of New Mexico.** A.K. GOFF AND H.J.H. EDGAR.
12. **Nonmetric dental variation of Sakishima Islanders, Okinawa, Japan: a comparative study among Sakishima and neighboring populations.** K. HANEJI, T. HANIHARA, H. SUNAKAWA, T. TOMA AND H. ISHIDA.
13. **Dental microwear of the mandibular canines of Neolithic and early modern Japanese.** T. HOJO.
14. **Assessing stress duration by means of linear enamel hypoplasias: a methodological comparison.** A.R. HUBBARD, D. GUATELLI-STEINBERG AND P.W. SCIULLI.
15. **Tooth shape and enamel thickness variation in primate teeth: An approach using topographic thickness maps.** C.D. HUBER, F.L. BOOKSTEIN AND G.W. WEBER.
16. **New data on enamel thickness in *Homo sapiens*.** J.E. LEWIS, D. DEGUSTA, S. MELILLO, R. CHENG AND P.W. BROWN.
17. **Evaluation of methods for estimating chronological age at linear enamel hypoplasia formation.** S. A. MARTIN, D. GUATELLI-STEINBERG, P. W. SCIULLI AND P. L. WALKER.
18. **Premolar microwear of three New World monkeys: *Cebus apella*, *Pithecia pithecia*, and *Ateles belzebuth*.** G.L. MCKUSICK AND M.F. TEAFORD.
19. **Biological distance analysis of households at Neolithic Çatalhöyük, Turkey.** M.A. PILLOUD AND C.S. LARSEN.
20. **The incredible shrinking molar: a study of the metrics and morphology of upper third molars.** S.T. PRICE.
21. **Dental size evolution in west Mediterranean populations.** J. RUIZ, C. GARCÍA, V. VILLAR AND M.E. SUBIRÀ.
22. **Dentine crown expression of discrete dental traits on extant hominoid and fossil hominin lower molars.** M.M. SKINNER, A.J. OLEJNICZAK, A. ROSAS, T.M. SMITH, B.A. WOOD AND J-J. HUBLIN.
23. **A unique case of maxillary premolar rotation: Evidence in support of premolar morphogenic fields.** V.H. STEFAN AND E.F. HARRIS.
24. **Health Status in Prehistoric Portugal: Dental Pathology and Childhood Mortality Patterns from the Late Neolithic burials of Feteira (Lourinhã).** A.J. WATERMAN.
25. **Activity-induced dental modification in Holocene Siberian hunter-gatherers.** A. WATERS-RIST, V.I. BAZALIISKII, A. WEBER, O.I. GORIUNOVA AND M.A. KATZENBERG.
26. **Are the Koh an indigenous population of the Hindu Kush? I: an odontometric investigation.** N. WILLITS AND B.E. HEMPHILL.
27. **Ecogeographic variation in Neandertal dietary habits: evidence from microwear texture analysis.** S. EL ZAATARI.
28. **Formation of localized hypoplasia of the primary canine.** C. FITZGERALD, S. SAUNDERS AND M. SKINNER.
29. **A fine line: a preliminary study comparing methods of estimating ages of linear enamel hypoplasia formation.** T.B. RITZMAN, B.J. BAKER AND G.T. SCHWARTZ.

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**Thursday Morning – March 29, 2007**


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30. **The timing of third molar formation in four groups.** H.M. LIVERSIDGE.

**Session 3. Biological Variation and Evolutionary Dynamics in Ancient Populations of the Americas.**  
**Poster Symposium. Bromley Room.**

Chair: KAREN J. WEINSTEIN, Dickinson College, and BENJAMIN AUERBACH, Johns Hopkins School of Medicine.

8:00 – 8:30 am	Poster set-up.
9:00 – 10:30 am	Authors present for questions.
10:30 am – 11:00 pm	Discussion by posters (CLARK SPENCER LARSEN)
12:00 – 12:30 pm	Poster take-down.

Ancient populations of North, Central, and South America encompassed a broad range of biological variation that developed over lengthy periods of time and in diverse environments. Accumulating archaeological evidence suggests that human settlement in the Western Hemisphere was earlier than previously thought, and should be viewed as part of the worldwide dispersal of *Homo sapiens* in the late Pleistocene. As people established settlements throughout North and South America, populations experienced selective pressures to adapt, both biologically and culturally, to their specific ecological contexts. Many studies of ancient Americans tend to focus on questions of population origins and interactions in circumscribed geographic regions and temporal periods, however. While these questions are important areas of inquiry, the degree of biological variation among native groups—and the evolutionary processes that these populations endured—has not been broadly considered.

Papers in this symposium demonstrate the morphological diversity of native populations from the early Holocene through the Contact period of the Americas. Rather than take a typological approach to categorizing this morphological variation, these papers—while varied in their temporal, geographic, and methodological focus—view ancient Americans as evolutionarily dynamic populations continually responding to environmental stressors. Interpretations of their biology should account for this ecological and evolutionary diversity.

31. **Nonmetric Dental Variation Among Prehistoric Andeans.** R.C. SUTTER.
32. **Evolution in the Andes: postcranial adaptations to multiple environmental stressors.** K.J. WEINSTEIN.
33. **Ecogeographical patterning and postcranial variation in pre-contact North America.** K.A. KING.
34. **Body proportions in recent Native Americans: Do they really follow ecogeographical rules?** R. L. JANTZ, C. A. JANTZ AND P. MARR.
35. **Proportional patterns in prehistory: Cranial and post-cranial correspondence in body proportions among pre-contact American populations.** B.M. AUERBACH.
36. **Growth and development of femur shape, size, and strength among three Native American groups.** D.J. WESCOTT, D.L. CUNNINGHAM AND D.H. UBELAKER.
37. **Craniofacial secular change and the African Diaspora.** M.K. SPRADLEY AND R.L. JANTZ.
38. **Skeletal biology and ecological diversity in northwestern North America.** J.S. CYBULSKI.
39. **Climate, human dispersals, and adaptation in body size and physique among indigenous populations of the Americas and Siberia.** J.T. STOCK AND M.M. LAHR.

**Session 4. Paternal Care in Primates. Symposium. Ballroom D.**

Organizer and Chair: EDUARDO FERNANDEZ-DUQUE, University of Pennsylvania.

Few aspects of the behavior of human and non-human primates are so intriguing, yet so poorly understood, as the prevalence of intense paternal care in some primate species and human societies. Early hominoids probably evolved a social organization that, among other things, changed from involving loose male-female relationships to close dyadic partnerships requiring male provisioning of offspring. Therefore, the development of extensive paternal care and provisioning is considered a fundamental adaptation in the evolution of human life history patterns and in the differentiation of humans from other primates. Until recently, an understanding of the evolutionary implications of paternal care in primates was limited by the paucity of longitudinal studies involving identified individuals and by practical methodological difficulties for assessing paternity, for studying the physiological mechanisms underlying observed behaviors and demographic outcomes. Recent increases in the number and extent of field studies, coupled with advances in field and laboratory techniques for genetic and hormonal analyses and new theoretical perspectives, provide now a solid ground from which to reexamine paternal care in primates.

- 8:00 am **Infant care and activity patterns of adult male and female siamangs (*Symphalangus syndactylus*): implications of male care for adult energetics.** S. LAPPAN.
- 8:15 am **Fathers and Stepfathers: Familial relations of old and new males within groups of *Callicebus brunneus* in southeastern Perú.** P.S. RODMAN AND F.J. BOSSUYT.
- 8:30 am **The importance of being dad: paternal care in a polygynandrous mating system.** S.C.

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**Thursday Morning – March 29, 2007**


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ALBERTS AND J. ALTMANN.

- 8:45 am **Food sharing as a form of paternal care in wild owl monkeys (*Aotus azarai*).** C.K. WOLOVICH, J.P. PEREA-RODRIGUEZ AND E. FERNANDEZ-DUQUE.
- 9:00 am **The Hadza Male's Dilemma: Good Father or Good Citizen?** F.W. MARLOWE AND B.M. WOOD.
- 9:15 am **Effects of paternal care among Tsimane forager-horticulturalists.** J. WINKING AND M. GURVEN.
- 9:30 am **Men in transition: Impact of lifestyle changes on paternal care practices in Toba and Wichí populations of Argentina.** C.R. VALEGGIA.
- 9:45 am **Why mating systems vary in cooperative-breeding lion tamarins.** J.M. DIETZ.
- 10:00 am **Costs and benefits of paternal care in free-ranging owl monkeys (*Aotus azarai*).** E. FERNANDEZ-DUQUE.
- 10:15 am **A comparison of paternal care in three socially-monogamous neotropical primates.** A. DI FIORE AND E. FERNANDEZ-DUQUE.
- 10:30 am **Hormonal correlates of fatherhood in Jamaica.** P.B. GRAY, J.C. PARKIN, T.E. ZIEGLER AND M.E. SAMMS-VAUGHAN.
- 10:45 am **Modeling parental investment relative to energy costs.** S.D. TARDIF.
- 11:00 am **What should we be looking for in brain and physiology to understand paternal care?** S.P. MENDOZA AND W.A. MASON.
- 11:15 am **Proximate mechanisms of paternal care in New World primates.** K.L. BALES.
- 11:30 am **What makes a good dad? Neuroendocrine factors influencing paternal care.** T. E. ZIEGLER.
- 11:45 am **Discussion.** B. HEWLETT

**Session 5. Skeletal Biology I. Variation and Adaptation.** Contributed Papers. *Ballroom A.*

Chairs: ERIC J. BARTELINK. California State University, Chico.

- 8:00 am **Exploring Human Craniometric Variation: Statistical, Mensural, Biological, and Historical Considerations.** S.D. OUSLEY, R. L. JANTZ AND D. FREID.
- 8:15 am **Environmental influences on human craniofacial shape variation.** T.J. BUCK AND U. STRAND VIDARSDOTTIR.
- 8:30 am **The effects of behavioral selection on skull shape and size: the case of Belyaev's domesticated silver foxes (*Vulpes vulpes*).** K. DUNCAN, D. LIEBERMAN, L. TRUT AND A. KHARLAMOVA.
- 8:45 am **Heritability of subtrochanteric femur shape (platymeric index): Implications for human postcranial variation and evolution.** M. KESTERKE, L.M. HAVILL AND J.C.M. AHERN.
- 9:00 am **The influence of climate on the obstetrical dimensions of the human bony pelvis.** R.L. NUGER.
- 9:15 am **Inca Imperialism and its Influence on Sex-Specific Phenotypic Variation** K.C. NYSTROM.
- 9:30 am **The impact of malnutrition on bone micro-anatomy.** R.R. PAINE AND B.P. BRENTON.
- 9:45 am **Costal process of sacrum is an obstetrical adaptation in humans.** R.G. TAGUE.
- 10:00 am **Break**
- 10:15 am **Biogeographic and sex variation in external rib cross-sectional area and geometry.** K.L. EAVES-JOHNSON, R.G. FRANCISCUS AND B. A'HEARN.
- 10:30 am **Two and Three Dimensional Analysis of Cortical Bone Microstructure from the Human Juvenile Mid-Shaft Femur** H.M. GOLDMAN, D.M.L. COOPER, S.C. MCFARLIN, K.M. RUDO, C.D.L. THOMAS AND J.G. CLEMENT.
- 10:45 am **Directional asymmetry in the knee joint of *Homo sapiens*: greater than previously supposed?** S.D. STEVENS
- 11:00 am **Secular trends in the cranial morphology of the Portuguese population from 1805-1960 assessed using three-dimensional morphometric data.** K.E. WEISENSEE.
- 11:15 am **Maximum likelihood variance components analysis of multivariate craniometric heritabilities: a comparison of two techniques.** E.A. CARSON.

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**Thursday Morning – March 29, 2007**


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- 11:30 am **Qualitative and Quantitative Assessment of Musculoskeletal Stress Markers.** C.Y. HENDERSON
- 11:45 am **Examining polymorphism and divergence in non-coding features of craniofacial genes.** H.A. LAWSON, R. HARDISON, D. KING, J. MARTIN, W. MILLER AND K. WEISS

**Session 6. Mid-Late Pleistocene Hominins. Contributed Papers. Ballroom C.**

Chairs: JOHN HAWKS. University of Wisconsin.

- 8:00 am **Buccal lateral enamel formation in Neandertal molars in comparison to two modern human population samples.** D. GUATELLI-STEINBERG AND D.J.REID.
- 8:15 am **Early Upper Paleolithic human dental remains from Ucagizli Cave (Hatay, Turkey).** E. GULEC, I. OZER, M. SAGIR AND S. KUHN.
- 8:30 am **Phylogenetic evaluation of adaptive explanations for Neandertal nasal morphology.** M.L. CHANG AND M.R. MEYER.
- 8:45 am **The Early Upper Paleolithic human remains of Nazlet Khater 2, Egypt.** I. CREVECOEUR.
- 9:00 am **More than meets the eye: LB1, the transforming hominin.** R.B. ECKHARDT, A.J. KUPERAVAGE, D.W. FRAYER AND M. HENNEBERG.
- 9:15 am **Binary cranial contrasts and hypothetical species demarcations versus sources of real intrapopulation variation: LB1 and other test cases.** A.J. KUPERAVAGE, R.B. ECKHARDT, R.M. NORRIS AND M. HENNEBERG.
- 9:30 am **Body size and shape in the Dmanisi hominids: implications for early genus *Homo* and *Homo floresiensis*.** MARC R. MEYER.
- 9:45 am **LB1 is not a microcephalic.** D. FALK, C. HILDEBOLT, K. SMITH, M.J. MORWOOD, T. SUTIKNA, JATMIKO, E.W. SAPTOMO, H. IMHOF, H. SEIDLER, B. BRUNSDEN AND F. PRIOR.
- 10:00 am **Break**
- 10:15 am ***Homo floresiensis* and *Homo sapiens* size-adjusted cranial shape variation.** L. NEVELL, A. GORDON AND B. WOOD.
- 10:30 am **Electronic segmentation methods reveal the preservation status and otherwise unobservable features of the Mladeč I cranium.** H. PROSSINGER AND M. TESCHLER-NICOLÁ.
- 10:45 am **Taphonomy and paleoecology of the mammalian and avian faunal assemblages of ‘Ubeidiya, Israel: Implications for ‘Out of Africa I’.** M. BELMAKER.
- 11:00 am **Evolution of Middle-Late Pleistocene human cranio-facial morphology: a three-dimensional approach.** K. HARVATI, J.-J. HUBLIN AND P. GUNZ.
- 11:15 am **Misconceptions about the postcranial skeleton of *Homo floresiensis*.** S.G. LARSON, W.L. JUNGERS, M.J. MORWOOD, T. SUTIKNA, JATMIKO, E.W. SAPTOMO, R.A. DUE AND T. DJUBIANTONO.
- 11:30 am **Taxonomy of Middle Pleistocene humans: What is *Homo heidelbergensis*, anyway?** R. MCCARTHY, M. HOLMES, L. LUCAS AND K. O'DONNELL.
- 11:45 am **Paleobiological aspects of El Sidrón (Asturias, Spain) Neandertals.** A. ROSAS, C. MARTÍNEZ-MAZA, M. BASTIR, A. GARCÍA-TABERNERO, C. LALUEZA-FOX, R. HUGUET, A. ESTALRRICH, S. GARCÍA-VARGAS, M. DE LA RASILLA AND J. FORTEA.

**Session 7. Molecular Variation and Population Genetics. Contributed Papers. Ballroom E.**

Chair: CONNIE J. MULLIGAN. University of Florida.

- 8:00 am **Recent Southeast Asian domestication and Lapita dispersal of sacred male pseudohermaphroditic “tuskers” and hairless pigs of Vanuatu.** J.K. LUM, J.K. MCINTYRE, D.L. GREGER, K.W. HUFFMAN AND M.G. VILAR.
- 8:15 am **Genetic contributions to normal variation in gene expression for a biomarker of cellular aging (*CDKN2A*) in baboons and humans.** M.C. MAHANEY, L.M. HAVILL, H.H.H. GÖRING, T.D. DYER, D.E. NEWMAN, M.P. JOHNSON, C.M. JETT, J.E. CURRAN, E.K. MOSES, J. BLANGERO, L.A. COX, J. ROGERS, S.A. COLE, C. BRUGNARA AND O.S. PLATT.
- 8:30 am **Patterns of mtDNA genetic diversity in capuchin monkeys at regional and local scales.** J. W. LYNCH ALFARO, G. GUTIÉRREZ-ESPELETA, L. E. OLSON, V. ROSS, S. NEITZEL, K. SUKRAW, D. M. DROWN AND M. E. ALFARO.
- 8:45 am **Ongoing positive selection on stomach lysozymes in African colobines.** J.M. BIEGEL, A.P.J. DE KONING AND C.-B. STEWART.

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**Thursday Morning – March 29, 2007**


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- 9:00 am      **3Dimensional Molecular Modeling and Comparison of Human and Chimpanzee Toll-Like Receptor 2.** J.F. BRINKWORTH AND J. L. HO
- 9:15 am      **Ecology, history and society as determinants of hybrid zone structure in baboons.** C.J. JOLLY AND J.E. PHILLIPS-CONROY.
- 9:30 am      **Break**
- 9:45 am      **Evolutionary population genetics of the human RhD negative blood type.** G.H. PERRY, S.A. MCCARROLL, P.C. SABETI, J.O. YANEZ, A.C. STONE AND C. LEE.
- 10:00 am      **Correlation of mammalian mitochondrial DNA diversity with population size.** C.J. MULLIGAN, A. KITCHEN AND M.M. MIYAMOTO.
- 10:15 am      **Genetic Structure of the Aleutian Archipelago: Mitochondrial DNA Sequences and NRY Markers.** M.H. CRAWFORD, M. ZLOJUTRO AND R.C. RUBICZ.
- 10:30 am      **Patterns of admixture in Mexican Americans assessed from 101,150 SNPs.** M.G. HAYES, A. PLUZHNIKOV, K. MIYAKE, M.C.Y. NG, CRAIG L. HANIS, G.I. BELL AND N.J. COX.
- 10:45 am      **Maternal Genetic Ancestry and Risk Factors for Cervical Cancer Prevalence in the Guarani Indians from the Province of Misiones, Argentina**  
S. RUBINSTEIN, T.G. SCHURR, I. BADANO, W. NARDARI, B.J. ZINOVICH, J.A. GALUPPO, P. BOS, J. GONZALEZ, M.A. PICCONI AND S.A. TONON.
- 11:00 am      **A comparative analysis of Y chromosome variability and admixture in Cape Verde, Sao Tome, and seven Anglophone Caribbean Islands.** J. BENN TORRES, R.A. KITTLES AND A.C. STONE.
- 11:15 am      **Genetic variation and the peopling of northeastern North America.** K.S. GRENNAN AND D.A. MERRIWETHER.
- 11:30 am      **Reconstructing the settlement history of the central Andes from mitochondrial DNA analyses.** K. BATAI AND S.R. WILLIAMS.
- 11:45 am      ***Alu* insertion polymorphisms and mtDNA in Peruvian populations: Implications for the genetic history and population structure of Peru.** R.Y. TITO, H.F. SMITH, V. RUBIN DE CELIS, B.R. LIZARRAGA AND A.C. STONE

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**Thursday Afternoon – March 9, 2006**


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**Session 8. Personal Guides to Life in Antiquity: The Bioarchaeology of Individuals.** Poster Symposium.  
*Bromley Room.*

Chair: ANN L.W. STODDER, The Field Museum, and ANN M. PALKOVICH, George Mason University.

1:00 – 1:30 pm	Poster set-up.
2:00 – 3:30 pm	Authors present for questions.
3:30 – 4:00 pm	Discussion by posters (GEORGE MILNER)
5:00 – 5:30 pm	Poster take-down.

This session addresses the role of the individual in bioarchaeological reconstructions of past societies. Each presentation focuses on the life history of one or two individuals whose remains have been recovered from archaeological excavations. The geographical and temporal scope of the session is intentionally very broad. What unites the cases is the core of osteobiography and the integration of biological information with the rich context of the historic or prehistoric record to tell the life stories of these people -- their families, homes, work, their diet, health, their ambitions, their art, their rituals. These "individual guides" give us a unique window into the past, but how do we as bioarchaeologists reconcile the life-history approach with the imperative to conduct populational research? How do these stories serve the broader realm of biocultural research? The stories of individual's lives are a vital part of community outreach for bioarchaeologists; how does consultation with indigenous communities contribute to various stakeholders' understanding of specific lives? How does the life history approach affect the siting of bioarchaeology in processual and postprocessual research contexts? How does our training as skeletal biologists help or hinder our understanding of past lives, and what new avenues of interpretation can we take in the future?

- Individuals and populations: complementary domains in bioarchaeology.** A.L.W. STODDER AND A.M. PALKOVICH.
- Life and death of a mother and child from a 19th century pioneer cemetery in Ontario, Canada.** M.A. KATZENBERG AND S.R. SAUNDERS.
- The 'St. Bees Lady': a medieval osteobiography.** C.J. KNÜSEL.
- Culture clash: individuals and identity in medieval Dublin.** B. O'DONNABHAIN.



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**Thursday Afternoon – March 29, 2007**


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5. **Sew long: A seamstress buried at medieval Polis, Cyprus.** B.J. BAKER, C.E. TERHUNE AND A. PAPALEXANDROU.
6. **Written in stone, written in bone: the osteobiography of a craftsman from Bronze Age Alalakh (Turkey).** A. BOUTIN
7. **A master artisan? Tribute to the founder of a Teotihuacan apartment compound.** R. STOREY.
8. **Breathing life into the study of the dead: a Maya example.** PAMELA L. GELLER.
9. **Reflections of life in death: mortuary use of an abandoned prehistoric Maya site as a form of resistance by Colonial populations.** G. D. WROBEL.
10. **Elegant in life, ambiguous in death: a high-status female mummy from northern coastal Peru.** J.W. VERANO.
11. **Social marginalization among the Chiribaya: the *curandero* of Yaray, Southern Peru.** M.C. LOZADA, K. KNUDSON, R.C. HAYDON AND J.E. BUIKSTRA.
12. **The Magician: Collaborative Studies of an Ancestral Hopi Leader.** J.E. NEITZEL.
13. **Anomalies and averages: the bioarchaeology of individuals in New Zealand.** J.H. LITTLETON.
14. **Reading Lives: Contextual Issues in Osteobiography.** A.M. PALKOVICH

**Session 9. Primate Social Behavior & Ecology.** Contributed Posters. *Hamilton Room.*

Chair: SUE BOINSKI. University of Florida.

1:00 – 1:30 pm	Poster set-up.
1:30 – 3:00 pm	Authors of even-numbered posters present for questions.
3:30 – 5:00 pm	Authors of odd-numbered posters present for questions.
5:00 – 5:30 pm	Poster take-down.

1. **Energetic costs of territorial patrolling behavior by chimpanzees at Ngogo, Kibale National Park, Uganda.** S.J. AMSLER.
2. **Impact-amplitude of controlled percussive strikes provides evidence of site-selection for enhancement of acoustic display behavior in brown capuchins (*Cebus apella*) in Suriname.** J.D. ANDERSON IV, M.J. OWREN AND S. BOINSKI.
3. **Feeding ecology and food choice of Gibbons in the Sebangau National Park, Indonesia.** S.M. CHEYNE.
4. **Mammalian predator recognition via olfactory cues in wild brown mouse lemurs (*Microcebus rufus*).** A.M. DEPPE, M. RANDRIAMIARISOA AND P.C. WRIGHT.
5. **Social cohesion and the evolution of facial expression in nonhuman anthropoids.** S.D. DOBSON.
6. **Primate Predation by Harpy Eagles in the Central Suriname Nature Reserve.** S.M. FORD AND S. BOINSKI.
7. **Cracking the color code: What information male color might convey to female rhesus macaques (*Macaca mulatta*).** M.S. GERALD, A.K. ACCAMANDO, A. WEISS, D. SEELIG AND J. AYALA.
8. **Hunting by chimpanzees at Kanyawara and Gombe: a test of the ‘meat-for-allies’ hypothesis.** I.C. GILBY, R.W. WRANGHAM AND A.E. PUSEY.
9. **Testing the resource dispersion hypothesis as a socioecological model for the folivorous primate, *Hapalemur griseus*.** C. GRASSI.
10. **Feeding competition and cheek pouch use in *Macaca mulatta*.** D.L. HANNIBAL AND M. RODRIGUES.
11. **Social coordination and gestural communication in a captive group of white-cheeked gibbons (*Hylobates concolor*).** E.J. INGMANSON.
12. **Lack of inbreeding avoidance and reduction of alliance formation in matrilineally-housed bonobos (*Pan paniscus*).** E.M. JOHNSON.
13. **Speed of infant development in Phayre’s leaf monkeys: A mother’s influence.** E. LARNEY AND A. KOENIG.
14. **Monkey abundance and population trends in and around Korup National Park, Cameroon.** J.M. LINDER.
15. **Female dominance relationships in Hanuman langurs - not as predicted by the socioecological model.** A. LU AND C. BORRIES.
16. **Courtship behaviors of genus *Cebus*: a test case for inferences from phylogeny.** L.J. MATTHEWS AND C.A. SCHMITT.
17. **Spatial distribution of feeding and sleeping trees in territorial owl monkeys (*Aotus azarae*).** M.V. MCLAUGHLIN AND E. FERNANDEZ-DUQUE.

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**Thursday Afternoon – March 29, 2007**


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18. **Body size and home range in nonhuman primates: Do they scale?** A.L. MORALES-JIMÉNEZ.
19. **Captive lemur response to two types of natural enrichment.** R.A. MUNDS, K. BEST, P. HOPPE, K. NIEBRUEGGE, D. SABIN, M. WHIPPLE, J. KNOBBE, I.J. PORTON AND S.M. FORD.
20. **Examining the diversity of colobine monkey folivory.** L.M. PACIULLI AND J.M. KAMILAR.
21. **Locating elusive animals: Using a passive acoustic system to study savanna chimpanzees at Ugalla, Western Tanzania.** A.K. PIEL AND J.M. MOORE.
22. **Coregulation during grooming in baboons and bonobos: implications for the evolution of attention.** H.B. POJE AND S.C. STRUM.
23. **Play and grooming as conflict management strategies in a captive group of Sulawesi crested macaques (*Macaca nigra*).** J.K. RAMSEY AND C.M. BERMAN.
24. **Release of social hormones in response to visual cues in a pair-bonded primate.** L.J. SELTZER AND T.E. ZIEGLER.
25. **Isotopic ecology of wild chimpanzees from Liberia and observed gender differences in adolescent isotopic profiles.** C.M.C. SMITH AND M.E. MORGAN.
26. **Juvenile Copulation Interference among Wild Chimpanzees.** R.M. STUMPF, R. WRANGHAM AND C. BOESCH.
27. **Seasonality phenology and feeding by *Eulemur rubriventer* in two sites in Ranomafana National Park, Madagascar.** S. TECOT.
28. **The effect of gut passage by *Cebus capucinus* on rates of seed germination and time to germination.** K. VALENTA AND L.M. FEDIGAN.
29. **A behavioral test of visual acuity in the catemeral strepsirrhine *Eulemur macaco flavifrons*.** C.C. VEILLEUX AND E.C. KIRK.
30. **Habitat use of habituated versus unhabituated gorilla groups in Bwindi Impenetrable National Park, Uganda: A preliminary study.** S.J. ADLEMAN AND M.L. GOLDSMITH.
31. **New research at Mainaro, Kibale Forest National Park, Uganda: primate and other mammal diversity in a mixed regenerating forest.** G.P. ARONSEN AND S. TEELLEN.
32. **Ranging patterns and group fluidity of black-and-white ruffed lemurs (*Varecia variegata*) at Mangevo (Ranomafana National Park, Madagascar).** A.L. BADEN.
33. **Seasonal home range use and defendability in white-handed gibbons (*Hylobates lar*) in Khao Yai National Park, Thailand.** T.Q. BARTLETT.
34. **Ontogenetic patterns of positional behavior during play in *Cebus capucinus* and *Alouatta palliata*.** M. BEZANSON.
35. **Spatial position and dominance rank in blue monkeys (*Cercopithecus mitis stuhlmanni*).** M. BROWN AND M. CORDS.
36. **Effects of avian attendants on predation risk and foraging efficiency of squirrel monkey and brown capuchin troops in Suriname.** J. COLBURN AND S. BOINSKI.
37. **Ranging and foraging behavior of red-capped mangabeys *Cercocebus torquatus* in Sette Cama, Gabon.** C. COOKE AND W.S. MCGRAW.
38. **Group size and individual travel costs in blue monkeys (*Cercopithecus mitis*).** M. CORDS, S. MASON AND N. COHEN.
39. **A comparison of salivary pH in sympatric lemur species (*Lemur catta* and *Propithecus verreauxi*) at Beza Mahafaly Special Reserve, Madagascar: Investigating feeding ecology, dietary chemicals, and primate tooth wear.** F.P. CUOZZO, M.L. SAUTHER, R.R. LAWLER, N. YAMASHITA, J.R. SCOTT, J. RATSIRARSON AND M.A. WEBER.
40. **Activity pattern and habitat use of the Río Mayo titi monkey (*Callicebus oenanthe*) in a premontane forest in the Alto Mayo, northern Peru.** A.M. DELUYCKER.
41. **Spatial organization and group composition in *Varecia variegata*.** E.M. ERHART AND D.J. OVERDORFF.
42. **If you give a monkey an onion: An introduction to fur rubbing in human-commensal white-fronted capuchin monkeys (*Cebus albifrons*).** M.Y. FIELD.
43. **Lack of special relationships between male and female mantled howling monkeys (*Alouatta palliata*).** R.T. FORD.
44. **Behavioral ecology of two Barbary macaque groups in a highly anthropogenic environment in Gibraltar.** A. FUENTES, E. SHAW, D. HOLMES, D. LAGUEA, S. CALLOWAY, G. FISHER, B. FULLER, M. KONECKI, E. LEUCKE, M. MCKENNA, A. RIVAS, P. SPADAFORA AND J. CORTES.
45. ***Hapalemur* on the edge--at Tampolo Forest Station, eastern Madagascar.** L. GOULD AND M. LAFLEUR.

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**Thursday Afternoon – March 29, 2007**


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46. **Hand preference and tool use in captive chimpanzees (*Pan troglodytes*), North Carolina Zoological Park, Asheboro, North Carolina.** D.M. GRIFFIN AND L.D. WOLFE.
47. **Common origins: commensalisms between humans and chimpanzees in southeastern Senegal.** M.E. HOWELLS
48. **Effect of habitat and sex on body mass and morphometrics of diademed sifakas (*Propithecus diadema*).** M.T. IRWIN, K. E. GLANDER, J.-L. RAHARISON AND K. E. SAMONDS.
49. **The effects of observer presence on the behavior of three groups of *Cebus capucinus* in Area de Conservación Guanacaste, Sector Santa Rosa, Costa Rica.** K.M. JACK, B.B. LENZ, E. HEALAN, S. RUDMAN, V. SCHOOF AND L.M. FEDIGAN.
50. **The relationship of fecal glucocorticoid levels with self-grooming rates and frequencies of being displaced in female rhesus macaques (*Macaca mulatta*).** V. KOSHKIN, P. BERMUDEZ, D. SEELIG, J. L. DANZY, P. L. WHITTEN AND M. S. GERALD.
51. **Feeding outside the forest- Importance of crop raiding and an invasive species in the diet of gallery forest *Lemur catta* following a cyclone at the Beza Mahafaly Special Reserve, Madagascar.** M. LAFLEUR AND L. GOULD.
52. **Censuses of parapatric howler monkeys (*Alouatta palliata* and *Alouatta pigra*) in Pantános de Centla Biosphere Reserve, Tabasco, Mexico.** L. G. LUECKE, R. MARTÍNEZ-MOTA AND A. ESTRADA.
53. **A preliminary analysis of parasite species and density patterns in white-collared lemurs, *Eulemur albocollaris* at Manombo Special Reserve and Mahabo Forest, and red-fronted brown lemurs, *Eulemur fulvus rufus* at Ranomafana National Park, Madagascar.** S.K. MARTIN, O.V. RANDRIANARIMALALASOA AND S.E. JOHNSON.
54. **Behavioral responses to tooth loss in ring-tailed lemurs (*Lemur catta*) at Beza Mahafaly Special Reserve, Madagascar.** J. B. MILLETTE, M.L. SAUTHER AND F.P. CUOZZO.
55. **Patterns of affiliation in two captive chimpanzee groups.** D.L. MOORE.
56. **Verreaux's sifaka (*Propithecus verreauxi verreauxi*) of Kirindy Mite National Park, a new field site in Madagascar.** H. NAGY AND R.J. LEWIS.
57. **Hand preferences during foraging in white-faced capuchins (*Cebus capucinus*).** R.C. O'MALLEY AND L.M. FEDIGAN.
58. **Observation of a birth in wild black and gold howler monkeys (*Alouatta caraya*).** S.PEKER, R. PAVE, G.E. ZUNINO AND M.M. KOWALEWSKI.
59. **Precision grips and tactile hand movements: comparison of gibbons with great apes.** J.M. PRIME.
60. **Spatial proximity and association patterns in four groups of wild black howler monkeys (*Alouatta pigra*) in Southern Mexico.** N. RIGHINI AND R. MARTÍNEZ-MOTA.
61. **Distribution of *Macaca ochreata* and identification of mixed *ochreata-tonkeana* groups in South Sulawesi, Indonesia.** E.P. RILEY, B. SURYOBROTO AND D. MAESTRIPIERI.
62. **Scratching the surface: observations of tool use in wild spider monkeys.** M.R. RODRIGUES AND S.L. LINDSHIELD.
63. **Comparative ranging behavior of eight species of primates in a western Amazonian rainforest.** C.A. SCHMITT, A. DI FIORE, A. LINK, L.J. MATTHEWS, M.J. MONTAGUE, A.M. DERBY, D. HURST, G. CARRILLO, C. SENDALL, M.Y. FIELD AND E. FERNANDEZ-DUQUE.
64. **Evidence for clans in a population of wild hamadryas baboons.** A.L. SCHREIER AND L. SWEDDELL.
65. **A preliminary study of mate-guarding in wild titi monkeys (*Callicebus discolor*).** C. SENDALL, E. FERNANDEZ-DUQUE AND A. DI FIORE.
66. **Return of *Alouatta pigra* to the forests around Nahá, Chiapas, Mexico.** D.S. SHEPSTON.
67. **The development of hunting behavior in young male chimpanzees at Ngogo, Kibale National Park, Uganda.** H.M. SHERROW.
68. **The maintenance of social bonds in adult pairs of captive cotton-top tamarins (*Saguinus oedipus*).** C. SHIBATA AND S.M. FORD.
69. **Gestural Communication in Captive Gorillas (*Gorilla gorilla*) at the Bronx Zoo, New York.** L.W. SMITH.
70. **Recognition of Primate Facial Displays by Humans: A Case of Chimpanzee Facial Signals.** R. TRNKA AND V. BLAZEK.
71. **Understanding the power of proximate mechanisms: patterns of ring-tailed lemur (*Lemur catta*) infant survival at Beza Mahafaly Special Reserve.** D.C. WHITELAW, M.L. SAUTHER, F.P. CUOZZO AND J.E. LOUDON.
72. **Energy intake when the stakes are high: Sifaka reproductive strategies in seasonal and disturbed habitats.** M.T. WILLIAMSON, S.J. ARRIGO-NELSON AND P.C. WRIGHT.
73. **Biogeochemical effects of anthropogenic disturbance on *Propithecus edwardsi* (Primates: Indriidae) from Ranomafana National Park in southeastern Madagascar.** E.M. MCGEE, S.E. VAUGHN.

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74. **Cyanide tests of foods and excreta of three *Hapalemur* species in Ranomafana National Park (RNP), Madagascar.** N. YAMASHITA, C.L. TAN, C.J. VINYARD AND C. WILLIAMS.
75. **How a prey seed tries to avoid its predator: the orangutan-*Mezzettia* interface.** P.W. LUCAS, T.K. LOWREY AND R.F. COOK.

**Session 10. Origins: The Genetic Evidence.** Symposium (Co-Sponsored by the American Association of Anthropological Genetics). *Ballroom D.*

Organizers and Co-Chairs: LESLEA J. HLUSKO, University of California, Berkeley, and LORENA HAVILL, Southwest Foundation for Biomedical Research.

As genetic analytical techniques improve, the diversity of questions that can be addressed using these methods expands dramatically. This symposium will highlight the vast array of topics that are currently being elucidated by genetic analyses, including developmental, population, and quantitative genetics. The organizing theme is “Origins”, which will highlight how these various approaches shed new light on questions concerning primate origins, human origins, and the genetic “origins” of various evolutionarily important phenotypes, such as variation in bony morphology and human behavior.

- 1:00 pm **The use of rare genomic changes in mammalian phylogeny estimation and the phylogenetic position of Primates.** W.J. MURPHY.
- 1:15 pm **Assessment of the time of origin of New World Primates and rodents.** C.E.G. SHRAGO AND C. RUSSO.
- 1:30 pm **Origins of the Old World monkeys: a molecular perspective.** T.R. DISOTELL.
- 1:45 pm **Evolutionary Origins of Malagasy Primates.** A.D. YODER AND K.L. HECKMAN.
- 2:00 pm **The origins of anthropoid apes.** A. WALKER.
- 2:15 pm **Genetic evidence concerning modern human origins.** M. STONEKING.
- 2:30 pm **Discussion:** D.H. O’ROURKE
- 2:45 pm **Break**
- 3:00 pm **The genetic basis of phenotypic integration in baboon and mouse craniomandibular morphology with implications for human cranial evolution.** C.C. ROSEMAN, K.E. WILLMORE, J.T. RICHTSMEIER, J. ROGERS, K.M. WEISS, A. WALKER, C.F. HILDEBOLT AND J.M. CHEVERUD.
- 3:15 pm **Primate dental morphology: something different but nothing new.** S. SHOLTIS, K. KAWASAKI, AND K. WEISS.
- 3:30 pm **The genetics of post-cranial skeletal development: implications for interpreting primate morphological evolution.** P.L. RENO AND C.O. LOVEJOY.
- 3:45 pm **The origin of primate skeletal traits: Insights from studies of a pedigreed baboon colony.** L.M. HAVILL.
- 4:00 pm **Origins of and variation in human behavior.** K.K. KIDD.
- 4:15 pm **Origins: human adaptation to high-altitude hypoxia.** C.M. BEALL.
- 4:30 pm **The genetic dissection of human susceptibility to parasitic infection.** S. WILLIAMS-BLANGERO
- 4:45 pm **Discussion:** M. MAHANEY.

**Session 11. Fossil Primates & Early Hominins.** Contributed Papers. *Ballroom C.*

Chair: THEODORE M. COLE, III. University of Missouri – Kansas City.

- 1:00 pm ***Protopithecus*, *Paralouatta*, and *Alouatta*: The making of a platyrrhine folivore.** S.B. COOKE, L.B. HALENAR, A.L. ROSENBERGER, M.F. TEJEDOR AND W.C. HARTWIG.
- 1:15 pm **A new *Mesopithecus* skull from Kryopigi, Macedonia, Greece.** A. BARTSIOKAS AND E. TSOUKAL

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- 1:30 pm **New sivaladapid primates from the Eocene Pondaung Formation of Myanmar and the anthropoid status of Amphipithecidae.** K.C. BEARD, L. MARIVAUX, SOE THURA TUN, AUNG NAING SOE, Y. CHAIMANEE, WANNA HTOON, B. MARANDAT, HTUN HTUN AUNG AND J.-J. JAEGER.
- 1:45 pm **A new Uintan genus of omomyine primate from the Casa Blanca community, Laredo, Texas.** J.W. WESTGATE, D.A. COPE AND K.C. BEARD.
- 2:00 pm **Reconstructing the AL 288-1 femur using three-dimensional computer models.** A.D. SYLVESTER, B.C. MERKL AND M.R. MAHFOUZ.
- 2:15 pm **Derived wrist anatomy in the genus *Homo* as evidenced by 3D quantitative analyses: the implications for understanding the evolution of stone tool behaviors in hominins.** M.W. TOCHERI.
- 2:30 pm **Can primary productivity explain skeletal robusticity in Pleistocene *Homo*?** S.K. DOYLE.
- 2:45 pm **Was sexual dimorphism in early *Homo erectus s.l.* as large as in *Gorilla*? A reassessment of the ER-1813 cranium in the light of hominoid allometries.** P. GUNZ, K. HARVATI, P. MITTEROECKER, F.L. BOOKSTEIN, G.W. WEBER AND JJ. HUBLIN.
- 3:00 pm **Break**
- 3:15 pm **Morphological affinities of Stw 329, a juvenile temporal from Sterkfontein, South Africa.** T.R. PETERSEN.
- 3:30 pm **Lower Paleolithic land use: allometric and spatial analyses of population size and range area at Koobi Fora, Kenya.** M.J. GROVE.
- 3:45 pm **Metric Variation in the Hominid Mandibles from Dmanisi, Georgia.** A. VAN ARSDALE AND D. LORDKIPANIDZE.
- 4:00 pm **The efficiency of stone and bone tools for opening termite mounds: implications for hominid tool use at Swartkrans.** J. LESNIK AND J.F. THACKERAY.
- 4:15 pm **Late Miocene Hominid Teeth from Gona Project Area, Ethiopia.** S.W. SIMPSON, J.QUADE, L. KLEINSASSER, N. LEVIN, W. MACINTOSH, N. DUNBAR AND S.SEMAW.
- 4:30 pm **Analysis of a small mammal fauna from the !Ncumsta Hills, western Ngamiland, Botswana.** P.J. LEWIS, B. WILLIAMS AND A.M. KENNEDY.
- 4:45 pm **Chimpanzee nesting tree preferences; implications for early hominid nesting patterns.** C.B. STANFORD AND R.C. O'MALLEY.

**Session 12. Primate & Human Brain Evolution. Contributed Papers. Ballroom A.**

Chairs: TOM SCHOENEMANN. University of Michigan, Dearborn

- 1:00 pm **White matter pathways in the brain of a gorilla revealed by high-field diffusion MRI.** J.A. KAUFMAN, J.M. TYSZKA, P.R. HOF AND J.M. ALLMAN.
- 1:15 pm **A comparative diffusion tensor imaging (DTI) study of the arcuate fasciculus language pathway in humans, chimpanzees and rhesus macaques.** J.K. RILLING, M.F. GLASSER, T.M. PREUSS, X. MA, X. ZHANG, T. ZHAO, X. HU AND T.E.J. BEHRENS.
- 1:30 pm **A comparative analysis of cytoarchitecture and vertical organization of Broca's area in humans, great apes and macaques.** N.M. SCHENKER, D.P. BUXHOEVEDEN, K. AMUNTS, K. ZILLES AND K. SEMENDEFERI
- 1:45 pm **Histological asymmetries of primary motor cortex predict handedness in chimpanzees (*Pan troglodytes*).** C.C. SHERWOOD, E. WAHL, J.M. ERWIN, P.R. HOF AND W.D. HOPKINS.
- 2:00 pm **Understanding vertebrate brain size evolution.** S.M. SHULTZ AND R.I.M. DUNBAR.
- 2:15 pm **Compensatory benefits to sustain the costs of encephalization: a mammal-wide analysis.** C.P. VAN SCHAIK AND K. ISLER.
- 2:30 pm **Sagittal crests, temporal fossae, and their putative relationships to masticatory function and encephalization in a diverse sample of strepsirrhine and platyrrhine primates.** C.D. BYRON, J. DHABLIWALA AND K. BOWLES.

**Session 13. Demography & Population History. Contributed Papers. Ballroom A.**

Chair: HEATHER J.H. EDGAR. University of New Mexico.

- 3:00 pm **10000 years of human demographic evolution.** J.L. BOLDSSEN.
- 3:15 pm **Is there biological meaning to "Hispanic" in New Mexico?.** H.J.H. EDGAR AND C.M. WILLERMET.
- 3:30 pm **A new method to assess adult age at death from the auricular surface of the ilium.** A. SCHMIT AND J. BRUZEK.

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**Thursday Afternoon – March 29, 2007**


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- 3:45 pm **Re-examining the issue of biodemographic changes in North America during the transition to agriculture.** J.-P. BOCQUET-APPEL AND S. NAJI.
- 4:00 pm **The effects of family composition on infant mortality in the early 20<sup>th</sup> century British Mediterranean.** L.WALZ, L.A.SAWCHUK.
- 4:15 pm **Are the Koh an indigenous population of the Hindu Kush? II: a dental morphology investigation.** S. BLAYLOCK AND B.E. HEMPHILL.
- 4:30 pm **Coca chewing and social inequality in the Moche Valley, Perú.** C.M. GAGNON.

**Session 14. Skeletal Biology II. Paleopathology. Contributed Papers. Ballroom E.**

Chairs: PATRICIA LAMBERT. Utah State University.

- 1:00 pm **Nitrogen beyond collagen: new sources of isotopic data.** K. KIRSANOW AND N. TUROSS.
- 1:15 pm **The eleven percent solution? Reducing growth cycle error in isotopic analysis of hair segments using tissue rehydration and phase identification.** L. WILLIAMS.
- 1:30 pm **Alternative biomolecular approaches for the identification of *Mycobacterium tuberculosis* in archaeological skeletons.** C.G. WARINNER, R. RAJU, J. BUIKSTRA AND N. TUROSS.
- 1:45 pm **Magnetic resonance imaging of ancient human mummies.** F. RÜHLI, T. BÖNI, J. PERLO, F. CASANOVA, E. EGARTER AND B. BLÜMICH.
- 2:00 pm **Applicability of confocal laser scanning microscopy for anthropological research.** C. PAPAGEORGOPOULOU, U. ZIEGLER AND F. RÜHLI.
- 2:15 pm **Methods and sources for an informed approach to the identification, quantification, and interpretation of violent trauma in the bioarchaeological record.** P. LAMBERT.
- 2:30 pm **Unimagining the past in Spain: Anthropological, political and statistical issues of human rights investigations.** D.W. STEADMAN, E. GASSIOT BALLBÈ, J. OLTRA PUIGDOMÈNECH, E. SINTES OLIVES, C. OLIART CARAVATTI, J. ESTEVEZ, J.M. BAUDER AND J.J. WILSON.
- 2:45 pm **Break**
- 3:00 pm **Health, conquest, and adaptive transition: the bioarchaeology of the late pre-Hispanic and postcontact Lambayeque Valley, north coast Peru (AD 900-1750).** H.D. KLAUS.
- 3:15 pm **Causes of infant mortality in 2<sup>nd</sup> century B.C. . Greece: evidence from the Athens Agora “baby well.”.** M.A. LISTON.
- 3:30 pm **Nonmetric traits and the identification of family groups: a test using the Christ Church, Spitalfields collection.** C. L. KUBA.
- 3:45 pm **Violence and death in Mongol Altai mountains during Iron Age.** X. JORDANA, P.H.GISCARD, TS. TURBAT, D. BATSUKH AND A. MALGOSA.
- 4:00 pm **Paleopathology of an urban military graveyard: Inferences about living conditions of low status soldiers in the late 18<sup>th</sup> century.** M. BINDER.
- 4:15 pm **Morphological integration in human long bones.** V.B. DELEON AND B.M. AUERBACH.
- 4:30 pm **A 'Garden of Eden' in the Western Desert? Good health and long life among the Neolithic Egyptians of Gebel Ramlah.** J.D. IRISH.
- 4:45 pm **Analysis of Harris lines from the working-class cemetery at Hierakonpolis, Egypt.** A. KUMAR AND A.J. WARD.

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**Session 15. Paleoanthropology. Contributed Posters. Hamilton Room.**

Chair: ROBERT L. ANEMONE. Western Michigan University.

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| 8:00 – 8:30 am      | Poster set-up.  |
| 8:30 – 10:00 am     | Authors of even-numbered posters present for questions. |
| 10:30 am – 12:00 pm | Authors of odd-numbered posters present for questions.  |
| 12:00 – 12:30 pm    | Poster take-down.                                       |

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**Friday Morning – March 30, 2007**


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1. **Upper Limb Growth and Development in Juvenile Neandertals.** A.M. BUSBY.
2. **Metacarpal proportions in *Australopithecus africanus*.** D.J. GREEN AND A.D. GORDON.
3. **The taxonomy of the Flores hominin: An historical perspective.** T. GUNDLING.
4. **A quantitative trait locus study of the mouse femur: investigating the genetic basis of characters relevant to hominid evolution.** J. JIN, D. DEGUSTA, S. A. GOLDSTEIN AND D. T. BURKE.
5. **Role of load carrying in the evolution of increased body size.** M.J. MYERS AND C.M. WALL-SCHEFFLER.
6. **The species problem: revisiting the idea of a temporary cessation in the naming of new species in hominin evolution.** C.B. QUINTYN.
7. **Brain size/body size ratios of insular and mainland foxes: possible implications for *Homo floresiensis*.** A.D. SCHAUBER.
8. **Size factor as a hard nut in the sex estimation of skulls: Upper Paleolithic sample from Predmosti (Czech Republic) as an example.** A. SEFCAKOVA, S. KATINA, J. VELEMINSKA, J. BRUZEK AND P. VELEMINSKY.
9. **Relative dating of South African Middle Stone Age (MSA) sites using variation in ostrich eggshell morphology.** T.A. STIDHAM AND J.K. BROPHY.
10. **The paleobiology of the robust australopithecines (*Paranthropus*): a test of the durophage model with trace element analysis.** A.B. SHABEL.
11. **The role of infant carrying costs on early tool development.** C.M. WALL-SCHEFFLER, K. GEIGER AND K. STEUDEL-NUMBERS.
12. **Normal magnetic polarity provenance for MLD 37/38, an *in situ* hominin from the Makapansgat Limeworks, South Africa.** G.L. WARR AND A.G. LATHAM.
13. **Do Qafzeh and Skhül represent the ancestors of Upper Paleolithic modern humans? A dental perspective.** S.E. BAILEY AND J.J. HUBLIN.
14. **New skeletal elements of *Dryopithecus brancoi* from Rudabánya, Hungary.** D.R. BEGUN AND L. KORDOS.
15. **Patterns of variation in the ontogeny of supraorbital form in species of *Homo* and *Pan*.** J. BLUMENFELD AND S.R. LEIGH.
16. **Geometric morphometric analysis of the UA 31 orbit (Uadi Aalad, Eritrean Danakil)** L. BONDIOLI, A. COPPA, G.F. DE STEFANO, D. FRAYER, Y. LIEBESKAL, R. MACCHIARELLI, L. ROOK AND G. SARAO.
17. **KB5223 from Kromdraai B: *Australopithecus robustus* or early *Homo*?** D.J. DE RUITER.
18. **Temporal and geographical patterning of mandibular corpus dimensions in *Homo* using Mantel tests.** R.G. FRANCISCUS, N.E. HOLTON, S.D. MADDUX, H.E. MARSH AND R.L. CIOCHON.
19. **Dietary reconstruction of Early Pliocene Bovids from Gona Project Area, Ethiopia.** J.R. FREDIEU, N. LEVIN, S. MELILLO, S.W. SIMPSON, J. QUADE AND S. SEMAW
20. **Plantar fascia micro-architecture at the ball of the hominoid foot.** K.R. GEHRET AND D.J. MELDRUM.
21. **Human Origins Database (HOD): managing published data and specimen information for fossil and comparative collections.** A.D. GORDON AND B. WOOD.
22. **3D reconstruction and study of a new late Middle Pleistocene Hominid: Biache-Saint-Vaast 2, Nord, France.** G. GUIPERT, B. MAFART, A. TUFFREAU AND M.-A. DE LUMLEY.
23. **Analysing the taphonomy and palaeoenvironment of *Dryopithecus* and other vertebrate specimens excavated from the fossil forests of Rudabánya.** M.P. HUTCHISON, L. KORDOS AND D.R. BEGUN.
24. **A baboon analogy to the pubic morphology of later *Homo*.** M.A. KILBERGER.
25. ***Homo erectus* taxonomy: A reconsideration of the single-species hypothesis.** J. LANTZ AND R. MCCARTHY.
26. **Pedal skeleton of the Jinniushan hominin from the late Middle Pleistocene of China.** LU Z., D.J. MELDRUM, HUANG Y. AND HE J.
27. **Cutmarks and breakage of human bones in the Upper Paleolithic, La Salpêtrière cave, Department of Gard, France.** B. MAFART, G. ONORATINI AND P. VALENSI.
28. **Density mediated attrition at ESA faunal assemblages: using new density measurements and reference samples to examine bone element frequencies at early hominid sites.** G.S. MCCALL AND JAMES ENLOE.
29. **Morphometrics of the outline shape of hominid footprints.** D.J. MELDRUM AND R.E. CHAPMAN.
30. **Testing for a molecular clock boundary between fertile and infertile primate hybrids.** G.G. MILLWARD.

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31. **Canine tooth crown and root proportions in African hominoids.** F.L. PAULUS, C.V. WARD AND J.M. PLAVCAN.
32. **Developmental genetic basis of primate craniofacial variation and human origins.** J.T. RICHTSMEIER, K.M. WEISS, A. BUCHANAN, A. WALKER, N. JABLONSKI, B.C. FRAZIER, K.E. WILLMORE, H. LAWSON, P. YAN, C.A. HILL, C.C. ROSEMAN, J.M. CHEVERUD, D. FALK, C.F. HILDEBOLT AND J. ROGERS.
33. **The new partial pelvis of Omo 1: implications for sexing early modern humans.** D.F. ROYER, F.E. GRINE, J.G. FLEAGLE AND W.L. JUNGERS.
34. **Exhibiting Human Evolution in the Museum: Does it Matter?** M. R. SCOTT
35. **Tools and strategies for online instruction in physical anthropology.** P.R. STUBBLEFIELD
36. **A 3D geometric morphometric study of morphological integration in the primate mandible.** N. SINGH, K. HARVATI, P. GUNZ AND J-J. HUBLIN
37. **Masticatory biomechanics in *Australopithecus africanus* examined using finite element analysis: a preliminary study based on Sts 5.** D.S. STRAIT, G.W. WEBER, S. NEUBAUER, J. CHALK, B.G. RICHMOND, B.W. WRIGHT, A.L. SMITH, Q. WANG, P.C. DECHOW, C.F. ROSS AND M.A. SPENCER.
38. **Diets of the Early Pliocene suids from Gona, Ethiopia.** K.E. TOWNSEND, N. LEVIN, S.W. SIMPSON, J. QUADE AND S. SEMAW.
40. **Cross-sectional geometry of the Roc de Marsal juvenile Neandertal femur, determined using high-resolution microtomography.** V. VOLPATO, C. RUFF, R. MACCHIARELLI AND L. COWGILL.
41. **The lunate bone of Peking man and its bearing on the classification of *Homo erectus*.** E.E. SARMIENTO
42. **The short lifespan of data in physical anthropology: why the big problem with data access is not hominid fossils.** D. DEGUSTA.
43. **The iliac cancellous network of a juvenile *Australopithecus africanus* (MLD 7): structural properties and biomechanical implications.** R. MACCHIARELLI AND V. VOLPATO.
44. **Primate fossils, geological marker beds, and anachronistic faunal assemblages from the early Paleogene of southwestern Wyoming.** R.L. ANEMONE, W. DIRKS, W. MOORE AND J. VAN REGENMORTER.
45. **Evaluating hearing sensitivity in *Homunculus patagonicus*.** M.N. COLEMAN, R.F. KAY AND M.W. COLBERT.
46. **Using functional morphology to compare morphological diversity of Early Miocene catarrhines and modern anthropoids.** A. GROSSMAN.
47. **The biogeographic origins of Primates and Euprimates: east, west, north, or south of Eden?** M.T. SILCOX.
48. **Functional morphology of the *Kenyapithecus* hand from Maboko Island (Kenya).** K.L. ALLEN, M.L. MCCROSSIN
49. **Diet and niche partitioning in *Dryopithecus* and *Anapithecus* from Rudabánya, Hungary.** A.S. DEANE AND M.C. NARGOLWALLA.
50. **New tarsals of *Ourayia* and *Chipetaia*, omomyine primates from the Uinta Formation, Utah.** R.H. DUNN.
51. **Articular kinematics of the knee of *Kenyapithecus*.** M.L. MCCROSSIN AND K.L. ALLEN.
52. **Late Miocene fossil locality Nakali in Kenya and its paleoenvironment.** M. NAKATSUKASA, Y. KUNIMATSU, H. NAKAYA, Y. SAWADA, T. SAKAI, H. HYODO, T. ITAYA AND E. MBUA.
53. **The “Primate Site A” - A new Pliocene fossil-bearing Site in the Southern Afar Triangle, Ethiopia.** A. STADLMAYR, T.B. VIOLA, O. SANDROCK, O. KULLMER, G. WEBER, K. SCHAEFER, W. HUJER AND H. SEIDLER.
54. **Creating, displaying, and querying interactive paleoanthropological maps using GIS: An example from the Uinta Basin, Utah.** G.C. CONROY.
55. **Faculty scholarly productivity in US Anthropology Ph.D. programs.** L.B. MARTIN AND A.J. OLEJNICZAK.

### Session 16. Paleopathology. Contributed Posters. Bromley Room.

Chair: DEBRA L. MARTIN. University of Nevada, Las Vegas.

8:00 – 8:30 am	Poster set-up.
8:30 – 10:00 am	Authors of even-numbered posters present for questions.
10:30 am – 12:00 pm	Authors of odd-numbered posters present for questions.
12:00 – 12:30 pm	Poster take-down.

1. **Fish tapeworm and anaemia on the Pacific Northwest Coast of America.** R.R. BATHURST.
2. **Feasting on the dead? Butchery of humans at Domuztepe, a late Neolithic settlement in southern Anatolia.** S.C. GAULD AND J.S. OLIVER.



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3. **Skeletal indicators of slavery and violence in the Greater Southwest (AD 800-1500).** D.L. MARTIN.
4. **Preliminary investigation of infant burials from 3<sup>rd</sup> millennium BC Kish, Iraq.** W.J. PESTLE AND C. TORRES-ROUFF.
5. **Two Scythian skeletons from Alexandropol, Ukraine.** R.K. WENTZ.
6. **Tarsal osteology of Charcot joint osteoarthropathy.** D. AGOADA.
7. **An analysis of the methods and purposes of post-mortem examinations as observed in a pauper cemetery.** T. CEPON, R. PATALITA, A. OZGA, B. WHITE, N. SULLIVAN, A. MANN, L. DEVITT AND S. DOUGHERTY.
8. **Falling, fighting or fleeing: Skeletal trauma analysis in eight sympatric cercopithecoids from Cameroon.** T.J. CHAPMAN AND S.S. LEGGE.
9. **Black Death Mortality: Selectivity with Respect to Frailty.** S.N. DEWITTE
10. **The physical dimension of warrior status in Early Medieval England.** S.E. GROVES.
11. **Bioarchaeological analysis of motives for pre-Columbian Peruvian trepanation.** K.M. JOHNSON.
12. **Bioarchaeological analysis of diet in Coles Creek populations in the Lower Mississippi Valley.** G.A. LISTI.
13. **A case of maxillo-mandibular and speno-mandibular ankylosis from Alaska.** M.R. LONDON AND E.B. JONES.
14. **Differential diagnosis of facial pathology in Dolní Věstonice 3: biobehavior in the Gravettian of Central Europe.** A.R. MICHAEL AND R.G. FRANCISCUS.
15. **An osteological analysis of human cranial remains from the Atlantic Watershed Region of Costa Rica.** A. M. NAGY.
16. **The prevalence of vertebral and peripheral characteristics of diffuse idiopathic skeletal hyperostosis (DISH) in a late nineteenth and early twentieth century Almshouse cemetery.** A. OZGA, R. PATALITA, T. CEPON, B. WHITE, N. SULLIVAN, L. DEVITT, C. MILLIGAN AND A. MANN.
17. **Reconstructing Lucayan Mortuary Practices through skeletal analysis.** M. PATEMAN AND E. KIMMERLE
18. **The quiet life? Indications from a rural late Anglo-Saxon village.** L.C.D. SCHOSS, S. S. LEGGE AND G. THOMAS.
19. **Ancient Disease and Trauma: A Case from Tell Mozan, Syria dating to 1600 BC.** L. RAMOS.
20. **The Taylor Burying Ground Skeletal Assemblage: Demographics, Antemortem Characteristics, and Health.** A. S. RICHTER.
21. **Syngnathia (I): craniofacial malformations in infants - a systematic methodological approach.** D. SCHAMALL, M.L. PRETTERKLIEBER, M. TESCHLER-NICOLA, F. KAINBERGER, H. IMHOF, F. BRANDSTÄTTER, B. PATZAK AND ST. TANGL.
22. **Syngnathia (II): craniofacial malformations in historic skulls.** M.L. PRETTERKLIEBER, D. SCHAMALL, ST. TANGL, F. KAINBERGER, H. IMHOF, F. BRANDSTÄTTER, B. PATZAK AND M. TESCHLER-NICOLA.
23. **Testing a ‘Caries Correction Factor’ in Two Populations with Differing Dental Caries Rates.** S.K. SIMON.
24. **Dietary analysis of DISH: using stable isotope analysis to investigate disease.** R.K. SPENCER.
25. **A high prevalence of premature craniosynostosis at the medieval Hospital of St. James and St. Mary Magdalene, Chichester, England.** R.A. STORM
26. **An unusual arrow wound in the distal humerus of a male Bell Beaker skeleton from Saxony (Germany) – a CT investigation and 3D reconstruction.** W.R. TEEGEN, P. GUNZ, M. CONRAD AND F. SCHMIDT.
27. **Is it trauma? Identifying pre- peri- and post-mortem skeletal fractures.** T.A. TUNG.
28. **Worldwide analysis of phenetic distances among Holocene populations from the evidence of morphological dental traits.** R. VARGIU, A. CUCINA, D. MARTORELLA, M. LUCCI AND A. COPPA.
29. **Health and wealth: preliminary research at the Cox site (40AN19), Anderson County, Tennessee.** J. VOGEL AND B. BRALY.
30. **The palaeodemography of the Black Death: the Hereford Cathedral Close cemetery.** D.A. WESTON, A.E. BOYLSTON, A.R. OGDEN AND D. HURST.
31. **Diet, Disease and the Paleopathological Record.** A.K. WILBUR, A.W. FARNBACH, K.J. KNUDSON AND J.E. BUIKSTRA
32. **Co-occurrence of DISH and HFI in the Terry Collection.** C.A. WILCZAK AND D.M. MULHERN.
33. **“We the people”: twenty-five years of bioarchaeology in Philadelphia.** T.A. CRIST AND A. WASHBURN.

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34. **“From many bodies posted in this clearing house”: anatomical specimens and surgical waste from Philadelphia’s two almshouse burial grounds.** M.H. CRIST, T.A. CRIST.
35. **Dental health, heterogeneity, and mortality in a Middle Mississippian skeletal sample from west-central Illinois.** J.J. WILSON AND D.W. STEADMAN.

### **Session 17. The Adaptable Phenotype and Biological Anthropology: Emerging Trends in the Study of Development, Genetics and Evolution.** Symposium (cosponsored by the Human Biology Association). *Ballrooms A/B.*

Organizers and Chairs: CHRIS KUZAWA, Northwestern University, DANIEL BENYSHEK, University of Nevada Las Vegas.

Evolutionary biology is currently poised at an historic cross-roads. Recent advances in the study of evolutionary-developmental biology, developmental plasticity, epigenetics, and life history theory are bringing the phenotype to the center of studies of evolutionary process and adaptation. These themes integrate the study of genetics with developmental, physiologic and behavioral processes; as such, they provide opportunities for collaboration across anthropological sub-disciplines, and across disciplines like ecology, life history theory, evolutionary-developmental genetics, and the now extensive animal model work on the mechanisms of developmental plasticity and epigenetic inheritance. The purpose of the proposed session is to highlight the contributions of biological anthropology to this new evolutionary synthesis, while providing an opportunity for anthropologists to benefit from the insights and discoveries of colleagues working in related fields.

- 8:00 am **Introduction.** C. KUZAWA and D. BENYSHEK
- 8:15 am **Environmental dynamics and the evolution of adaptability.** R. POTTS.
- 8:30 am **Testing hypotheses of primate evolution: The power of the model organism.** C.-H. CHIU.
- 8:45 am **The Epigenetic Funnel and the Cranial Base: how cranial base growth helps integrate interactions between the face and brain to constrain overall skull shape.** D.E. LIEBERMAN, B. HALLGRÍMSSON AND W. LIU
- 9:00 am **The Developmental Basis for Morphological Integration and the Structure of Variation in the Skull.** B. HALLGRÍMSSON, D.E. LIEBERMAN AND W. LIU.
- 9:15 am **Plasticity in gut function and its implications for understanding species coexistence and evolution of Cercopithecinae dietary niches.** J.E. LAMBERT.
- 9:30 am **An adaptive perspective on the developmental origins paradigm.** P.D. GLUCKMAN AND M.A. HANSON.
- 9:45 am **Break**
- 10:00 am **The role of epigenetics in developmental plasticity and developmental induction of risk of adult disease.** M.A. HANSON AND P.D. GLUCKMAN.
- 10:15 am **The intergenerational implications of developmental programming.** A.J. DRAKE.
- 10:30 am **The normalization of intergenerationally transmitted, developmentally programmed traits in experimental animals: implications for adaptive hypotheses.** D.C. BENYSHEK.
- 10:45 am **Early life nutritional cues, developmental plasticity and human life history: new evidence.** C.W. KUZAWA.
- 11:00 am **Density dependence in human life history variation.** R.S. WALKER.
- 11:15 am **Metabolic scaling and social network structure: The fractal organization of hunter-gatherer populations.** M.J. HAMILTON.
- 11:30 am **Synthesis & Comemntary:** E. JABLONKA

### **Session 18. What’s New with Old Monkeys? Systematics, Phylogeny, and Paleobiology of Fossil Cercopithecids.** Symposium. *Ballroom C.*

Chair: ERIC DELSON, City University of New York, STEVEN FROST, University of Oregon, and NINA JABLONSKI, Pennsylvania State University.

Research on the cercopithecoid fossil record has flourished in the last decade because of an explosion of new material, and ever-growing numbers and kinds of analyses being marshaled to study the fossils themselves. Analyses ranging from stable isotopes, to multivariate morphometrics, to spatial statistics are enabling new and diverse insights into the morphology, phylogenetic relationships, paleobiogeography, and overall paleobiology of the Cercopithecidae. This represents diverse aspects of this

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rapidly expanding field, including descriptions of new fossil material, reanalyses other collections, several aspects of cercopithecoid diet and paleobiology, and systematic and other comparisons covering much of the cercopithecoid record in general.

- 8:00 am **Mesopithecus sivalensis** from the Late Miocene of the Siwaliks. T. HARRISON AND E. DELSON
- 8:15 am **Late Miocene Cercopithecidae from the Middle Awash, Afar, Ethiopia.** S.R. FROST, Y. HAILE-SELASSIE AND L. HLUSKO.
- 8:30 am **Fossil colobines from Asa Issie, Ethiopia and Lemudong'o, Kenya.** L.J. HLUSKO.
- 8:45 am **Cercopithecoid assemblages in the Koobi Fora Formation, Omo-Turkana Basin, northern Kenya.** M.G. LEAKEY.
- 9:00 am **Monkeys in the ecosystems of Koobi Fora through time.** N.G. JABLONSKI.
- 9:15 am **New cercopithecoid fossils from Asbole, Ethiopia and their environmental and ecological significance.** Z. ALEMSEGED AND S. FROST.
- 9:30 am **The Problematic Papionina of Sterkfontein Member 4, Gauteng, South Africa.** J.L. HEATON.
- 9:45 am **Break**
- 10:00 am **Origin of the genus *Papio* at Plio-Pleistocene South African cave sites.** F.L. WILLIAMS.
- 10:15 am **Diet and taxonomy: fossil cercopithecoids from Makapansgat.** N. H. FOURIE, J. LEE-THORP AND R. R. ACKERMANN
- 10:30 am **Preliminary Results of Cercopithecidae Dental Microwear from the Gona Project area, Ethiopia.** E. HENDERSON, S.R. FROST, S.W. SIMPSON, J. QUADE, S. SEMAW AND N. LEVIN.
- 10:45 am **Adaptations and relationships of North African Miocene cercopithecoids.** B.R. BENEFIT.
- 11:00 am **Cranio-mandibular morphology supporting the molecular African papionin clades and the identification of "*Cercocebus*" antiquus.** C.C. GILBERT.
- 11:15 am **Temporal characteristics of fossil cercopithecoid diversity and longevity in southern Africa.** J.K. MCKEE.
- 11:30 am **Discussants:** E. DELSON and N. JABLONSKI

### **Session 19. Predation, Competition and Vocalizations in Primates.** Contributed Papers. *Ballroom D.*

Chair: ANTHONY DI FIORE. New York University.

- 8:00 am **Exploring diachronic change in the group specific vocalizations of chimpanzees (*Pan troglodytes*).** A.R. HALLORAN, D. BROADFIELD, S. ROSS AND A. MARSHALL.
- 8:15 am **Dominance and inter-group relationships: Do group identity, group size and interaction location affect the outcome of between-group contest competition in *Cebus capucinus*?** M.C. CROFOOT.
- 8:30 am **Predator detection and the evolution of primate sociality: insights from experiments on a rain forest primate.** C.H. JANSON.
- 8:45 am **Behavioral responses of *Propithecus edwardsi* to an experimental multiple-predator community in Ranomafana National Park, Madagascar.** S.M. KARPANTY.
- 9:00 am **Long-distance solo calls of white-handed gibbon males (*Hylobates lar*).** U.H. REICHARD AND C. NEUMANN.
- 9:15 am **The function of alarm calling among wild tufted capuchin monkeys (*Cebus apella*).** B.C. WHEELER.
- 9:30 am **Making sense of sounds: The behavioral context of vocalizations in wild sifakas.** Z.J. FARRIS AND T.L. MORELLI.
- 9:45 am **Determining home range "volumes" in primates: why are we using two-dimensional measures for species that live in a three-dimensional world?** L.J. DIGBY.
- 10:00 am **Break**
- 10:15 am **Do male black howler monkeys (*Alouatta pigra*) assess the fighting ability of individual rivals during inter-group encounters?** D.M. KITCHEN, S. KENNEY AND R.E. WILSON.
- 10:30 am **Chimpanzee charging displays: a case of social rhetoric?** S.J. O'HARA.
- 10:45 am **The PCFA-MCA Method: A New Approach for Studying Reconciliation in Nonhuman Primates.** D. SEELIG.

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- 11:00 am **Female power in lemurs: A new framework for understanding “female dominance”.** R.J. LEWIS.
- 11:15 am **Taphonomy of primate skeletal remains from chimpanzee hunts at Ngogo, Kibale National Park, Uganda.** B.L. POBINER, J. DESILVA, W.J. SANDERS AND J.C. MITANI.
- 11:30 am **Wild brown capuchins in Suriname exploit combinatorial manipulation for multiple functions.** S. BOINSKI, D.M. FRAGASZY, E. EHMKE AND L. KAUFFMAN.

### Session 20. Anatomy, Ecology and Mastication. Contributed Papers. *Ballroom E.*

Chair: CHRISTOPHER J. VINYARD. NEOUCOM

- 8:00 am **The anatomical relationship between the infraorbital foramen and infraorbital nerve: Validating the use of infraorbital foramen size to infer ecology.** M.N. MUCHLINSKI.
- 8:15 am **Genetic and phenotypic variation in craniofacial dimorphism in baboons.** K.E. WILLMORE, C.C. ROSEMAN, J.M. CHEVERUD, B.C. FRAZIER, J. ROGERS, K.M. WEISS, A. WALKER, C.F. HILDEBOLT AND J.T. RICHTSMEIER.
- 8:30 am **Finite element analysis of masticatory stress hypotheses.** J.M. CHALK, B.G. RICHMOND, D.S. STRAIT, B.W. WRIGHT, Q. WANG, C.F. ROSS, P.C. DECHOW, M.A. SPENCER.
- 8:45 am **Evidence of convergent masticatory morphology among durophagous anthropoids from four different clades.** P. CONSTANTINO.
- 9:00 am **Masseter muscle strain during chewing in tufted capuchins (*Cebus apella*).** C.J. VINYARD, C.L. THOMPSON, C.D. STIMPSON, A.L. MORK, B.A. ARMFIELD, A.H. DOHERTY, H.M. WASSERMAN, E.M. JACKSON AND W.I. HORNE.
- 9:15 am **Hybrids, spandrels, and the evolution of development: insights from baboons.** R.R. ACKERMANN.
- 9:30 am **The mechanical properties of hominoid foods: I. *Pongo pygmaeus wurmbii*.** E.R. VOGEL, N.J. DOMINY, J.T. VAN WOERDEN, P.W. LUCAS AND C.P. VAN SCHAİK.
- 9:45 am **Mechanical properties of hominoid foods: II. Plant underground storage organs and the adaptive significance of molar enamel thickness.** N.J. DOMINY, E.R. VOGEL, J.D. YEAKEL, J.T. VAN WOERDEN, P.W. LUCAS AND C.P. VAN SCHAİK.
- 10:00 am **Break**
- 10:15 am **Complex interactions between estrogen, strain, and exercise-induced periosteal bone growth.** M.J. DEVLIN AND D.E. LIEBERMAN.
- 10:30 am **Three-dimensional analysis of temporal bone pneumatization patterns in olive baboons.** C.A. HILL.
- 10:45 am **Functional morphology of the temporomandibular joint in catarrhines.** C.A. LOCKWOOD AND D.J. FEATHERSTONE.
- 11:00 am **Canine dimorphism, dental growth, and the evolution of anthropoid mating systems: the platyrrhine angle.** R.T. HOGG.
- 11:15 am **Canine tooth crown, root and facial dimorphism in anthropoid primates.** C.V. WARD, J.M. PLAVCAN AND F.L. PAULUS.
- 11:30 am **New primate tali from the middle Eocene of Asia.** D.L. GEBO, M. DAGOSTO, X. NI AND C. BEARD.
- 11:45 am **Jaw-muscle fiber architecture in *Cebus*.** A.B. TAYLOR AND C.J. VINYARD.

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## Friday Afternoon – March 30, 2006

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### Session 21. Skeletal Biology. Contributed Posters. *Hamilton Room.*

Chair: MEGAN A. PERRY. East Carolina University.

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| 2:00 – 2:30 pm | Poster set-up.  |
| 2:30 – 4:00 pm | Authors of even-numbered posters present for questions. |
| 4:00 – 5:30 pm | Authors of odd-numbered posters present for questions.  |
| 5:30 – 6:00 pm | Poster take-down.                                       |

1. **Micromorphology of cut-marks in Palaeolithic Britain.** S. M. BELLO, C. SOLIGO AND, S. PARFITT.
2. **Evidence of Decapitation and ‘trophy-taking’ during the Late Archaic in Southern Indiana.** R.A. LOCKHART AND C.W. SCHMIDT.

3. **Ontogeny and musculoskeletal stress markers in prehistoric New Mexico.** M. MONDRAGÓN, A. BUSBY AND O.M. PEARSON.
4. **Bioarchaeological investigations at the church of San Felipe de Neri, Albuquerque, NM.** A.J. OSTERHOLTZ.
5. **Investigating the transport of Byzantine mining camp prisoners into southwestern Jordan using strontium and oxygen isotopes.** M.A. PERRY, A.H. AL-SHIYAB AND D. COLEMAN.
6. **Mahalanobis distance, missing values, and the end of the Mesolithic.** H.C. PETERSEN.
7. **A test of articular modeling in response to load in human upper limb.** K.RABEY.
8. **Effects of the periodontal ligament in occlusal load distribution and the implications for finite element modeling of the primate skull.** C.J. SELF AND D.J. DAEGLING.
9. **A test of the Buckberry and Chamberlain revised method for age estimation from the auricular surface using a modern sample.** N.L. SHIRLEY, J.D. BETHARD.
10. **Histomorphological variation in the human appendicular skeleton.** R.A. WALKER, C.O. LOVEJOY AND R. CORDES.
11. **Bone remodeling in historical African Americans.** V.L. WEDEL.
12. **Activity and Asymmetry at Islamic Écija (Spain).** S.R. ZAKRZEWSKI, L.A. CASHMORE AND E.E. POMEROY.
13. **Histomorphological aging of subadults: A test of Streeter's method on a medieval archaeological population.** A.M. AGNEW, M. STREETER AND S.D. STOUT.
14. **An evaluation of the precision of two histological age estimation techniques.** J. ALLISON AND D.W. STEADMAN.
15. **Bone resorption and reproductive status in baboons.** S.K. AMUGONGO, M.C. MAHANEY AND L.M. HAVILL.
16. **New evidence for ritual activity, relatedness, and diet in the precontact Cook Islands.** S.C. ANTÓN, R.L. QUINN, B. POBINER, D. EMERA, I. SOLOMON, T.R. DISOTELL AND D.W. STEADMAN.
17. **Working towards higher pelvic standards: accuracy, comparability & sex.** D.M. BOEKER.
18. **A mechanical analysis of the bioarchaeological remains from Frankfort cemetery (15Fr154).** K.M. BROWN, C.B. RUFF, P.E. KILLORAN, D. POLLACK AND V.B. DELEON.
19. **A re-examination of the relationship between cranial deformation and extra-sutural bone formation.** J.L. CLARK AND A.P. VAN ARSDALE.
20. **Metric evaluation of changes in cadaver stature.** R.H.COOLIDGE AND D.R.HUNT.
21. **Assessing mobility patterns for the Early Bronze Age community of Bab edh-Dhra' using radiogenic isotope analysis of human enamel.** A.L. COOPER, J.M. ULLINGER, D.S. COLEMAN AND S.G. SHERIDAN.
22. **A bioarchaeological investigation of materials recovered from two unmarked graveyards in Bridgetown, Barbados.** C. CRAIN AND K. FARMER.
23. **Variability of the Stature of the Central European Population from the Neolithic Age to Present.** M. DOBISÍKOVÁ, S. KATINA AND P. VELEMÍNSKÝ
24. **West Indies Indentured Irish in the 17<sup>th</sup> Century: An Osteological Case Study.** A.M. DOYING.
25. **Handedness and bilateral asymmetry: comparisons of humeral length and weight.** K. DRISCOLL.
26. **Midfacial intermediacy in post-contact Amerindian skeletal samples and European-Amerindian admixture.** A.D. FOSTER, J.C.M. AHERN, C.R.F. MEYER.
27. **Skeletal and dental measures relating to the transition from foraging to herding in the Eastern Cape Province, South Africa.** J. K. GINTER.
28. **Handedness and Directional Asymmetry of Lower Limbs: Testing the Hypothesis of the Crosse Symmetry Pattern in Articular Dimensions.** S.A.F. GLOUX.
29. **The relationship of Nubians with their neighbors, the Egyptians.** K. GODDE.
30. **Children of God: subadult weaning, mortality, and isotopic associations with monastic diet in Byzantine Jerusalem.** L.A. GREGORICKA, M. SCHURR AND S.G. SHERIDAN.
31. **The use of digital X-ray technology in the identification of radiopaque transverse lines.** J.A. HALPAIN.
32. **Are musculoskeletal markers indicative of biomechanical stress? A test using individuals of known occupations.** M. S. HARLE AND K. A. KING.

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33. **Standards for univariate metric sex discrimination in prehistoric Fremont.** M.A. HATCH AND S.A. NOVAK.
34. **Bioarchaeology of prehistoric pastoralists of northern Kenya.** C.E. HILTON, P.LANE AND B. STRAIGHT.
35. **Characterization of palatal strains in *Sus domesticus*: implications for the mechanical behavior of the primate palate.** J.L. HOTZMAN, C.J. SELF AND D.J. DA EGLING.
36. **Comparison between Yearly Attrition Rates and Skeletal Marker Aging in Four Samples.** A.E. HUARD.
37. **Nonmetric sex determination using the sternal end of the fourth rib.** B.J. KEMP.
38. **Trabecular and cortical architecture of captive versus wild specimens of *Loris tardigradus* and *Callithrix jacchus* using micro-computed tomography.** J.M. KNITTEL.
39. **Nonmetric cranial variation of the ancient Okhotsk cultural people around the Okhotsk Sea coast.** A. KOMESU, T. HANIHARA, T. AMANO, H. ONO, M. YONEDA, T. FUKUMINE AND H. ISHIDA.
40. **Paleodemography under duress: Growth and sexual dimorphism of the minimum femoral circumference.** L.W. KONIGSBERG AND S.R. FRANKENBERG.
41. **A control bone for trabecular architecture variation.** D.V. KOPP AND J.G. SKEDROS.
42. **Using the Calcaneus as an indicator of stature in Chinese populations.** S.M. MAGAHA
43. **Variability in osteon and Haversian canal sizes between medieval and recent human populations from Slovakia.** M. MARTINIAKOVÁ, R. OMEKKA, B. GROSSKOPF, A. JANČOVÁ AND M. BAUEROVÁ.
44. **Ontogenetic and regional variability in intracortical remodeling at the midshaft femur and humerus of *Chlorocebus aethiops*, *Hylobates lar* and *Pan troglodytes*.** S.C. MCFARLIN, C.J. TERRANOVA, A.L. ZIHLMAN AND T.G. BROMAGE.
45. **Skeletal biology of new Gallina burials from Rio Arriba County, New Mexico.** G.C. NELSON, T.D. LARGAESPADA, D.C. CAMERON AND D.D. RAYOME.
46. **The expression of femoral trochanteric spicules with relation to age.** K. PEARLSTEIN, D.R. HUNT AND R.W. MANN.
47. **The impact of Roman imperialism: skeletal evidence of dental health and diet in Britain.** J.J. PECK.
48. **The reemergence of the Joseph Jones collection.** A.P. RIDGELY, J.B. ROTTENSTEIN AND J.E. BUIKSTRA.
49. **Blood atonement in Nephi, Utah: an event from the Walker War of 1853.** R. ROOD AND D.V. KOPP.
50. **The effects of musculoskeletal stress markers on cortical thickness decline in the humerus of Black adults.** M.V. ROUSSEAU.
51. **'Put your shoulder into it': Upper limb pathology at a Byzantine Jerusalem monastery.** G. SAMOLCZYK, T. SHUGG, J. ULLINER, D. ORTNER AND S.G. SHERIDAN.
52. **A test of three regression formulae to age fetal skeletal remains.** J.E. SANDERS.
53. **Sexual dimorphism in the superior mandibular ramus.** I.A. SCOTT AND H. SCHUTKOWSKI.
54. **Evidence for a Galatian occupation of Gordion, Turkey from human skeletal remains.** P. SELINSKY.
55. **Analysis of commingled skeletal remains from Bee Cave rockshelter, Val Verde County, Texas.** T.L. SIMMONS.
56. **Warfare in the Bell Beaker period revisited: An analysis of size and shape of humeral cross-sections.** V. SLADEK, D. SOSNA AND M. BERNER.
57. **Using Rasch analysis to describe the developmental sequence of osteoarthritic change for individuals from a Middle Anglo-Saxon cemetery.** J. C. STEVENSON, R. KENDALL, P. M. EVERSON AND E. R. MAHONEY.
58. **Modern Frequency of os acromiale in the William M. Bass Skeletal Collection.** L. VILLAO.
59. **Partnering in a south Philadelphia dig: the Washington Avenue bioarchaeology project.** A. WASHBURN, T.A. CRIST, M.B. GOLDBERG AND M. KIRKPATRICK.
60. **Frequency and distribution of osteoarthritis in the Orendorf adult population sample.** M.C. WELZEIN AND D.W. STEADMAN.
61. **Geospatial bioarchaeology: using geographic information systems to model terrain and population patterns of osteoarthritis and long bone structural adaptation.** K.D. WILLIAMS, C.S. LARSEN, P.W. SCIULLI, K. GREMILLION AND D. MUNROE.
62. **The effects of different sample treatments on bone apatite stable isotope analysis: implications for paleodietary reconstruction.** C.J. YODER AND E.J. BARTELINK.

63. **Occupational stress and slavery: evidence from Bridgetown, Barbados.** S.K. MUNO.

**Session 22. Forensic Anthropology. Contributed Posters. Bromley Room.**

Chair: DIANE L. MARKOWITZ. Rowan University.

2:00 – 2:30 pm	Poster set-up.
2:30 – 4:00 pm	Authors of even-numbered posters present for questions.
4:00 – 5:30 pm	Authors of odd-numbered posters present for questions.
5:30 – 6:00 pm	Poster take-down.

1. **Determining sex using the upper limb.** J. ALBANESE.
2. **A test of the Igarashi *et al.* method for estimating age-at-death from the auricular surface of the ilium.** J.D. BETHARD AND N.L. SHIRLEY.
3. **Assessment of FORDISC 3.0's Accuracy in Classifying individuals from W.W. Howell's Populations and the Forensic Data Bank.** A.R. CAMPBELL AND G.J. ARMELAGOS.
4. **How to determine sex using the pubic bone even when it is not recovered.** G. EKLICS AND J. ALBANESE.
5. **Roman Gladiators - The Osseous Evidence.** F. KANZ AND K. GROSSSCHMIDT.
6. **Pathology, development - or cranial deformation caused by taphonomic processes? Distinguishing among possible causes of asymmetry in Arikara subadult skulls.** D.L. MARKOWITZ
7. **"New equations for estimating stature in forensic cases".** A.J. TUCK AND J. ALBANESE.
8. **A comparison of cortical bone thickness of the radius between humans and two non-human mammals.** S.L. CROKER, W. REED AND D. DONLON.
9. **Sacrificial burials in a Mixtec sweatbath.** W.N. DUNCAN AND A.K. BALKANSKY.
10. **A practical method for estimating age-at-death through quantification of changes in the chest plate.** H.M. GARVIN AND N.V. PASSALACQUA.
11. **Selection of variables for discriminant analysis of human crania for determining ancestry.** A. KOLATOROWICZ.
12. **Distinguishing Amerindian populations using calcaneal proportions.** A.O. LUJAN.
13. **Bone Weathering in a Cold Climate: Forensic Applications of a Field Experiment Using Animal Models.** C.M. MARCEAU.
14. **Sex determination using the second cervical vertebra – a test of the method.** E.J.MARLOW.
15. **Strontium isotope ratios as a valid tool in the geographic fingerprinting of hard tissue samples in the United States.** M.C. OLIVER, B.M. CARLO AND J.M. ZEIGLER.
16. **Forensic age-at-death assessment: Multiple methodologies based on four techniques.** N. V. PASSALACQUA AND L. CABO.
17. **Body mass estimation and personal identification.** C.W. RAINWATER, L.L. CABO AND S.A. SYMES.
18. **Sacral fusion as adult age indicator.** L. RÍOS, K. WEISSENS AND C. RISSECH.
19. **Dimorphism of the Radial Head Diameter and its Potential for Sex Determination.** D. SEMERARO AND N.V. PASSALACQUA.
20. **Geographic variation in orbital shape in modern human populations.** M. ŠEŠELJ.
21. **Radiography of the pubic symphysis: an alternative method for the age at death estimation of human skeletal remains.** P. SHERIN.
22. **A histological examination of the effects of burning on fragmentary deer bone** L.H. TRAMMELL.
23. **Potential use of carpals in sex determination of human skeletal remains.** D.L. WALTON AND A.M. BURROWS.
24. **Assessing individual variability among sternal rib ends for the purpose of skeletal aging: intercostal consistency in an archaeological assemblage.** C. S. SPEAL.
25. **Demographic trends within the Forensic Anthropology Center's body donation program.** R.J. WILSON, B. ALGEE-HEWITT AND L.M. JANTZ.
26. **A study of decomposition rates in eastern North Carolina.** L. LEONE.

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**Friday Afternoon – March 30, 2007**


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27. **Mystery skull: paleopathology and biological variation in an Indigenous Australian.** C. ECHAZABEL AND E.H. KIMMERLE

**Session 23. The Nature of the Earliest Asian Hominin Lifeways: The Current State of the Evidence.**  
Symposium. *Ballrooms A/B.*

Organizer and Chair: CHRISTOPHER J. NORTON, Institute of Vertebrate Paleontology and Paleoanthropology, Chinese Academy of Sciences.

Co-Organizers: JOHN W.K. HARRIS, Rutgers University and DAVID R. BRAUN, Rutgers University.

Sometime after 2 Ma *Homo ergaster/erectus* moved out of Africa in two initial directions: 1) north toward Dmanisi, Georgia, and 2) east toward Yuanmou and Sangiran, Indonesia. Paleomagnetic reconstructions from sites in the Nihewan Basin (northern China) suggest hominins reached Northeast Asia by 1.66 Ma. However, the hominin migration route to Northeast Asia is unclear, as *H. erectus* could have traveled north through Dmanisi and then east, or from the south passing by Yuanmou and/or Sangiran. In addition, the essence of Plio-Pleistocene Asian hominin lifeways is largely unknown in terms of their ability to adapt to new environments. Currently poorly identified arenas of Asian paleoanthropological research include what types of stone toolkits hominins utilized, lithic raw material sourcing, taphonomic investigation of the nature of hominin-carnivore interactions, and how quickly hominin home ranges may have expanded through the Pleistocene. The primary goal of this symposium is to present a series of papers from leading authorities that synthesizes the current state of research regarding the evidence for the earliest hominin migrations into Asia and the nature of Plio-Pleistocene Asian *Homo* lifeways.

- 2:00 pm **The colonization of Savannahstan: issues of timing(s) and patterns of hominin dispersals across Asia in the Late Pliocene and Early Pleistocene.** R.W. DENNELL.
- 2:15 pm **Ecological correlates of the initial spread of hominids from Africa.** W.R. LEONARD, S.C. ANTÓN AND M.L. ROBERTSON.
- 2:30 pm **The role of Dmanisi in early hominin dispersals.** G.P. RIGHTMIRE AND D. LORDKIPANIDZE.
- 2:45 pm **The history of hominin occupation in Central Asia in review.** M. M. GLANTZ.
- 3:00 pm **Plio-Pleistocene biogeography of the Indian subcontinent: implications for early human dispersals.** P.R. CHAUHAN.
- 3:15 pm **South Asia as a geographic crossroad: patterns and predictions of hominin morphology in Pleistocene India.** S. ATHREYA.
- 3:30 pm **Paleoecological setting for the arrival and early evolution of *Homo erectus* in the Solo Basin, Java.** R.L. CIOCHON, E.A. BETTIS, III, S.J. CARPENTER, Y. ZAIM AND H.E. MARSH.
- 3:45 pm **Break**
- 4:00 pm **Cranio-dental morphology and variation in the earliest Indonesian hominids.** Y. KAIFU, E. INDRIATI, F. AZIZ, T. JACOB AND H. BABA.
- 4:15 pm **Magnitude and pattern of geographic variation in cranial shape within *Homo erectus*, especially from Asia.** K.L. BAAB.
- 4:30 pm **Early *Homo erectus* occupations appear in Northeast and Southeast Asia. What about Central-East Asia (JAS, China)?** C.J. NORTON.
- 4:45 pm **Lithic technology and hominid behaviour of the earliest occupations at the Nihewan Basin, northern China.** C. SHEN.
- 5:00 pm **Faunal and behavioral context of earliest Pleistocene *Homo* in East Asia.** R.L. TEAGUE AND R. POTTS.
- 5:15 pm **The Early Paleolithic: A comparison of African and Asian Industries: Hypotheses and Future Expectations.** D.R. BRAUN, C.J. NORTON AND J.W.K. HARRIS.
- 5:30 pm **Discussants:** A. BROOKS AND E. DELSON

**Session 24. Reproductive Ecology.** Contributed Papers. *Ballroom C.*

Chair: CHERYL D. KNOTT. Harvard University.

- 2:00 pm **'Dangerous fertile ages' for women: a universal medieval pattern?** S. WEISE AND J.L. BOLDSSEN
- 2:15 pm **"Maleness" reconsidered: hominoid craniofacial sexual dimorphism.** K. SCHAEFER, P. MITTEROECKER, P. GUNZ, M. BERNHARD AND F.L. BOOKSTEIN.
- 2:30 pm **Inter-individual variation in levels of reproductive hormones in human females: Genotype-diet interaction.** G. JASIENSKA.
- 2:45 pm **Associations between the neuropeptides oxytocin and vasopressin and the behavior of free-ranging female rhesus macaques (*Macaca mulatta*).** M.L. SCHWANDT, S. HOWELL, K. BALES, B.D. JAFFE, G.C. WESTERGAARD AND J.D. HIGLEY.



- 3:00 pm **Mating systems and male genital anatomy in strepsirhine primates.** K. TREATMAN-CLARK.
- 3:15 pm **Diet and reproductive function in East African chimpanzees (*Pan troglodytes schweinfurthii*).** M. EMERY THOMPSON AND R.W. WRANGHAM.
- 3:30 pm **Evaluating C peptide as a measure of net energy gain in *Colobus guereza*.** T.R. HARRIS AND S.L. MONFORT
- 3:45 pm **Female reproductive competition in western gorillas at Mondika Research Center, Central African Republic and Republic of Congo.** D. FERNÁNDEZ, C. BORRIES AND D. DORAN-SHEEHY.
- 4:00 pm **Break**
- 4:15 pm **Sexual Coercion and Mating Strategies of Wild Bornean Orangutans.** C.D. KNOTT, M. EMERY THOMPSON AND R.M. STUMPF.
- 4:30 pm **Patterns of female dispersal in an Asian colobine monkey.** A. KOENIG, E. LARNEY, A. LU AND C. BORRIES.
- 4:45 pm **Mating promiscuity, energetics, and reproductive strategies in black and gold howler monkeys (*Alouatta caraya*).** M. KOWALEWSKI AND P. A. GARBER.
- 5:00 pm **Male dispersal as a mating strategy in the ringtailed lemur (*Lemur catta*).** J.A. PARGA AND R.G. LESSNAU.
- 5:15 pm **Hominoid milk composition: relationship to phylogeny and ontogeny.** L.A. MILLIGAN AND O.T. OFTEDAL
- 5:30 pm **It Takes a Community to Raise a Child, or Does it? Socialization in Wild Chimpanzees (*Pan troglodytes*).** M.M. BEUERLEIN AND W.C. MCGREW.
- 5:45 pm **Milk composition and yield in primiparous and multiparous rhesus macaques (*Macaca mulatta*).** K. HINDE.

## **Session 25. Anatomy and Functional Morphology. Contributed Papers. Ballroom E.**

Chair: MATTHEW RAVOSA. Northwestern University.

- 2:00 pm **Obstetric load: implications for the evolution of lumbar lordosis in bipeds.** K. WHITCOME
- 2:15 pm **Can the Frontal bone be used as a distinguishing tool between Hominins? The Zuttiyeh frontal: is it still an enigma?** H. PESSAH.
- 2:30 pm **Evolutionary and developmental implications of species-specific brain growth patterns within the genus *Pan*.** J. BRAGA AND J. TREIL.
- 2:45 pm **The biogeography and genomic patterns of primate endogenous retroviruses support a long Asian sojourn of the ancestral human lineage.** C.-B. STEWART, H.M. MILLER AND D.S. STRAIT.
- 3:00 pm **Growth of wild chimpanzees from Tai National Forest: implications for hominid evolution.** A. ZIHLMAN, D. BOLTER AND C. BOESCH.
- 3:15 pm **The cranial vault in fossil hominids: Computerized shape analysis.** P.E. LESTREL, F. OHTSUKI, R.M. CESAR JR. AND C.A. WOLFE.
- 3:30 pm **Exploring STET: a new method for examining variation and species** S.-H. LEE.
- 3:45 pm **Break**
- 4:00 pm **Craniodental versus postcranial variables as estimators of size dimorphism in extinct taxa.** J.M. PLAVCAN AND A.D. GORDON.
- 4:15 pm **Evaluating character independence for hominin systematics using geometric morphometrics.** B. VILLMOARE.
- 4:30 pm **Which cranial regions reflect genetic distances most reliably in humans? Evidence from three-dimensional morphology.** H.F. SMITH.
- 4:45 pm **3D architecture of the middle cranial fossa and modern human origins.** M. BASTIR, A. ROSAS AND P. O'HIGGINS.
- 5:00 pm **MicroCT of *Proconsul heseloni* metatarsals.** H.M. DUNSWORTH.
- 5:15 pm **Microtomographic investigation of enamel thickness and enamel-dentine junction shape in *Gigantopithecus blacki*.** A. OLEJNICZAK, T. SMITH, W. WEI, R. POTTS, R. CIOCHON, O. KULLMER, F. SCHRENK AND J-J. HUBLIN.
- 5:30 pm **The biogeographic dietary ecology of *Theropithecus*: an isotopic approach.** J.D. YEAKEL, D. GERAADS, P.L. KOCH AND N.J. DOMINY.
- 5:45 pm **The fused frontal as an anthropoid synapomorphy - perhaps not.** A.S. PAGANO AND A.L. ROSENBERGER

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**Friday Afternoon – March 30, 2007**


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**Session 26. Human Genetic Variation. Contributed Papers. Ballroom D.**

Chair: CHRISTOPHER R. TILLQUIST. University of Louisville.

- 2:00 pm      **A global survey of cytokine expression polymorphism in human populations.** F.A. CRESPO, J.A. BOULDIN, G.R. FERNANDEZ-BOTRÁN, M.F. CASANOVA AND C.R. TILLQUIST.
- 2:15 pm      **Acceleration of adaptive evolution in modern humans.** J. HAWKS AND G. COCHRAN.
- 2:30 pm      **The Effects of Incomplete Selective Sweeps on the Site Frequency Spectrum.** C. HUFF, A. ROGERS AND H. HARPENDING.
- 2:45 pm      **Population expansion in the American Southwest: A case for the study of ancient DNA in the region.** B.M. KEMP.
- 3:00 pm      **JCV Mutation Rate and Demographic History Estimation** A. KITCHEN, M.M. MIYAMOTO AND C.J. MULLIGAN.
- 3:15 pm      **Paternal heritage for the Indonesian peoples.** T. M. KARAFET, H. SUDIYI, J. S. LANSING AND M. H. HAMMER.
- 3:30 pm      **Origins of the Chamorros: A mtDNA perspective.** M.G. VILAR, D.E. LYNCH, C.W. CHAN, R.M. GARRUTO AND J.K. LUM.
- 3:45 pm      **Mitochondrial DNA study of human variation in regards to behavior and the inheritance of landscapes.** S. E. MCGRATH AND D. A. MERRIWETHER.
- 4:00 pm      **Break**
- 4:15 pm      **Sequence variation in the pigmentation candidate gene *SLC24A5* and evidence for independent evolution of light skin in European and East Asian populations** H.L. NORTON AND M.F. HAMMER
- 4:30 pm      **Migrations in and out of Africa; historical inference aided by simulation.** R.L. RAAUM, A.L. NON AND C.J. MULLIGAN.
- 4:45 pm      **Ethnogenesis in the slave trade: the case study of São Tomé (Gulf of Guinea).** J. ROCHA, M. COELHO, C. ALVES, V. COIA, D. LUISELLI, A. USELI, T. HAGEMEIJER, A. AMORIM AND G. DESTRO-BISOL.
- 5:00 pm      **Ancient Population Structure and Migration in Africa Inferred from Genome-wide Genetic Markers.** S. A. TISHKOFF, F.A. REED, A. FROMENT, M.W. SMITH, S.M. WILLIAMS, S.A. OMAR, M.J. KOTZE, G.S. PRETORIUS, M. IBRAHIM, O. DOUMBO, M. THERA, C. WAMBEBE, S.E. DOBRIN AND J.L. WEBER.
- 5:15 pm      **Genetic profile of Macaronesia islands: evidences from mitochondrial DNA.** C. SANTOS, V.M. CABRERA, R. FREGEL, P. LOURENÇO, T. CYMBRON, Y. DAHMANI, J.M. LARRUGA AND M. LIMA.
- 5:30 pm      **The utility of molecular techniques to address the impact of paleoclimatic events on demographic history of populations in Africa and Arabia.** A.L. NON, R.L. RAAUM AND C. J. MULLIGAN.
- 5:45 pm      **The Phylogeography of Haplogroup N1a.** O. GOKCUMEN, M. DULIK, S. ZHADANOV, L. OSIPOVA AND T.G. SCHURR.

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**Saturday Morning – March 31, 2007**


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**Session 27. Primate Biology: Morphology, Brain Evolution, Physiology and Reproduction. Contributed Posters. *Hamilton Room.***

Chair: DANA COPE. College of Charleston.

8:00 – 8:30 am	Poster set-up.
8:30 – 10:00 am	Authors of even-numbered posters present for questions.
10:30 am – 12:00 pm	Authors of odd-numbered posters present for questions.
12:00 – 12:30 pm	Poster take-down.

1. **Nutrition early in life predicts relative cortex size in primates.** C. J. CHARVET.
2. **4-dimensional diffeomorphic modeling: A novel approach for investigating human embryonic brain development.** L.D. GLOTZER AND P. T. SCHOENEMANN.
3. **Brain ontogeny in infant baboons (*Papio hamadryas*).** P. JELINEK, P. KOCHUNOV, M. DAVIS, J. ROGERS AND S. LEIGH.
4. **Encephalization and life history: Lessons from primate brain growth trajectories.** S.L. ROBSON.
5. **Stratigraphic distribution of middle Eocene primates in the eastern Uinta Basin, Utah.** D.A. COPE, K.E. TOWNSEND AND D.T. RASMUSSEN.
6. **Primate tibiae from the middle Eocene Shanghuang fissure-fillings of Eastern China.** M. DAGOSTO, D.L. GEBO, X. NI, T. QI AND C. BEARD.
7. **An allometric approach to maxillary sinus growth in *Pongo* and *Pan*.** T. KOPPE, T.C. RAE, O. RÖHRER-ERTL AND T. NISHIMURA.
8. **Paleontological models of intraspecific variation and molar-size dimorphism in Miocene apes.** C.M. SCHREIN, J.E. SCOTT AND J. KELLEY.
9. **Stabilizing selection and adaptive optima in the evolution of platyrrhine body size.** T.M. COLE III,
10. **Molar-size dimorphism in highly dimorphic extant anthropoids and *Lufengpithecus lufengensis*.** J.E. SCOTT, C.M. SCHREIN AND J. KELLEY.
11. **Molar crown development in wild orangutans.** T.M. SMITH.
12. **Inter- and intra-sexual dimorphism in an Early Miocene Catarrhine- *Rangwapithecus gordonii*- as demonstrated by new material from Western Kenya.** S. COTE AND I. NENGO.
13. **Ape body plans as examples of carcinization.** D. SWARTZ.
14. **Was it worth digitizing all those curves? A worked example from craniofacial primatology.** S. KATINA, F. L. BOOKSTEIN, P. GUNZ AND K. SCHAEFER.
15. **A comparative analysis of internal cranial anatomy in the Hylobatidae.** E.R. LESLIE.
16. **The ins and outs of mangabeys: An examination of internal versus external basicranial and facial architecture.** T.A. PEBURN.
17. **A comparative analysis of lingual fungiform papillae and diet in primates.** L. ALPORT.
18. **Cercopithecoid cranial variation of the primates of Vietnam.** M.R. ANDERSON, H.H. COVERT, V. DAO AND V. THANH.
19. **Chimpanzee and gibbon bipedality: a contrast in limb and muscle proportions.** D. BOLTER, C. UNDERWOOD AND A. ZIHLMAN.
20. **A test of the generality of the association between molar flare and diet in anthropoid primates.** L.K. DELEZENE.
21. **Inter- and intraspecific differences in primate carpal morphology.** I. GUIMONT AND T. L. KIVELL.
22. **Intraspecific scaling of preferred bite size in strepsirrhines and a narrow allometric comparison of preferred bite size in a frugivore and a folivore.** A. HARTSTONE-ROSE AND J.M.G. PERRY.
23. **Age and sex-related changes in degenerative joint disease in the lumbar vertebrae of Japanese macaques.** A.N. LIPPS, S.C. AGARWAL AND Y. HAMADA.
24. **Analysis of intrinsic joint function in the primate foot by evaluating apparent density in the calcaneus.** M.G. NOWAK, B.A. PATEL AND K.J. CARLSON.

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**Saturday Afternoon – March 31, 2007**

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25. **Do lemurs bite off more than they can chew?** J.M.G. PERRY AND A. HARTSTONE-ROSE.
26. **Variability of the femoral head in catarrhines – a new 3D method for describing anatomical structures.** T. PFISTERER, F.L. BOOKSTEIN, B. BREUCKMANN, K. SCHÄFER, T.B. VIOLA, H. WOERNER AND H. SEIDLER.
27. **Quantifying the angle of orientation of the metatarsophalangeal joint surface of proximal phalanges in extant primates.** T.R. REIN AND T. HARRISON.
28. **Ontogeny of fore limb and hind limb muscular mass distribution in habitually upright versus quadrupedal primates.** K.J. SEARIGHT, J.J. BAKER, M. MICHAELS, M.B. KEHRER, B. DEMES AND T.D. SMITH.
29. **Bone microstructural variation in primates: an overview of significance for the study of fossil taxa.** J. WARSHAW AND T.G. BROMAGE.
30. **Does craniofacial variation among *Rhinopithecus* species follow an altitudinal cline?** B.W. WRIGHT, Q. LE KHAC, R. PRODHAN, H.H. COVERT AND T. NADLER.
31. **Testing the association between limb anatomy, positional behavior and habitat structure of *Macaca fuscata* from Yakushima and Kinkazan Islands.** R. SCHUBERT AND W.S. MCGRAW.
32. **Birth season glucocorticoids are related to the presence of infants in male sifaka (*Propithecus verreauxi*).** D.K. BROCKMAN, A. COBDEN AND P.L. WHITTEN.
33. **The color of stress? Preliminary evidence linking sexual skin coloration with cortisol in free-ranging rhesus macaques.** J. L. DANZY, D. SEELIG, P. BERMUDEZ, V. KOSHKIN, P. L. WHITTEN AND M. S. GERALD.
34. **Mechanics of the masticatory apparatus favor muscle force production at wide jaw gapes in tree-gouging marmosets.** C.M. ENG, S.R. WARD, T.M. WINTERS, T.D. KINGSBURY, C.J. VINYARD AND A.B. TAYLOR.
35. **Seasonal variation in testosterone and cortisol in juvenile male, captive chimpanzees.** K.D. HUGHES, S.F. ANESTIS AND R.G. BRIBIESCAS.
36. **Energetics and encephalization in strepsirrhines.** N.L. BARRICKMAN.
37. **Hormonal correlates of ontogeny in baboons and mangabeys.** R.M. BERNSTEIN AND S.R. LEIGH.
38. **Reproductive schedules of brown mouse lemurs (*Microcebus rufus*) at Ranomafana National Park, Madagascar.** M.B. BLANCO.
39. **Flexible Asian folivores: Life history in the genus *Trachypithecus*.** C. BORRIES, N. SHELMIDINE, E. LARNEY, A. LU, C. MCCANN AND A. KOENIG.
40. **A comparative analysis of the ontogeny of body mass dimorphism in lorisooids.** M.T. O'MARA, K.K. CATLETT, C.J. TERRANOVA AND G.T. SCHWARTZ.
41. **Using ultrasound to determine gestational age and litter size in marmoset monkeys.** J. RUTHERFORD, D. LAYNE COLON AND S.D. TARDIF.
42. **The relationship between age, weight, and leptin in male and female chimpanzees: sex differences and life history implications.** S. F. ANESTIS AND R. G. BRIBIESCAS
43. **“Life history space”: A multivariate analysis of life history variation in extinct and extant Malagasy lemurs.** K.K. CATLETT, G.T. SCHWARTZ, L.R. GODFREY AND W.L. JUNGERS.
44. **Skeletal evidence for trauma in infant chimpanzees.** C.A. KIRCHHOFF.
45. **Calculating the stochastic population growth rate in a wild population of lemurs (*Propithecus verreauxi verreauxi*) using long-term rainfall data.** R.R. LAWLER AND H. CASWELL.
46. **Reproductive strategies in captive *Hylobates* populations.** L. MARTINEZ AND M. MUEHLENBEIN.
47. **Using the length of the 2<sup>nd</sup> to 4<sup>th</sup> digit ratio (2D:4D) to investigate the influence of prenatal sex hormones on non-human primate mating systems and human social evolution.** E.C. NELSON AND S. SHULTZ.
48. **A Preliminary Analysis of Associations and Time Budgets in Wild Orangutan Females in the Period Preceding and Following Birth.** J.T. VAN WOERDEN, E.R. VOGEL, C.P. VAN SCHAIK, S.A. WICH AND M.A. VAN NOORDWIJK
49. **Female reproductive state, ecology, and serum leptin in wild vervet monkeys (*Chlorocebus aethiops*).** P.L. WHITTEN AND T.R. TURNER.

50. **(In)congruence between molecular and morphological phylogenies in the Papionini.** K.E. FOLINSBEE.
51. **Morphological variation within primate species: papionines versus koalas.** R.M. NORRIS, R.B. ECKHARDT, A.J. KUPERAVAGE AND M. HENNEBERG.
52. **Haplorhini, haplorhinism, and nasolacrimal ducts.** J.B. ROSSIE AND T.D. SMITH.
53. **Mitochondrial data suggest Pliocene splits within extant African colobine lineages.** N. TING.
54. **Variation in craniofacial suture fusion in the Galagidae.** D.P. STUMP.
55. **Incongruence of phylogenetic and geographic distances among members of the *Cercopithecus lhoesti* species group.** A.J. TOSI.
56. **A New and Comprehensive Analysis of the Taxonomy of East Africa's Threatened Mangabeys and its Importance to Conservation** C.L. EHARDT, T.M. BUTYNSKI, T.R. DISOTELL, J.P. GAUTIER AND W.S. MCGRAW.

### **Session 28. Bioarchaeological Perspectives on Migration and Human Health in Ancient East Asia.**

Poster Symposium. *Bromley Room*.

Organizers and Chairs: EKATERINA A. PECHENKINA, Queens College of City University of New York, and JAQUELINE T. ENG, University of California, Santa Barbara.

8:00 – 8:30 am	Poster set-up.
9:00 – 10:30 am	Authors of even-numbered posters present for questions.
10:30 am – 11:00 pm	Discussion by posters. (JOHN R. LUKACS and CLARK SPENCER LARSEN)
12:00 – 12:30 pm	Poster take-down.

In this symposium we will examine the role of population exchange and agricultural intensification within the Chinese sphere of interaction during the Neolithic and Early Metal periods. Biological evidence for migration across continental East Asia and to Japan will be addressed via the analysis of non-metric dental and cranial traits. Stable isotope signatures from human and animal bones will be deployed to track the adoption and intensification of agriculture in this area. Results of the analysis of bone pathology and oral health will be used to underscore human physiological and skeletal responses to the biomechanical stresses of farming, the inadequacies and benefits of diets heavily weighted toward millets and/or rice, and the roles of animal husbandry and population movement in the introduction and spread of specific pathogens.

- Biological connections across the Sea of Japan: a multivariate craniometric study of ancient and more modern crania from Japan, China, and Korea.** M. PIETRUSEWSKY.
- Population movement into the Japanese Archipelago during antiquity: a craniofacial and odontometric perspective.** N. SEGUCHI, H. UMEDA, A.R. NELSON AND C.L. BRACE.
- The biological affinities of populations from China and Mongolia: dental nonmetric trait evidence from the Neolithic through the modern period.** C. LEE.
- A cranial nonmetric study of archaeological and modern populations from Mongolia and Korea.** M. ERDENE.
- Comparative craniofacial morphology of archaeological populations from Mongolia.** D. TUMEN.
- Dental caries, dietary variation, and behavior among the prehistoric Yayoi of Japan.** D.H. TEMPLE AND C.S. LARSEN.
- Distribution of Osteoarthritis in the Jomon era of Japan.** M. TANIHATA AND Y. ABE.
- Palaeohealth in Sub-arctic Hokkaido, Japan: the Evidence from Trauma and Infection.** M.F. OXENHAM.
- Early prevalence of tuberculosis in Japan and Korea - as a biological indicator of population movement across the Japan sea during antiquity.** T. SUZUKI.
- Stable carbon isotope evidence for Neolithic Chinese diet differences in the Huang He and Yangtze River valleys.** S.H. AMBROSE, R. WANG, Y. DONG, E.A. PECHENKINA, L. LIU, Y. HU, C. WANG AND X. CHEN.
- Paleodietary studies using stable carbon isotopes from human bone: an example from the late Bronze age Xindianzi cemetery, Inner Mongolia, China.** Q.C. ZHANG, Y. HU, Y. LI AND H. ZHU.
- Long Bone dimensions as an index of the socioeconomic change in ancient Asian populations.** P. L. WALKER AND J.T. ENG.

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13. **Patterns of trauma in pastoralists of the Donghu culture in northern China.** J.T. ENG, H. ZHU AND Q.C. ZHANG.
14. **Work or violence: Traumatic injuries during the Chinese Neolithic.** E. PECHENKINA AND M. XIAOLIN.
15. **Childhood stress of Iron Age Taiwan: The Shih-san-hang site as an example.** C.-H. LIU AND J.S. KRIGBAUM.
16. **Understanding the origins of millet agriculture: Stable isotopic evidence.** Y. HU, M.P. RICHARDS, Y. YANG, S. WANG, F. LUAN AND C. WANG.

**Session 29. Principles of Primate Locomotion: How Unique is Primate Walking, Running and Climbing?. Symposium. Ballrooms A/B.**

Organizers: MATTHEW O'NEILL, Johns Hopkins University School of Medicine, DAVID RAICHLEN, University of Arizona and HERMAN PONTZER, Washington University.

Three decades of locomotor research have suggested that primates differ from other mammals in many kinematic and kinetic characteristics, and these differences are often attributed to the non-cursorial primate body plan. Yet humans – the best-studied primate – appear to follow the general principles of mammalian whole-body mechanics and energy use despite their unique anatomy. This raises the question: are humans unique among primates, or do all primates “play by the rules” of mammalian locomotor biomechanics in spite of their kinematic and kinetic distinctions? This symposium will investigate whether primate walking, running and climbing are fundamentally different from other mammals. We will apply insights gained from these studies to current debates regarding locomotor evolution in primates, including hominids.

- 8:00 am **Center of mass movements in primates.** D. SCHMITT, A.K. PAI AND K.L. BISHOP.
- 8:15 am **Energetics of climbing in mammals: Where do primates fit in?** J.B. HANNA.
- 8:30 am **Metabolic cost of locomotion and muscular force generation in strepsirhine quadrupedalism.** M.C. O'NEILL.
- 8:45 am **Substrate alters asymmetrical gait dynamics in common marmosets (*Callithrix jacchus*).** J.W. YOUNG.
- 9:00 am **Relationship between speed and forelimb kinematics in terrestrial quadrupedal locomotion: Why do primates adopt digitigrade hand postures?** B.A. PATEL.
- 9:15 am **Comparative analyses of body support and joint posture in primates.** J.D. POLK.
- 9:30 am **Limb loading in nonlinear locomotion.** B. DEMES AND K.J. CARLSON.
- 9:45 am **Break**
- 10:00 am **Center of mass position, quadrupedalism, and stability: Where do primates fall?** L.J. SHAPIRO AND D.A. RAICHLEN.
- 10:15 am. **Joint kinetics in chimpanzees and other mammals: are large bodied primates unique?** D.A. RAICHLEN, H. PONTZER AND M.D. SOCKOL.
- 10:30 am **Dynamics of terrestrial and arboreal Locomotion in Bonobos.** K. D'AOÛT, E. VEREECKE, K. SCHOONAERT AND P. AERTS.
- 10:45 am **Contributions of muscular and skeletal morphology to locomotor performance: How much can bones tell us about locomotion?** H. PONTZER, D.A. RAICHLEN AND M.D. SOCKOL.
- 11:00 am **The energetic cost of human running: factors affecting its variability.** K.L. STEUDEL-NUMBERS, CARA M. WALL-SCHEFFLER, MARCELLA J. MYERS AND TIMOTHY D. WEAVER.
- 11:15 am **The dynamics of locomotion on limbs: What must be accomplished?** J.E.A. BERTRAM
- 11:30 am **Discussant:** D. LIEBERMAN AND S. LARSON

**Session 30. From the Shoulders of a Giant: Perspectives on the Legacy of William White Howells (1908-2005).** Fifth Annual Wiley-Liss Symposium. *Ballroom D.*

Organizers and Co-Chairs: ROBERT JURMAIN, San Jose State University, and LAURIE R. GODFREY, University of Massachusetts, Amherst.

In a remarkable career spanning more than six decades, W.W. Howells became one of the giants of 20<sup>th</sup> Century physical anthropology. His research was unusually diverse, even for a time when our discipline was less specialized than is now typical. As a result, he has influenced numerous central aspects of contemporary research (including paleoanthropology, population biology, primate biology, and, most characteristically, sophisticated statistical analyses of human variation). This session, organized by his admiring students, seeks to pay tribute to our teacher and mentor, trace ramifications of his major contributions, and show how his legacy continues.

- 8:00 am **William White Howells: A physical anthropologist in the making.** E. GILES.
- 8:15 am **Peopling of the Pacific: resolving the controversy.** J.S. FRIEDLAENDER, F.R. FRIEDLAENDER, J.A. HODGSON, L.B. SCHEINFELDT, K.K. KIDD, J.R. KIDD, M. BAUCHET, G. CHAMBERS, R. LEA, G. KOKI, F. REED AND D. A. MERRIWETHER.
- 8:30 am **Understanding human races: the retreat of neutralism.** H. HARPENDING.
- 8:45 am **Multivariate studies of cranial form: The impact of Howells' research on defining *Homo sapiens*.** J.B. GAINES AND P. RIGHTMIRE
- 9:00 am **Getting Here: The Howells' style of mentorship and hominid postcranial morphometrics.** H.M. MCHENRY.
- 9:15 am **A Howells grasp on prehistoric and recent Japan: A precursor to the Kennewick connection.** C. L. BRACE AND N. SEGUCHI.
- 9:30 am **Discussant:** J. RELETFORD
- 9:45 am **Break**
- 10:00 am **3D approaches in paleoanthropology: small steps beyond William White Howells.** E. DELSON, W.E.H. HARCOURT-SMITH, S.R. FROST, A.L. ROSENBERGER, F. J. ROHLF, A.B. AMENTA AND D.F. WILEY.
- 10:15 am **Comparing Primate Crania.** J.G. FLEAGLE AND C.C. GILBERT.
- 10:30 am **Skeletal evidence of aggression in humans and African apes: An evolutionary perspective.** R. JURMAIN AND L. KLIGORE
- 10:45 am **In memoriam: The megafauna of Madagascar.** L.R. GODFREY, G.T. SCHWARTZ, W.L. JUNGERS, M.T. IRWIN, K.E. SAMONDS, K.K. CATLETT AND D.A. BURNEY.
- 11:00 am ***Homo floresiensis* Cranial and Mandibular Morphology.** J.Y. ANDERSON.
- 11:15 am **Ecogeography of cranial volume in *Macaca fascicularis*.** J. FROELICH.
- 11:30 am **Tails of two macaques: Terrestrial locomotion, niche differentiation and a possible function of bipedalism in forested habitat.** M.D. SOCKOL, P.S. RODMAN AND H.M. MCHENRY.
- 11:45 am **Discussant:** B. WOOD

### **Session 31. Primate Behavior, Social Organization and Genetic Variation.** Contributed Papers. *Ballroom C.*

Chair: MARINA CORDS. Columbia University.

- 8:00 am **Long-term stability of male chimpanzee social relationships at Ngogo.** D.P. WATTS.
- 8:15 am **Differential social relationships and subgrouping among wild female chimpanzees at Ngogo, Kibale National Park, Uganda.** M.L. WAKEFIELD.
- 8:30 am **The evidence for social bonds in primate groups.** J.B. SILK.
- 8:45 am **The pair bond in brown titi monkeys (*Callicebus brunneus*): male and female reproductive interests.** J.M. LAWRENCE.
- 9:00 am **Social organization in two sympatric lemur species: a lack of dominance.** B.Z. FREED.
- 9:15 am **Wild male chimpanzees preferentially affiliate and cooperate with maternal but not paternal siblings.** K.E. LANGERGRABER, J.C. MITANI AND L. VIGILANT.
- 9:30 am **Weight and time matter: determinants of ape social system and biogeography.** J. LEHMANN, A.H. KORSTJENS AND R.I.M. DUNBAR.
- 9:45 am **Predicting within-species variation in primate behavior and ecology: A quantitative approach using comparative methods.** J.M. KAMILAR.
- 10:00 am **Break**

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- 10:15 am **Mitochondrial sequence diversity of the southernmost extant New World monkey, *Alouatta caraya*.** M.S. ASCUNCE, E. HASSON, C.J. MULLIGAN AND M.D. MUDRY.
- 10:30 am **Are protected areas really protecting lemurs? A look at the genetic diversity in and around Ranomafana National Park, Madagascar.** T.L. MORELLI, R.A. BRENNEMAN AND P.C. WRIGHT.
- 10:45 am **Patterns of mitochondrial and nuclear DNA variation in Chinese rhesus macaques (*Macaca mulatta*).** D.G. SMITH, J.A. SATKOSKI, D. GEORGE AND S. KANTHASWAMY.
- 11:00 am **The influence of population size, habitat fragmentation and demographic history on gorilla populations.** R.A. BERGEL AND L. VIGILANT.
- 11:15 am **Primate phylogeny and divergence dates based on complete mitochondrial genomes.** J. L. BOORE, D. DEGUSTA, H. M. FOURCADE, D. ENGEL, J. MORGAN AND C. R. GIGNOUX.
- 11:30 am **The complex evolutionary history of gorillas.** L. VIGILANT, O. THALMANN, A. FISCHER AND S. PÄÄBO.
- 11:45 am **Genetic estimation of patterns of social organization in western gorillas (*G. g. gorilla*) in the northern periphery of the Dja Reserve, Cameroon.** J.A. SATKOSKI, J. DUPAIN, D.J. MELNICK AND T.R. DISOTELL.

**Session 32. Growth and Development. Contributed Papers. Ballroom E.**

Chair: EVELYN J. BOWERS. Ball State University.

- 8:00 am **The Development of Craniofacial Sexual Dimorphism in Humans.** R.A. GONZALEZ.
- 8:15 am **Lifespan health parameters: Evidence for take-off growth disruption among the Ache? Upper incisor evolution in plesiadapiform primates.** MARY T. SILCOX,.
- 8:30 am **Feeding, hormones and body composition: a reproductive ecological approach to the study of infant growth.** A.L. THOMPSON, P.L. WHITTEN AND M. LAMPL.
- 8:45 am **From face to brain: progress in the neonatal anthropometrics of fetal alcohol damage.** F.L. BOOKSTEIN.
- 9:00 am **On using tooth enamel zinc concentrations as indicators of diet and nutritional status: insights from analyses of a contemporary Mexican sample.** A.E. DOLPHIN, A.H. GOODMAN AND D. AMARASIRIWARDENA.
- 9:15 am **Development but not ancestry explains large lung volumes in female Peruvian Quechua at high altitude and sea-level.** M. KIYAMU, T. BRUTSAERT, A. BINGHAM, M. SHRIVER, E. PARRA, F. LEÓN-VELARDE, M. RIVERA, A. PALACIOS AND E. CHIRINOS.
- 9:30 am **Further examination of growth accomplishment in children with clefts of the lip and/or palate.** E. J. BOWERS
- 9:45 am **Break**
- 10:00 am **The paradox of drug reward in human evolution.** R.J. SULLIVAN, E.H. HAGEN AND P. HAMMERSTEIN.
- 10:15 am **Human counter-exploitation of plant neurotoxins: Towards resolving the paradox of drug reward.** E.H. HAGEN, R.J. SULLIVAN AND P. HAMMERSTEIN.
- 10:30 am **Activity or biological affinity? Predictive equations for body mass in female collegiate athletes.** S. DANESHVARI, O. M. PEARSON AND R. M. MALINA.
- 10:45 am **Directive 15 OMB, bureaucratic race and science.** NICOLE A. NAAR AND GEORGE J. ARMELAGOS.
- 11:00 am **Impaired reproductive function in women in obese populations: an evolutionary perspective.** T.M. POLLARD.
- 11:15 am **Infection and human evolution.** L.M. VAN BLERKOM.
- 11:30 am **Do ovarian steroid levels covary within and between populations? V.J. VITZTHUM, C.M. WORTHMAN, H. SPIELVOGEL AND J. THORNBURG.**
- 11:45 am **Anemia and physical function in older adults – results from the National Social life Health and Aging Project.** S.R. WILLIAMS AND S.A. LEITSCH.



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**Session 33. Human Biology and Variation. Contributed Posters. *Hamilton Room.***

Chair: ROBERT HALBERSTEIN. University of Miami.

1:00 – 1:30 pm	Poster set-up.
1:30 – 3:00 pm	Authors of even-numbered posters present for questions.
3:30 – 5:00 pm	Authors of odd-numbered posters present for questions.
5:00 – 5:30 pm	Poster take-down.

1. **Dietary practices of Southern French Neolithic populations: new stable isotope data.** E.HERRSCHER AND G. LE BRAS-GOUDE.
2. **Alaskan Eskimo and Polynesian Island population skeletal anatomy: The “Pacific Paradox” revisited through surface area to body mass comparisons.** W. LEACH.
3. **Genetic, geographic, and environmental correlates of human temporal bone variation.** C.E. TERHUNE, H.F. SMITH AND C.A. LOCKWOOD.
4. **Sex Recognition by Face.** V. BLAZEK AND M. HOSKOVA.
5. **A preliminary study on the relationship between nasal cavity and maxillary sinus volumes.** L.N. BUTARIC, D.C. BROADFIELD AND R.C. MCCARTHY.
6. **A test of the relationship between health status and body proportions.** B. HOLT AND D. TOMPKINS.
7. **Body size reconstruction in a small-bodied sample: applicability of current methods.** H.K. KURKI, J.K. GINTER, J.T. STOCK AND S. PFEIFFER.
8. **Iris color and texture in admixed populations.** E.E. QUILLEN, S. BELEZA, E.J. PARRA, J.M. ROCHA, R.W. PEREIRA AND M.D. SHRIVER.
9. **2005 Turkey nationwide anthropometry survey.** M. SAGIR, T. GULTEKIN, B. KOCA OZER, G. AKIN, Y. BEKTAS AND E. GULEC.
10. **The adaptive value of android body shape in women.** I. SCOTT, GR BENTLEY, M. TOVEE, F. UDDIN AHAMED, K. MAGID AND T. SHARMEEN.
11. **Black populations on St. Catherines Island, Georgia, 1760-1930.** W.L. EASTON, J.T. WOODS AND G.J. ARMELAGOS.
12. **Establishing the nature of the differences between skull samples from two populations.** S.P. EVANS AND T. MOLLESON.
13. **Secular trends of the European male facial skull from the Migration Period to the present.** E. JONKE, H. PROSSINGER, F.L. BOOKSTEIN, K. SCHAEFER, M. BERNHARD AND J.W. FREUDENTHALER.
14. **A Biological Distance Study of Non-Metric Cranial Traits for Three Prehistoric New Mexico Sites: Nanishagi Ruins, Kuaua Pueblo, and the Angus Site.** L.R. MATT.
15. **Contextualizing Conflict: War and peace in Neolithic Europe.** M.J. SMITH AND M.B. BRICKLEY.
16. **Demographic simulations of the admixture between foragers and farmers in central European Neolithic.** P. GALETA AND J. BRUZEK.
17. **The OY ratio for a large late prehistoric site.** B.I. JONES
18. **A preliminary demographic study on a historical cemetery from rural Canada: children mortality at St. Ignace-du-Lac village (Matawinie, Quebec, early 1900s).** I. RIBOT AND M.-É. BOISJOLI.
19. **Saving the Babies from the Bathwater: a new Method for estimating Fertility.** G. ROBBINS.
20. **Stature estimation in an Archaic sample: implications from the Fully Technique.** J.C. BERBESQUE AND G.H. DORAN
21. **Infant growth in a low socioeconomic urban environment.** T. COMER AND L.M. SCHELL.
22. **The incomplete juvenile: cranial vault thickness as an aging technique for juvenile skeletal remains.** E.M. GAROFALO, M.K. ZUCKERMAN AND D.J. ORTNER.
23. **Linear diaphyseal growth in southern African forager children.** L. HARRINGTON AND S. PFEIFFER.
24. **Skeletal height estimation in precontact and postcontact adult populations in northern coastal Peru.** G.J. JAKUBOWSKA

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25. **Relationship of childhood socioeconomic conditions and cohort (historical microenvironments) to adult nutritional status in Blackfoot women.** S.L. JOHNSTON.
26. **Human molar crown formation in Bronze Age Britain.** P. MAHONEY AND C.A. DETER.
27. **Polarized light microscopy of the dural tracks underlying prematurely synostosed coronal sutures in New Zealand white rabbits.** J.C. REED, M. E. KOVACIK, T. BARBANO, M.I. SIEGEL AND M.P. MOONEY.
28. **The impact of craniosynostosis on patent suture complexity.** R.L. WRIGHT AND M.A. WILLIAMSON.
29. **Western medicine meets rural Africa: an assessment of a HIV mother-child transmission program in rural Tanzania and related biocultural issues.** K. BRADLEY AND L.A. WINKLER.
30. **Written on the bones: global transformations, local biologies.** M. CERULLO, D.L. MARTIN AND F. GIAHI.
31. **Trauma risk in the neolithic community at Çatalhöyük, Turkey.** B. GLENCROSS, S.C. AGARWAL AND C.S. LARSEN.
32. **Facial Asymmetry in Relatives of Individuals with Oculo-Auriculo-Vertebral-Spectrum (OAVS).** R.E. WARD, P.L. JAMISON AND T.L. SMARSH.
33. **Community health and cultural bias in predicting HIV rates in Tanzania.** L.A. WINKLER, K. BRADLEY, M. BUSS AND G. WOLFE.
34. **Anemia or scurvy: distinguishing the etiology of porotic hyperostosis via differential cranial vault thickness in juvenile humans.** M.K. ZUCKERMAN, E.M. GAROFALO AND D.J. ORTNER.
35. **Prevalence of overweight and obesity in Turkish adults 20-35 years of age.** Y. BEKTAS, G. AKIN, T. GULTEKIN, B. KOCA OZER, M. SAGIR AND E. GULEC.
36. **Ethnic and menopausal status differences in symptom reports: the Hilo Women's Health Study.** D.E. BROWN, A. GOODLOE, N.J.M. RABACH, A.M. REZA, L.A. MORRISON AND L.L. SIEVERT.
37. **Social stratification in a Christian cemetery? An assessment of stress indicators and social status at Anglo-Saxon Raunds.** E.F. CRAIG AND J.L. BUCKBERRY.
38. **The effects of ethnicity and oral contraceptive use on diurnal electrolyte regulation over the menstrual cycle.** G.D. JAMES.
39. **Life History Theory, Early Childhood Risk and Adolescent Behavior in Colombia.** D. LENDE.
40. **Obesity in an Adult East Indian Community of Limon, Costa Rica.** L. MADRIGAL, M.H. RAXTER, E. RUIZ, F. OTAROLA AND M. BLELL.
41. **The steamroller blues.** J.J. PRUTSMAN-PFEIFFER.
42. **Two northern Nevada Chinese cemeteries: A bioanthropological assessment.** R.W. SCHMIDT.
43. **Patterns of gastrointestinal infection in nineteenth century Rochester, New York.** J.E. SIRIANNI AND R.L. HIGGINS.
44. **Diet and health at Puruchuco-Huaquerones, a Late Horizon cemetery on the central coast of Peru.** J.S. WILLIAMS AND M.S. MURPHY.
45. **Botanical medicines for blood pressure regulation.** R.A. HALBERSTEIN.
46. **Polygyny as a social mediator of women's health in rural and urban Mali.** R.M. BOVE AND C.R. VALEGGIA.
47. **Direct and indirect evidence for a spectrum of endometrial function.** K.B.H. CLANCY.
48. **The ecology of puberty: C-peptide and anthropometry in an Eastern Toba population.** M.W. REICHES, C.R. VALEGGIA AND P.T. ELLISON.
49. **Variation in facial features among European populations measured from 3D photographs.** D.K. LIBERTON, B. MCEVOY, M. BAUCHET, C.A. HILL, J.T. RICHTSMIEIER, T. FRUDAKIS AND M.D. SHRIVER.

**Session 34. Primate and Human Genetics. Contributed Posters. Bromley Room.**

Chair: RIPAN MALHI, University of Illinois, Urbana-Champaign.

1:00 – 1:30 pm

Poster set-up.

1:30 – 3:00 pm

Authors of even-numbered posters present for questions.

3:30 – 5:00 pm      Authors of odd-numbered posters present for questions.  
 5:00 – 5:30 pm      Poster take-down.

1.      **High inter-individual microbial diversity among baboon vaginal ecosystems.** A. RIVERA, R. STUMPF, M. HO, S. SHARMA, N. NAKAMURA, S.R. LEIGH, B.A. WILSON.
2.      **Genetic contributions to normal variation in expression of a gene associated with susceptibility to multiple human autoimmune disorders (*PTPN22*) in baboons.** A. VINSON, N. BOTTINI, D.E. NEWMAN, T.D. DYER, C.M. JETT, M.P. JOHNSON, J.E. CURRAN, E.K. MOSES, J. BLANGERO, S.A. COLE, L.A. COX, J. ROGERS, J.L. VANDEBERG, C. BRUGNARA, O.S. PLATT AND M.C. MAHANEY.
3.      **The state of bone preservation is related to successful genetic sex determination of medieval skeletal remains from Dubovany cemetery, Slovakia.** M. BAUEROVÁ, L. LUPTÁKOVÁ, R. OMELKA, M. MARTINIAKOVÁ, M. VONDRÁKOVÁ AND M. BAUER.
4.      **Molecular sequence data from *Treponema pallidum* elucidate the possible evolutionary histories for three human pathogenic subspecies.** R.R. GRAY, C.J. MULLIGAN, B.J. MOLINI, L. GIACANI, C. GODORNES, S.A. LUKEHART AND A. CENTURION-LARA.
5.      **Sahara passage: the post-glacial re-colonisation of North Africa by mitochondrial L\* haplotypes.** A.D. HOLDEN AND P. FORSTER.
6.      **A comparison of mitochondrial diversity in the Papua New Guinea Highlands, islands in the Bismarck Archipelago, and Easter Island.** D.N. JAMES, J.G. LORENZ, F.R. FRIEDLAENDER, G. KOKI AND J.S. FRIEDLAENDER.
7.      **Characterization of mitochondrial DNA variation and population structure of Papua New Guinea.** E.J. LEE, J.S. FRIEDLAENDER<sup>2</sup>, D.A. MERRIWETHER.
8.      **Mitochondrial DNA diversity in six Mennonite communities from Kansas and Nebraska.** P.E. MELTON, M.J. MOSHER AND M.H. CRAWFORD.
9.      **Variability in the ESR and CALCR genes in Slovak postmenopausal women and its associations with bone mineral density, bone-related biochemical markers and fracture incidence.** R. OMELKA, M. MARTINIAKOVÁ, V. KRAJČOVIČOVÁ, D. GALBAVÝ AND M. BAUEROVÁ.
10.     **Nucleotide sequence variation of the oxytocin receptor (*OXT*) locus in ethnically diverse human populations.** L.A. PFEIFER AND S.A. TISHKOFF.
11.     **How short is too short? Evaluating the explanatory power of statistical modeling methods when using recent ancient DNA data.** A. SCOLA, C. HUFF, E. MARCHANI, AND D. H. O'ROURKE.
12.     **Identification of polymorphic markers in the Rhesus macaque (*Macaca mulatta*) genome.** M. WATSA.
13.     **Admixture in Mexico City: implications for admixture mapping.** E. CAMERON, V.L. MARTINEZ-MARIGNAC, A. VALLADARES, A. CHAN, A. PERERA, R. GLOBUS-GOLDBERG, N. WACHER, J. KUMATE, P. MCKEIGUE, D. O'DONNELL, M.D. SHRIVER, M. CRUZ AND E.J. PARRA.
14.     **A phylogeographic analysis of haplogroup D5 and its implications for the peopling of East Asia.** M.C. DULIK, O. GOKCUMEN, S.I. ZHADANOV, L.P. OSIPOVA, T.G. SCHURR.
15.     **Ancient Cemetery Social Patterning Project: Ancient DNA in Tirup Cemetery.** L.E. BAKER, B.M. USHER, J.D. WEETS, J.L. BOLDSSEN AND D.T. CASE.
16.     **Analysis of Genetic Diversity in Ethnic Populations of Afghanistan.** P. BERMUDEZ, C. PANTER-BRICK, S. IKRAM, S. SAFDAR, M. EGGGERMAN AND T.G. SCHURR.
17.     **Intracontinental Distribution of Haplotype Variation: Implications for Human Demographic History.** M.C. CAMPBELL, S.A. TISHKOFF, C.D. BUSTAMANTE, J.H. LEE, A. CARRACEDO, E.J. PARRA, R. DESALLE AND R.L. HOLLOWAY.
18.     **The impact of geography, ecology and language on native South American genetic structure.** M.E. HEALY AND K. HUNLEY.
19.     **A comparison of mitochondrial DNA and Y chromosome DNA variation on Manus Island.** K.E. LATHAM, D.N. JAMES, J.G. LORENZ, F.R. FRIEDLAENDER AND J.S. FRIEDLAENDER.
20.     **Mitochondrial D-loop characterization of the Amazonian Ticuna population.** J.G. LUEDTKE AND D.A. MERRIWETHER.
21.     **Using Nested Clade Analysis to explore temporal change in ancient population structure with aDNA sequence data.** B. MALEY.
22.     **Collaboration with a Native American community reveals novel insight into mitochondrial DNA history of Native North Americans.** R.S. MALHI, J.S. CYBULSKI AND H. HARRY.
23.     **An anthroposcopic approach to South Indian human population genetics: coalescence of data from the literature.** J.L. MAYHER, R.S. CORRUCINI AND V. RAMI REDDY.
24.     **Domestication of alpacas: Genetics of the North American herd.** D.A. MERRIWETHER.

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25. **Contribution of mitochondrial diseases to molecular anthropology: haplogroup distribution of A3243G French patients.** D. PIERRON, C. ROCHER, D. THORAVAIL, T. LETELLIER AND P. MURAIL.
26. **Heritability of the human jaw and dentition.** R.J. SHERWOOD, D.L. DUREN, S. WILLIAMS-BLANGERO, J. BLANGERO, R. SHRESTHA, J. SUBEDI, B. JHA AND B. TOWNE.
27. **Genetic Diversity of Native Peruvian Populations: mtDNA Analyses of Two Native Amazonian Populations.** S.E. SMITH, G.S. CABANA, V. RUBIN DE CELIS, M. CONTRERAS AND A.C. STONE.
28. **Genetic structure and implications for human biological and cultural evolution: a case study of the Yanomamo.** J.E. SPENCE, K. HUNLEY AND D.A. MERRIWETHER.
29. **Integrating the SWGDAM forensic mitochondrial DNA database into the anthropology community.** R.M. THOMAS, B. BUDOWLE AND D. POLANSKEY.
30. **Skeletal and genetic determination of spatial social patterns in cemeteries.** B.M. USHER AND R.S. POLMATEER
31. **Evidence for modularity in the cranium: quantitative genetic analysis of a pedigreed mouse population.** O.T. RIZK AND L.J. HLUSKO.
32. **Evolution of candidate genes underlying increased relative testes size in chimpanzees.** S. BANDLA, A.P.J. DE KONING AND C.-B. STEWART.
33. **Color vision and food detection in squirrel monkeys (*Saimiri boliviensis*).** M.R. SHATTUCK.

**Session 35. Recent Advances in Understanding Oral Pathology: Clinical, Evolutionary and Prehistoric Perspectives on Sex and Status Differences. Symposium. Ballroom E.**

Organizer and Chair: JOHN LUKACS, University of Oregon.

In this symposium recent advances in clinical research on mechanisms of dental disease in living humans are reviewed with the goal of contributing to a broader and more precise understanding of the role these processes play in causing differences in dental health by gender and status in past peoples. Clinical researchers document new research on cariogenesis and epidemiological case studies of living populations. Anthropologists present recent data illustrating sex and status differences in prehistory as well as ecological and evolutionary perspectives on sex differences in dental health.

- 1:00 pm **New perspectives on cariogenesis: Implications for anthropological and epidemiological research.** D.T. ZERO, A. FERREIRA ZANDONÁ AND H. EGGERTSSON
- 1:15 pm **Nutritional status and dental health: the complicating influence of gender and status.** WALTER PSOTER.
- 1:30 pm **The relationship between height and dental caries – A life course perspective.** B NICOLAU
- 1:45 pm **Methodological issues in comparing dental pathology profiles of human populations past and present.** S.W. HILLSON.
- 2:00 pm **Sex differences in dental caries in living populations: a global meta-analysis.** JOHN R. LUKACS.
- 2:15 pm **Evolutionary perspectives on pregnancy and its impact on dental health in women.** M. CHEYNEY.
- 2:30 pm **Food Cravings and Aversions in Pregnancy: An Evolutionary Perspective on Gender Differences in Dental Health.** H. VALLIANATOS
- 2:45 pm **Break**
- 3:00 pm **Sex and gender differences in periapical lesions: clinical and anthropological perspectives.** K.W. ALT, A. ROSSBACH AND A. GRAEFEN.
- 3:15 pm **Dental indicators of hunter-gatherer adaptation and cultural change in the mid-Holocene Cis-Baikal (Siberia).** A.R. LIEVERSE.
- 3:30 pm **Gender, wealth, and status in Bronze Age Central Asia: a dental pathology investigation.** B.E. HEMPHILL.
- 3:45 pm **Early childhood caries in prehistoric Southeast Asia: oral health in an often ambiguous status and gender category.** M.F. OXENHAM, H. MATSUMURA, K. DOMETT, D.K. NGUYEN, T.K. NGUYEN AND C.L. NGUYEN.
- 4:00 pm **Dental pathology and diet at Apollonia, a Greek colony (5th-2<sup>nd</sup> centuries BC) on the Black Sea.** A. KEENLEYSIDE
- 4:15 pm **Differences in dental health by sex and status in Mesoamerica.** A. CUCINA AND V. TIESLER.

4:30 pm **Discussant:** J.T. MAYHALL

### **Session 36. Primate Behavior and Ecology.** Contributed Papers. *Ballrooms A/B.*

Chair: LISA M. PACHIULLI. Ithaca College.

- 1:00 pm **Experimental field study of handedness in wild tufted (*Cebus nigritus*) and white-faced (*Cebus capucinus*) capuchins: Evidence for individual and species differences.** P.A. GARBER, D.F. GOMES AND J.C. BICCA-MARQUES.
- 1:15 pm **Patterns of positional behavior among atelines: a comparative analysis of *Alouatta seniculus*, *Lagothrix lagotricha*, and *Ateles belzebuth* in Ecuador.** D.M. GUILLOT, R.R. LAWLER AND L.M. MACLATCHY.
- 1:30 pm **Lessons from collaborative bio-cultural anthropological research for improving conservation of African apes and protected area management.** M. J. REMIS AND R. HARDIN.
- 1:45 pm **The impact of selective logging on sifaka feeding behavior and food quality in Ranomafana National Park, Madagascar.** S.J. ARRIGONELSON.
- 2:00 pm **Lemurs through time: using stable isotopes from modern animals to understand extinct communities.** B.E. CROWLEY, P.L. KOCH, L.R. GODFREY AND D.A. BURNEY.
- 2:15 pm **Site differences in orangutan (*Pongo spp.*) behavioral ecology: Implications for sociality and community structure.** R.A. DELGADO, JR. AND C.D. KNOTT.
- 2:30 pm **Ecological influences on red howler monkey density: A comparison of two Western Amazonian sites.** A.M. DERBY.
- 2:45 pm **Ethoarchaeology of manual laterality: well-digging by wild chimpanzees.** L.F. MARCHANT, W.C. MCGREW AND K.D. HUNT.
- 3:00 pm **Break**
- 3:15 pm **Prospects for bonobo insectivory: what's on the menu at Lui Kotal.** W.C. MCGREW, L.F. MARCHANT, M.M. BEUERLEIN AND D. VRANCKEN,
- 3:30 pm **The seasonality of sex differences in the feeding ecology of the chimpanzees (*Pan troglodytes*) of Kibale National Park, Uganda.** A. POKEMPNER.
- 3:45 pm **Niche expansion of a cryptic primate, *Callimico goeldii*, during polyspecific associations.** L.M. PORTER AND P.A. GARBER.
- 4:00 pm **Implications of spatial and temporal heterogeneity of food resources for variation in chimpanzee community size in Kibale National Park, Uganda.** K.B. POTTS, C.A. CHAPMAN AND J.S. LWANGA.
- 4:15 pm **The effects of demographic and ecological factors on territory size and ranging patterns of Argentinean owl monkeys (*Aotus azarai*).** M.V. RAKHOVSKAYA, E. FERNANDEZ-DUQUE AND A. DI FIORE.
- 4:30 pm **The role of social learning in the acquisition of foraging skills in wild Bornean orang-utans (*Pongo pygmaeus*).** A. JAEGGI, L. DUNKEL AND C.P. VAN SCHAİK.
- 4:45 pm **Parasite ecology and socioecology of ring-tailed lemurs (*Lemur catta*) and Verreaux's sifaka (*Propithecus verreauxi*) at the Beza Mahafaly Special Reserve, southwest Madagascar.** J.E. LOUDON AND M.L. SAUTHER.

### **Session 37. Diet, Health and Stature.** Contributed Papers. *Ballroom D.*

Chair: HOLGER SCHUTKOWSKI. University of Bradford.

- 1:00 pm **Historic African-Americans of Virginia: mortality, stress and secular change from 1690 – 1930.** D.C. BOYD AND C.C. BOYD
- 1:15 pm **Diet during imperial influence in ancient Peru: The impact of the Wari Empire on Nasca populations (AD 750-1000).** C.M. KELLNER AND M.J. SCHOENINGER.
- 1:30 pm **Biological evidence for increased sedentism during the mid-late Holocene at Dakhleh Oasis, Egypt.** J.L. THOMPSON
- 1:45 pm **Acculturation and geographic origins: Integrative bioarchaeological and archaeological chemical analyses of an individual from Solcor 3, north Chile.** C. TORRES-ROUFF AND K.J. KNUDSON.

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**Saturday Afternoon – March 31, 2007**


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- 2:00 pm **The Biological Diversity of the Early Medieval European Population, in Light of Discrete Traits: Central versus Southwest Europe.** P. VELEMÍNSKÝ, J. VELEMÍNSKÁ, D. CASTEX, M. DOBISIKOVÁ, J. BRŮŽEK AND L. POLÁČEK.
- 2:15 pm **Feeding the children: Isotopic evidence for weaning practices in the ancient Greek colony of Apollonia (5<sup>th</sup>-2<sup>nd</sup> centuries BC).** C. KWOK AND A. KEENLEYSIDE.
- 2:30 pm **Diet and subsistence during the Middle Bronze at Sidon, Lebanon - The isotope evidence.** H. SCHUTKOWSKI AND M.P. RICHARDS.
- 2:45 pm **Break**
- 3:00 pm **Marine and Terrestrial Resource Consumption in Late Holocene Central California: Stable Isotopic Evidence from San Francisco Bay and the Lower Sacramento Valley.** ERIC J. BARTELINK AND LORI E. WRIGHT.
- 3:15 pm **An animal model for the assessment of Harris lines in relation to growth and nutritional stress.** M.P. ALFONSO AND M.A. LITTLE.
- 3:30 pm **Strontium isotope evidence for prehistoric migration in the Valley of Cuzco, Peru: a diachronic study of pre-Inca and Inca populations.** V.A. ANDRUSHKO, M.R. BUZON, A. SIMONETTI AND R.A. CREASER.
- 3:45 pm **Prediction of body size from juvenile skeletal remains, with application to KNM-WT 15000.** C.B. RUFF.
- 4:00 pm **New long bone stature estimation equations for ancient Egyptians.** M.H. RAXTER, C.B. RUFF, A. AZAB, M. ERFAN, M. SOLIMAN, A. EL-SAWAF AND B.M. AUERBACH.
- 4:15 pm **Early life pollutant exposure of enslaved Africans in colonial New York: a microspatial analysis of dental enamel lead.** J.L. JONES, A.H. GOODMAN, D. AMARASIRIWARDENA, M.L. BLAKEY AND A.N. SMITH.
- 4:30 pm **Effects of rearing temperature on long bone growth in mice: an experimental model for examining Allen's rule.** M.A. SERRAT, D. KING AND C.O. LOVEJOY.
- 4:45 pm **Ongoing work with the Helena Crossing collection: An analysis of life, health, and death in an Arkansas community.** J.M. BAUDER, M.P. ALFONSO AND B.T. GILES.

**Session 38. Functional Anatomy and Locomotion.** Contributed Papers. Ballroom C.

Chair: DAVID WEBB. Kutztown University.

- 1:00 pm **Does the morphology of the human atlas and axis reflect bipedality? A multivariate approach to functional morphology.** P. MITTEROECKER, E. MANFREDA, F.L. BOOKSTEIN AND K. SCHAEFER.
- 1:15 pm **Plantar Pressure and Foot Shape in habitual barefoot Walkers.** P. AERTS, A.S. VINAYA, D. DE CLERCQ, B. VAN GHELUWE, K. D'AOÛT.
- 1:30 pm **Foot dorsiflexion during vertical climbing in chimpanzees.** J.M. DESILVA.
- 1:45 pm **Primate locomotion and the semicircular canal system.** F. SPOOR, T. GARLAND JR., G. KROVITZ, T.M. RYAN, M.T. SILCOX AND A. WALKER.
- 2:00 pm **Comparative forefoot bone architecture in extant hominids.** N.L. GRIFFIN, B.G. RICHMOND AND R.A. KETCHAM.
- 2:15 pm **Why are our toes so tiny? Walking, running and the evolution of a short forefoot in the genus *Homo*.** C. ROLIAN, D.E. LIEBERMAN AND J.W. SCOTT.
- 2:30 pm **New primate fossils from Rusinga Island, Kenya.** K.P. MCNULTY, W.E.H. HARCOURT-SMITH AND H.M. DUNSWORTH.
- 2:45 pm **What can small mammals tell us about giant lemurs?: Paleoenvironment of the late Holocene fauna at Ankilitelo Cave, SW Madagascar.** K.M. MULDOON AND E.L. SIMONS.
- 3:00 pm **Break**
- 3:15 pm **Experimental determination of behavioral input to diaphyseal cross-sectional shape: a mouse model approach.** K.J. CARLSON AND S. JUDEX
- 3:30 pm **Dental microwear texture analysis of megaladapids and archaeolemurids.** J.R. SCOTT, P.S. UNGAR, W.L. JUNGERS, L.R. GODFREY, R.S. SCOTT, E.L. SIMONS, M.F. TEAFORD AND A. WALKER.

- 3:45 pm **And the band played on: maintaining dental function across the life span in *Hadropithecus stenognathus*, an extinct giant lemur from Madagascar.** S.J. KING, A. HITCHCOCK, G.T. SCHWARTZ AND L.R. GODFREY.
- 4:00 pm **Ontogeny and phyletic size change in living and fossil Malagasy primates.** M.J. RAVOSA
- 4:15 pm **Mechanical adaptation of trabecular bone in the growing human femur and humerus.** T.M. RYAN, B. VAN RIETBERGEN AND G. KROVITZ.
- 4:30 pm **Ontogeny of digitigrade hand and foot postures in infant baboons (*Papio cynocephalus*).** A. ZEININGER, L.J. SHAPIRO AND D.A. RAICHLEN.
- 4:45 pm **Intrinsic hand proportions of plesiadapiforms and extant euarchontan mammals.** E.C. KIRK, P. LEMELIN, J.I. BLOCH, D.M. BOYER AND M.W. HAMRICK.

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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

### Hybrids, spandrels, and the evolution of development: insights from baboons.

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While much recent attention has focused on hybridization, particularly when considering the evolution of modern humans, relatively little attention has been paid to understanding the skeletons of known primate hybrids, or to considering how they can inform our understanding of evolutionary process. Here I discuss the craniofacial morphology of a sample of hybrid baboons (N=57). In particular, I focus on how the morphological manifestation of the breakdown of early development in this sample allows us to consider the genetic underpinnings of developmental divergence of the parental taxa, and potentially to gain insight into the evolutionary processes responsible for this divergence. Dental abnormalities, especially supernumerary teeth, are prevalent in this sample and vary in expression; they probably result from an extension of tooth morphogenesis. Recent research suggests that genes which have been shown to affect tooth morphogenesis and differentiation are part of a network which regulates the development of a suite of ectodermally-derived tissues. One possible evolutionary explanation for the divergence of the parental baboon taxa is that selection is acting on this system, particularly since abnormal traits that appear in hybrid offspring but not in parental animals are considered the result of mixing two separately co-adapted genomes. In this light, the anomalies seen in the baboon sample may be 'spandrels' resulting from differential selection on other aspects of morphology (e.g. pelage) that are targeted by shared regulatory genes. Future consideration of similarly integrated networks might provide important insight into evolutionary developmental divergence in Plio-Pleistocene primates, including hominins.

### Habitat use of habituated versus unhabituated gorilla groups in Bwindi Impenetrable National Park, Uganda: A preliminary study.

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Ecotourism is a conservation tool proposed to ensure the mountain gorillas' survival, but the habituation process required for tourism likely has consequences. This study compares behaviors of habituated versus unhabituated gorillas at the Nkuringo

site in Bwindi National Park from June-August 2005. As a result of the habituated groups's reduced fear towards humans, it was hypothesized they would spend more time outside the park boundary, in and around agricultural land, than unhabituated groups within the same study area. Data were collected indirectly on one habituated group, Nkuringo with 19 individuals (n=20 days), and two unhabituated groups XY with 7 individuals (n=10 days) and W with 4 individuals (n=6 days). Global position data support the hypothesis that Nkuringo spent significantly more time outside the park (95%) than either XY (9%) or W (16%) (p < 0.01). Furthermore, when outside the park, Nkuringo traveled shorter daily distances than either of the two unhabituated groups, regardless of its much larger group size (Nkuringo= 580m, XY= 646m, W= 1327m; F<sub>[2, 33]</sub> = 8.86, p<0.05). Vegetation analyses at this site demonstrate a greater availability and distribution of both wild plant and crop species used by the gorillas for food and nesting outside versus inside the park, which would support shorter daily path lengths. Preliminary results suggest that habituation of gorillas living near the park boundary can significantly influence their behavioral ecology. It is therefore recommended that management consider habituating gorillas deeper within the park to avoid groups from including agricultural areas into their home ranges.

### A multivariate analysis for sex determination from deciduous, morphometric tooth traits

C, J. Adler and D. Donlon.  
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Sex identification of juvenile skeletons is difficult due to the subtlety of sexual dimorphism. Previously, sexual dimorphism has been observed in the crown size of deciduous teeth. There is little investigation of alternative morphometric tooth traits or application of these to multivariate analysis, to classify sex. It was hypothesized that using multiple tooth traits would improve the sex classification accuracy.

The data were collected from 151 Caucasian children from Sydney, Australia. The variables recorded on the deciduous teeth in the mixed dentition, included crown size, the size of the trigonid and talonid, Carabelli's trait and molar cusp number. Two types of multivariate analysis, linear discriminant analysis and logistic regression, were used to determine sex classification accuracy. Males exceeded females in 22 of the 24 variables. Crown size was significantly different between the sexes in ten of the

twelve diameters and the average sexual dimorphism was 2.92 %. The trigonid and talonid displayed significant sex differences in six of the eight dimensions. The average sexual dimorphism was 4.77 %. The highest sexual dimorphism of all variables was 11.11 %, in the trigonid of the first deciduous molar. The morphological tooth traits, Carabelli's and molar cusp number, displayed non-significant sex differences. Using all 24 variables, the accuracy of sex classification was 76.5 % to 79.5 %. Selecting only maxillary variables, sex classification was 57.0 % and 78.8 % for mandibular variables. Compared with previous studies, the accuracy of sex classification was improved by adding trigonid and talonid measurements to simple crown size.

### Plantar Pressure and Foot Shape in habitual barefoot Walkers.

P. Aerts <sup>1,2</sup>, A.S. Vinaya <sup>3</sup>, D. De Clercq <sup>4</sup>, B. Van Gheluwe <sup>5</sup>, K. D'Août <sup>1,6</sup>. <sup>1</sup> University of Antwerp, Belgium <sup>2</sup> Ghent University, Belgium <sup>3</sup> Jain Institute of Vascular Sciences, Bangalore, India <sup>6</sup> Centre for Research and Conservation, Belgium.

Footwear only appeared when humans were already anatomically modern. Therefore, native barefoot walkers represent the biologically normal situation. We performed barefoot plantar pressure measurements on 27 habitually barefoot Indians, 126 habitually shod Indians and 49 Westerners, documenting foot shape (length, width, and relative width of the metatarsal and phalangeal zones), foot type (relative amount of midfoot contact area) and the distribution of pressures and relative impulses.

Westerners had narrower feet than both Indian groups, who did not differ. The shape of the toe region differs significantly between the groups, being most fan-shaped in barefoot Indians and narrowest in Westerners. These differences in overall foot shape reflect differences in both footwear use and in ethnicity. On average, Westerners had a slightly higher longitudinal foot arch, than both Indian groups. Strikingly, the variation within the Western group was significantly larger than in both Indian groups, i.e. Western feet ranged from very flat to high-arched, whereas such extreme foot types were rare in Indian feet.

Relative impulses, indicating overall load, were similar in both Indian groups, which had lower values in the heel and higher values in the midfoot. In the metatarsal and toe region, no differences were found. Peak pressures showed a similar pattern, although barefoot walkers had lower heel pressures



and higher midfoot pressures than shod Indians.

Our analyses strongly suggest that footwear has a subtle but existing influence on foot anatomy and function. Therefore, habitually barefoot walkers should ideally be used as the base of comparison in evolutionary studies.

**Histomorphological aging of subadults: A test of Streeter's method on a medieval archaeological population.**

A.M. Agnew<sup>1</sup>, M. Streeter<sup>2</sup>, S.D. Stout<sup>1</sup>.  
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Cortical bone growth, modeling, and remodeling in subadult ribs are so dynamic that age-related patterns of histomorphology are extremely complex. Resulting young mean tissue-ages make adult histomorphological age estimation methods not applicable to subadults. Streeter (2005) has developed a method for subadult age-estimation that recognizes four distinct histomorphological age phases based upon the amount and location of woven bone, circumferential lamellae, secondary osteons, drifting osteons, primary vascular canals, and primary lamellar bone. The purpose of this research is to establish whether Streeter's subadult age phases are observable in archaeological skeletal remains, and to test its ability to estimate age relative to standard osteological methods. Rib cross sections from the medieval cemetery at Giecz, Poland (11-12 c.) were analyzed and individuals placed into one of Streeter's four defined age groups (Phases I-IV). When assigned histomorphological phases for each individual are compared with ages determined by standard osteological methods, there is only 38% agreement. Seriation based on diaphyseal lengths, however, shows a progression of Streeter's phases corresponding with increasing diaphyseal lengths. This suggests different patterns of growth and development in the medieval population relative to the modern population upon which Streeter's method is based. It is concluded that, although general stages of development can be identified based upon rib histomorphology in subadults, Streeter's method should not be used to predict age at death in archaeological populations without further research.

**Tarsal osteology of Charcot joint osteoarthropathy.**

D. Agoada, Department of Forensic Medicine, Philadelphia College of Osteopathic Medicine.

Charcot joint osteoarthropathy is described as traumatic bone and joint changes that take place in individuals with sensory impairment. The damage is usually initiated by minor injury that the individual is unaware of. Continued stress results in fracture of bone, and joint dislocation. The involved body part is usually red, hot and

swollen, though the individual may have little, if any, discomfort. As the affected area goes from the acute stage to the chronic stage, the inflammation will lessen and joints and bone may fuse. Once healing is complete, the result may be a bizarre, grossly deformed body structure, permanently altered in structure and function.

Due to stress and strain on the human foot in bipedal locomotion, Charcot joint osteoarthropathy is often seen in the tarsal region of an individual with peripheral neuropathy. In the United States, pedal Charcot joint osteoarthropathy is most commonly present in patients with diabetes mellitus and the complication of peripheral neuropathy. However, before modern medicine prolonged the life of individuals with diabetes, neuropathy was usually the result of infectious processes, such as leprosy and syphilis, or due to spinal or peripheral nerve injuries.

In this study, the amputated feet of four diabetic patients with tarsal deformities secondary to Charcot joint osteoarthropathy have been examined, x-rayed, and skeletalized. The osteological changes have been described. Though a small sample size, these observations will be useful in interpreting the paleopathology of pedal remains found in archeological and prehistoric context.

**Determining sex using the upper limb.**

J. Albanese, Department of Sociology and Anthropology, University of Windsor.

A new probabilistic metric sex determination method is presented using various combinations of traditional and new measurements of the clavicle and arm bones. A sample from the Terry Collection and the Coimbra Collection (n = 566) was used to develop and test a series of logistic regression equations, a robust statistical approach that is ideal for predicting a dichotomous dependent variable such as sex. The study represents a new application of the methodology that has been previously used to develop highly accurate metric sex determination methods that are not population specific and are widely applicable in forensic and archaeological contexts using the pelvis and femur (Albanese 2003). The sample was selected to include a wide range of human variation. Allocation accuracies for various equations exceed 90% when tested with an independent sample not used to create the equations (n = 136). The differences in allocation accuracy by sex are minimal for all equations. Additionally, in most cases when allocation is incorrect, the probabilistic approach clearly indicates when no confidence should be placed in the allocation. In other words, it is obvious when the equations fail and the results should not be considered valid. In 134 of 136 independent test cases, the best equation predicted the correct sex (91%) or classified an ambiguous case as sex indeterminate (7%). Only one male and one female out of

136 individuals in the test sample were incorrectly allocated. Unlike other metric methods for sex determination, the methods work well on larger females and smaller males.

Funding for this research was provided by the Social Science and Humanities Research Council of Canada.

**The importance of being dad: paternal care in a polygynandrous mating system.**

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Many male primates exhibit obvious male-male competition and have pronounced weapons (their canines) and large body size. Consequently, research on sexual selection in these species has usually focused on fighting ability and gaining access to females. This has resulted in an archetypal view in which male primates are primarily selected for fighting. However, researchers have long understood that sexual selection must be acting on many other traits of male primates. Here we discuss results from our study and others, showing that male baboons exhibit mate choice and provide paternal care, and that social bonds between paternal half siblings, possibly mediated by relationships with the father, occur in both baboons and macaques. Consequently, a more nuanced view of male primates is emerging, one in which males carefully allocate their mating and paternal effort, and in which paternal kinship has the potential to structure relationships in the same ways that maternal kinship does.

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**New cercopithecoid fossils from Asbole, Ethiopia and their environmental and ecological significance.**

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A sample of 117 fossil cercopithecids has been collected from the Middle Pleistocene site of Asbole, Afar Region, Ethiopia. A minimum of five species is present. There are two species of Cercopithecini, here recognized as cf. *Chlorocebus* aff. *aethiops*, and cf. *Chlorocebus* cf. *patas*. There are also two species of Papionini: *Papio hamadryas* ssp. indet. and *Theropithecus oswaldi leakeyi*. Finally there is a single species of colobine present, *Colobus* sp. indet. The assemblage is chronologically constrained and is derived from sediments dated to approximately 600

Ka. Cercopithecids make up a large component of the mammalian fauna from Asbole, and among cercopithecids *Colobus* sp. is by far the most common species present, outnumbering the other four species combined. Among Middle Pleistocene Afar sites, Asbole is most like Andalee in these respects, and differs from Daka and Dawaitoli, where cercopithecids, and colobines in particular, are rare. Asbole differs from Andalee in other respects. Cercopithecines are less relatively abundant at Asbole and *Papio* is absent at Andalee. Overall, the cercopithecids are consistent with the other fauna from Asbole, indicating a relatively wooded paleoenvironment.

This research was supported by the Leakey Foundation, CNRS, the Ministère des Affaires Étrangères, the New York College of Osteopathic Medicine, and the University of Oregon.

#### **An animal model for the assessment of Harris lines in relation to growth and nutritional stress.**

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Harris lines are transverse radiopaque lines visible in radiographs and histological cuts of long bones. They are frequently used as markers of slowed or stopped growth in both paleopathology and archaeology studies. Their association with illness, and deficient growth is however low, and it is unclear whether, if associated with stress at all, they result from chronic or acute conditions. Indeed, the interpretation of Harris lines as a stress marker is questionable since new studies show that growth is saltatory, and that its occasional but repetitive absence is normal. Harris lines, then, must be reevaluated, since they may result from normal growth.

This study evaluated whether Harris lines are: 1) associated with deficient growth and nutrition; or, 2) the normal outcome of growth. Three groups of New Zealand white rabbits were used in this study. The control group (C) was raised under normal laboratory conditions. The undernourished experimental group (E1) was fed with a restricted diet (chronic stress), while the second experimental group (E2) was exposed to repetitive fasting during growth (acute stress). The right front limb was measured every two days to control for growth, and monthly x-rays of this limb were taken to document Harris lines formation. Results obtained from growth and Harris lines are evaluated to determine the possible association of Harris lines with growth, and/or nutritional deficiencies.

This study has been funded by American Women in Science, Sigma-Xi, and Wenner-Gren (Gr-7431).

#### **Functional morphology of the *Kenyapithecus* hand from Maboko Island (Kenya)**

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*Kenyapithecus* hand elements from the middle Miocene site of Maboko Island (Kenya) were analyzed to reconstruct locomotor capabilities. Of particular interest is a complete third metacarpal, which displays an amalgam of characteristics unparalleled in living primates. A prominent dorsal transverse ridge, or metacarpal torus, exists on the dorsal surface of the metacarpal head, presumably to prevent hyperextension of the metacarpophalangeal joint. We quantified this feature in several ways, all of which ally *Kenyapithecus* with extant African apes. When the total height of the metacarpal head (including metacarpal torus) is divided by the height of the head measured at the base of the torus, African knuckle-walkers are separated from all other catarrhines. Although it has been suggested that this feature may be indicative of the ventral digitigrady of terrestrial cercopithecines, our measurements found no indication of significant bony expansion of this feature in those groups. Inouye's (1994) method likewise confirms the moderate prominence of this feature in *Kenyapithecus*.

Overall, the metacarpal morphology of *Kenyapithecus* is dissimilar to that of extant African apes. *Kenyapithecus* lacks the proximal stabilization characteristics seen in modern knuckle-walkers. No significant degree of mediolateral and dorsopalmar expansion is found at either articular end. The transverse orientation of the carpometacarpal joint and the overall shape of the proximal and distal articulations are more similar to those of non-hominoid anthropoids. This likely reflects a strong retention of primitive catarrhine morphology. Although the metacarpophalangeal joint is similar to that of extant knuckle-walkers, the carpometacarpal articulations reveal a more generalized functional morphology.

#### **An evaluation of the precision of two histological age estimation techniques.**

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Paleohistology can be a very useful tool in estimating age at death of individuals in past populations. This study tests the precision of two histological aging methods based upon the ribs. Cross-sections of the ribs were attained from 32 individuals with estimated osteological ages of 17 or older from Orendorf, a Middle Mississippian Population (ca. AD 1150) from west-central Illinois. Initial examination of the 35 prepared histological slides led to a useable sample size of nine due to preservation problems at the microscopic level. The histological methods of Stout and Paine (1992) and Cho et. al. (2002) were compared to osteological age estimations based upon the pubic symphysis, auricular surface, and suture closings to assess the

precision of the age ranges. Due to the small sample size and the concern about normality, statistical analysis was performed using the Wilcoxin test. Results indicate that the population specific equation for African Americans provided by Cho et. al. (2002) is the only one to provide results equivalent to the osteological aging methods in the Orendorf sample. The other three Cho et. al. (2002) formulae produced variable results that tended to be older than the osteological ages. In the Orendorf sample, the Stout and Paine (1992) method tends to underestimate the age of individuals when compared to the osteological age estimates. Based upon the results of this study, histological aging methods are not recommended for ancient skeletons for which osteological ages are reliable, given that the histological preservation cannot be deduced prior to sectioning.

#### **A comparative analysis of lingual fungiform papillae and diet in primates.**

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Fungiform papillae contain the only taste buds on the anterior two-thirds of the tongue, and are the first gustatory structures to come into contact with food items. Research on humans has shown that the density of lingual fungiform papillae (DFP) is associated with food selection. The goal of this research is to better understand the relationship between primate gustatory anatomy and diet by investigating inter-specific variation in lingual anatomy. I hypothesize that DFP is associated with species-specific dietary patterns. To test this hypothesis, DFP was quantified in four primate taxa—*Alouatta palliata*, *Ateles* sp., *Colobus guereza*, and *Cercopithecus aethiops*. Both *A. palliata* and *C. guereza* are leaf specialists. By contrast, *Ateles* is frugivorous and *C. aethiops* has a diet mostly comprised of flowers and seeds. DFP was analyzed within each radiation, comparing the two ateline and two cercopithecoid species separately. The DFPs of *A. palliata* (n = 20; mean 24.6±10.0) and *Ateles* (n = 5; mean 64.5±14.2) differ significantly (Mann-Whitney U, p < 0.01). *C. guereza* (n = 2; mean 23.1±6.52) and *C. aethiops* (n = 18; mean 133.1±38.6) also differ significantly in their DFPs (Mann-Whitney U, p < 0.01). These results are significant when correcting for body mass. Accordingly, in both comparisons, the folivorous species has a significantly lower DFP than its non-folivore relative. These results suggest that the sensory mechanisms used in food selection have evolved to serve different functions in folivorous and non-folivorous primates.

#### **Sex and gender differences in periapical lesions: clinical and anthropological perspectives.**

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Gender specific medicine is a part of gender research which has been insufficiently considered up to the present in both medicine and anthropology. Dental disease is an important topic in paleopathological studies because they provide useful information about former living conditions and dietary patterns. The purpose of this study is to compare the prevalence and frequency of periapical lesions in both recent and (pre)historic populations under sex and gender aspects. The etiology of periapical lesions is different in ancient and modern times. Today, dental caries is the main risk factor for endodontic infection, which results in periapical lesions. In former times, periapical lesions were associated not only with dental caries, but also with extensive dental wear. The clinical examination and diagnoses of endodontic cases are based on radiography, while the differentiation of periapical lesions is carried out by soft tissue histology. Recently we developed criteria for differentiating periapical granulomas from radicular cysts in human skeletal remains based on, amongst others, defect size, X-ray representation, resorption of the root apex, shape and surface of the defect and protrusion of the corticalis. Regarding gender aspects, we found predominantly significant differences in the occurrence of periapical lesions between females and males, with the latter being affected more frequently in both modern and historic samples and even in primates. So far no strong evidence could be found to explain the higher prevalence of pericardial lesions in males. Other studies described a balanced ratio between the sexes or preponderance in females.

#### Stable carbon isotope evidence for Neolithic Chinese diet differences in the Huang He and Yangtze River valleys.

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Neolithic agriculture in the Huang He (Yellow River) Valley of east-central China was based mainly on millets, which are C4 plants with high stable carbon isotope ratios. Agriculture in the Yangtze River Valley of southeast China was based on rice, a C3 plant with low carbon isotope ratios. Previous isotopic analyses in far southern Huang He sites show that middle and late Neolithic humans consumed substantial amounts of C4-based foods. New data largely

reinforce this conclusion. Isotopic analysis of human bones from the early Neolithic site of Jiahu, located in a far northern tributary of the Yangtze River Valley, demonstrates that only one of 14 individuals consumed small amounts of C4-based foods. One ceramic vessel also contained residues derived from C4 plants.

Yangtze and Huang He sites are located within 100 km of each other, and the low divide between them is not a substantial physical barrier to interaction, yet their diets were remarkably different. Explanations for this difference include: (1) Climatic differences may have favored C4 plants in the north and C3 plants in the south; (2) Jiahu may have been occupied before millet agriculture was well established in the north; (3) Interactions between regions may have been limited; (4) Populations in each region may have been culturally and economically conservative. These hypotheses are not mutually exclusive. Analyses of middle and later Neolithic humans in the Yangtze Valley are needed to evaluate the second hypothesis. Strontium isotope analysis of human teeth may also provide information on interactions between regions.

#### Energetic costs of territorial patrolling behavior by chimpanzees at Ngogo, Kibale National Park, Uganda.

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Chimpanzees are well known for their territorial behavior. Community males jointly defend heavily-used core areas and routinely patrol peripheral areas and overlap zones in large parties, occasionally making deep incursions into the territories of neighboring communities. Although such territorial boundary patrols have been reported at all long-term chimpanzee study sites, quantitative data on patrolling energetics do not exist. Despite the paucity of data, chimpanzee researchers have assumed that in addition to a risk of injury, patrols exact both energetic and opportunity costs for participating males. To investigate these possibilities, I observed territorial behavior by male chimpanzees at Ngogo, Kibale National Park, Uganda for 14 months between July 2004 and February 2006. During each of 29 patrols and matched control periods, I recorded distance covered with a handheld GPS unit, and recorded time spent traveling and feeding. I found that male chimpanzees cover longer distances, spend more time traveling, and spend less time feeding during patrols than during control periods. These results support the hypothesis that male chimpanzees incur energetic costs during territorial boundary patrols and suggest that ecological factors may constrain the ability of male chimpanzees to patrol.

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#### Bone resorption and reproductive status in baboons.

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The baboon (*Papio hamadryas*) is a well-established model for human bone maintenance and turnover, but serum markers of bone formation and their relationship to age and reproductive status have not been thoroughly investigated in this species. The highest levels of bone resorption in human females occur during the first decade post-menopause largely due to reduced estrogen levels.

To test the hypothesis that baboons show trends in the association between age and reproductive status and serum markers of bone resorption that are similar to those for humans, we measured levels of collagen fragments and collagen crosslinks/pyridinoline and estradiol in serum from 95 adult female baboons. We tested for effects of age and reproductive status and for a correlation between resorption markers and estradiol.

Both markers of bone resorption increased with age in the older females, but the overall correlation with age was low and non-significant. There was a low inverse correlation ( $r=0.20$  to  $0.24$ ) between bone resorption markers and estradiol, but this relationship also was not significant. Using combination of age and estradiol level, 42 animals could reliably be designated "premenopausal" ( $n=30$ ) or "postmenopausal" ( $n=12$ ). Comparison of means between these two groups showed absolutely but not significantly ( $p=0.35$  and  $p=0.18$ ) higher mean values of resorption markers in the postmenopausal group. Estradiol levels differed significantly between the two groups ( $p<0.001$ ). Our results demonstrate that qualitatively baboons show trends in serum markers of bone resorption similar to those of humans, but that considerable variability exists within age and reproductive status.

#### *Homo floresiensis* Cranial and Mandibular Morphology

J.Y. Anderson, University of New Mexico

The Flores hominids (2004, 2005) present an enigma. Body size, postcranial limb proportions, and cranial volume suggest

possible Australopithecine affinity. At the same time, some dental and cranial characters suggest possible derivation from *Homo erectus*, while cranial endocast/ CT data, asymmetry of the skull, and cranial nonmetric pattern suggest Flores may represent a microcephalic dwarfed population with affinities to Australomelanesians. Results are presented here from analysis of the Flores material in comparison to a global sample including Bushmen, Australian, and Andaman Island individuals. Two series of comparisons were performed. The first series, using W.W. Howell's cranial dataset suggests size-controlled populations of *Homo sapiens* group exclusive of the Flores material. Secondly, a global mandibular dataset was compared with similar results; both cranially and in the mandible Flores exhibits a distinctive morphology not based on size. These results suggest the Flores material does not represent a population derived from Australomelanesians, and do not represent a non-pathological dwarfed population of *Homo sapiens*. These results do not completely rule out a representation of a microcephalic dwarfed population, at the same time it is suggested possible affinities to earlier hominin groups is equally parsimonious.

#### **Cercopithecoid cranial variation of the primates of Vietnam.**

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The purpose of this project was to study the variation in cranial anatomy of the Cercopithecoids in Vietnam. This is of anthropological significance because 15 monkey species live in this small country. A high density of species cohabitating the same geographic area suggests that they are utilizing different ecological niches. Variation in food choice is one way these primates may have diversified to decrease competition. Cranial differences will offer insight into these dietary adaptations.

Colobine cranial characteristics include a wide interorbital region, deep jaw, and short face. Although these features do identify the skulls of leaf-eating monkeys, a qualitative examination of the subgroup indicates a significant amount of diversity within this subfamily. The purpose of this project was to perform a quantitative analysis to test for this cranial diversity.

190 skulls were measured in July-August 2006. The sample included skulls from the Hanoi Zoological Museum and the Institute for Ecology and Biological Resources. 12 species were represented: five macaques (*Macaca*), one snub-nosed monkey (*Rhinopithecus*), two doucs (*Pygathrix*), and four langurs (*Trachypithecus*). Calipers were used to take 32 measurements per skull. These indices were chosen to represent the overall shape, dietary morphology, and corresponding musculature. The analysis will compare and contrast the skull

morphology of three colobine groups (*Trachypithecus*, *Rhinopithecus*, and *Pygathrix*), two Old World sub-families (colobines and cercopithecines). Particular attention will be paid to species whose habitat ranges overlap.

This project was funded by the University of Colorado Museum of Natural History William H. Burt Fund.

#### **Impact-amplitude of controlled percussive strikes provides evidence of site-selection for enhancement of acoustic display behavior in brown capuchins (*Cebus apella*) in Suriname.**

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Percussive striking of food objects on hard substrates during foraging occurs species-wide in brown capuchins (*Cebus apella*), but may have additional signaling functions for animals living in the dense habitat of Raleighvallen in the Central Suriname Nature Reserve. During a 43-month study, 498 episodes of percussion on tree ranches by adult and juvenile males were documented. Hard-husked fruits of *Phenakospermum guyannense* (Strelitziaceae) were the item most commonly percussed by male capuchins (N=183 episodes). *Phenakospermum* also accounted for the greatest number of strikes per episode (median=43; range=450). Food-extraction success, nevertheless, varied inversely with strike number. Impact sounds generated by these strikes could travel distances > 400 m, raising the possibility that *Phenakospermum* percussion allowed males to broadcast honest signals of their location, alliance size, individual strength, and skill level.

We tested the general hypothesis that percussive episodes have a communicative function in Raleighvallen capuchins by comparing impact-amplitudes associated with actual percussed sites to nearby control sites selected for similarity in plant structure characteristics. Strikes were produced on 17 actual sites within 15 trees located up to 6.6 meters above the ground using a custom-built apparatus. The apparatus uses a baseball bat that falls through a fixed travel path under its own weight, and thereby strikes a horizontal substrate with standardized force. Analyses to date indicate that strikes at percussive sites produced significantly greater impact-amplitudes than at comparison sites. Implications for communicative function and cultural transmission of percussive behavior in brown capuchins are discussed.

Major support for the ongoing Monkey-Forest Project at Raleighvallen comes from the US National Science Foundation (SBR-9722840, BCS-0078967 and BCS-0352316).

#### **Strontium isotope evidence for prehistoric migration in the Valley of Cuzco, Peru: a diachronic study of pre-Inca and Inca populations.**

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Two contrasting views currently exist regarding Inca origins, one focused on indigenous development in the Cuzco Valley, the other emphasizing migration from the Lake Titicaca Basin. Strontium isotope analysis of enamel samples from 59 individuals buried at the site of Choquepukio, in the Valley of Cuzco, Peru was undertaken to clarify the emergence of the Inca Empire by recognizing the geographic origins of the Inca ethnic group. The <sup>87</sup>Sr/<sup>86</sup>Sr values were compared to the local value determined through faunal specimens; migrants were revealed by identifying deviations from this local population signature. The results show little variation from the local <sup>87</sup>Sr/<sup>86</sup>Sr value in the pre-Inca groups, suggesting that migration did not occur extensively during the time of Inca origins. In contrast to the similarity of values from the pre-Inca groups, the <sup>87</sup>Sr/<sup>86</sup>Sr values of the Inca period individuals vary widely, indicating a substantial amount of migration after the Inca Empire had emerged. Observed sex differences include a higher percentage of Inca female foreigners (75% of females vs. 41% of males), as well as more variation within Inca female values than within Inca male values. While most of the Inca males appear to have traveled from the same general area, the Inca women apparently emigrated from numerous regions throughout the Empire. The present study highlights the use of strontium isotope analysis for identification of past population movements and indicates the utility of this scientific method for testing hypotheses of state formation.

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#### **Primate fossils, geological marker beds, and anachronistic faunal assemblages from the early Paleogene of southwestern Wyoming**

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Recent fieldwork in late Paleocene and early Eocene deposits of the Fort Union, Wasatch, and Green River formations in Wyoming's Great Divide Basin has been directed towards understanding the stratigraphic relationships between geological marker beds and primate and other mammalian fossils. Comparisons between fossil assemblages from a series of different localities in the Great Divide Basin and the standard biostratigraphic chronology developed in the Bighorn Basin suggest the presence of an anachronistic faunal assemblage from the latest Paleocene (Clarkforkian land mammal age) of southern Wyoming. At our Locality 110 (Mark's locality), the co-occurrence of two plesiadapiforms (*Plesiadapis cookei* and *Carpolestes nigridentis*) is unexpected, based on the well-studied and extensive fossil record of the Bighorn Basin of northern Wyoming, where the former taxon is typically found in middle and the latter in early Clarkforkian deposits. We evaluate three different hypotheses to explain this surprising faunal co-occurrence. Can the basin-margin hypothesis of Gunnell and Bartels (2001) be applied to the fauna from Mark's locality, or can this assemblage be regarded as transitional between early and middle Clarkforkian age? Finally, we explore the possibility that this example of faunal anachronism may be the expected result of latitudinal and climatic gradients between northern and southern faunas in the Paleogene of the American Western Interior.

**The relationship between age, weight, and leptin in male and female chimpanzees: sex differences and life history implications.**

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The hormone leptin is secreted mainly by adipose tissue, and signals stored energy availability. It is therefore an important component of life history allocation decisions, particularly in females where stored energy is related to reproductive outcome. The relationship between leptin and physiological measures such as body weight and body fat percentage has been studied in a variety of species and several human populations, but not in humans' closest relative, the chimpanzee. In this study, we measure serum leptin levels in juvenile, adolescent, and adult male (n = 36) and female (n = 39) captive chimpanzees (*Pan troglodytes*). We test the hypotheses that leptin increases in association with age and weight, and that females exhibit higher leptin levels than males following the pattern observed in other primates and mammals. We found that females exhibited significantly higher leptin levels (3.62 ng/ml ± 4.19) than males (1.46 ±

1.91) (p < 0.0001), but that after controlling for age, the differences between the sexes were eliminated (p < 0.36). However, while multiple regression analysis of weight and age on leptin in females was significant (r<sup>2</sup> = 0.20, p < 0.02), no such significant relationships were found in males (r<sup>2</sup> = 0.06, p < 0.35). We conclude that developmental associations with leptin are more likely to be central to female than male physiology in *Pan troglodytes*, consistent with sex differences in life history investment strategies.

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**New evidence for ritual activity, relatedness, and diet in the precontact Cook Islands.**

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Late in the prehistory of Oceania, population growth led to dramatic resource scarcity and dietary shifts. This resource stress has been argued to have led to intertribal warfare and sometimes to cannibalism. Archaeological evidence of such practices comes primarily from a single "special-use" site on Mangaia, Cook Islands (MAN-84). While a number of possible scenarios have been proposed for this assemblage of burnt human remains, its uniqueness in the Pacific has hampered interpretation.

Additional, "special-use" sites were found and excavated on Mangaia in 2001. To test the hypotheses raised by the MAN-84 assemblage, the new remains were subject to morphological and taphonomic analyses, dietary isotopic analyses, and mtDNA extraction. In general, these sites duplicate the pattern at MAN-84 but on a smaller scale. None shows evidence of regular habitation activities. Multiple humans of different ages and probably sexes associated with underground earth ovens form most of the faunal assemblage. Most bones have been heated or burned, and some show human modification. Isotopic signatures are similar to those of pigs. mtDNA extraction was attempted from three sites; only one individual yielded an endogenous sequence. That sequence, similar to Lineage Group II in the Pacific, is present in 18% of Cook Islanders today. This could suggest that those found at these sites were from minority lineages – as has been suggested to be the

case in ethnohistoric tales of cannibalism. Taken together, this evidence strengthens the case for either ritual or nutritive cannibalism similar to that predicted for periods of resource stress.

**New research at Mainaro, Kibale Forest National Park, Uganda: primate and other mammal diversity in a mixed regenerating forest.**

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The Kibale forest is well known for its large and diverse primate population. Mainaro, a site in southern Kibale, has a history of encroachment by humans, but recent efforts in reforestation and conservation make this site attractive for detailed, long-term research.

We conducted surveys of primary and regenerating forest through census walks, chimp nest counts, vegetation analysis, and camera traps over a thirty-day period. We found that the density and abundance of *Lophocebus albigena*, *Cercopithecus ascanius*, and *Procolobus rufomitratus* are considerably higher at Mainaro in comparison with other sites within Kibale. In addition, chimpanzee nest counts indicate that chimpanzee density is higher than at other Kibale sites, and that this has increased since earlier studies at the site. Previous studies also suggested that the Mainaro forest is dominated by *Cynometra*, but our vegetation analysis suggests higher diversity, with many primate-preferred fruiting tree species available. In this paper we will discuss possible reasons for these differences, such as elephant presence and activity.

While these results are preliminary, Mainaro presents unique opportunities for primate research, from group structure to their interaction with existing and regenerating forests at the borders of a protected area. Further study of forest dynamics and changing patterns of primate distribution will provide additional data on ecology, behavior, and conservation at Mainaro and Kibale as a whole.

This project was supported by the Department of Anthropology, Yale University.

**The impact of selective logging on sifaka feeding behavior and food quality in Ranomafana National Park, Madagascar.**

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Selective logging within the rainforests of southeastern Madagascar, has led to substantial changes in forest structure, plant species composition, and food availability. This study investigates the impact that this selective logging has had on the feeding behavior and food quality of the Milne-

Edwards' sifaka (*Propithecus edwardsi*) within Ranomafana National Park (RNP), using a total of 2,957 hours of focal group observations that were collected from seven sifaka groups between December 2002 and November 2003. In agreement with the findings of other studies on primate feeding ecology, this study finds that sifakas living within a selectively logged habitat consumed fewer fruit resources (31% vs. 47% of diet) and more leaf resources (67% vs. 49%) than sifakas living in pristine forest. Analyses of the macronutrient composition of sifaka foods however are not consistent with these same studies, as sifaka foods were not found to differ between sites in their macronutrient content. When taken together, these data suggest that changes in feeding behavior, and not changes in the macronutrient content of individual foods, is the long-term legacy of selective logging within RNP. Sifakas living within the disturbed forest habitat, therefore, consume fewer fats and sugars than their pristine forest counterparts, not because of differences in the macronutrient content of these foods, but because they were able to spend less time feeding on fruits than their pristine forest counterparts.

Funding for this project was provided by: Fulbright (IIE), St. Louis Zoo (FRC), National Science Foundation (DDIG), Earthwatch Institute, Primate Conservation, Inc., Stony Brook University, and University of Notre Dame.

#### **Mitochondrial sequence diversity of the southernmost extant New World monkey, *Alouatta caraya*.**

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Variability in mitochondrial DNA sequences was analyzed in the howler monkey, *Alouatta caraya*, in order to delineate evolutionary relationships among populations in the most southerly distributed New World monkey. Based on new and previously published sequence data, fourteen cytochrome *b* haplotypes were observed among 33 howlers sampled in Argentina, Paraguay and Brazil, and grouped in two main haplogroups. In northeastern Argentina and southern Paraguay, new sequence data on 73 specimens sampled from six localities gave 34 mitochondrial control region haplotypes that also clustered in two main haplogroups. At this southern distribution, both mitochondrial markers revealed the presence of two sympatric and differentiated clades that we interpret to be the consequence of a secondary contact between previously allopatric populations. Given evidence for a demographic expansion at the beginning of the Holocene 15,500-7,000 years ago (Fu's test,  $F_s = -12.137$ ;  $P < 0.001$ ), we suggest that at least two populations of *Alouatta caraya* have colonized the

southernmost range since the Holocene employing forested corridors on the Paraná and Paraguay Rivers.

CONICET (MDM-PIP 4431/97-2000, EH-PIP 2451/2000), Universidad de Buenos Aires (MDM-EX 020/97-2000 and EH-TX221/2000) and Agencia de Promoción Científica y Tecnológica (PICT99 1-6171 to G. Zunino) grants supported this work.

#### **South Asia as a geographic crossroad: patterns and predictions of hominin morphology in Pleistocene India.**

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Current models of Asian Pleistocene hominin evolution are based on finds that represent a small portion of the geographic expanse of that continent. This is due to the sparse nature of the fossil record as well as varying traditions of paleoanthropological inquiry in these countries. As a result, models of hominin evolution that have emerged for Asia as a whole are not necessarily appropriate characterizations for individual regional populations. The Indian subcontinent in particular is expected to be distinct from China and Indonesia, based in part on genetic studies that suggest this was one of the first regions to be occupied by dispersing African populations. Given this background, this study evaluates patterns of hominin morphology using Narmada, the only fairly complete Pleistocene fossil from South Asia. Craniometric analyses of this specimen are conducted along with a sample of Pleistocene fossils from sub-Saharan Africa, China and Indonesia. Comparative analyses of early Holocene South Asians and Andaman Islanders are included to elucidate patterns of variation observed today. The results indicate that South Asians, including the Narmada hominin, exhibit a mix of Southeast Asian and sub-Saharan African features. These results are consistent with India's location between these two regions. A unique evolutionary model for Pleistocene *Homo* in India is proposed, incorporating the fact that this region was a geographic crossroad and predicting that the morphology found there will not conform to that of other Asian regions. Rather, morphological evolutionary trajectories for Pleistocene South Asian hominins are expected to reflect a blend of African and Asian traits.

#### **Proportional patterns in prehistory: Cranial and post-cranial correspondence in body proportions among pre-contact American populations.**

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Intra- and inter-limb proportions, relative trunk length, body breadth, and cranial and facial proportions are ascribed to vary clinally with ecogeographic factors, namely climate

(e.g., Beals et al., 1983; Ruff, 1994; Holliday, 1997). Based on these previous studies, the clinal patterns of cranial and of post-cranial variation appear to be similar in humans. However, ecogeographic patterns of morphological variation have not been studied together in both crania and post-crania within a large, geographically diverse sample. New World humans are an interesting group for testing the correspondence of these proportions given the recent human migration, ostensibly from a limited number of initial populations, to the Americas.

1050 archaeological skeletons were selected from 59 sites located from Alaska to Peru. 42 linear osteometric measurements were taken on crania, limb bones, and vertebrae using established methods and those of the recently revised Fully technique.

Across the Americas, cranial and facial proportions show low, non-significant correlations ( $r < 0.1$  in most cases), and have no significant correlations with post-cranial proportions ( $r < 0.1$  in all cases). Post-cranial proportions have generally small, significant correlations ( $r = 0.10-0.25$ ,  $p < 0.05$ ), with the exception of brachial and crural indices ( $r = 0.57$ ,  $p < 0.01$ ). Neither body breadth nor relative trunk length significantly correlate with inter- or intra-limb proportions, despite previously-reported patterns in the Old World. However, these correlations are higher when examined in region-specific analyses, indicating that the correspondence of body proportions varies geographically. This morphological diversity among groups may reflect different periods of settlement or migration, and different influences of behavior on morphology.

Research supported by the NSF (DIG #0550673) and Graduate Research Fellowship.

#### **Magnitude and pattern of geographic variation in cranial shape within *Homo erectus*, especially from Asia.**

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The application of cladistic principles to *Homo erectus* alpha taxonomy in the 1980s suggested that the nomen *H. erectus* be largely restricted to the more derived Asian portion of the hypodigm, with most early African fossils assigned to the species *H. ergaster*. Since that time several other species nomina have been proposed for portions of this fossil sample, including *H. georgicus* and *H. cepranensis*. Other studies have supported a single widespread *H. erectus* species with polytypism attributable to intraspecific variation. This study takes a new approach to the question, applying geometric morphometric methodologies to three-dimensional shape data collected from a large and representative sample of *H. erectus* cranial fossils.

The results of this multivariate analysis show that the *H. erectus* lineage, as broadly construed, retained a very similar cranial

shape for over one million years, showing limited intraspecific variation when compared to modern humans. In addition, when recent fossil discoveries are included, no clear African-Asian shape dichotomy is distinguishable. However, when taken together geological age, geographic origin and size have a statistically significant relationship with cranial shape in *H. erectus*. Within *H. erectus*, both the later Indonesian (Ngandong, Sambungmacan and Ngawi) and the Zhoukoudian fossils exhibit separate and distinct cranial shapes, while the African and Sangiran samples are more variable. In addition, an in-depth comparison of the more complete Asian fossils confirms a separation between the Zhoukoudian and the combined early and late Indonesian fossils and places Sambungmacan intermediate in some respects between Sangiran and Ngandong. Grant support provided by NSF (BCS 04-24262, DGE 03-33415 and DBI 96-02234), L.S.B. Leakey Foundation and Sigma Xi.

**Ranging patterns and group fluidity of black-and-white ruffed lemurs (*Varecia variegata*) at Mangevo (Ranomafana National Park, Madagascar).**

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The genus *Varecia* is known to exhibit considerable social and behavioral plasticity. Long-term studies have noted significant variations in group and/or community size, social organization, and home range. Previous studies of *Varecia variegata* from Ranomafana National Park (RNP) have supported this notion, citing both pair-bonded (White 1991) and cohesive multimale-multifemale groups (Balko 1998).

This study provides preliminary results from a newly established site, Mangevo (S21°22'49.8", E047°26'88.3"), located in the southeastern parcel of RNP. Data were collected from three habituated groups (n = 9 individuals) during June-August 2005 (n = 206 hours). Instantaneous group scans and *ad libitum* sampling were used to document group dynamics, while concurrent GPS coordinates were collected to document ranging patterns. All occurrences of affiliation and agonism were used to record inter-individual interactions.

Results on group dynamics run counter to previous studies in RNP. Mangevo group sizes and compositions varied daily and sometimes even hourly, with a rate of 0.5 transitions/hour (either fission or fusion). Although group sizes fluctuated, individuals spent a majority of their time in 'core groups' that showed little temporal or spatial cohesion. Using 95% kernel estimates, GPS data gathered on ranging behaviors support previous studies from northern Madagascar (Morland 1991; Vasey 1997) suggesting that individuals reside in 'core groups' during periods of resource scarcity, typically maintaining exclusive core ranges, though some overlap was evident amongst

neighboring groups. Finally, association indices demonstrate that core group members preferentially associated with each other rather than with extra-group members. However, little association preference existed amongst core-group members.

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**Do Qafzeh and Skhul represent the ancestors of Upper Paleolithic modern humans? A dental perspective.**

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The early modern humans from Qafzeh and Skhul are often considered representatives of the populations from which later (e.g., Upper Paleolithic) modern humans derived. In this context, archaic features observed in early Upper Paleolithic humans, but not in the Qafzeh/Skhul fossils, are sometimes interpreted as originating from Neandertals, suggesting admixture between these two groups.

However, the fossils from Qafzeh and Skhul are not the only modern humans that pre-date the early Upper Paleolithic. North African Aterian fossils may represent an alternative ancestral population from which Upper Paleolithic humans derived. The goal of this study was to investigate the potential of these early North Africans as a source for early Upper Paleolithic populations.

The study sample included 15 Aterian individuals. These were compared to Neandertals, Upper Paleolithic and early modern humans. The sample is too small for statistical analysis; however, some important observations were made. In their size and morphology the teeth of the Aterians can be considered archaic. Metrically, the teeth are larger than the average of both early and later Neandertals and early modern humans. Morphologically, they retain archaic features such as a relatively large M<sup>1</sup> hypocone, as well as complex occlusal morphology that is similar to that observed in the Oase M<sup>3</sup>s. But they lack the derived configuration of the P<sub>4</sub> seen in most Neandertals. If these fossils represent the source of early Upper Paleolithic people, there is no need to invoke admixture with Neandertals to explain archaic dental features observed in some early Upper Paleolithic humans.

**Sew long: A seamstress buried at medieval Polis, Cyprus.**

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Mortuary practices of the early medieval period (late first millennium AD) in Cyprus are known from only a handful of sites on the island. The Princeton University Cyprus Expedition to Polis Chrysochoos has discovered a wealth of burials clustered in and around two early sixth-century basilicas. Grave location, construction, and the type and variety of grave goods permit differentiation of high and low status interments. A grave excavated in 2005, located approximately 25m south of one church, contained remains of a woman who died in her 30s. Interred in a subsurface pit covered by limestone slabs, her grave was simpler than other cist tombs found in the vicinity. The extended, supine position, with feet to the east and head toward the west, typifies Christian practice. During excavation, a bone needle found by the right femur suggested the possibility she was a seamstress. Subsequent skeletal analysis supports this hypothesis. Grooves on the incisal edges of mandibular incisors and distal maxillary lateral incisors indicate she used these teeth to hold pins and draw thread. Malocclusion and wear suggest she pulled material with her anterior teeth. Muscle attachments and facet development on hand bones are consistent with occupational stress attributed to tailors. Other alterations indicate habitual kneeling or squatting. Identification of this seamstress contributes personal detail to archaeological data collected over 20 years, exemplifying how study of one individual, integrating the archaeological context of the burial and analysis of the skeleton, enriches our understanding of everyday life and death in ancient Cyprus.

**Ancient Cemetery Social Patterning Project: Ancient DNA in Tirup Cemetery.**

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Fundamental to the anthropological study of any community is an understanding of the genetic and social relationships among its members. The aim of the Ancient Cemetery Social Patterning Project (ACSPP) is to use methods and models that test assumptions about the interpretation of data from cemeteries, to better understand social organization. This project has developed models of genetic distribution of patrilineal and matrilineal markers and tested them against simulated cemeteries and known historic cemeteries with great success. Now, ACSPP is applying these same genetic models to reconstruct the social organization of the Danish medieval community that used Tirup cemetery. Tirup is the only completely

excavated rural village cemetery in Scandinavia. As a first step, ancient DNA is analyzed from two individuals selected from the Tirup cemetery to confirm the morphological sex determination of each as well as test the developed models. This first phase examines mitochondrial hypervariable region I sequence variation. Results of the analysis are presented and the ways that these results can contribute to the overall research goals are discussed. When applied to populations over time, genetic kinship analyses have the potential to highlight social adaptations that take place as communities and cultures evolve.

This research has been supported by an American Scandinavian Foundation Fellowship, a Lois Roth Fund Award, and a SUNY Potsdam Grant Development Program Award to Usher.

#### **Proximate mechanisms of paternal care in New World primates.**

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While monogamous mammals are sexually monomorphic in many respects, increasing evidence indicates the existence of sexually dimorphic neural mechanisms for outwardly similar behaviors. The neural mechanisms for male parenting, which in male New World monkeys includes all parental behaviors except lactation, are especially interesting in this regard. While research on male parenting (mostly done in monogamous rodents) has focused on the peptide hormone, arginine vasopressin (AVP), research on female parenting has focused on its "sister" hormone, oxytocin (OT). However, these hormones can bind to each other's receptors, and evidence indicates that males may be able to facilitate parental behavior through either receptor system. In addition, while a subset of OT receptors is estrogen-dependent, a subset of AVP receptors is androgen-dependent, leading to the potential for steroid-peptide interactions. I will discuss the evidence for sex differences in regulation of parenting behavior in New World monkeys, with a focus on the monogamous titi monkey (*Callicebus cupreus*). Finally, I will discuss current questions on the proximate regulation of paternal care that can best be addressed in the field vs. in the laboratory.

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#### **Evolution of candidate genes underlying increased relative testes size in chimpanzees.**

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Chimpanzees and bonobos have promiscuous mating systems, wherein multiple males mate with receptive females and thus experience intense sperm competition. Species with high levels of sperm competition often have large relative testes size, presumably because increased sperm output enhances reproductive success. We analyzed the relative testes size of hominoid primates in a phylogenetic framework, using maximum likelihood estimation of ancestral states. Our results suggest that the ancestor of chimpanzees and bonobos experienced a major increase in the rate of change in relative testes size per unit time, while the human lineage did not. We argue that with regard to reproductive biology, chimpanzees and bonobos are highly derived, and therefore neither provides an appropriate model for ancestral hominid behavior.

Because the dramatic increase in relative testes size on the chimpanzee lineage was likely driven by Darwinian selection, we are analyzing genomic data for signatures of adaptive evolution in testes size-related genes. One of our candidate genes is SRY, a transcription factor involved in male sex determination. SRY is known to have evolved rapidly in primates, particularly on the chimpanzee lineage, although the driving force remains unknown. We hypothesize that SRY is involved in testes size increase on the chimpanzee lineage. One reason to believe this is because SRY stimulates Sertoli cell proliferation, a known correlate of testis size. Importantly, a unique amino acid replacement on the ancestral chimpanzee SRY lineage has been shown to alter the structure of the DNA-binding domain, and to increase the expression of SRY-regulated genes.

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#### **Energetics and encephalization in strepsirrhines.**

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The energetic cost of encephalization could be offset in one of three ways. The growth and reproductive rates can be decreased, the gut size reduced, or the resting metabolic rate increased. It is also possible that a combination of these three strategies lifts the energetic constraint on large brain sizes.

To test these hypotheses, growth of the body and braincase was examined in three strepsirrhine species (*Daubentonia madagascariensis*: n = 3; *Propithecus verreauxi*: n = 4, *Lemur catta*: n = 5) housed at the Duke University Lemur Center. The width and length of the cranium of immatures were taken periodically using calipers. Body weight, interbirth interval and age at maturity for each species were derived

from the Lemur Center records. The gut size of *Daubentonia* and *Lemur* were measured from dissections, and *P. verreauxi* was taken from the literature. Resting metabolic rate in *Daubentonia* was measured at the Lemur Center, and the values for *Lemur* and *Propithecus* were taken from the literature.

*Daubentonia* had a head growth rate nearly double that of *Propithecus* and *Lemur*. *Propithecus* had the fastest somatic growth rate, and *Daubentonia* and *Lemur* had similar rates. The energetic costs of rapid brain growth in *Daubentonia* appear to be compensated in three ways: they have a high resting metabolic rate, a reduced gut size, and a slow reproductive rate. The energetic costs of rapid somatic growth in *Propithecus* are met through a high resting metabolic rate.

#### **Marine and Terrestrial Resource Consumption in Late Holocene Central California: Stable Isotopic Evidence from San Francisco Bay and the Lower Sacramento Valley**

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Recent studies in central California archaeology indicate significant changes in hunter-gatherer diets during the late Holocene, marked by a shift towards greater reliance on terrestrial plant resources, such as acorns and seeds, and smaller fauna. We examine diets in prehistoric central California (4500-200 B.P.) using evidence from stable carbon and nitrogen isotopes of bone collagen and carbon isotopes of bone apatite. The study sample included 110 adult burials excavated from shellmound sites along San Francisco Bay and from sites in the Sacramento Valley interior.

We explore regional and temporal variability in food consumption patterns between the Bay and Valley. Mean bone collagen values for Valley skeletons are homogenous through time, and indicate a strongly terrestrial diet, with some contribution from freshwater fish ( $\delta^{13}\text{C} = -20.0\text{‰}$ ;  $\delta^{15}\text{N} = 11.0\text{‰}$ ). Surprisingly, isotope data do not show that salmon was an important food in the region, despite its prominence in ethnohistoric and ethnographic accounts. In the Bay, bone isotope values are consistent with a marine diet, although diets became increasingly terrestrial through time (Early period:  $\delta^{13}\text{C} = -14.3\text{‰}$ ;  $\delta^{15}\text{N} = 16.0\text{‰}$ ; Middle period:  $\delta^{13}\text{C} = -17.7\text{‰}$ ;  $\delta^{15}\text{N} = 10.0\text{‰}$ ; Late period:  $\delta^{13}\text{C} = -17.2\text{‰}$ ;  $\delta^{15}\text{N} = 10.7\text{‰}$ ). Inter-regional comparisons further indicate that groups from the Valley and Bay subsisted on isotopically distinct foods, with little overlap in dietary values. We address the implications of these findings to central California prehistory.

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**Seasonal home range use and defendability in white-handed gibbons (*Hylobates lar*) in Khao Yai National Park, Thailand.**

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Social monogamy in gibbons has been tied to the inability of males to defend areas large enough to support > 1 adult female and her offspring. To test this hypothesis investigators have employed Mitani and Rodman's (1979) defendability index in reverse, concluding that gibbon males could easily defend the ranges of  $\geq 2$  females. These findings have been used to argue in favor of alternative models for monogamy. But, while gibbon territories are stable year round, daily path length varies over the year. As a result, both defendability and the maximum number of defendable females ( $N_{max}$ ) will change monthly. Here I examine the potential for gibbon males to defend multiple females in seasonal evergreen rainforest.

I studied the feeding ecology of two lar gibbon groups in Khao Yai National Park over 12 consecutive months. Daily path length was recorded monthly during 5-day samples. Home range size was determined by calculating the area of a minimum convex polygon encompassing the cumulative day ranges of each group. Weighted monthly, mean daily path lengths for the two groups were 1160 m and 1329 m. Home range size was 25.4 and 21.4 ha respectively. This yields an  $N_{max}$  for the two groups of 5.2 and 6.2. For both groups, however,  $N_{max}$  fell below 2 during November, the month of lowest fruit abundance. These findings suggest that the maximum area defensible by gibbons may be constrained by seasonal variation in resource abundance and that females may represent an over-dispersed resource.

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**3D architecture of the middle cranial fossa and modern human origins.**

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Encephalization is a key factor in modern human evolution and has an important influence on the spatial organization of the skull. This is related to developmental and evolutionary interactions between the brain and the basicranium. Several studies have shown that particularly the degree of basicranial flexure in the midline increases with absolute and relative brain size in primates. It has been posited that this accommodates the increasingly globular

brain. However, midline basicranial flexure already reaches the modern human range in *Australopithecus* although dramatic encephalization occurred during the later evolution of *Homo*. Thus alternative mechanisms probably accommodate the further increases in absolute and relative brain size among which relative independence in the variation of midline and lateral basicranial elements might play a role. The results of a comparative 3D geometric morphometric analysis of basicranial morphology of chimpanzees, fossil hominins and modern humans suggest considerable modifications in the 3D-architecture of the middle cranial fossa (MCF) in modern humans. Modern and fossil *H. sapiens* show significantly different MCF-configurations compared to all other hominins and chimpanzees. Morphologically, *H. sapiens* is characterized by a relatively increased forward and lateral projection of the MCF-pole, a modification occurring mainly within the anterior part of the MCF. Additionally, the MCF floor becomes relatively lowered. Such modifications suggest that overall expansion of the middle cranial fossa -possibly related to localized evolution of the temporal lobes- is an important factor involved in the evolutionary origins of modern humans.

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**Reconstructing the settlement history of the central Andes from mitochondrial DNA analyses.**

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Mitochondrial DNA haplogroup frequencies were constructed from two ancient Peruvian populations, Kilometer 4 and Chiribaya Alta, from the coastal Osmore valley. Kilometer 4 was a "Peruvian Chinchorro" Archaic site (main occupation 4000-3000 BP). Chiribaya Alta, capital of the Chiribaya coastal polity, dates to about 1000 AD. These results were then compared with published mtDNA haplogroup frequencies from 29 ancient and modern South American populations. Exact tests and pairwise population genetic distances were calculated. Genetic distances were visualized using MDS analysis.

Our data suggests population continuity through time in the Osmore Valley. Our two samples are similar to each other in genetic composition and do not significantly differ from a Middle Horizon Osmore mid-valley sample. These results differ from a recent study of northern Chilean samples where the early samples were significantly different from later samples and suggested population change with possible replacement. We also noted some general trends among the combined ancient and modern population analyses. Not surprisingly, sample sets from the same regions clustered together. The ancient coastal populations generally clustered together and were found near the

modern highland groups from the central Andes, but did not overlap with them. We found that among central Andean ancient and modern population samples, haplogroup B frequencies increased through time, while haplogroup A frequencies declined. At this point, we do not yet have sufficient data to determine whether these patterns indicate different population histories between ancient coastal and modern highland populations, or a larger temporal trend in entire central Andes region.

**Fish tapeworm and anaemia on the Pacific Northwest Coast of America**

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*Diphyllobothrium* spp. (broad fish tapeworm) eggs have been recovered from several archaeological shell midden sites along the Pacific Northwest Coast of North America. The oldest range of dates associated with these finds establishes the presence of this parasite among the hunting-fishing-foraging populations of the Northwest Coast between 5650-5440 Cal. BP. Cultural sediment from shell midden matrices collected from pre-contact era sites in Washington and British Columbia were microscopically examined for preserved evidence of intestinal parasite eggs. Eggs of *Diphyllobothrium* spp. are the most abundant identifiable genera recovered. Given circumstantial evidence relating to the geographical location of the study area, the most common intermediary host species of this parasite, patterns of food choice, methods of food preparation and human skeletal evidence of anaemia in the region, this paper argues for the likely indigenous presence of *Diphyllobothrium latum* in North America prior to European contact. Previous studies have hypothesized that parasite burden exacerbated conditions of iron deficiency in early coastal populations. This research provides independent correlating evidence of a pathogenic parasite species capable of causing anaemia.

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**Ongoing work with the Helena Crossing collection: An analysis of life, health, and death in an Arkansas community.**

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The site of Helena Crossing, located in Arkansas, has figured prominently in archaeological formulations of the Middle Woodland period (150 BC – 210 AD ± 75) in the Central and Lower Mississippi River Valleys. Excavation of two mounds at Helena Crossing recovered a small (MNI = 30) but significant burial population that contains individuals of all ages and both sexes. Recent

reanalysis of this collection has already yielded meaningful results. These include a revised demographic profile, which deviates considerably from the original and an analysis of the unique pathological features of Burial Group F, a distinct grouping within Mound C.

Ongoing work continues to reveal important information concerning the life, health, and death of these prehistoric people. This paper reports on the results of several areas of bioarchaeological investigation with the Helena Crossing sample including: dental pathologies (AMTL, caries, EH, abscesses, etc), infectious disease (treponematosis), metabolic disorders as indicated by porotic hyperostosis, antemortem injury (depression fractures, spondylolysis, etc) and postmortem trauma (cutmarks). Results obtained by these analyses indicate the variety of health stressors that these communities faced. In addition, evidence of widespread artificial cranial deformation in the sample and postmortem processing of remains consistent with defleshing of limbs and alteration of crania and mandibles suggests these bodies were manipulated both during life and after death.

**The state of bone preservation is related to successful genetic sex determination of medieval skeletal remains from Dubovany cemetery, Slovakia.**

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Sex identification of excavated skeletal remains contributes to the investigation of demographic structure in medieval human populations. However, anthropological analysis is complicated in a case of fragmentary bones and in skeletons from infants. The development of DNA-based techniques has led to improvements in sex determination.

*In this study eight adult human skeletons from Dubovany cemetery (9<sup>th</sup> century A.D.) were analyzed. The standard methods were employed in sexing the individuals (JHE 1980; 517-549). The DNA was isolated from spongy bone of femoral proximal epiphysis by silica matrix extraction (Bauerová et al., AJPA 2005; Suppl. 40:70). aDNA was amplified by multiplex nested PCR assay with SRY (chromosome Y) and DXZ4 (X) as target loci. Thin sections for histological analysis were prepared from femurs according to procedures described by Martiniaková et al. (AJPA 2005; Suppl. 40:146).*

According to our investigation, three men and five women were determined. The results of PCR analysis showed that 204 bp fragment corresponding to SRY locus was not identified in any tested sample. However, PCR fragment (91 bp) corresponding to DXZ4 locus was amplified only in women samples

although it was expected in all bones. Histological methods revealed very well preserved bone microstructure in all successfully amplified samples. Remaining (men) bones showed worse preservation due to diagenesis (2 samples) and osteoporosis (1 sample).

In general, molecular methods are inevitable in the investigation of archeological bone remains. However, bone histology could be used as a potential screening method for predicting samples that are most likely to yield aDNA.

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**Dental developmental patterns in Neandertals: A high-resolution 3D analysis.**

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Available evidence on dental developmental patterns in Neandertals suggests the lack of significant differences with respect to the extant human condition (e.g., Tompkins 1996). However, this is essentially based on a radiographic record; in addition, the quantitative assessment of the degree of relative maturation between deciduous and permanent elements is still unreported in the case of specimens displaying a mixed dentition. Here we present the first results from the high-resolution 3D analysis of three juvenile Neandertals spanning over 70000 years: S37 from La Chaise (OIS 6), Kr51 from Krapina (OIS 5e), Roc de Marsal (OIS 4).

The specimens from La Chaise and Roc de Marsal were detailed at a spatial resolution of 45.5 µm by synchrotron radiation microtomography (SR-µCT); that from Krapina was scanned by an industrial microtomographer at 50 µm. A set of linear, angular, surface, and volume variables were measured on each virtually extracted dental element and crypt. The degree of dental crown and root maturation was scored following Liversidge and Molleson (2004) and Demirjian (1973), for the deciduous and the permanent dentition, respectively. The sequences obtained for the secondary elements were compared by means of a Bayesian approach (Braga & Heuzé 2006) to those shown by an orthopantomographic-based sample of 591 living children of African, European, and Middle Eastern origin.

As a whole, our results show that all three Neandertal sequences fall within the variation range illustrated by the extant comparative sample, with no obvious time-related differences.

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**Origins: human adaptation to high-altitude hypoxia.**

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Variation in human adaptation to high-altitude hypoxia provides an approach to analyses of the processes of human adaptation and evolution. Adaptation to the severe unrelenting stress of high-altitude hypoxia differs between acutely exposed low-altitude populations and chronically exposed indigenous high-altitude populations and it also differs among indigenous populations. The hypothesis is that natural selection acting on the indigenous populations has modified or supplemented the adaptive responses maintaining oxygen homeostasis during everyday life at low altitude.

Demonstrating the action of natural selection in these situations is challenging. One reason is that the hypothesized adaptive traits are complex, quantitative phenotypes with unknown genetic bases, influenced by many physiological systems and individual characteristics. This paper presents a case study illustrating the human adaptability and quantitative genetic approaches to explaining the unique biological characteristics of Tibetan highlanders that are thought to be adaptations offsetting high-altitude hypoxia. There is evidence of strong directional natural selection operating on a major gene for oxygen saturation of hemoglobin in this population, although the genetic locus is not known. The Tibetan case study illustrates some of the challenges and opportunities of incorporating rapidly advancing knowledge of human biology and new techniques in genetic analysis into research on adaptation to extreme environments.

This paper is based on research supported by NSF, the National Geographic Committee on Research and Exploration, and the Committee for Scholarly Communication with China.

**New sivaladapid primates from the Eocene Pondaung Formation of Myanmar and the anthropoid status of Amphipithecidae.**

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We describe two new genera and species of sivaladapid primates from the late middle Eocene Pondaung Formation of Myanmar, along with tarsal elements that are appropriate in size and morphology to belong to one of these new taxa. These are the first undoubted adapiforms (and the first fossil primates other than anthropoids) to be reported from the Eocene of Myanmar. The discovery of sivaladapids in the Pondaung Formation enhances the taxonomic and paleoecological diversity of the late middle Eocene primate fauna of Myanmar. In this respect, the fossil primate community from the Pondaung Formation appears to have been similar to roughly contemporaneous assemblages from China, Thailand, and Pakistan. The newly discovered sivaladapid tarsal elements help to resolve conflicting interpretations regarding the taxonomic allocation of large-bodied primate postcranial elements from the Pondaung Formation. The NMMP 20 partial skeleton from the Pondaung Formation, which has often been assumed to be an amphipithecoid, is more plausibly interpreted as pertaining to a third Pondaung sivaladapid. If NMMP 20 actually pertains to a sivaladapid, character conflict for reconstructing the phylogenetic position of amphipithecids is significantly reduced. Amphipithecids are most parsimoniously regarded as a clade of basal anthropoids, in agreement with traditional views on their relationships.

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#### The functional significance of the lumbar Transverse processes of *Homo neanderthalensis*.

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Spinal morphology is essential for the understanding of posture and locomotion of early hominins. The transverse processes (T.P.) that serve as attachment areas for the muscles that move the spine provide important information regarding the motion of the trunk. New studies suggest that there were some differences in locomotion between Neandertal and *H. sapiens*, therefore the aim of this work is to characterize the morphology the lumbar T.P. of Neandertal and to discuss its implications regarding their spinal motion.

The sample included 76 lumbar spines (L<sub>1</sub>–L<sub>5</sub>) of *H. sapiens* and three Neandertal specimens- Kebara 2, Shanidar 3, and La Chappelle-aux-Saints. Linear and angular measurements of each of the T.P. were taken. The results of the study show that in four (L<sub>1</sub>–L<sub>4</sub>) out of the five lumbar vertebrae there is a significant difference between the morphology of the T.P. of Neandertal and *H. sapiens*. In the upper three vertebrae (L<sub>1</sub>–L<sub>3</sub>) the difference is in the spatial orientation of the

T.P. and in L<sub>4</sub> the difference is in the length of the T.P.

Based on the morphology of the T.P. of Neandertal it is reasonable to conclude that their back muscles had a better ability to perform side flexion of the lumbar spine, and at the same time were lacking in their ability to perform extension, when compared with *H. sapiens*. This does not automatically imply differences in range of motion. The morphology of the T.P. of Neandertal correlates with their wide pelvis and their hypolordotic posture.

#### New skeletal elements of *Dryopithecus brancoi* from Rudabánya, Hungary.

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During the 2006 field season at the late Miocene hominid locality of Rudabánya several important specimens attributable to *Dryopithecus brancoi* were recovered. These include the most complete mandible of *Dryopithecus* and associated innominate fragments, previously unknown for the genus. The mandible preserves an intact and undistorted corpus and most of the right ramus, missing only the gonial angle. The dentition is diagnostic of *Dryopithecus brancoi*, including tall, compressed incisors and canines, molars with peripheralized cusps lacking cingula, and strongly tapered M<sub>3</sub>s. The canines are diagnostically female. Differences from other *D. brancoi* mandibles and lower dentitions include a relatively robust mandibular corpus, small dental dimensions and a well developed P<sub>3</sub> metaconid. The undistorted symphysis, previously unknown for *Dryopithecus*, is moderately inclined with a relatively long planum alveolare and small transverse tori separated by a moderate genioglossal fossa. The ramus, the most complete preserved for *Dryopithecus*, is vertical along the anterior edge and relatively short with coranoid and condylar processes of equal height, separated by a deep mandibular notch. The extramolar sulcus is wide.

Two innominate specimens were also recovered. On the left side the ilium is well preserved, relatively broad, with a comparatively short and thick neck. The acetabulum is large with well defined lunate surfaces that arise subtly from the depth of the joint. The ischium and superior pubic ramus are relatively robust. In overall morphology the innominate most closely resembles those of great apes, and is unlike that of *Epipliopithecus*. They are consistent in size with *Dryopithecus* as well.

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#### Prevalence of overweight and obesity in Turkish adults 20-35 years of age.

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The recent increase in the prevalence of overweight and obesity at earlier stages in adult life are considered one of the major health risks faced in many developed and some developing countries. The aim of this study was to assess the prevalence of overweight and obesity in The Turkish population.

A cross-sectional nationwide survey was carried out on 962 adults (508 males and 454 females) aged 20 to 35 years from 7 geographical regions of Turkey. Sampling was done by The State Statistical Institute (TURKSTAT) by using multi-stage, multi-cluster and multi-weighted methods. Height and weight were measured according to the Anthropometric Standardization Reference Manual. The body mass index (BMI) (weight (kg)/height<sup>2</sup> (m)) was calculated and the frequency of overweight (25≤BMI<29.9), and obesity (BMI≥30) prevalence was determined.

The mean BMI was found to be 24.67 for males and 24.61 for females. 13.4% of males and 20.3% of females were overweight, while 9.5% of males and 13.2% of females were classed as obese. Results showed that both overweight and obesity showed significant sexual dimorphism (p<0.05). The increased rates of overweight and obesity in Turkish young adults might be closely related to acute health problems having a higher degree in females.

#### Micromorphology of cut-marks in Palaeolithic Britain.

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Cut-marks left on bones of animals, and occasionally humans, represent some of the earliest available direct evidence of human activity. As such, they can provide an unparalleled window into the cognitive ability of early to anatomically modern humans and direct evidence of behaviour in the evolutionary lineage leading to modern humans. Surface modification studies are becoming increasingly useful in reconstructing the behavioural and ecological contexts in which hominid activities occurred and microscopic criteria for the detailed characterization of surface alterations provide additional evidence for their interpretation. Here we present a new approach, using innovative technology, that allows for a three-dimensional characterisation of cut-mark micromorphology and the quantitative interpretation of resulting 3D-coordinates. The employed technique presents a series of advantages: the measurements do not damage the surface, numerical data in three dimensions are obtained and setting-up procedures are quite simple and not particularly time consuming.

We interpret a series of cut marks found on skeletal fossil human remains from Gough's

Cave (Upper Palaeolithic, Somerset, England) and dental and skeletal fossil human and animal remains from Boxgrove (Lower Palaeolithic, West Sussex, England). The results demonstrate the method's potential for interpreting butchery processes and give new insights into the microscopic properties of cut-marks.

**Taphonomy and paleoecology of the mammalian and avian faunal assemblages of 'Ubeidiya, Israel: Implications for 'Out of Africa I'.**

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During the Lower Pleistocene, hominins dispersed from Africa into Eurasia via the Levant. It has been suggested that the success of hominins in higher latitudes was attained by an increased in their preferred habitat, namely savanna type grasslands. One of the sites which testifies to this event is 'Ubeidiya, Israel. The site exhibits several rich lithic and faunal assemblages and is dated to ca. 1.6 - 1.2 Ma. The presence of Africa taxa at the site has been interpreted as indicative of a savanna environment and support for the above hypothesis.

The mammalian and avian faunal assemblages of 'Ubeidiya were studied using multivariate taphonomic and paleoecological analyses in order to reconstruct the accumulation processes and paleoenvironments throughout the sequence. Results suggest that the 'Ubeidiya assemblages represent an amalgamation of several processes. The large mammalian faunal assemblages represented kill or near kill sites of large carnivores. Hominin involvement in the accumulation and subsequent utilization of the assemblages was most probably minimal. The remains were further scavenged by carnivores such as the spotted hyaena. The small mammals and avian fauna were deposited by raptors.

Two distinct faunal units were identified throughout the sequence. The change in faunal abundances can be related to the slow trend of desiccation identified both in gross and micro geomorphology.

All 'Ubeidiya strata have high affinities with both modern and Plio-Pleistocene Mediterranean sites and that the ecological success of hominins in higher latitudes should be sought in intrinsic characters rather than in their adaptation to savanna grasslands.

Support for this research was made available by the L.S.B. Leakey Foundation, the Irene Levy Sala CARE Foundation and the American School of Prehistoric Research, Peabody Museum, Harvard University.

**Adaptations and relationships of North African Miocene cercopithecoids.**

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In this paper the zoogeographic relationship between North Africa and other faunal regions is examined based on the phylogenetic relationships of Miocene cercopithecoids.

The unique occurrence of cercopithecoids in northern and eastern Africa prior to 11 mya suggests a stronger faunal connection between these two regions than either had with Europe or Asia. Comparison of "*Prohylobates*" *simonsi* from Jabal Zaltan and *Prohylobates tandyi* from Wadi Moghara with victoriapithecids from Buluk, Kipsaraman and Maboko in Kenya indicates the northern and eastern species are best attributed to distinct genera. Biostratigraphic and zoogeographic correlation between northern and eastern Africa based on the shared presence of *Prohylobates* is weakened. The faunal corridor between North and East may have been open only briefly during the early and/or middle Miocene.

Late Miocene *Libypithecus markgrafi* from Wadi Natrun differs significantly from *Mesopithecus* and other Eurasian cercopithecoids. It shares several cranial features with *Victoriapithecus* that are considered primitive for Old World monkeys. Dentally, the highly folivorous adaptations of *Libypithecus* are similar to those late Miocene and Pliocene colobines from eastern Africa and unlike *Mesopithecus*.

Generalized fossil papionins and colobines from Sahabi are smaller and occlusally different from their counterparts at Wadi Natrun and Menacer. Sahabi colobines may have belonged to a clade of small colobines including *Microcolobus* and *Colobus* sp. (KNM-ER 150) that were rare but continuously present from the late Miocene through Pliocene of Africa, but do not occur in Europe. Semi-terrestrial adaptations of the Sahabi cercopithecoids indicate they could have lived in woodland to open settings.

**A comparative analysis of Y chromosome variability and admixture in Cape Verde, Sao Tome, and seven Anglophone Caribbean Islands.**

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The emergence of sugar cane plantations as an industrial powerhouse during the 16<sup>th</sup> century had an indelible impact on the histories of West African, Indigenous American, and European peoples. Cape Verde and Sao Tome, both islands off the West African coast, were initial sites for European sugar cane cultivation. These islands were colonized by the Portuguese and were predecessors for the sugar cane plantation systems that eventually developed throughout the Caribbean. African labors were the principal workforce in both

geographic regions. In order to explore how differences in population histories have influenced current levels of genetic variability, comparative analyses of Y chromosome microsatellites was made between data gathered from published sources for Cape Verde and Sao Tome, and original data from seven Anglophone Caribbean islands. Specifically, heterozygosity, population structure, and admixture ascertained from DYS19, DYS389I and II, DYS 390, DYS391, DYS392, and DYS393, were considered.

Heterozygosity values ranged from 0.512 to 0.663 in the West African and Caribbean populations. R<sub>ST</sub> analysis showed no significant difference between these groups ( $\Phi_{CT} = 0.220$ , p-value = 0.221). However, high levels of variability within each group (and  $\Phi_{ST} = 0.737$ , p-value = 0.000) was detected. Admixture estimates showed similar levels of European genetic contribution to both the Cape Verde (m = 44.25%, sd = 0.072) and Caribbean (m = 32.77%, sd = 0.031) groups. Sao Tome however, had only 8.46% (sd = 0.059) European contribution. These analyses indicated that while the differences in the population history have not deflated Y chromosome diversity, they have influenced the levels of admixture observed in each group.

**The normalization of intergenerationally transmitted, developmentally programmed traits in experimental animals: implications for adaptive hypotheses.**

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Human and animal studies have demonstrated a strong link between the developmental environments of fetal and perinatal life and later susceptibility to disease in adulthood. While this relationship has usually been interpreted in the context of human pathology and epidemiology, there is a growing interest in the possible evolutionary significance of these predispositions. Attempts to explain this relationship in evolutionary terms include the "Predictive Adaptive Response" hypothesis in which the degree of mismatch between pre- and postnatal nutritional environments is an important determinant of subsequent health, and the "Phenotypic Inertia" hypothesis which suggests that the flow of nutrients to the developing fetus represents an integrated signal reflecting matrilineal nutrition over multiple generations that acts as a buffer against the "noise" of short-term seasonal or stochastic fluctuations within longer-term ecological trends.

Although a large body of animal model research exists on the effects early developmental environments have on adult health, very few studies have been designed to assess the heritability of these effects over multiple generations. What few studies have been done suggest a trend towards

normalization in successive generations. These findings are considered in terms of what they may tell us about the possible evolutionary significance of developmentally programmed traits.

#### Stature estimation in an Archaic sample: implications from the Fully Technique

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Estimates of stature are used in forensic contexts as well as prehistoric population study. In the prehistoric context, estimates of stature are used as a proxy for population health, because stature is sensitive to health differences during the subadult years. There are numerous methods for estimating stature. In many cases, prehistoric stature estimates use regression equations derived from modern samples (Genoves 1967, Trotter & Gleaser 1958, Sjøvold 1990 etc.). Some studies have applied the anatomical method of Fully (1956) relying on relatively complete skeletons. Sciulli et al. 1990 used the Fully technique on 64 individuals from Ohio dating to 400-3000 ypb to estimate stature in this prehistoric sample. Despite authors (Trotter & Gleaser 1958, 1952) warnings against applying formulae derived from one population on another, it is sometimes a matter of necessity due to the fragmentary nature of older prehistoric skeletal material. When possible, it is arguably more appropriate to develop specific formulae for prehistoric populations.

This study applies the Fully technique to the best preserved individuals from the Windover site with a median date of 7400 <sup>14</sup>C years B. P. uncorrected (Doran, 2002), which is the largest sample of this antiquity in North America. The stature estimates from Windover may be more appropriate for sample older than 3000 ypb. Preliminary analysis indicates there are chronological differences in sexual dimorphism and proportionality which would need to be taken into consideration when choosing stature estimators for prehistoric samples.

#### The influence of population size, habitat fragmentation and demographic history on gorilla populations

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Genetic diversity may be reduced in small and fragmented due to increased levels of drift and inbreeding. This reduced diversity is of concern as it is often associated with decreased fitness and a higher probability of extinction. However, it is difficult to assess whether a population has low diversity except in a comparative context. We sampled 7 of 11 subpopulations of the critically endangered Cross River gorilla and analyzed one third to one half (N=71) of the total estimated

population using 11 microsatellites. First, we found that variability is not evenly distributed across subpopulations and that diversity was higher in gorillas living in less fragmented and isolated habitats. Next, we compared levels of diversity in Cross River to estimates from published data from three other gorilla populations. All measures of genetic variability in the Cross River population are similar to those of the similarly small mountain gorilla (*Gorilla beringei beringei*) populations at Bwindi and the Virungas. However, for some measures, both the Cross River and mountain gorilla populations show lower levels of diversity than a sample from a large, continuous population (Mondika, *Gorilla gorilla gorilla*). Finally, we tested for the genetic signature of a population bottleneck in each of the four populations. Only Cross River shows strong evidence of a reduction in population size, suggesting that the decrease in this population was more recent or abrupt than in the two mountain gorilla populations. These results illustrate the value of inter-population comparisons and emphasize the need for maintaining connectivity between the Cross River subpopulations while allowing the population to expand.

#### Analysis of Genetic Diversity in Ethnic Populations of Afghanistan

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The Middle East has the distinction of being a major crossroads of human migration. The genetic diversity of Afghanistan, however, has long remained a missing piece to this rich and complex puzzle. To explore both the diversity within Afghanistan and to understand the relative genetic contributions from various groups throughout the Eurasian continent, buccal swabs were collected from 252 unrelated Afghani men for mitochondrial DNA analysis. Each of these men hailed from one of four major ethnic groups inhabiting the region: the Pashtun, Hazara, Tajik or Nooristani. The Indo-Iranian speaking Pashtun represent the largest ethnic group in Afghanistan; the Tajiks have a complex genetic history that likely involves admixture between Turkic groups and smaller distinct ethnic groups within Afghanistan; the Hazara, on the other hand, are thought to represent remnants of Ghengis Khan's army left behind as it expanded through Asia; and the Nooristani have biological links to populations in northern Pakistan and the claim of descent from Alexander the Great's army. All samples were analyzed for HVS1 and SNP variation. In all of these populations, Western Eurasian haplogroups (H, HV, R, J, I, U, X) were most common, with the highest frequency occurring in the

Nooristanis, while the remaining East Eurasian haplogroups including D, G, and various other M types. The results of this study will be instrumental in expanding our knowledge of Afghani genetic history, in addition to broadening our understanding of population migrations throughout West and Central Asia.

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#### Hormonal correlates of ontogeny in baboons and mangabeys.

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This study investigates the relationship between serum hormone levels and somatometrics during ontogeny in mangabeys and baboons. A previous study of papionins suggested that the relationship between absolute hormone levels and body size could not be characterized simply as a positive one. Specifically, the prior study found that some smaller-bodied species had higher absolute growth-related hormone levels than larger-bodied species. Therefore, this study looks in more detail at hormones and size growth in two papionin species, one "large-bodied" (*Papio hamadryas anubis*) and one "small-bodied" (*Cercocebus atysi*), using multivariate analyses to more precisely characterize how hormones relate to growth in these taxa.

Utilizing a mixed longitudinal sample, this study compares change in 20 different measurements, which reflect overall size growth as well as growth in length and circumference, with change in levels of six important growth related hormones. Results suggest that while many of the hormones analyzed are integral for growth in both species, changes in these hormone levels are more tightly correlated with changes in somatometric measurements in baboons than mangabeys. Baboons grow for relatively shorter periods of time than mangabeys, but reach larger sizes. Males of both species show more accelerations in velocity than females, while female growth patterns are generally characterized by decelerations in velocity. We propose that the more "organized" growth profile shown by baboons is underlain by more regular patterns of hormone secretion compared to mangabeys.

#### The dynamics of locomotion on limbs: What must be accomplished?

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To evaluate the design expressed by the morphology of an organism one needs to find the functional role of that morphology. For

locomotion three areas must be considered: stability, support and propulsion. Slow moving animals approach the static situation where statics-based analyses are sufficient. For faster moving organisms, even when speed is not particularly great, dynamic considerations alter many features of the mechanics, both in terms of constraints and opportunities. For faster organisms dynamic stability can be accomplished even without any position in the gait cycle being statically stable. Although weight must be carried in rapidly moving animals just as it must be for slow ones, usually in rapid motions the forces involved are much larger than the actual body weight. Rapidly moving organisms have substantial momentum, and much of the design of the locomotory system can be interpreted in light of strategies designed to best maintain this momentum. Most primates inhabit 3-dimensionally complex environments which can obscure some of the basic strategies used for locomotion. Nature's solutions to these problems may be either passive (unforced dynamics) or active (muscular dynamics). Some solutions, such as brachiation, are unique to primates while others have much in common with many other groups.

**A test of the Igarashi *et al.* method for estimating age-at-death from the auricular surface of the ilium.**

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The purpose of this research was to test Igarashi and colleagues' (2005) new method of age-at-death estimation from the auricular surface of the ilium. In their study, Igarashi and coworkers utilized a sample of 700 modern Japanese skeletons of known age. They identified 13 age-related morphological traits of the auricular surface. Nine features represent auricular surface traits while four features are derived from the hypertrophied structures around the auricular surface. Igarashi *et al.* utilize a binary coding system and score a trait as present if it is found anywhere on the surface. They utilized multiple regression analysis to generate parameter estimates for each trait and developed six models of age-at-death estimation for males, females, and unknown individuals.

In order to test Igarashi and colleagues' method, a subsample of known skeletons was drawn from the William M. Bass Collection curated at the University of Tennessee. Mean age-at-death for the subsample was 63.18 years. Traits from right and left sides were scored blind to real age and independently of each other. Age-at-death estimates were calculated and R-square coefficients were calculated. Preliminary results indicate that the full model is more appropriate than the reduced model for both males and females. An R-square of 0.37 generated from the male full model indicates that the method is only somewhat helpful in estimating age-at-death and should be used

in conjunction with commonly utilized methods. In addition, our results are similar to the original authors' and indicate that this method performs better when applied to male individuals.

**Dental health, diet, and social variation in Late Prehistoric Eastern Tennessee.**

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Oral health reflects dietary variation of a population. Sex- and status-based differences are inferred from the prevalence of dental pathological conditions in each group. Often, females have poorer oral health than males, resulting from consumption of a more cariogenic diet. Comparison of dental health of high- and low-status individuals in a wide range of settings is not consistent, owing to population-specific differences. Based on the results of previous research, we test the hypothesis that males and females from Citico, a Mississippian maize agricultural population, will show a similar prevalence of dental pathological conditions. Additionally, lower status individuals will have greater prevalence of these pathological conditions than higher status individuals.

To test the first hypothesis, dental caries, calculus, and antemortem tooth loss in the permanent teeth of 83 adults (50 females, 33 males) were recorded. Statistical analysis reveals no significant differences between males and females (chi-square;  $p < 0.05$ ), indicating the oral health of males and females was similar due to consumption of an equivalent, if not identical, diet. These results support our hypothesis and corroborate the findings of our earlier study of the Toqua site. However, the results contradict most findings in agricultural populations.

To test the second hypothesis, the permanent teeth of 115 individuals (94 high status, 21 low status) were assessed. Statistical analysis reveals that the prevalence of caries, calculus, and antemortem tooth loss is significantly higher among lower status individuals (chi-square,  $p < 0.05$ ). We interpret these differences to reflect overall variation in diet between higher and lower status individuals.

**It Takes a Community to Raise a Child, or Does it? Socialization in Wild Chimpanzees (*Pan troglodytes*).**

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The complexities of fission-fusion society and underlying social intelligence of the chimpanzee (*Pan troglodytes*) have been

shown by long-term field studies, and in captive observations and experiments [deWaal, 1998; Goodall, 1986; Nishida, 1970; & Matsuzawa, 2003]. The socialization of juvenile chimpanzees should reflect these demands in preparing them to lead dynamic social lives; in a sense, it *should* take a community to raise a chimpanzee. Published, quantitative research on the social relations of young chimpanzees in nature is surprisingly scarce. Much has been published on mother-infant interaction, but far less on youngsters' relations with other age and sex classes. This study aims to describe the role of members of the community in the socialization of juvenile chimpanzees by supplying normative data and by exploring the range of variation in social experiences. We focus on the impact of fission-fusion society on the lives of young chimpanzees, in terms of companionship and spatial proximity. Analyses are based on 355 hours of observational data on five juvenile chimpanzees (*Pan troglodytes schweinfurthii*) of the Kasekela community at the Gombe Stream Research Centre (GSRC) in Tanzania in 1973. Youngsters spend most of the time alone with their mothers and rarely encounter some members of the community. Most of their social time is spent in small parties, in which they stay close to their mothers. Overall, the mother is the main companion, and thus by implication, the main socializing agent. This likely has ramifications for birth order effects, orphaning, and gender development.

Data collection was supported by W.T. Grant Foundation funding to Stanford University, Department of Psychiatry and Behavioral Sciences.

**Ontogenetic patterns of positional behavior during play in *Cebus capucinus* and *Alouatta palliata*.**

M. Bezanson. Department of Anthropology Santa Clara University

Play is described as an important aspect of locomotor development in mammal lives. While play as an aspect of social behavior is perceived to be a time of practice of motor control and development, studies rarely emphasize locomotion and posture during play even though this activity can be associated with disparity in relative amounts of positional modes between young individuals and adults. I collected 955.7 hours of data (57,344 individual activity records) on locomotion and posture, activity, branch size, branch angle, and crown location in five age categories of white-faced capuchins and mantled howlers during a 12 month period at Estación Biológica La Suerte in northeastern Costa Rica.

Infancy and juvenile periods in both species were characterized by play behavior, a continued association with the mother during social behavior, progressive locomotor independence, and continued social learning. In both species, positional modes were more

diverse in juveniles when compared to adults. As play increased in juveniles, the positional repertoire became more varied. In capuchins and howlers, play involved chasing, wrestling, and associated faster and more acrobatic positional modes. Positional modes such as *tail suspend*, *leap*, and *quadrupedal run* increased during social play. A comparison of positional behavior within all behavioral contexts (feeding, foraging, travel, social behavior), showed that the greatest differences ( $p < 0.05$ ) among age categories in both species were within the contexts of social behavior and are related to the relative proportions of play in juveniles. This pattern was consistent with the intuitive suggestion that as play increases, so will the frequency of locomotor modes. Results presented here not only illustrate the importance of play and locomotor development but also suggest that studies of ontogenetic patterns of positional behavior consider differences among more precise behavioral contexts.

#### Ongoing positive selection on stomach lysozymes in African colobines.

J.M. Biegel, A.P.J. de Koning, C.-B. Stewart. Department of Biology, University at Albany.

The independent evolution of foregut fermentation in the artiodactyl ruminants and the colobine monkeys provides a classic system for the study of adaptive molecular evolution. This laboratory has previously reported evidence for adaptive evolution of colobine stomach lysozymes and pancreatic ribonucleases, two enzymes that appear to have been co-opted to digest foregut bacteria. Here we present new sequence data for the lysozyme gene from African red colobus monkey, and analyze the primate lysozyme dataset using novel phylogeny-based methods for detecting episodes of positive selection and for identifying selected sites. For comparison, we have sequenced the lactalbumin gene (a homolog of lysozyme on the same chromosome) from a matching set of species, and have applied the same analytical methods.

Our analyses of the lysozyme dataset confirm the previously-reported adaptive episode on the ancestral colobine lineage. More interestingly, we find that lysozyme has continued to evolve under positive selection on the African colobus lineage, and has sustained numerous amino acid replacements. In contrast, lysozyme has evolved relatively slowly within the Asian colobines. Several of the replacements on the red colobus lysozyme lineage significantly reduce this protein's isoelectric point, such that it is more similar to cow stomach lysozyme, and some replacements are shared between these two distantly-related lineages. In contrast to lysozyme, lactalbumin has evolved slowly in the primates; no positive selection was detected on any lineage. Taken together, these results support the hypothesis that stomach lysozymes from foregut-fermenting species have evolved under

positive Darwinian selection for their new digestive roles.

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#### Paleopathology of an urban military graveyard: Inferences about living conditions of low status soldiers in the late 18<sup>th</sup> century

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During construction works in central Vienna in 2005, parts of an 18<sup>th</sup> century military graveyard were discovered. Of the 393 skeletons unearthed in the course of the following salvage excavation, a sample of 58 skeletons was chosen for further anthropological investigation. According to written sources, the graveyard was related to a nearby military hospital and was in use between 1769 and 1784. The soldiers buried there belonged to the permanent army and died for other reason than direct violent action. Rank affiliation could be drawn from the death records which showed that they mostly derived from the lowest ranks.

The evaluation of the health status of the soldiers is based on the occurrence of cribra orbitalia and porotic hyperostosis, periosteal reactions in the cranial and postcranial remains, dental pathologies and trauma. High frequencies in all parameters point to high levels of pathogen exposure and poor living conditions of low status soldiers of the Austrian Army in the late 18<sup>th</sup> century. The osteological findings could be supplemented by written accounts of daily life in Vienna as well as medical literature of the 18<sup>th</sup> century which very well support the results.

#### Dental variation in Holocene Khoesan populations.

W. Black, R.R. Ackermann, J. Sealy. Department of Archaeology, University of Cape Town.

While studies of dental variation in Holocene populations of Europe and the Americas are plentiful, similar studies in African populations are limited. Here, we present some preliminary work focusing on dental variation in the Khoesan, an African people who have received considerable attention from archaeologists and physical anthropologists. Recent studies of well-dated Khoesan cranial and post-cranial material have suggested long-term morphological (and presumably genetic) continuity in the populations who occupied South Africa's southern and western coasts and coastal forelands during the past 12,000 years. Changes in body shape in particular have been attributed to environmental factors, such as dietary stress, rather than being

indicative of gene flow into the region from other sources.

This study complements this work, through an analysis of dental metric and non-metric variation. Because dental traits may be less influenced by environmental factors than other regions of the skeleton, this study may provide clearer insight into genetic continuity in this region. Additionally, the relative abundance of dental remains, particularly in the early Holocene, adds further to our understanding of the emergence of the Holocene phenotype. Preliminary results are largely consistent with prior analyses, indicating population continuity through time. Interestingly, changes in tooth size also appear to follow the late mid-Holocene size fluctuations seen in cranial and post-cranial material.

#### Locomotor ecology of three sympatric lemur species in Mantadia National Park, Madagascar.

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Despite similar body size, locomotor repertoire, and folivorous diet, *Indri indri* and *Propithecus diadema diadema* are sympatric throughout forests of western Madagascar. *Haplemur griseus griseus*, smaller and more specialised in diet, has a diversity of locomotion similar to that of the Indriidae, but maintains quadrupedalism as a substantial element in its repertoire. The study asks whether the more specialised locomotion of the Indriidae gives them any advantage over *H. g. griseus*; what function is served by quadrupedalism in the latter, and whether sympatry of *I. indri* and *P. d. diadema* is facilitated or hindered by their locomotor similarities and differences.

A field study was conducted at Mantadia National Park from November 2004 to October 2005. One group of *I. indri* and *P. d. diadema* and two groups of *H. g. griseus* were habituated and followed. Detailed analysis of substrate-locomotion interactions is ongoing, but clear differences were found in mean height of observation, and locomotor frequencies. The mean height of *I. indri* was 12.6 m, for *P. d. diadema* 10.6 m and for *H. g. griseus* 5.9 m. *H. g. griseus* used leaping in 48% of displacements, quadrupedal walking in 38% of cases. Although both indriids used leaping more than any other locomotor mode *I. indri* leapt more often (81% versus 75% of observations) but used vertical climbing less (10% versus 13%). These differences appear consistent with height of observation and consequent substrate availability.

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#### Reproductive schedules of brown mouse lemurs (*Microcebus rufus*) at



### Ranomafana National Park, Madagascar.

M.B. Blanco. Department of Anthropology, University of Massachusetts, Amherst.

The reproductive status of female brown mouse lemurs (*Microcebus rufus*) was examined during a three-month period, from October 2005 to early January, 2006 at Ranomafana National Park, an eastern rain forest in Madagascar. Intensive capture/mark/recapture techniques were used to track individual changes in vaginal morphology, and body mass and vaginal smears were collected for individuals with open vaginas. The goals of this study were to determine (1) the length and starting date of the primary breeding season of *Microcebus rufus* at Ranomafana; (2) whether proximity of females affects the timing of estrus; (3) whether female body mass affects the timing of estrus; and (4) whether polyestry is manifested in *M. rufus* in the wild.

*Microcebus rufus* at Ranomafana exhibits moderate estrous synchrony (vaginal openings were observed between October 11 and November 18) with clusters of females showing strong estrous synchrony (6 of 15 on October 15, and 3 of 15 on October 25). Neither trapping proximity nor body mass explained the intrapopulation variation in estrous timing: this study shows only weak support for the proximity hypothesis (that closer females will enter estrus simultaneously) and no support for the notion that body mass influences the timing of estrus in female brown mouse lemurs. Females gave birth during the second and third weeks of December. There were signs that polyestry may exist in wild mouse lemurs at Ranomafana, although more data are needed to confirm this hypothesis.

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### Are the Koh an indigenous population of the Hindu Kush? II: a dental morphology investigation.

S. Blaylock and B.E. Hemphill. Dept. of Sociology and Anthropology, California State University, Bakersfield.

Little is known about the population history of the ethnic groups in Chitral District, Pakistan, an area long been regarded as the "crossroads of Asia." Some scholars emphasize that the Koh lifeway is the consequence of long-standing indigenous isolation. Others stress the equestrian tradition among Koh villagers indicate they are descendants of Central Asians who emigrated across the Hindu Kush Mountains during the second millennium BC. To still others, an array of Persian linguistic inclusions indicates the Koh are more recent emigrants from the Iranian Plateau.

This investigation tests these hypotheses for Koh origins through assessment of dental morphology variations of the permanent dentition scored as 17 tooth-trait combination

in accordance with the Arizona State University Dental Morphology System in a sample of 134 Kho school children from Chitral City. These data were contrasted with 17 additional samples. Comparisons are in two stages and include cluster analysis, multidimensional scaling and principal coordinates analysis.

First, sex-pooled and sex-specific data compared Koh to six contemporary ethnic groups from India. Results indicate the Koh share equidistant affinities to Indo-European-speaking west-Central Indian and Dravidian-speaking South Indian ethnic groups.

Second, sex-pooled data compared the Koh to 13 prehistoric samples from Neolithic to Early Iron Age sites located in the Indus Valley, Central Asia and the Iranian Plateau. Results indicate that the Koh share little affinity to prehistoric Indus Valley groups. Rather, the Koh share nearly equal affinities to prehistoric inhabitants of the Iranian Plateau and Central Asia.

### Sex Recognition by Face

V. Blazek, M. Hoskova, Department of Anthropology, University of West Bohemia, Pilsen, Czech Republic

Besides speech, the face is the most important source of information in the interaction between individuals and it is stimulating to study the discernment of individual facial features and the process of its effect on human behavior or actions.

Our research focuses on the recognition of sex. We divided the human face into segments. Horizontal strips were cut off the photographs, adjusted and inserted into a neutral facial scheme. The strips consisted of forehead and eyebrows, eyes, nose and chin with mouth. Informants, university students (32 males and 32 females), were asked to estimate sex from the photographic strips. It was expected that females would be more successful in sex estimation; that the upper part of the face, including the eyes would be essential for the estimation; and that males would recognize female faces more easily and vice versa.

The results indicate that females and males do not differ in the degree of successful sex estimation and show that males are more successful in recognition of female faces and vice versa. However, statistical tests were mostly nonsignificant. The hypothesis about the role of the upper part of the face was refuted; it was proved for the forehead and eyebrows but not for the eyes. Both females and males were most successful in identifying the mouth and chin of males, followed by recognition of the forehead and eyebrows; especially the male forehead and eyebrows identified by females. Male eyes were the least successfully identified features.

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### Patterns of variation in the ontogeny of supraorbital form in species of *Homo* and *Pan*.

J. Blumenfeld, S.R. Leigh. Department of Anthropology, University of Illinois, Urbana-Champaign.

This study examines patterns of variation in the ontogeny of supraorbital form in species of *Homo* and *Pan*. Previous studies have offered conflicting results for the presence of a widely shared craniofacial ontogenetic pattern among and between hominins and nonhuman primates. This study investigates this controversy further, and tests for variation in ontogenetic trajectories within a single skeletal element: the frontal bone of the skull. Variation in supraorbital morphology has often been used in studies of human evolution to distinguish between different species and sexes, and this project tests the hypothesis that major differences in frontal bone form may actually be the result of small changes in size that manifest themselves as significant differences in browridge shape during growth.

Three-dimensional data from the supraorbital region of the frontal bone was collected from an ontogenetic sample of anatomically modern humans, Neandertals and chimpanzees (*Pan troglodytes*) through the use of a newly developed photometric method called ShapeCam. These data were then subjected to geometric morphometric methods of analysis (GPA and PCA).

Differences in shape correlate with differences in size in all three species, and results indicate a modern human supraorbital ontogenetic trajectory that involves little shape change from birth to approximately 5 years of age, with an accelerated change in shape shortly afterwards. This may indicate the presence of complex allometry in this sample. The Neandertal sample appears to follow a similar trajectory, albeit to a much larger endpoint. These results and their implications will be discussed.

This research was supported by a Graduate College Dissertation Travel Grant Award (University of Illinois, Urbana-Champaign), and an NSF Doctoral Dissertation Research Improvement Grant (BCS-0622420.)

### Re-examining the issue of biodemographic changes in North America during the transition to agriculture.

J.-P. Bocquet-Appel, S. Naji. Centre National de la Recherche Scientifique, Paris, France.

The signal of a Neolithic demographic transition has been detected from bioarchaeological data from 100 cemeteries in Europe, North Africa and North America. The cemeteries were set within a relative chronology encompassing the transition from forager societies to horticulturalist-farmer societies. What were the consequences of this change in the economic system on the population's health? Using the same relative chronology approach, the paradigmatic



question raised 30 years ago by Mark Cohen is re-examined: did biological stresses, which are negative indicators of a population's well-being, increase with the transition to agriculture?

Signals from 4 skeletal biological markers from North America (caries, cribra orbitalia, porotic hyperostosis and sexual dimorphism in femur length) are set, together with the signal of the Neolithic demographic transition, within the same chronological framework. How did they co-vary?

The frequency of caries increases one thousand years before the shift to agriculture. This pattern probably indicates a broadening dietary range during the time before the advent of agriculture, as well as the addition of sugars in diet. Furthermore, as soon as the farming economy appears, birth and fertility rates shoot up and the prevalence of anemia markers increases. Conversely, decreasing sexual dimorphism in stature seems to be the continuation of a trend that had already appeared during the forager period.

The picture as a whole clearly confirms the hypothesis regarding biological stresses during the transition.

#### **Working towards higher pelvic standards: accuracy, comparability & sex.**

D.M. Boeker. Department of Anthropology, University of Montana.

It is universally accepted that the pelvic girdle is the most important part of the human skeleton when determining sex. What many do not consider is the large degree of inter- and intra-population variability in pelvic morphology, and how this variation can easily lead to faulty determinations of sex if not considered during analysis. The objectives of this study include: to determine the most reliable reference points for the standardization of pelvic measurements; to determine what measurements and indices are the most reliable for within and between group sexual determinations; to expose difficulties in sexing prehistoric and modern individuals using the pelvis; to demonstrate that certain measurements highly accurate in determining sex for one population may not be as accurate in another. A total sample of 328 pelvic bones was analyzed at the AMNH in NY, consisting of modern and prehistoric individuals. Methods used to reach and display conclusions include descriptive statistics, One-Way ANOVA tests, Post Hoc tests (Tukey HSD), Eta squared calculations, Effect Size (Cohen 1988), histograms and boxplots. Fifteen measurements were calculated on each pelvis, and derived from these are seven index values that are used for comparative and analytical purposes. The coxal index is shown to be the least reliable index in distinguishing sex both between and within populations. The most reliable index is the ischio-pubic index. The modern sample shows less sexual dimorphism overall, exhibiting less options for reliable indices. In 4 of 6 instances, modern males and

prehistoric females are most similar in pelvic morphology.

#### **Wild brown capuchins in Suriname exploit combinatorial manipulation for multiple functions.**

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*Combinatorial manipulation* (CM; actions combining an object with another object or surface) is commonplace in foraging in brown capuchin monkeys in Suriname, e.g., striking tough objects against a substrate to open them, or rubbing hairs off a caterpillar. CM also occurs during displays between troops, as in striking a tree with a branch.

We hypothesized that CM serves both foraging and signaling functions in brown capuchin monkeys. We tested predictions derived from this hypothesis using data collected on six troops of brown capuchins, *Cebus apella* (70 individuals) during 43 months of fieldwork at Raleighvallen, in the Central Suriname Nature Reserve. We present four key findings. ●Striking an object on a branch in a foraging context is the most commonly performed CM. ●The form of CM varies substantively between foraging and display contexts. ●Ages and sexes diverge in the forms and contexts in which they combine objects with surfaces; males engage in CM in display contexts. ●Individual males vary in CM expression. Some demonstrate flamboyant 'percussion', repetitively striking hard objects on branches, the longest episode being 452 strikes over 90 minutes. These actions garner little food, but they do generate loud mechanical sounds. Repetitive, flamboyant percussion occurred during periods when the group was not disturbed as well as during agonistic inter-group encounters. This behavior is consistent with honest condition-dependent signaling as regards male vigor and the size of male alliances. This is the first report suggesting that monkeys use sounds generated by combinatorial manipulations as social signals.

Major support for the ongoing Monkey-Forest Project at Raleighvallen comes from the US National Science Foundation (SBR-9722840, BCS-0078967 and BCS-0352316).

#### **10000 years of human demographic evolution.**

J.L. Boldsen. Department of Anthropology (ADBOU), Institute of Forensic Medicine, University of Southern Denmark.

Since the onset of food production some 10000 years ago in the Middle East dramatic change in human patterns of mortality have taken place. All pre-modern societies would by modern standards demographically be characterized as high mortality regimes. However, the age distribution of the risk of dying has fluctuated a lot. The central

tendency of this fluctuation can be described by the second, age independent mortality component of the Siler Model. It started out low in foraging, pre-agricultural societies, increased through the mostly horticultural Early Neolithic Period, reached a high plateau in the subsistence agricultural period from the Late Neolithic Period to the Iron age. With the gradual integration of agricultural production in a regional and continental scale marked network this mortality component gradually diminished. Age independent mortality plays virtually no role in any modern community be it First or Third World.

Probably, the age independent mortality component had been low for most of the pre-Holocene evolutionary history of our species. This means that evolutionary pressure introduced by an increase of this component could alter the genetic make up of humankind. During the episodes when the age independent mortality component was high selection would favor genes pushing reproduction into younger ages. In some regions of the Old World this episode lasted up to 8000 years.

This presentation uses regional differences in the time depth of the episode with high levels of age independent mortality to formulate an evolutionary and mathematical model giving origin to empirically testable hypotheses about the genetic consequences.

This research has been supported by the Max Planck Institute for Demographic Research in Rostock, Germany.

#### **Chimpanzee and gibbon bipedality: a contrast in limb and muscle proportions.**

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Chimpanzees and gibbons have differing locomotor repertoires although both are capable of two-legged walking. Chimpanzees are quadruped generalists; they travel on the ground, climb, feed, and sleep in trees. Gibbons are suspensory brachiators, noted for their swift movements through the tree canopy, and frequent upright posture. Here we investigate the underlying mechanics of the two species' bipedalism, specifically the thigh muscularity, as this is a key body segment in human bipedal locomotion. We also consider relative limb mass. Whole body dissections of 5 adult gibbons and 5 adult chimpanzees reveal contrasting anatomical patterns. Chimpanzee forelimbs are relatively lighter than hindlimbs (15-16% and 20-25%, respectively) than gibbons (18-19% and 17-18%, respectively). In proportions of thigh muscle, chimpanzee adductors comprise 48%, quadriceps 34%, and hamstrings 18%. In gibbons the proportions differ: adductors are only one-third at 31%, while quadriceps are well over half of the total mass at 55%, and hamstrings 14%. Chimpanzee thigh muscles provide powerful adduction for walking as quadrupeds, and as bipeds. The quadriceps

muscles extend the knee, and hamstrings supply propulsive power in walking and running. In contrast, gibbons' legs are muscled for powerful knee extension with massive quadriceps, yet lack power in hamstring propulsion with slighter mass, slender origins and insertions, and relatively short tendons. We conclude that gibbon and chimpanzee bipedality are convergent behaviors. Given the distribution of the thigh muscle groups of chimpanzees combined with their heavier hindlimbs, they offer a better model for visualizing the transition to human bidedality.

#### **Geometric morphometric analysis of the UA 31 orbit (Uadi Aalad, Eritrean Danakil)**

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An intact orbital cavity is rarely preserved in the early human fossil record, despite its potential significance in taxonomic assessment and phylogenetic reconstructions. The restoration of the one-million-year-old UA 31 cranium from Uadi Aalad, discovered in the sedimentary basin of Buia, northern Danakil depression of Eritrea (Abbate et al. 1998), revealed an almost complete, undistorted left orbit.

Buia's orbit is characterized by a tall and thick external contour. The socket is greatly elongated antero-posteriorly and its volume (37 cc) substantially exceeds the range of variation in modern *sapiens*. We analyzed UA 31 by geometric morphometrics and compared results with a sample of 164 modern crania of different geographic origins using a set of 16 landmarks specifically defining the orbit (margin and socket) and 12 external landmarks (7 on the face, 5 on the braincase). In the modern sample, principal components 1 and 2 (25% of the total variation) correlate orbital axis orientation and length and height of the cavity with the morphology illustrated by the external landmarks. The remaining principal components account for the modification of the socket's shape, where the orbital floor plays a key morphological role.

In UA 31, the zygo-orbitale is positioned closer to the lateral orbital margin; the point where frontal, zygomatic and sphenoid intersect and the inferior orbital fissure are more deeply placed in the orbital cavity; and, in superior view, the optical canal is shifted laterally. These morphometric and morphological features separate UA 31 from modern *sapiens*.

#### **From face to brain: progress in the neonatal anthropometrics of fetal alcohol damage.**

F.L. Bookstein. Department of Anthropology, University of Vienna, Austria, and Department of Psychiatry & Behavioral Sciences, University of Washington, USA.

One could argue that the human birth defect now called Fetal Alcohol Spectrum Disorder (FASD) arose in 1973 as applied anthropometry. A group of Seattle infants who all had the same odd facial features happened all to have alcoholic mothers; later they all showed severe neurobehavioral deficits as well. Today we know that those facial features were only incidental concomitants of the brain damage that was actually immiserating the lives of these patients -- that there never really was a facial anthropometrics of FASD after all.

But over these same 30 years there has been considerable progress in two fields abutting anthropometrics, medical image analysis and morphometrics, so that newly specified neonatal brain imaging protocols now show the same association of a sharply localized feature with prenatal alcohol exposure as was noted "from the outside" in the original 1973 discovery. The appearance of a "hook" (obtuse angle) between the splenium of corpus callosum in the medial plane and the long diameter of the arch characterizes 12 out of 23 alcohol-exposed infants as anomalous with only one false positive among 21 unexposed. This talk will demonstrate the finding and show how in its formal structure it maps onto one classic

strategy of anthropometrics, the post-hoc construction of a discriminating feature that confirms an important group difference. Early detection of salient human variations bears important implications both for public health and for "social engineering," and represents a reopened domain for applied anthropology that could help increase the chances of the survival of the field as a whole.

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#### **Primate phylogeny and divergence dates based on complete mitochondrial genomes.**

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The phylogeny of the primates is not well established, even at higher taxonomic levels and among extant taxa. Molecular studies of primate phylogeny have tended to use a limited number of loci and focus on relationships within single subfamilies or genera. In general, few molecular or morphological studies have produced robust, well-resolved estimates of primate phylogeny. The estimation of primate divergence dates using molecular clock methods has also yielded a wide and conflicting range of inferred split dates. In hopes of improving estimates of primate phylogeny and divergence dates, we report here the sequencing of the complete mitochondrial genomes of 10 primate genera. Using mitochondrial genomes, primate phylogeny can be reconstructed from multiple homologous loci. The most "clock-like" mitochondrial locus can be identified and used to provide estimates of relative and absolute divergence dates. The pattern of evolution of the mitochondrial genome within primates can be ascertained. In general, this work substantially expands the dataset available for analyses of primate phylogeny and divergence dates.

#### **Flexible Asian folivores: Life history in the genus *Trachypithecus*.**

C. Borries<sup>1</sup>, N. Sheldimide<sup>2</sup>, E. Larney<sup>3</sup>, A. Lu<sup>3</sup>, C. McCann<sup>2</sup>, A. Koenig<sup>1</sup>. <sup>1</sup>Department of Anthropology, Stony Brook University, <sup>2</sup>Wildlife Conservation Society, New York, <sup>3</sup>Interdepartmental Doctoral Program in Anthropological Sciences, Stony Brook University.

Life history variables across taxa can be influenced by multiple factors, including body mass, food availability and the presence of allocare. Abundant food availability due to folivory and/or captivity may allow for more constant food intake while allocare eases maternal investment. Both may accelerate growth rates and reproductive rates. This study proceeds from two data sets for the genus *Trachypithecus*, an Asian colobine taxon characterized by folivory and extensive allocare. One wild population, *Trachypithecus phayrei*, has been studied since the year 2000 at Phu Khieo Wildlife Sanctuary, Thailand (N = 59 infants). The other population, *Trachypithecus cristatus*, is housed at the WCS's Bronx Zoo, New York and has been studied since 1985 (N = 84 infants). Growth rates were estimated via change from natal to adult coat, age at weaning and at maturity. Reproductive rates were determined via interbirth intervals (IBI). Food availability has a major impact on life history. Growth rates in the wild population were about 60% and reproductive rates about 40% lower. In spite of folivory and allocare, wild *Trachypithecus* seems to mature rather slowly (e.g., first birth at 5 years) compared to other primates of comparable body mass. Reproductive rates were very flexible, revealed in a yearly shifting birth peak and a large variation in individual performances

(IBI after surviving infant: 13-27+ months wild, 10-46 captive). This flexibility has been interpreted as an adaptation to the unpredictable nutritional conditions in Asia where plant mast production may be followed by years of low food availability.

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**Written in stone, written in bone: the osteobiography of a craftsman from Bronze Age Alalakh (Turkey).**

A. Boutin, Department of Anthropology, University of Pennsylvania

The second millennium BCE city of Alalakh (Tell Atchana) in southern Turkey was excavated by Sir Leonard Woolley from 1936-49. Although Woolley's expedition excavated well over two hundred burials at this Middle and Late Bronze Age regional capital, he published them in a meager fashion, and subsequent research on these burials has been minimal. Since 2003, numerous burials (MNI=64) have been discovered in the course of new excavations at Alalakh. When studied as an assemblage, the burials from the two expeditions make a richly contextualized contribution to the study of life and death in the Bronze Age Near East. Specifically, they attest to the recursive relationship between mortuary practices and social identities.

This integrated, fine-grained bioarchaeological inquiry prioritizes four axes of identity (age, sex, discrete traits, and health status). The morphological and morphometric data are interpreted in light of abundant socio-historic contextual information, particularly archives of cuneiform tablets from Alalakh. The results are detailed osteobiographies of people who lived, worked, loved, and died at Alalakh.

One such osteobiography is written in the bones of a middle-aged male who lived during the Middle Bronze Age. Clues to his lifestyle are found in robust muscle attachments of the face and jaw, a distinctive pattern of heavy dental attrition, and evidence of past trauma and significant degenerative joint disease in the upper limbs. Contemporary texts from Alalakh describe various craft specialists who plied their trades at the market, such as leather workers, tailors, and weavers; surely this man was one of their number.

**Polygyny as a social mediator of women's health in rural and urban Mali.**

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C.R. Vaggia, Ph.D., Department of Anthropology, University of Pennsylvania.

Over the past two decades, the impact of social status on women's health has been well elaborated. Polygyny is a paradoxical social

arrangement requiring women to cooperate in child bearing and subsistence activities, with co-wives who represent their more significant competitor in these very activities. The impact of polygyny on women's health, and on their ability to seek treatment and social support during illness, has received limited attention. This study examines symptom reporting and health seeking history among monogamous and polygynous women in a patriarchal society where polygyny is a normative social arrangement.

A health event and treatment questionnaire was administered to over 250 women in rural Mali, and over 250 women in urban Mali. These women, aged 15 and older, were randomly selected within communities chosen to reflect a variety of socioeconomic groups. Personal, household, and community information was obtained. The utilization of pre- and peri-natal health resources for women who became pregnant within the two years prior to the study, was also obtained.

We found that polygyny is associated with poorer health and treatment seeking behaviors in both urban and rural communities. Both polygynous and monogamous urban women tend to seek formal treatment more often than rural women, which can be explained, at least in part by their access to health centers. Social support was available to both groups of women.

Polygyny plays an important role in structuring women's access to health resources. However, significant methodological barriers remain to a full assessment of its impact on women's health.

**Further examination of growth accomplishment in children with clefts of the lip and/or palate.**

E. J. Bowers, Anthropology Department, Ball State University.

This work continues the reanalysis of data from the records assembled by Prof. Wilton M. Krogman and his students at the Philadelphia Growth Center, later the W.M. Krogman Center for Research in Child Growth and Development. It looks at growth accomplishment in children with clefts of the lip and/or palate as reflected in radiographs of their hands and wrists. Previous work on such children attending the Philadelphia Facial Reconstruction Center, demonstrated differences in their growth accomplishments, particularly with regard to height in males. In order to distinguish growth delay from growth deficit, a sample of hand-wrist films from the Krogman Cleft Palate Series were reanalyzed for skeletal age using the Tanner-Whitehouse II system, which looks at individual bones. Dismorphologies of the wrists were seen, taking the form of unusually small size of some carpals as compared to the rest, and deficits in the ulna styloid. In this paper a further sample of these records are examined in order to replicate these observations. Since the initial analyses were made while blind to the

chronological age, sex, or diagnosis for the individual, this analysis also determines whether these observations are specific to certain sex or diagnostic categories, and examines the range of differences between skeletal and chronological age in children with various kinds of clefts in order to clarify the question of growth delay versus growth deficit.

**Historic African-Americans of Virginia: mortality, stress and secular change from 1690 – 1930.**

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Little is known about the skeletal correlates of slavery in terms of its effects on bone morphology and health and how these parameters may have changed with emancipation. The current study examines human skeletal remains from five African-American cemetery sites in Central and eastern Virginia dating from 1690 to 1930. Nearly 150 skeletons are derived from these sites; three of the sites represent the ante-bellum slave period in Virginia, while the remaining two reflect emancipated populations. Skeletal data in the form of demographic, pathologic, dental, and metric parameters are compared across these populations as well as to more modern African-Americans in order to: 1) investigate the skeletal correlates of slavery and emancipation; and 2) discern trends in African-American health and bone morphology across this temporal period.

As predicted, high frequencies of subadult mortality, infectious lesions, dental disease, enamel hypoplasia, and other indicators of non-specific stress are evidenced by the two slave samples. In contrast, the early 20<sup>th</sup> century sample shows significantly reduced frequencies for the majority of stress parameters observed, suggesting a trend of improved general health across the 19<sup>th</sup> and early 20<sup>th</sup> centuries in Virginia. Musculoskeletal Stress Markers (MSM) in addition to cranial and postcranial metrics are also compared across these groups to investigate evidence for secular change in bone morphology across this period. These data are interpreted from functional, behavioral, and health and dietary perspectives.

**A Howells grasp on prehistoric and recent Japan: A precursor to the Kennewick connection.**

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William White Howells was truly a multivariate man. He had a polished grasp of the English language that was part of the tradition that had generated his literary grandfather, William Dean Howells, elegant writer and long-term editor of *The Atlantic*

*Monthly.* Both his grandson's written and spoken use of the English language displayed a grace and eloquence well beyond that of anyone else in our business. In addition, he had a statistical flair that set a standard for future generations of practitioners in biological anthropology. His own students felt that a demonstration of competence in factor analysis was absolutely *de rigueur*.

He arrived at Harvard in the mid-fifties just at the time when computer storage capabilities made major matrix analysis practical. And he promptly set about collecting a data base that would allow the comparison of the major human populations of the world. Howells' test of the Ainu and the Jōmon of Japan (Howells 1966) demonstrated both the strengths and the weaknesses of his approach. He was able to show that the Ainu could not encompass the prehistoric Jōmon, but that the Jōmon could include the modern Ainu but not the Japanese. Using many more samples, our results are compatible with what Howells showed for his Japanese comparisons, and, using the neighbor-joining technique, we can go on to show that Kennewick ties with the Ainu who are the descendants of the Jōmon. The Jōmon then are the probable ancestors of the first inhabitants of the western hemisphere.

**Western medicine meets rural Africa: an assessment of a HIV mother-child transmission program in rural Tanzania and related biocultural issues.**

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Given Africa's disproportionately large number of cases of mother to child HIV transmission, and the western origin of programs to combat transmission, there have been relatively few attempts to examine the efficacy of these programs. This study of a prevention program focuses on the impact of biocultural factors on medical practices.

This study examined a mother-child transmission prevention program in rural northwestern Tanzania. It employed analysis of hospital records and ethnographic interviews with traditional birth attendants and healthcare workers. The program, offered through district medical facilities (hospital and clinics), provides free prenatal services. Less than 50% of pregnant women attending the prenatal clinic were tested for HIV (N=2868) with 3.66% testing positive and offered HIV prevention services. Hospital records indicated that only 20% of these women returned to the hospital for delivery and/or neonatal drug treatment. Most of the women delivering in the hospital sought treatment for their newborns, but only 50% took the recommended drug dose themselves during labor onset. Less than 10% of the women sought alternatives to breast feeding, as recommended.

Fear of domestic abuse and stigma associated with AIDS diagnosis and avoidance of any behaviors serving as identifiers are important

factors in resistance to program compliance. Additional cultural factors include a strong preference for home birthing with 65% or more women birthing at home. Multiple service demands on program staff, limited availability of public transport, and funds to pay for transport are other important factors limiting access to this program.

This research was funded by a University of Pittsburgh Research Abroad grant.

**Evolutionary and developmental implications of species-specific brain growth patterns within the genus *Pan*.**

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Among primates, only for humans, an overlay of altriciality accounts for neonate physical retardation and helplessness. Because of the absence of this pattern of secondary altriciality in chimpanzees (*Pan troglodytes*), this phenomenon is hypothesized to represent a derived feature of the human lineage. However, bonobos (*Pan paniscus*) and chimpanzees are evolutionarily equidistant to us and are both species of the genus *Pan*. There is no brain growth data hitherto available for bonobos.

In order to test the aforementioned hypothesis, here we compare the bonobo and chimpanzee postnatal brain growth in evolutionary and developmental perspectives using an objective randomization procedure that assesses intra-species variability. We use a large cross-sectional sample (143 bonobos and 87 chimpanzees) in virtual imaging of the amount of endocranial capacity.

We find that until mixed dentition, bonobos, in comparison to chimpanzees, display brain growth delay by 75% of endocranial capacity in proportion to that of the adult, and follow a rapid 8-12% growth trajectory of brain size relative to body weight. Our findings interconnect the bonobo developmental retardation, social repertoire promoting food-sharing and weaning, and finally reproductive success in natural habitat. This leads us to discuss the evolutionary and developmental implications of our results. We conclude that, in contrast to chimpanzees, bonobos are more secondary altricial with the appearance of a post-weaning stage of childhood that has been regarded as a reproductive adaptation. Supported by the EVAN and GDR 2152 CNRS projects.

**The Early Paleolithic: A comparison of African and Asian Industries: Hypotheses and Future Expectations.**

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The Early Paleolithic of Asia represents the best record of hominin adaptive flexibility. Recent research suggests that

hominins may have occupied northern China by 1.66 Ma (Zhu et al. 2004). The habitation of a substantial part of the Old World was complete less than 1.0 Ma after the first appearance of artifacts in East Africa. For much of the Early Pleistocene archaeological evidence in Asia is very dispersed. Early Asian assemblages are dominated by Mode I technologies. This is the case even after Mode II technologies have expanded to cover the entire African continent. If these early Asian sites represent the apex of hominin adaptability it does not appear to have been mediated by technological innovation.

Here we hypothesize that the hominins that produced the Early Paleolithic of Asia occupied a very different part of their ecosystem than their counterparts in Africa. It has been hypothesized that hominins in Asia were occupying the margins of available hominin habitat. As such we would expect a reflection of this unique scenario in the archaeological record. Here we compare and contrast the African and Asian record from 1.7 Ma through 300 kyr. Specifically we are interested in the importance of stone tool mediated resources for hominins across these areas and through time. This should be reflected in differences in the importance of stone artifacts in these different areas. We compare technological variation and hypothesize on the interrelationship of hominin technology and latitudinal change.

**3Dimensional Molecular Modeling and Comparison of Human and Chimpanzee Toll-Like Receptor 2.**

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Toll-like receptor 2 (TLR2) is an innate immune receptor found on peripheral blood leukocytes known to recognize pathogen associated molecular patterns (PAMPS) ligands from gram-positive bacteria, mycobacteria and HIV-1. TLR2 mediated immune cell activation leads to an inflammation response and cytokine release. Given the differences in distribution TLR2-recognized pathogens amongst higher primates, we tested the hypothesis that variations in TLR2 may exist by undertaking a protein sequence and structural analyses. Comparisons of published TLR2 sequences between human, chimpanzee and macaque revealed 4 divergent amino acids (AAs) between humans and chimpanzees, three of which were shared between humans and macaques. All divergent AAs are located in the TLR2 extracellular PAMP-interactive domain, and between long-leucine repeat (LLR) 6 and 10. All divergent AAs between chimpanzees and human confer changes in protein folding, charge and/or hydrophobicity. TLR2 was modeled in 3-dimensions (3D) using the fold recognition and 3D modeling programs Fugue and 3Djigsaw. Low sequence

identity between TLR2 and proteins with known structure meant that modeling was restricted to 212 AA of TLR2 (LLR7 to LLR10, that included the divergent 2<sup>nd</sup> and 3<sup>rd</sup> AA) with human CD14 as the sole template. The models were verified with moderate success in 3Dverify. Models showed four significant 3D structural differences at or near the divergent AAs including several conversions of alpha helices to turns. This study raises important questions regarding TLR2 activation differences in chimpanzees and humans and 3D molecular modeling options for proteins with moderate to low identity with proteins of known structure.

**Birth season glucocorticoids are related to the presence of infants in male sifaka (*Propithecus verreauxi*).**

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Primate responses to environmental stressors are little understood in free-ranging populations, but recent studies of gregarious species suggest that ecological factors and social milieu influence the variable physiological stress responses observed among individuals. Our previous studies examining fecal glucocorticoid (fGC)-behavior interactions in male *Propithecus verreauxi* show that fGC elevations coincide with specific dispersal events, in particular the eviction of subordinates by resident alpha males. This study examined the utility of fGC assays for assessing stress responses of male sifaka to demographic changes in the population during the birth season.

Analyses were based on a total of 889 fecal samples collected over 5 field seasons from 124 adult males residing in 57 different groups in Parcel 1 at Beza Mahafaly, Madagascar. A corticosterone radioimmunoassay was previously validated and found to reliably detect glucocorticoid metabolites in sifaka feces and to index stressful events and states. Fecal GC associations with male rank, group stability, group sex ratio and the presence of infants were tested. Variations in fGC levels were also examined in relation to the annual and diurnal cycle and to demographic-related events.

Results showed that the significant annual variation in fGCOS levels in males was unrelated to rank, group stability or group sex ratio. fGC was, however, strongly linked to the presence of infants, annual elevations in fGC in males paralleling increasing numbers of infants in the population. These patterns can be interpreted in the context of paternal care and male infanticide at this site.

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**Ethnic and menopausal status differences in symptom reports: the Hilo Women's Health Study.**

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A survey on women's health concerns was mailed to randomly selected households in Hilo, Hawaii which included a checklist of thirty symptoms experienced within the past two weeks. Imbedded in the checklist were concerns of a menstrual, menopausal, general health, and psychological nature, although symptoms were simply presented in alphabetical order. Women also reported the date of survey and last menstrual period, from which menopausal status (pre-, peri- or post) was ascertained. Many women reported mixed ethnicity, but four major ethnic groups were identified: Hawaiian/part Hawaiian (N=437), Euro-American (N=434), Japanese (N=484), and Filipino (N=149). The ethnic groups differed in age, and therefore in proportions of menopausal classification. When binary logistic regressions were carried out, 18 symptoms differed significantly by menopausal classification, and 15 symptoms differed significantly by ethnic group. Three of the four "menstrual" symptoms were significantly more frequent among premenopausal women, while all four of the "menopausal" symptoms were significantly less common in premenopausal women. Several general and psychological complaints were less common among postmenopausal women than women in other menopausal categories. For 14 of the 15 symptoms with significant ethnic differences, Japanese had significantly fewer complaints than women from other ethnic groups ( $\chi^2$  tests,  $p < 0.004$ ), and this occurred for both "general" and "psychological" types of symptoms. The noted difference in reported vasomotor symptoms between Japanese and European-derived populations may in part reflect a general, culturally-based tendency among Japanese to report fewer health complaints.

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**Spatial position and dominance rank in blue monkeys (*Cercopithecus mitis stuhlmanni*).**

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Like other cercopithecine primates, female blue monkeys (*Cercopithecus mitis stuhlmanni*) establish stable dominance hierarchies, yet high rank does not result in a higher reproductive or feeding rate, nor in increased infant survivorship (Chowdhury 2004; Cords 2000). We aimed to determine whether high rank is associated with reduced predation risk among adults, which could in

turn influence survivorship. Predation risk was measured for eight adult females in one troop of blue monkeys in the Kakamega Forest, Kenya. Individual predation risk – judged as the presumed level of exposure to crowned hawk eagles (*Stephanoaetus coronatus*) – was assessed in relation to other troop members and within individual tree crowns. Our data on within-crown spatial position also allowed us to correlate dominance rank with advantageous feeding positions, given that fruit quality may vary within a single crown (Houle 2004). We predicted that relative to low ranking females, high-ranking females would more often occupy 'safe' positions (relative to the troop and within individual tree crowns) and energetically advantageous positions (within tree crowns). We found that dominance rank did not correlate with the use of safe or energetically advantageous locations. In summary, female dominance rank does not correlate with exposure to predation risk in blue monkeys and may actually have no effect on adult survivorship or lifetime reproductive success.

**A mechanical analysis of the bioarchaeological remains from Frankfort cemetery (15Fr154).**

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The Frankfort cemetery (15Fr154) was rediscovered in 2002 during construction of a new Department of Transportation building in Frankfort, KY. Historical accounts of the cemetery are vague, but records indicate that it dates from the mid-1800's and was utilized as a potter's field for poor whites and free blacks. Individuals may have participated in laborious hemp agriculture, and initial radiographs suggested that long bone architecture varied between whites and blacks, indicating possible differences in activity (Killoran, 2005).

This study is a biomechanical analysis of long bones in a sample of 25 adults, representing males and females from black and white populations. Peripheral quantitative computed tomography imaging was performed on left and right humeri, a left tibia, and a left femur for each individual. Second moments of area and section moduli were calculated to assess relative rigidities and strengths of bones (Ruff, 2002). Data were standardized by body mass, estimated using femoral head diameter.

Factorial ANOVA demonstrates significant sexual dimorphism in body mass and stature estimation within the black sample, but not in the white sample. Males have humeri that are relatively stronger in resisting torsional loadings than those of women, regardless of ethnicity. There is an effect of age on percent cortical area of both the

humerus and the femur, with older individuals having relatively less cortical bone than younger ones. The interaction between ethnicity and aging for the tibia suggests that black individuals lost more cortical bone as they aged when compared to white individuals.

#### Environmental influences on human craniofacial shape variation.

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It is generally considered that the human craniofacial skeleton is plastic and susceptible to changes in shape due to environmental factors, such as temperature and altitude. In particular, the effects of cold temperatures on aspects of nasal morphology have been well documented. This study uses geometric morphometric techniques to examine the degree to which environmental factors determine the patterns of human craniofacial diversity on and around the Indian Ocean rim. Mean climatic data were collected in order to study the relationship between variation in climate and in size and shape of the craniofacial skeleton. Overall cranial shape is seen to be determined to some degree by temperature. Correlations are found between biological distances and both average high and low temperatures. Additionally, principal components analysis allows for the determination of the effects of environmental variables on specific regions of the craniofacial skeleton. The first principal component correlates significantly with temperature. The third principal component correlates with both temperature and annual precipitation. The results of multiple regression analyses suggest that a general relationship exists between the morphology described by PC3 and levels of average temperature and precipitation. Precipitation levels usually suggest the influence of seasonality and prime productivity, although analyses using seasonality indices did not produce significant correlations. It may be that precipitation levels have an indirect effect of the craniofacial skeleton by determining subsistence behaviour which in turn has biomechanical implications.

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#### Microanatomical comparison of the orbicularis oris muscle between chimpanzees and humans: implications for the evolution of speech.

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The orbicularis oris muscle (OOM) plays a critical role in the production of human speech and in other non-verbal functions in humans and non-human primates. Since the chimpanzee, *Pan troglodytes*, is the closest living relative of humans, a comparison of the OOM between chimpanzees and humans may increase our understanding of the structure, function, and role of the muscle in the evolution of human speech. To these ends, this study compares the microanatomy of the OOM between chimpanzees and humans. A mid-line portion of the OOM was harvested from upper lips of two adult chimpanzee and human cadavers. Each sample was processed for paraffin histology, sectioned, and stained with a variety of protocols. Sections were examined for fiber direction, relative thickness of muscle layers, and relative amount of muscle fiber vs. connective tissue. In humans more cross-sectional area was devoted to connective tissue than muscle while in chimps the situation was reversed. The extrinsic layer of the OOM in humans made up 15% of the cross-sectional area and the intrinsic layer made up 20%. In contrast, the extrinsic layer in chimpanzees made up 33% of the cross-sectional area and the intrinsic layer made up over 50%. While the greater proportion of muscle relative to connective tissue in chimps may reflect the increased mobility of the upper lip, the role of the OOM in production of human speech may be related to factors other than a relatively large muscle mass.

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#### Upper Limb Growth and Development in Juvenile Neandertals

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The pattern of growth and development in fossil species has been a focus of paleoanthropological research for the last two decades. Efforts to better understand the genetic component of adult morphological characteristics necessitates examining juvenile remains. Neandertals continue to be a dominating interest to paleoanthropologists. Adult Neandertal morphology has been examined in detail and Neandertal juveniles are increasingly becoming the focus of major research. This study examines the growth and development of typical 'Neandertal' morphological characteristics of the shoulder and upper limb. These characteristics include the axillary border of the scapula, the development of the deltoid tuberosity, the flattening of the humerus, the curvature of the radius, and the robusticity of the upper limb. These features were examined on the Neandertal juveniles from Krapina, Dederiyeh, La Ferrassie, Teshik-Tash, Kiik Koba, and Le Moustier. The aim of this research was to determine at what age Neandertal juveniles develop the morphological characteristics typical of Neandertal adults. This project revealed that some characteristics are present early in ontogeny, suggesting a strong genetic component for the characteristic, while others develop much later in juveniles, suggesting biomechanical forces may be responsible for the morphology in older juveniles and adults.

#### A preliminary study on the relationship between nasal cavity and maxillary sinus volumes.

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Previous research suggests that nasal cavity volume (NCV), thought to be related to climate, is inversely correlated with maxillary sinus volume (MSV). According to this hypothesis, changes in nasal cavity size and shape reflect physiological needs, such as warming and humidifying inspired air. Owing to volumetric constraints in the mid-face, relative increases in NCV are hypothesized to result in concomitant decreases in MSV, respectively.

To test this hypothesis thirty-nine dried adult human crania from seven different climatic regions were examined using computerized tomography (CT) scans. Significant differences in MSV and NCV between populations were identified using Analysis of Variance (ANOVA). In addition, least-squares and reduced major axis (RMA) regression analyses were performed to test the scaling relationships between MSV, NCV and several cranial size variables.

Contrary to previous studies, results indicate that MSV and NCV are not significantly correlated. RMA analyses indicate that NCV, but not MSV, scales isometrically with skull size. Finally, *post hoc* ANOVA results identify significant differences between human populations for MSV that do not follow climatic or environmental trends. These results suggest that (1) it is unlikely that NCV and MSV compete for space in the mid-face, (2) NCV is largely a byproduct of skull size, and (3) NCV and MSV may not be as closely tied to climate as previously thought. Additional genetic and epigenetic factors need to be considered regarding the structure and function of the human maxillary sinus.

#### Sagittal crests, temporal fossae, and their putative relationships to masticatory function and encephalization in a diverse sample of strepsirrhine and platyrrhine primates.

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Within cranial sutures, previous analyses have shown a form-function link between morphological complexity and masticatory function. Data from *Caiman* alligators, genetically engineered mice, and *Cebus* primates demonstrate a positive relationship between masticatory form and suture lines of greater complexity. Specifically, positive correlations between temporal, mandibular, and sagittal suture measures suggest that

variations among these features are significantly related. Here we explore the same suite of masticatory features in a more diverse assemblage of primates including nineteen species and fourteen genera that were sampled from platyrrhine and strepsirrhine groups. Both of these groupings have diversified through a robust adaptive radiation process. Therefore, they represent an opportunity to study the morphological ramifications of niche partitioning in species sharing recent common ancestry but divergent lifestyles (e.g., differing food preferences and masticatory function). It is understood that brain expansion within the cranial vault and the material properties of an organism's food preferences influence craniofacial architecture. Cranial sutures are included here as an additional feature to study primate dietary functional morphology. Across this primate sample, cranial cresting does appear to relate to relatively smaller brains and a relatively larger bony architecture supporting masticatory muscles. Additionally, sagittal sutures tend to show increased complexity in species which process and consume more obdurate foods. In conclusion, epigenetic forces such as mechanical strains transmitted to the cranial suture help direct bone formation and resorption. It is also predicted that an inherited genetic signal plays a more diminished role in patterning the waveform characteristic of vertebrate cranial sutures.

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#### **Admixture in Mexico City: implications for admixture mapping.**

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We have characterized the admixture proportions and dynamics in a sample of 286 unrelated Type 2 diabetes patients and 275 controls from Mexico City. Admixture proportions were estimated using 69 autosomal ancestry-informative markers (AIMs). Maternal and paternal contributions were estimated from geographically informative mtDNA and Y-specific polymorphisms. The average proportions of Native American, European and West African admixture were estimated as 65%, 30% and 5% respectively. The contributions of Native American ancestors to maternal and paternal

lineages were estimated as 90% and 40% respectively. In a logistic model with higher educational status as dependent variable, the odds ratio for higher educational status associated with an increase from 0 to 1 in European admixture proportions was 9.4 (95% credible interval 3.8 – 22.6). This association of socioeconomic status with individual admixture proportion shows that genetic stratification in this population is paralleled, and possibly maintained, by socioeconomic stratification. The effective number of generations back to unadmixed ancestors was estimated as 6.7 (95% CI 5.7 to 8.0), from which we can estimate that genome-wide admixture mapping will require typing about 1,400 evenly distributed AIMs to localize genes underlying variation in disease risk between populations of European and Native American ancestry. Sample sizes of about 2,000 cases will be required to detect any locus that contributes an ancestry risk ratio of at least 1.5.

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#### **Intracontinental Distribution of Haplotype Variation: Implications for Human Demographic History.**

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In human evolutionary studies, a continued challenge has been to characterize ancestral genetic structure among ethnically diverse human populations within continental regions, particularly in Africa. To approach this challenge, we examined the distribution of haplotype variation at Sortilin1 (SORT1) on chromosome 1 within major geographic regions (~1400 individuals from 58 human populations). SORT1 is a receptor protein that binds neuropeptides and has been associated with neurological disorders. We selected 18 HapMap SNPs located in the non-coding regions of SORT1 for genotyping by mass spectrometry. SNP haplotypes were reconstructed using PHASE

and PL-EM algorithms, and population divergence was measured using Wright's fixation index ( $F_{ST}$ ) and Raymond and Rousset's exact test of sample differentiation in ARLEQUIN. Our results show that the among-population  $F_{ST}$  value is significantly higher in sub-Saharan Africa than in Europe, the Middle East, Central/South Asia and East Asia. In addition, exact tests also indicate that sub-Saharan African populations are more differentiated (Exact P-value = 0.00368 < 0.00035) than populations within Europe, the Middle East, Central/South Asia and East Asia. These results suggest that diverse African populations were more subdivided with lower levels of gene flow during human history. This study provides further information regarding intracontinental haplotype variability using a large sample of healthy individuals from diverse human groups, including 11 distinct African populations which are mostly underrepresented in genetic studies.

#### **Assessment of FORDISC 3.0's Accuracy in Classifying individuals from W.W. Howell's Populations and the Forensic Data Bank.**

A.R. Campbell, G.J. Armelagos. Department of Anthropology, Emory University.

The introduction of the latest version of FORDISC 3.0 (Jantz and Ousley, 2005), which makes available a number of new measurements for discriminant function analysis, necessitates a reassessment of the program's classification capabilities. FORDISC 3.0's new individual scores option was employed to obtain data on the program's effectiveness in classifying members of both the W.W. Howell's and Forensic Data Bank (FDB) reference populations. The ability or inability of FORDISC 3.0 to classify members of its reference populations provides an estimate of its classification capabilities for individuals from the reference populations. Each individual is classified by the program considering the measurements of all population members except the individual being classified. Sample size determined the number of measurements that could be used to analyze Howell's reference population; FORDISC 3.0's stepwise selection feature was utilized to select measurements for these analyses. Analyses of FDB populations utilized all measurements available. In the sex unknown analyses, FORDISC 3.0 was able to accurately classify 1411 (58.9%) individuals from Howell's populations and 576 (59.4%) from the FDB. Given the sex, Howell's and FDB accuracy increased to 1737 (72.5%) and 687 (70.9%) respectively. Including only significant results (Fried et al. 2005) rates improved to 73.1% (Howell's) and 72.0% (FDB) with the sex unknown and 80.7% (Howell's) and 78.6% (FDB) given the sex. Similarity of results between the Howell's population sample and the FDB in each of these analyses leads us to question if these results are approaching the limit of



craniometric analysis to assign group membership.

**Experimental determination of behavioral input to diaphyseal cross-sectional shape: a mouse model approach.**

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Cross-sectional geometric properties of long bone diaphyses are cited widely in assessing activity levels and profiles of extant and extinct primates. Experimental studies of long bone loading regimes characterizing select locomotor activities, however, demonstrate disconnect between observed loads during these activities and predicted loads based on bone morphology. This promotes caution when attempting to link specific locomotor abilities and specific diaphyseal morphologies. We adopt an alternative approach to addressing this issue. Thirty growing BALB/cByJ female mice were assigned randomly to three groups (n = 10). Mice were single-housed for eight weeks from day 30 post-birth. Custom-designed cages accentuated zig-zag or linear locomotion in experimental groups, while control mice inhabited standard laboratory cages. Locomotor behavior was documented approximately twice per day for eight weeks using instantaneous focal sampling. Bones were harvested for microCT scanning at day 87 post-birth. Femoral midshaft cross-sectional properties were compared. Groups do not differ significantly in mean cortical area, mean body weight, or activity level. Zig-zag mice have significantly more elliptical diaphyses than controls (p = 0.025), and also more elliptical diaphyses than linear mice, though this latter difference is not significant (p = 0.083). Linear and control mice do not differ (p = 0.725). Shape differences reflect the reduced anteroposterior (AP) rigidity of zig-zag mice, though group differences in AP rigidity are not significant. Given virtually absent genetic variability and equivalent bone mass and activity levels, distinct shapes in zig-zag mice (i.e., accentuated elliptical shape with a ML-directed major axis) can be attributed parsimoniously to turning.

Supported by NASA and NSF.

**Maximum likelihood variance components analysis of multivariate craniometric heritabilities: a comparison of two techniques.**

E.A. Carson, Department of Anthropology, University of New Mexico.

Additive genetic variance or narrow-sense heritability has been estimated for individual cranial measurements, but there has been little research into the heritability of the size and shape of the human skull in multivariate, three-dimensional (3D) space. This study compares multivariate heritability

values generated by two different methods: the principal components analysis of standard linear measures, and Procrustes transformation and principal components analysis of 3D coordinates of cranial landmarks. A total of 23 measurements collected on the pedigreed crania from Hallstatt, Austria, were analyzed in SAS, version 9.1.3 (SAS Institute, 2002), while 81 landmarks were entered into the shape analysis software package Morphologika (O'Higgins and Jones, 2004). The first four principal components, which constitute approximately 70% of the total variation, describe general size, cranial length versus breadth, total cranial height versus posterior cranial length, and facial measurements versus posterior cranial measurements, respectively. Narrow-sense heritabilities range from  $h^2 = 0.358 \pm 0.207$  to  $h^2 = 0.635 \pm 0.158$ , with the greatest heritability value for the second principal component (cranial length versus breadth). Both sex and year of birth proved to be significant covariates for the heritability estimates. These values are higher than the majority of univariate craniometric heritabilities, and they provide further evidence of morphological integration of the cranium.

This research was funded by a Fulbright fellowship from the Austrian-American Educational Commission.

**Explaining primate gaits: a carnivoran test case.**

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Kinkajous (*Potos flavus*) and binturongs (*Arctictis binturong*) are distantly related Carnivora that have evolved independently into arboreal frugivores with prehensile tails and non-divergent halluces. Videometric data show that binturongs walking on both flat substrates and poles retain lateral-sequence gaits (both lateral-couplets and diagonal-couplets) like most carnivorans, whereas kinkajous exhibit mostly primate-like DS walking gaits on supports of both sorts. This comparison provides a crucial test for competing theories that attempt to explain the peculiarities of primate gaits in terms of hindlimb prehensility, relative limb lengths, or mass distribution. Funded by NSF BCS-0137930 and NSERC.

**Hand morphology, hand preference and laterality.**

L.A. Cashmore & S.R. Zakrzewski. Centre for the Archaeology of Human Origins (CAHO), Department of Archaeology, University of Southampton, UK.

The lateralised organisation of language capabilities may be crucial for the development of the human genus. A functional link in the primary motor cortex

between the Broca's area and the motor control centre for the hands has led researchers to propose an evolutionary link between the development of language capabilities and manual dexterity. Studies of manual dexterity within skeletal populations have, for methodological reasons, focused on bilateral asymmetry of the bones of the arm and shoulder. This research demonstrates that the study of the bones of the hand can inform understanding of hand preference in hominin evolution, and hence tool manufacture and use.

Forty-eight measurements were taken on the humeri and hand bones in a sample of 40 modern humans from medieval Écija (Spain). Visual assessment of muscle attachment development in the upper limb was also undertaken in order to compare upper limb bilateral asymmetry. Contrary to expectation, the pattern of results was not consistent between the humeri and the hands. Metric and muscle data also provided conflicting patterns of upper limb development, although the expected right side dominance was found in the data. These results suggest a more inclusive method of assessing upper limb bilateral asymmetry is required to understand the expression of hand preference in skeletal populations.

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**"Life history space": A multivariate analysis of life history variation in extinct and extant Malagasy lemurs.**

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Research on changes in the ecological characteristics of Malagasy primates demonstrates a reduction in ecospace as a result of extinctions over the past 2000 years. Evidence suggests that this extinction event also reduced the diversity of life history profiles of lemurs across Madagascar. To investigate the complex interaction of life history variables, we create a multidimensional "life history space" to understand the impact of extinction on life history strategies of past and present Malagasy primates. Life history data (age at weaning, gestation length, and interbirth interval) are compiled for 19 extant species (representing all 5 extant families) and 5 extinct species (representing 3 extinct families) and two separate principal components analyses are performed: extant lemurs only, and extant and extinct lemurs together.



Overall, weaning age and interbirth interval are most highly correlated and the PCA reveals an overall reduction, from the past to the present, in "life history space." For the extant lemur analysis, PC 1 (68.7% of total variation) and PC 2 (17.6%) separate *Daubentonia* from all other species due to a combination of a large brain (along PC1) and a long gestation and late age at weaning (PC2). When extinct lemurs are included, the Archaeolemuridae join the aye-aye and occupy a corner of the life history space characterized by a similar combination of scores on those variables. The peripheral placement of extinct lemurs in the PCA suggests a reduction or loss of niche space - some niches have no modern representatives, others have only one remaining species. NSF BCS-0503988 (GTS), NSF BCS-0237338 (LRG).

**An analysis of the methods and purposes of post-mortem examinations as observed in a pauper cemetery**

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The Milwaukee County Almshouse Cemetery was the place of burial for the indigent of the city as well as residents of institutions for long term care. The cemetery was in active use from 1884 to 1925 and included an estimated 6,400 inhumations. Mitigation excavations of a construction impact area recovered 1,649 burials of which 588 were non-adults and 1,061 were adults at the time of death.

Data were gathered on intentional alterations of 114 adults that are likely to have been associated post-mortem examination. Two methods were used to remove part of the cranial vault with the most common being a circular cut to remove the calotte and the second removing only the frontal bone by a cut above the supraorbital ridge with a right angle cut at various points of the frontal or parietals. Post-mortem examinations of post-cranial elements were observed in only 13 instances.

Individuals with evidence of post-mortem examinations were analyzed for indicators of pathology and only 42 percent exhibited features interpreted to be a consequence of trauma or infection.

Autopsy records from the Milwaukee County Coroner's Office were examined for the period from 1920 to 1925. Comparisons of cause of death listed in the autopsy report are made with cause of death listed in the almshouse cemetery registry. The records lead to the suggestion that the almshouse residents were less likely to be autopsied than the general population.

**Written on the bones: global transformations, local biologies.**

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This project reports on unexpected findings from a three-year study of calcium consumption, bone density, and diet in a subsistence farming community in Morelos, Mexico. Results (Martin and Cerullo, 2006) indicated that a significant proportion of the adult males and premenopausal (but not postmenopausal) women had low bone density. Fausto-Sterling (2006) suggested that the emphasis on osteoporosis as a function of menopause in women has undermined research on both males and premenopausal women. Currently there is very poor documentation on the ways that early (pre-menopausal) experiences and socio-economic and cultural factors affect bone integrity. In this study, men and women of childbearing age participated in significant numbers. We analyzed ethnographic observations and interviews in conjunction with the biological data to explore factors that shape local biologies, treating embodiment as a dynamic system of biocultural formation. The large number multi-year participant interviews were critical in understanding the low bone density seen in men and younger women, and the higher bone density in the older women. For example, the data demonstrate that livestock farmers are avoiding meat and even dairy products that they know to be contaminated with hormones and other by-products; smoking and alcohol consumption among rural men may be a significant factor explaining their low bone density; and pregnancy and lactation may serve to protect older peasant women's bone density (in contrast to prevalent forms of birth control used in urban areas). None of these findings were obtained from the questionnaire in spite of being designed to capture such information.

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**Finite element analysis of masticatory stress hypotheses**

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Researchers have hypothesized that the biomechanics of biting and chewing in the primate skull can be modeled as predominantly one of several global loading regimes, including bending in a sagittal plane, bending in a frontal plane, dorso-ventral shear, and torsion of the face about the braincase. *In vivo* strain results suggest that no single regime can account for the strain patterns observed during primate feeding. However, because the primate skull is not a simple structure (e.g., a cylinder), it is unclear what strain patterns are expected in a primate skull subjected to idealized biomechanical loading regimes. This study uses finite element (FE) analysis to test the hypotheses that simple structures can provide adequate strain predictions, and that one of several global loading regimes is primarily responsible for the pattern of craniofacial deformation in the macaque skull.

We applied each loading regime to a previously-validated FE model of a macaque skull comprising 311,057 polyhedral elements with orthotropic, regionally-assigned material properties, and compared the pattern of craniofacial strain in each regime to that observed during *in vivo* strain experiments and in the validated macaque model.

Results show that global loading regimes yield strain orientations and relative magnitudes that often differ dramatically from those predicted from simple structures. Multivariate analysis of multiple sites shows that no single global regime fully explains masticatory strain magnitudes and orientations. However, in the circumorbital region, the frontal bending regime yields maximum principal strain orientations that most closely match those in the validated mastication FE model.

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**Oxygen isotope analysis of human tooth enamel carbonate: Implications for climatological and environmental research.**

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Oxygen isotope analysis allows researchers to detect past climatic patterns in mid-to-high latitude environments based on overall precipitation patterns. Although well established in studies of non-human mammalian remains, this method is less commonly applied to human material. The purpose of this study is to determine whether oxygen isotope signatures from human dental enamel carbonate reflect overall climatic changes experienced by past populations. Twenty-four enamel samples were obtained from mandibular third molars of individuals from Abingdon Cemetery, Oxfordshire, England. These burials roughly correspond

with periods of known climatic fluctuation, the Medieval Warming Period (A.D. 950-1450) and Little Ice Age (A.D. 1450-1850).

Twelve individuals from each time period were selected and 7-10 mg of enamel was removed using a carbide-bit drill. Samples were treated with 2% NaOCl and 0.1 M acetic acid, neutralized, and reacted with 100% phosphoric acid in an Isocarb common acid bath. Resultant CO<sub>2</sub> gas was analyzed using a VG PRISM (Series II) mass spectrometer. The difference in δ<sup>18</sup>O values between Abingdon MWP and LIA samples is not statistically significant (p = 0.38). However, the MWP δ<sup>18</sup>O values are comparable to a study including human samples from a similar time period and climatic regime (Fricke et al., 1995). The elevated Abingdon LIA oxygen isotope signatures may be the result of diet, migration, and culture experienced by the Abingdon inhabitants. The results of this study suggest that oxygen isotope signatures obtained from human dental enamel carbonate are reflective of overall climatic changes, especially if external variables are considered.

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#### **Cranial expansion of the thorax in hominoids.**

L.K. Chan. Department of Anatomy, St. Matthew's University, Cayman Islands.

It has long been assumed that the dorsoventral compression of the thorax in hominoids has caused a shorter dorsoventral thoracic diameter, and hence a more dorsally situated scapula, which in turn implies a higher shoulder mobility. It has been suggested that this increased shoulder mobility is an adaptation for brachiation or slow climbing. However, Chan [in press] found that the dorsoventral diameter of the thorax is actually longer in hominoids than in other primates. In this study, this peculiar finding was investigated using biplanar radiographs of intact fluid-preserved specimens, from which the cross-sectional shape at 10 different levels was measured. The relative volume of the 9 intervening thoracic segments was also calculated. It was found that hominoids had a significantly larger cranial thorax than arboreal quadrupedal monkeys. Their thoracic indices were similar to those of arboreal quadrupedal monkeys in the cranial thorax, but significantly higher in the caudal thorax. These features explain the longer dorsoventral thoracic diameter in hominoids. The cranial expansion of the thorax in hominoids can be understood as an adaptation for orthograde posture by reducing the alveolar-arterial oxygen difference, while the dorsoventral compression of the caudal thorax can be explained as an adaptation for suspensory behaviour or for respiratory movement in orthograde posture.

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Improvement Grant, Award number 9528321), the Leakey Foundation, the Sigma Xi Society, the American Museum of Natural History, and Duke University.

#### **Phylogenetic evaluation of adaptive explanations for Neandertal nasal morphology.**

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The external dimensions and internal morphology of the Neandertal nose are often considered to reflect physiological and behavioral adaptations to the cold, dry climate of the late Pleistocene. An extension of this perspective argues that these putative adaptations represent unique derived traits (autapomorphies) distinguishing Neandertals from modern humans at the specific level. However, few of these hypotheses have been empirically tested. In addition, previous analyses found no significant correlations between nasal characters and environmental variables that might suggest an adaptive relationship in either Neandertals or modern humans (Meyer, Chang, and Lewis 2005).

For the present study, the distribution of discrete and continuous characters of the internal nasal cavity, nasal aperture, and face were evaluated in a sample of Neandertals, Middle Pleistocene *Homo*, and anatomically modern humans using phylogenetic methods. Relationships between these taxa were reconstructed via parsimony analyses conducted in PAUP\* v. 4.0.0b10, using a total data set of over 75 characters. The evolution of alleged adaptive characters upon the resulting trees was then traced using MacClade v. 4.05. Our results were not congruent with the hypothesis that environmental adaptation is the best explanation for Neandertal nasal morphology. The implications of these results for models of Pleistocene evolution will be discussed.

#### **Falling, fighting or fleeing: Skeletal trauma analysis in eight sympatric cercopithecoids from Cameroon.**

T.J. Chapman, S.S. Legge. Department of Anthropology, University of Kent.

Skeletal trauma is described in a museum collection of eight sympatric monkey species from Cameroon. Trauma data were collected from observations of crania, vertebrae, sterna, pelves, scapulae, femora, tibiae, fibulae, humeri, radii, ulnae, and clavicles. Monkeys observed included mangabeys (*Cercocebus galeritus*, *Cercocebus torquatus*, *Lophocebus albigena*), colobines (*Ptilocolobus badius*, *Colobus guereza*), and guenons (*Cercopithecus nictitans*, *Cercopithecus cephus*, *Cercopithecus pogonias*). The mangabeys exhibited the highest fracture frequencies with values of

80%, 67%, and 64% for *C. galeritus*, *C. torquatus*, and *L. albigena* respectively. Colobines and guenons were found to have varying fracture frequencies, ranging from 17% for *C. guereza* to 44% for *C. nictitans*. Canopy height utilisation was considered in relation to sympatric associations and pressures of predation. A significant association was found between fracture occurrence and canopy height travelled at, with those species travelling nearest the forest floor exhibiting the most fractures. Previous studies assert that falls from trees and intra-/interspecies violence account for the majority of fractures in non-human primates. However, this study suggests that predation may indirectly be a significant cause of traumatic injuries in these species of monkeys.

#### **Nutrition early in life predicts relative cortex size in primates.**

C. J. Charvet. University of California, Irvine.

The human brain is characterized by its unusually large and disproportionate expansion of the cortex. It is usually thought that the variation in timing and number of cell divisions during development contribute to the cortical size differences observed in primates. Nutrition early in life has been shown to play an essential role in the control of the parameters that influence relative cortex size. However, comparative approaches that emphasize the relationship between nutrition and relative expansion of brain structures during development has largely gone unexplored. The possibility that protein, fat and sugar concentrations in the milk of primates predict the enlargement of the cortex was investigated in 19 primates including humans. The results show that milk composition, specifically protein levels, predict relative cortex size and that the size of the human cortex fits on the same logarithmic scale as its primate relatives.

#### **Plio-Pleistocene biogeography of the Indian subcontinent: implications for early human dispersals.**

P.R. Chauhan. Stone Age Institute, CRAFT Research Center (Indiana University).

Owing to its central position in the Old World, the Indian subcontinent provides a critical geographical link between the palaeoanthropological evidence from East Africa and Asia. In recent decades, a large amount of data of late Pliocene and Early Pleistocene age has accumulated regarding ecological adaptations and associated technological innovations. The most obvious points of entry into the subcontinent are represented by Afghanistan and Pakistan in the northwest and Myanmar in the northeast. Both zones offered coastal routes, as well inland mountain passes, and ecologically-rich tropical and deciduous zones, without any major mountain ranges or deserts impeding

potential movements. During the Pliocene in peninsular India, there was a gradual replacement of evergreen tropical rainforest by deciduous forests. At this time and also during the Lower Pleistocene, the presence of open grasslands or C4 vegetation, have been inferred for the sub-Himalayan Siwalik region. General climatic conditions may have been moister than in younger contexts, evidence indirectly supported by the extinction of herbivore browsers at the Plio-Pleistocene boundary indicating a possible reduction in woodland environments in the north. Biostratigraphic chronology and research has also been conducted extensively in India, showing clear evidence of taxonomic change throughout the Plio-Pleistocene. This paper integrates such data to highlight the region's eco-biogeographic role in early hominin dispersals and evolution. Known palaeoenvironmental signatures are correlated with such data as Plio-Pleistocene sea level changes, topographic barriers, potential corridors, and the availability of raw material resources, to understand why early hominins may or may not have occupied certain zones.

#### Feeding ecology and food choice of Gibbons in the Sebangau National Park, Indonesia.

S.M. Cheyne. Centre for the International Cooperation in Management of Tropical Peatlands, University of Palangka Raya.

The Sebangau National Park encompasses one of the largest peat-swamp forests in the world and is recognized as a low-productivity habitat. The area is home to probably the largest population of Bornean agile gibbon (*Hylobates agilis albibarbis*). Knowledge of how gibbons exploit this habitat and of the tree species most important to gibbons' continued survival is essential for their conservation.

Six groups of gibbons were habituated and followed daily for 18-months from June 2005-December 2006. Data were collected on behavior, food species eaten, distance traveled, singing behaviour and feeding tree revisit frequency. Forest productivity was measured monthly using established plots.

During the dry season, gibbons ate flowers in far greater quantities than previously noted (for either Sebangau or other sites): 21% flowers in dry season compared to 3% in wet season and leave consumption also increased from 17% to 21%. Feeding-bout length increased during times of food scarcity (27mins dry vs 12mins wet), as did daily distance traveled (as gibbons searched more widely in search of food), dry average 1800m, wet average 1300m. There was no significant difference in singing behaviour during times of low food availability.

This study indicates that gibbons are very adaptable in both diet and behavior and can exploit low-productivity forest well. It also sheds light on possible fallback food species exploited in times of food scarcity.

This work was supported by the Department of Anthropology, George Washington University; PCI and Cambridge Philosophical Society.

#### Evolutionary perspectives on pregnancy and its impact on dental health in women.

M. Cheyne. Dept. of Anthropology, Oregon State University.

This paper examines the tendency in anthropological and clinical literature to attribute higher rates of caries in women, both in prehistoric and contemporary populations, to proximate and exogenous factors such as dietary consistency, frequency of food intake moderated by sexual divisions of labor and women's roles in domestic food production, dental hygiene habits and culture-based gender differences in dietary composition. A review of the clinical literature, as well as recent meta-analytical findings on dental caries prevalence by sex in skeletal populations are better explained by a more inclusive and complex etiology of gender-specific cariogenesis that integrates ultimate and proximate, exogenous and endogenous processes. In particular, pregnancy-related changes in circulating blood volume, estrogen to progesterone ratios, maternal immune suppression, decreased maternal stomach capacity and insulin insensitivity are argued to be frequently overlooked, over simplified and yet, significant, contributors to dental health in women. Pregnancy induced microfloral, host immune response and behavioral/nutritional changes are complex, interdependent and mediated by evolved, physiological accommodations that allow for the energetically costly gestation and prolonged feeding of large-brained and secondarily altricial infants, but also leave women at higher risk for poor dental health.

#### Testing hypotheses of primate evolution: The power of the model organism.

C.-H. Chiu<sup>1,2</sup>. <sup>1</sup>Department of Genetics, Rutgers University, <sup>2</sup>Center for Human Evolutionary Studies, Department of Anthropology, Rutgers University.

In this talk I use the limb as a model system for incorporating evolutionary developmental biology (evo-devo) in the study of primate morphological diversity.

I first discuss the power of traditional model organisms like mouse and chick for identifying and defining the modules (morphological and developmental) of the tetrapod limb. This information is critical for generating and testing hypotheses of mechanisms responsible for evolution of limb diversity in primates. I next discuss how comparative genomics can define the structure of regulatory sequences, with focus on Hox genes that play an essential role in limb and digit development. This information serves as a basis for examining the evolution

of regulatory sequences in different primates, testing their functions, and investigating their phenotypic consequences. Finally, I apply this approach to understanding the developmental and genetic causes of variation in ratios of the 2nd to 4th digits (2D:4D), observed in humans (e.g. between men and women; different ethnic groups) with focus on HoxA and HoxD cluster genes. Our results implicate that differential responses of HoxA and HoxD genes to estrogen may influence their role in effecting variation in 2D:4D digit ratios.

In summary, a multidimensional approach that incorporates developmental genetics, comparative genomics, and molecular embryology with model organisms provides the foundation on which to build innovative studies of genotype-phenotype relationships in humans and other primates.

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#### Paleoecological setting for the arrival and early evolution of *Homo erectus* in the Solo Basin, Java.

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We present an initial reconstruction of paleoenvironments associated with early *Homo erectus* occupation of the Solo Basin, Indonesia based on interpretation of recent field and laboratory data. Sediments, fossil soils and mollusk shells from localities in Sangiran Dome yield information on Early Pleistocene sedimentary environments, vegetation, and climate at the southeastern endpoint of *Homo erectus*' spread out of Africa. *H. erectus* first arrived in the Sangiran area about 1.6 Ma and occupied a low relief landscape along the upper reaches of an estuary fed by streams draining nearby volcanic highlands. This low-lying landscape varied from marsh-edge environments to moist savannas and witnessed seasonal variations in precipitation and water tables. Shortly before 1.5 Ma, large bedload streams draining volcanic highlands to the northwest and southeast began to fill in the estuary with volcanoclastic sands and silts. This valley landscape varied from riparian forest along active channel belts, where shifting channels left many sand bars and shallow abandoned channels, to moist savanna with scattered trees and shrubs on frequently deposited floodbasins. Open woodland occupied well-drained landforms such as terraces and natural levees. Paleosol evidence indicates that early Pleistocene climate in central Java, and the Sunda subcontinent was monsoonal. Our data also indicate that the annual dry season intensified between about 1.5 and 1.3 Ma, the time period with the richest fossil record of *H. erectus* in the area. We suggest that the

presence of the monsoon, with an annual dry season supporting open woodlands and savannas, fostered the immigration and establishment of *H. erectus* in Sunda.

#### Direct and indirect evidence for a spectrum of endometrial function.

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Ovarian function is suppressed with increasing ecological stress. Endometrial function is suppressed in a similar manner, suggesting a spectrum of endometrial function that varies with developmental influences and current energetic condition. I suggest that in order to alleviate moderate ecological stress endometrial tissue resorbs after the implantation window prior to menstruation, and that with greater ecological stress the post-implantation window luteal phase shortens leading to an earlier-onset menstrual phase. This hypothesis is tested with direct evidence of endometrial variation with hormone concentrations in an agricultural Polish population ( $n = 26$ ), which illustrates that estradiol promotes follicular proliferation of endometrial tissue, and progesterone promotes maintenance during its receptive phase. Further, endometrial suppression has been observed in Polish women with seasonal workload and fluctuation in day-to-day energy intake. Indirect testing of this hypothesis includes evidence of the strong relationship between endometrial pathology and surplus energy in developed populations: endometriosis, endometrial polyps and endometrial cancer are all comorbid with insulin resistance, diabetes, hypertension, obesity and polycystic ovarian syndrome. The spectrum of endometrial function from luteal resorption of endometrial tissue to amenorrhea and its role as link between ovarian function and reproductive success is one that continues to be developed.

This research was performed with grant support from the Yale University Center for Human and Primate Reproductive Ecology and the Polish State Committee for Scientific Research.

#### A re-examination of the relationship between cranial deformation and extra-sutural bone formation.

J.L. Clark and A.P. Van Arsdale, Department of Anthropology, University of Michigan.

The relationship between cranial deformation and the occurrence of extra-sutural bones remains poorly understood. Scholars are divided about whether or not cranial deformation causes an increased occurrence of these bones, and even those who agree that deformation does have an influence often disagree about which locations on the crania are most impacted. Unfortunately, the results of previous studies are often incomparable because of variation in methodology and sample selection. The present study examines

the effects of fronto-occipital (F-O) and occipital-only (O-O) deformation on the occurrence of extra-sutural bones through an analysis of 53 deformed and undeformed crania from the Philippines. We collected data on the presence of extra-sutural bones along six sutures and at five cranial landmarks. For each locality, the occurrence of extra-sutural bones was compared across the samples using resampling. Crania with F-O deformation had a significantly higher occurrence of extra-sutural bones than undeformed crania at two localities, while O-O crania differed from undeformed crania at a single location. Given the size and variance in our sample, a nested resampling analysis was conducted to test whether or not the number of differences between the deformed and undeformed crania was greater than that expected by chance. The number of differences was not greater than expected. This suggests that although the forces exerted on the cranium during the process of fronto-occipital and occipital-only deformation may cause an increased incidence of extra-sutural bones at particular localities, extra-sutural bone formation is likely to be more closely linked to genetic and other environmental factors.

#### Neanderthals and the Inuit of Igloolik: A comparative tooth wear study.

A.F. Clement, Institute of Archaeology, University College London.

Comparisons have often been made between Neanderthals and the Inuit of Alaska, Canada and Greenland. Both Neanderthals and recent Inuit groups have frequently been noted for their heavy tooth wear, especially in their anterior dentition. In recent Inuit groups this heavy anterior wear has been attributed the use of their teeth for cultural purposes such as softening raw seal hide.

This paper presents the results of a tooth wear study that examined 30 Neanderthals and 90 adults from the Inuit community of Igloolik, Canada. Tooth wear was measured from digital photographs of original specimens, high resolution casts and good quality published photos. A computer software programme and a graphics tablet were used to measure the area of exposed dentine and occlusal surface of each tooth. The area of dentine was then divided by the area of the occlusal surface to create a wear ratio. Wear patterns for both the Neanderthals and Inuit of Igloolik were compared independent of age, by dividing the wear ratio of each tooth by that of the first molar.

The results showed that while Neanderthals and the Inuit of Igloolik both possess patterns of heavy anterior wear, the Neanderthal anterior wear appeared 'mild' when compared to that of the Inuit of Igloolik. The Neanderthals did, however, show much heavier wear in their posterior dentition than the Inuit of Igloolik.

This research was funded by the Arts and Humanities Research Council.

#### Effects of avian attendants on predation risk and foraging efficiency of squirrel monkey and brown capuchin troops in Suriname.

Colburn, J. and S. Boinski, Department of Anthropology, University of Florida

Commensal monkey-bird associations are well documented in the Neotropics, with faunivorous avian followers deemed the beneficiaries. Observations from the ongoing Monkey-Forest Project at Raleighvallen, in the Central Suriname Nature Reserve, however, necessitate reconsideration of this generality. At Raleighvallen, tolerance for the two predominant avian followers, White Hawks, *Leucopternis albicollis*, and Double-toothed Kites, *Harpagus bidentatus*, varies across seven sympatric primate species and within species by context. Here we revisit this ecological interaction to test fundamental hypotheses on the costs and benefits accruing to monkeys from monkey-bird associations. ●Do monkey-troop attendants attract, deter or enhance detection of aerial and terrestrial predators? ●Does faunivorous gleaning by bird associates decrease foraging success among troop members? This assessment exploits an exceptionally powerful data set: multi-year, quantitative ecological samples from Raleighvallen, including arthropod and plant food availability and 15-minute interval scans on squirrel monkey, *Saimiri sciureus*, and brown capuchin, *Cebus apella*, troops and any of 50 other vertebrate species present within a 50 m radius. Analyses to date indicate that hawk and kite associates likely decrease monkey harvest of the many protein-rich prey targeted by both taxa. Yet, this cost appears offset by enhanced sensitivity to potential attack by large raptors, notably Harpy Eagles, *Harpia harpyga*, afforded to monkeys from the presence of the smaller raptors.

Major support for the Monkey-Forest Project at Raleighvallen comes from the US National Science Foundation (SBR-9722840, BCS-0078967, and BCS-0352316).

#### Stabilizing selection and adaptive optima in the evolution of platyrrhine body size.

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This study considers the evolution of body mass in platyrrhines, weighing the relative contributions of adaptation and phylogenetic inertia. Phyletic changes in mass are studied using Hansen models of stochastic evolution under the influence of stabilizing selection. Fluctuations in body mass through time are modeled as Ornstein-Uhlenbeck processes, where the strength of selection toward an adaptive optimum (here based on dietary specialization) increases as that optimum is approached. The "pull" exerted on an evolving taxon by the nearest adaptive optimum models the effects of stabilizing

selection. Phyletic changes in mass occur when environmental conditions change to produce new optima or to alter existing ones.

The data are mean female body masses for representative species of each living platyrrhine genus. A working phylogeny is based on published molecular data, which also provide estimates of divergence times. Different evolutionary scenarios for diet-related changes in mass are fit to the data using generalized least-squares methods, and the "optimal" model is chosen using Akaike information criteria.

The best model found contains one instance of phyletic size increase (in atelines) and three instances of phyletic dwarfism (once for *Saimiri* and twice for the callitrichines). The ateline size increase is most likely a correlate of increased folivory, while the instances of dwarfism can be related to increased degrees of insectivory or gummivory. The average intensity of selection for the best model suggests that phyletic size changes occurred relatively rapidly with the opening of new adaptive niches, with phylogenetic inertia doing relatively little to constrain change.

#### **T.M. Evaluating hearing sensitivity in *Homunculus patagonicus*.**

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*Homunculus patagonicus*, an early Miocene (~16 Ma) fossil platyrrhine from Patagonian Argentina, is known from several cranial specimens. The remarkable preservation of one specimen from Killik Aike Norte provides a rare opportunity to explore the functional anatomy of the auditory region. Using high-resolution CT data, we measured four auditory structures that have significance for reconstructing auditory range and acuity: the volume of the middle-ear cavities, the area of the tympanic ring, the area of the oval window, and the length of the cochlea. These measurements were also collected on an extant comparative sample including haplorhines and strepsirrhines using both CT and traditional morphometric techniques.

The auditory structures in *Homunculus* are more similar to extant platyrrhines in size and configuration than they are to those of the other taxa examined. Although the *Homunculus* cranium is slightly larger than that of *Saimiri* and *Aotus*, its cochlear length and oval window area are nearly identical to those of *Saimiri*. The size of the tympanic ring is intermediate in size between *Saimiri* and *Aotus*. The total volume of the middle-ear cavities is moderately larger than the means of either *Aotus* or *Saimiri* but still falls within the upper range for *Aotus*. *Homunculus* also displays a pattern typical of platyrrhines in having the largest portion of the middle-ear

cavity volume contained within the anterior accessory cavity. Such structural resemblance among *Homunculus*, *Saimiri* and *Aotus* strongly suggests similarity in hearing performance characterized by increased low-frequency sensitivity relative to strepsirrhines but decreased compared to catarrhines.

#### **Infant growth in a low socioeconomic urban environment.**

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Mother-infant pairs from the Albany Pregnancy Infancy Lead Study (n=309) were analyzed to explore the influences of infant size at 12 months in a sample drawn from a low socioeconomic urban population. Maternal height, weight nutrient intakes and socio-demographic variables were tested for their influence on infant weight, length and head circumference at 12 months. Maternal nutrient intakes were high compared to US RDAs and no relationships were observed between maternal nutrient intakes and infant growth. Measures of infant size were most strongly associated with birth weight. Controlling for birth weight, the strongest associations were between infant size and maternal height, age and parity. The sample was categorized by mother's self-described race, a dichotomous social variable. In black mother-infant pairs (n=156), maternal age and parity were significantly negatively correlated with infant size but not among white mother infant pairs (n=111). Median family income for zip code differed significantly between these groups (p<0.001). Although this sample is drawn from a lower socioeconomic stratum, economic resources differed between black and white mothers which may explain observed differences in the predictors of their infant's growth. This analysis suggests that even within an already economically disadvantaged cohort, socioeconomic variation can have significant consequences on postnatal growth. This project was supported by grants 5RDMD001120 from NCMHD and R01-ES05280 from NIEHS.

#### **Creating, displaying, and querying interactive paleoanthropological maps using GIS: An example from the Uinta Basin, Utah.**

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Geographic Information Systems (GIS) comprise a powerful set of tools designed for storage, retrieval, mapping, and analysis of geographic data. In GIS, all spatial data are geographically referenced to a map projection in an earth coordinate system that are associated with descriptive attributes that can be layered together for mapping and analysis. Although GIS has found numerous

applications in business and industry, and in a variety of anthropology-related investigations, its application to paleoanthropological field studies has remained underutilized. Here I illustrate some of the ways GIS can be effectively used in analyzing, and planning, paleoanthropological fieldwork. The examples come from Washington University Eocene fossil locality data from the Uinta Basin, Utah, but are just as applicable to fossil sites in any remote badland area where such data are available. More specifically, I show how GIS can be used to: 1) create and display *interactive* maps of paleoanthropological interest; 2) create custom maps based on attribute tables that can be queried by individual researchers based on any *combination* of fossil locality attributes (stratigraphic level, sedimentological characteristics, faunal composition, etc.); 3) create maps with hyperlinks to relevant pdf and/or URL references for the immediate retrieval of further detailed information about any fossil locality; 4) plan field logistics by mapping the accessibility of fossil localities (by 4WD vehicle or any other means of transport) using Spatial (Proximity) Analysis; and 5) characterize topographic features of fossil sites such as *degree* and/or *aspect* (direction) of slope on regional and/or local scales

#### **Evidence of convergent masticatory morphology among durophagous anthropoids from four different clades.**

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Previous work by Lucas and others has investigated the relationship between food mechanical properties and tooth form. However, less has been done to examine how these same properties affect skull shape. This project investigates whether, and in what way, the fracture resistance of foods influences the hard tissues of the anthropoid masticatory system. A comparative study was designed to test the hypothesis that the taxa that eat the most fracture resistant foods all feature similar trends in masticatory morphology related to either increasing the mechanical advantage of the masticatory system or decreasing the stress or strain on that system. The face and jaws of cebines (*Cebus* + *Saimiri*), macaques, baboons, and apes were compared in three dimensions using geometric morphometrics (5-7 taxa per clade, 63-73 landmarks per skull). The taxa from each clade that are reported to eat the most fracture resistant foods all showed similar morphological trends in their masticatory systems relative to the other members of their clade. These trends include a taller mandibular corpus and symphysis, a taller and broader mandibular ramus, and a more orthognathic and broader face (related to greater intercondylar breadth). The fact that these morphological trends exist in New

World monkeys, Old World monkeys, and apes suggests that the influence of food mechanical properties on masticatory form is widespread in living anthropoids. This observation not only has the potential to increase our understanding of primate dietary adaptation, but could also be valuable in interpreting homoplasy in both living and fossil primates.

***Protopithecus*, *Paralouatta*, and *Alouatta*: The making of a platyrrhine folivore.**

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Howler monkeys are the most folivorous platyrrhine primates, and they are also highly unusual in cranial morphology. Recent discoveries of large and plus-sized subfossil alouattin platyrrhines in Cuba and Brazil provide insight into the mosaic craniodental evolution of *Alouatta* features and adaptations. Both incisor and cheek tooth morphology of *Protopithecus* and *Paralouatta* indicate that ancestral alouattins were not dedicated folivores; rather, they were highly frugivorous. This is consistent with character analyses and evolutionary scenarios based on the more restricted sample of modern ateline genera. While *Protopithecus* is still somewhat primitive in this regard, craniofacial and basicranial anatomy of both subfossils is distinctly similar to living howlers in features relating to head posture and the enlarged hyolaryngeal apparatus, showing that the howler-like vocalizations and head carriage were already established in ancestral alouattins. There is also evidence of a relatively small brain size in *Protopithecus* and *Paralouatta*, resembling *Alouatta*, and more tenuous indications of phyletic size decrease, suggesting that de-encephalization, body size increase and folivory may not be coupled adaptively as a folivory syndrome in this tribe. Knowing that definitive leaf-eating alouattins more closely related to *Alouatta* were already present in the middle Miocene of Colombia, these taxa demonstrate that alouattins experienced an adaptive radiation. They had a diverse and complex prior evolutionary history that far exceeds projections based on living forms alone or the

close linkage and dental correspondence of *Stirtonia* from La Venta and living *Alouatta*. They also underscore the unique "semi-folivorous" ways that characterize the platyrrhines' only leaf-eating icon.

**Ranging and foraging behavior of red-capped mangabeys *Cercocebus torquatus* in Sette Cama, Gabon.**

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Numerous lines of evidence indicate that terrestrial mangabeys of the genus *Cercocebus* are more closely related to mandrills and drills than they are to arboreal mangabeys of the genus *Lophocebus*. The *Cercocebus-Mandrillus* clade is united by a suite of skeleto-dental and ranging/grouping features associated with a reliance on hard object foods acquired from the forest floor. These foods tend to be sparsely distributed, require extensive gnathic processing, and exert a significant influence on group size and daily path lengths. Detailed behavioral information on *Mandrillus* are available, however the lack of long-term observations on most terrestrial mangabey species have hampered tests of this form-function complex within the clade. In this paper, new data on a little-known mangabey, *Cercocebus torquatus* (red-capped mangabey), are used to test how reliance on hard-object foods influences foraging, grouping and ranging behavior.

Data on two groups of red-capped mangabeys were collected in Sette Cama Gabon from July - September 2006. The groups (n=20, n=45) occupy home ranges of ~ 2 km and day ranges are ~1 km. During the 2 month study, the diets of both groups were dominated by fruits and seeds that required extensive dental processing prior to ingestion. For example, *C. torquatus* uses its enlarged incisors to scrape skin from *Sacoglottis gabonensis* before eating the pulp and the seeds of *Guibourtia tessmannii*, *Lacouli carlifolia* and *Craibia laurentii* are processed with their expanded premolars. Ongoing study of mangabeys in Gabon will reveal how hard object foods influence additional aspects of their anatomy and behavior.

**Metric evaluation of changes in cadaver stature.**

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Trotter and Gleser (1952) calculated a correction factor of negative 2.5 centimeters for converting measured cadaver stature (CSTAT) to living stature (LSTAT). This correction factor was computed from long bone estimated statures derived from the LSTAT in a sample of White males from the WWII war dead and the CSTAT from White males in the Terry Collection. They assumed

the correction factor was applicable to Black males as well as to Black and White females. This correction factor continues to be used by researchers studying stature estimation methods from samples using CSTAT from anatomical collections. To date, the anthropological and medical literature lacks the systematic documentation of changes in cadaver anthropometry that would allow accurate determination of a correction factor.

The present study answers the need for this systematic documentation of the human cadaver by quantifying the changes in total body length and body segment lengths. Measurements are taken from the recumbent cadaver including: total length, length to acromion, length to the pubic symphysis and length to anterior-superior iliac spine. Body size changes are also assessed using chest breadth and diameter, bi-acromial breadth, bi-iliac breadth, and thigh diameter.

By this systematic metric evaluation of various body segments, the present study identifies the regions of the body most subject to change due to effects of desiccation, temperature change and infusion, and provides accurate correction factors appropriate for population specific groups.

**Assessing mobility patterns for the Early Bronze Age community of Bab edh-Dhra' using radiogenic isotope analysis of human enamel.**

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Isotopic analysis of enamel was conducted as part of an investigation of human mobility for the Early Bronze Age community of Bab edh-Dhra' (3000-2300 B.C.E.) located in modern-day Jordan. Enamel from twenty second molars was analyzed for radiogenic strontium isotope content (<sup>87</sup>Sr/<sup>86</sup>Sr). Two faunal samples were also examined to provide a local and temporal chemical baseline. Strontium is incorporated into the hydroxyapatite crystal due to its chemical similarities to calcium. Different geographic regions have distinct geochemical profiles with relatively unique <sup>87</sup>Sr/<sup>86</sup>Sr isotopic ratios. Thermal Ionization Mass Spectrometry (TIMS) was used for this phase of the analysis.

The isotopic data, combined with dental and cranial non-metric studies of this collection, demonstrate considerable homogeneity among the group. Archaeological evidence and mortuary practice are indicative of the development of a settled, urban culture at Bab edh-Dhra' where no previous settlement has been identified. The relative homogeneity of the representative sampling, though, does not offer evidence of extensive human migration into the growing community.

As part of a larger examination of Near Eastern human mobility patterns, radiogenic strontium isotope analysis of enamel was also

performed on upper left third molars from the Byzantine monastic community of St. Stephen's in Jerusalem (5<sup>th</sup>-7<sup>th</sup> C.E., n=24) and from remains of Tel Dothan in ancient Palestine (1500-1000 B.C.E., n=26). The three Near Eastern sites demonstrated comparable <sup>87</sup>Sr/<sup>86</sup>Sr ratios, suggesting a trend of regional stability.

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#### Stratigraphic distribution of middle Eocene primates in the eastern Uinta Basin, Utah.

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Illuminating biogeographic patterns and processes during changes in primate diversity through the Eocene is essential to understanding their paleobiology. The later Eocene saw a drastic reduction in primate diversity. This has been attributed to cooling, following the warmer earlier Eocene. Recent stratigraphic work in the Basin has documented these processes to a finer time resolution than in other contemporaneous localities. The Uinta Formation (UF) provides a unique case study to understand the processes of local extinctions contributing to regional and continental patterns.

We have measured a stratigraphic section from our lowest Uinta B locality in the UF and extending 366 m through Uinta C, upward to the contact with the Duschene River Formation (DRF). All primate localities have been tied into this section. Magnetostratigraphy indicates dates of 42.5 ma and 41.4 ma for the UF B/C boundary and the contact with the DRF respectively. In Uinta B there are four primate species known, *Chipetaia lamporea*, *Macrotarsius jepsoni*, *Trogolemur* sp. nov. and *Ourayia uintensis*. In Uinta C, the only primate known is *Ourayia hopsoni*.

Ecological diversity analysis, and other evidence indicate a shift, toward relatively more open country habitats beginning in Uinta B with a marked transition around 42.5 ma. The presence of large channel sandstones in Uinta C does indicate the probability of some gallery forest habitats. The only primate seemingly adapted to this shift is *Ourayia hopsoni*, which persisted for nearly a million years in Uinta C environments.

#### Non-carious cervical tooth lesions (NCTL) from the early Neolithic site of Mehrgarh

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The dentitions of 225 individuals from the early Neolithic site of Mehrgarh, (VII millennium B.C., Baluchistan, Pakistan) were examined for the presence of non-carious cervical tooth lesions (NCTL), commonly described as the loss of enamel and root at the cervix. Ten individuals (114 teeth of a total of 3880 including 303 deciduous teeth) show labial or lingual NCTLs involving upper and lower teeth. Another 22 individuals present lingual and labial crown wear and interproximal grooves related to non-masticatory activity, but no lesions. No NCTLs occur in the primary teeth and in adults the presence and the severity of the lesions are highly correlated with age at death. Males and females are equally affected.

As documented by modern dental researchers and practitioners, NCTLs are common in today's dental patients. On the contrary, they are generally absent in prehistoric and Medieval populations. From our observations and a literature search, we found evidence for prehistoric NCTLs only in "Olduvai Hominid 1" and a single individual from Gricignano d'Aversa (Campania, Italy) dated to the Bronze Age.

The aetiology of NCTLs is unclear. Some have proposed a multifactorial pathogenesis, involving heavy tooth brushing (abrasion), extrinsic acids from the diet and intrinsic acids from gastric reflux (corrosion) and occlusal stress due to malocclusion or bruxism (abfraction). Our analysis suggests that load stresses linked with the non-masticatory use of dentition as tools are an additional factor.

#### Group size and individual travel costs in blue monkeys (*Cercopithecus mitis*).

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A major cost of group living is increased feeding competition, which should ultimately limit group size in social animals. Among frugivorous primates, the cost of competition is manifest as a travel cost: larger groups generally travel farther than smaller ones, as larger groups exhaust a local food-supplying area more quickly. We present data on the travel rates of wild adult female blue monkeys (*Cercopithecus mitis stuhlmanni*), largely frugivorous guenons, that contradict this general trend. Using focal animal sampling, we measured the distance traveled by individual females among four habituated study groups in the Kakamega Forest. Individual travel rate was not a function of group size, nor of female dominance rank. Variable habitat quality could not explain our findings. These results confirm an earlier

study (Cords & Ross 2005) that examined group-level travel in the same population, and similarly found no group-size effect. We believe that travel costs are minimal in this species because of its foraging strategy, in which individuals are widely spaced. Our results, however, beg the question of what limits group size in blue monkeys. Time budgets, birth rates, and rates of male take-over do not vary systematically with group size. Nevertheless, groups do fission when they become very large. Factors limiting group size in these guenons remain elusive.

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#### Inter- and intra-sexual dimorphism in an Early Miocene Catarrhine-*Rangwapithecus gordonii*- as demonstrated by new material from Western Kenya.

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The degree of inter- and intra-sexual variation in catarrhine primates can provide important information on the social structure of the species. Sufficient material to assess inter- and intra-sexual dimorphism is rarely available for fossil primates. This is particularly true of Miocene catarrhines, where information on social structure could have important implications for understanding the social evolution of Old World Monkeys and Apes.

Here, we report new material of *Rangwapithecus gordonii* from Songhor in Western Kenya. They are two complete hemi-mandibles, both clearly assignable to *R. gordonii*, due to the unique molar morphology of this species (Andrews 1978). The first, KNM SO 22228, comes from the main locality at Songhor, while KNM KT 31234 comes from a new locality- Lower Kapurtay- believed to be contemporaneous with the main Songhor locality (19-20 Ma).

KNM SO 22228 is female while KNM KT 31234 is male. These specimens demonstrate that *Rangwapithecus* is significantly more sexually dimorphic than had previously been thought and that several isolated canines thought to represent females are in fact male (Kelley 1986). Comparisons of KNM KT 31234 with other male *R. gordonii* material, including the more complete mandible KNM SO 17500 (Hill and Odhiambo 1987) and the type palate (KNM SO 700) show significant differences in body size, and particularly in canine size and morphology, amongst males of this species. Comparisons with extant catarrhines show that although extreme, the degree of inter- and intra-sexual dimorphism seen in *Rangwapithecus* does not exceed that of some modern catarrhine species.

### **Humeral retroversion revisited: a functional and ontogenetic model for populational variation.**

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Anthropological interest in humeral torsion or retroversion has a long history, and multiple functional explanations for variation in the orientation of the humeral head have been proposed. Recent clinical studies have revived this topic by linking patterns of humeral retroversion to habitual activities such as overhand throwing in baseball. However, the precise functional implications and ontogenetic history of humeral retroversion remain unclear. This analysis examines the ontogeny of humeral retroversion in a large sample of immature remains from six different skeletal collections ( $N = 550$ ). The results of this research confirm that humeral retroversion displays consistent developmental variation within all populations of growing children; neonates display relatively retroverted humeral heads, and the level of retroversion declines steadily into adolescence. However, as in adults, variation in the angle of humeral retroversion in immature individuals varies by population and by humeral side, and these differences arise early in development.

When the results of this analysis are combined with evidence from clinical literature on growth pathology and sports medicine, a clearer picture of the ultimate causes of adult variation in humeral retroversion emerges, and a new explanatory model drawing together both functional and ontogenetic perspectives can be reached. When humeral retroversion is examined in the context of the developing muscles of the shoulder complex, it becomes apparent that variation in this feature is not necessarily related to *specific* habitual activities, but is caused by a more general functional imbalance between muscles of medial and lateral rotation during growth.

### **Social stratification in a Christian cemetery? An assessment of stress indicators and social status at Anglo-Saxon Raunds.**

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The assumption that late Anglo-Saxon burial practice was egalitarian is beginning to be challenged. This research investigates the relationship between social status and burial rites during the 8<sup>th</sup>- to 11<sup>th</sup>-century cemetery at Raunds Furnells, Northamptonshire, UK. The prevalence of three stress markers – cribra orbitalia, tibial periostitis and linear enamel hypoplasia (LEH) – was compared with grave elaborations and grave location within the cemetery. It was hypothesized that higher status individuals, buried in more

elaborate graves, would have lower prevalence rates of these markers.

The occurrence of statistically more individuals with both cribra orbitalia and tibial periostitis in plain graves rather than graves with stone arrangements, and LEH in plain graves rather than graves with a cover or marker, suggests that individuals buried in more elaborate graves enjoyed better levels of health and may been of higher social status than those buried in plain graves.

Spatial analysis revealed that the area directly south of the church contained those with the lowest occurrence of stress markers and some of the most elaborate graves. It is hypothesized that this area was for high status burial. In contrast, burials in the far south-east corner had greater instances of stress markers and less elaborate graves. It is suggested that this liminal zone was seen as more appropriate for those of lower status. This research shows that combining biological and funerary data can reveal important evidence of social differentiation in cemetery topography, even from a period commonly believed to have had egalitarian burial rites. This research was supported by the Natural Environment Research Council and the British Academy.

### **A bioarchaeological investigation of materials recovered from two unmarked graveyards in Bridgetown, Barbados.**

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In 1996 and 2000 excavations were conducted to recover the skeletal material from two unmarked graveyards in Bridgetown, Barbados, uncovering the remains of at least 14 individuals (MNI= 14). Though the grave goods indicated that the deceased were interred during the 17<sup>th</sup> and 18<sup>th</sup> centuries there was still speculation as to who these people were. During the summers of 2004 thru 2006 osteological analyses of the material revealed that these two samples were made up of individuals of various age groups, both sexes, and most importantly of African ancestry.

The purpose of this presentation is to reveal the results of these analyses including any observed evidence of pathological lesions and indicators of occupational stress. This is one of the first presentations of this material and as such represents new information on the livelihoods and health of members of the enslaved population of Bridgetown during its early historical period.

### **Genetic Structure of the Aleutian Archipelago: Mitochondrial DNA Sequences and NRY Markers.**

Crawford, M.H., M. Zlojutro and R.C. Rubicz. Laboratory of Biological Anthropology, University of Kansas.

The Aleutian Archipelago stretches 1200 miles from the Alaskan Peninsula to

Kamchatka, Siberia. Although the estimated pre-Contact population consisted of 15,000-20,000 inhabitants, distributed over scores of islands, currently only 11 Aleut communities persist. We have sampled all 11 of the populated communities: Atka, Adak, Akutan, Bering, False Pass, King Cove, Nelson Lagoon, St. George, St. Paul, Umnak, and Unalaska. In addition, DNA samples were obtained from Anchorage, Alaska (site of relocated Aleuts) and Kamchatka (potential sources of Koryak, Itemen and Even migrants into the islands). Despite the depopulation, population relocations (to the Commander Islands and the Priblofs), Japanese invasion and displacements of the Attu inhabitants, and European admixture, the "signal" for genetic microdifferentiation of the subpopulations in the islands remains strong. The Aleuts are distinguished from all other circumpolar populations by mtDNA A7 subclade of A3 (16192T). Based on mtDNA sequences the correlation between genetic distances and geographic distances is highly significant,  $r = 0.68$ ,  $p > 0.004$ . In contrast, the Y STR markers observed in the archipelago show few, if any, Siberian/Native America haplotypes.

This study demonstrates: (1) the persistence of genetic structure as measured by the maternal lineages; (2) patterns of gene flow from Russian administrators and military in the western and central Aleutian Islands and Scandinavian fishermen in the eastern regions. This research was supported by grants from NSF OPP-990590 and OPP-0327676

### **A global survey of cytokine expression polymorphism in human populations.**

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Cytokines are soluble immunomodulatory glycoproteins that are involved in the regulation of both physiologic and pathologic processes associated with inflammation, immune responses, and hemopoiesis. Changes in cytokine expression or activity can lead to alterations in these responses. Cytokines and their receptors are often encoded by highly polymorphic genes. In recent years, surveys using general continental-based samples have documented differences in the distribution of cytokine genetic polymorphisms. Some genotypes are responsible for the observed inter-individual differences in levels of cytokine production, and thereby constitute a mechanism for adaptive modulation of the immune response. Here, we report a survey of common polymorphisms giving differential expression in anti-inflammatory (TGF $\beta$ 1 and IL-10) and pro-inflammatory (TNF $\alpha$ , IFN $\gamma$ , and IL-6) cytokines in ten geographically distinct populations.



Our results show that within certain cytokines, the distributions of expression phenotypes appear to be non-random and exhibit regional variation. Among the anti-inflammatory cytokines, there is a clear trend of increased expression, though IL-10 shows more of a regional concentration of increased expression. Among pro-inflammatory cytokines, both IL-6 and IFN $\gamma$  show a trend of decreased expression, but IL-6 gives a pattern geographically concordant with IL-10. These preliminary data depict two patterns of genotypic and phenotypic variability: a transition in humans of increased expression of anti-inflammatory cytokines but decreased expression of pro-inflammatory cytokines; and, evidence for recent regional evolution of the balance of expression among cytokines.

#### **The Early Upper Paleolithic human remains of Nazlet Khater 2, Egypt.**

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The Nazlet Khater 2 skeleton has been discovered in 1980 during the excavations of the *Belgian Middle Egypt Prehistoric Project* in the Nile Valley (Egypt). Its association with the Early Upper Paleolithic chert mining site of Nazlet Khater 4 (whose exploitation period range from 35 to 40 ka) makes it the oldest complete OIS 3 modern human skeleton in northern Africa.

The Nazlet Khater 2 remains belong to a young adult male. It is well preserved with the exception of the distal part of the legs and the foot. Comparative analyses of the specimen underline the complex morphology of modern human from this time period. NK 2 exhibits several retained archaic features notably on the face and the mandible. The inner ear structures display morphological characteristics that stand on the fringe of extant human variation. The postcranial remains have strong muscular insertions and are adapted to high biomechanical strength. Furthermore, Nazlet Khater 2 has vertebral and membral lesions. All of this might be related to intensive mining activities.

The study of this specimen provides an opportunity to increase our understanding of modern human variation during this time period (OIS 3) for which very rare human remains are known.

#### **“From many bodies posted in this clearing house”: anatomical specimens and surgical waste from Philadelphia’s two almshouse burial grounds.**

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In 1765, the College of Philadelphia (now the University of Pennsylvania) enrolled students in the first medical school in the American colonies. Following the Edinburgh model, lectures in anatomy and autopsies constituted core components of the medical curriculum, complemented by clinical

training in the city’s almshouses and hospitals. For the next century, Philadelphia enjoyed its role as America’s preeminent center of medical education, with its almshouse offering a steady supply of patients for experimental treatments and cadavers for autopsies and practice surgeries. Among the luminaries in American medicine who frequented the almshouse were William Shippen, Jr.; Benjamin Rush; Caspar Wistar; Joseph Leidy; Sir William Osler; and Elizabeth Blackwell, the first woman in America to earn a medical degree.

Philadelphia’s first almshouse opened near Independence Hall in 1729 and was replaced by a much larger one, the Blockley Almshouse, in west Philadelphia in 1834. Recent excavations of the two almshouse burial grounds have revealed thousands of anatomical specimens from the almshouse morgue and Pathology Museum, including the remains of autopsied children, amputated limbs, and discarded laboratory equipment. Collectively, these remains serve as tangible evidence of early American medical education, the material results of courses taught by the country’s most prominent anatomists and surgeons. From a paleopathologic perspective, the remains also provide unique information about the socially marginalized individuals who populated the almshouses, people described by a resident physician as representing “a multitude of those social maladies that degrade man-hood, undermine national strength and threaten civilization itself.”

#### **“We the people”: twenty-five years of bioarchaeology in Philadelphia.**

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From patriots to the poor, over the past 25 years bioarchaeology in Philadelphia has revealed unique information regarding the lives of the people who witnessed the birth and infancy of the United States. Beginning in 1980 with the Eighth Street First African Baptist Church Cemetery project, one of the earliest and best examples of descendant community partnering in the country, mortuary excavations in Philadelphia have uncovered Revolutionary War soldiers and epidemic victims at Washington Square; the earliest gunshot victim in Pennsylvania at Block 3 of Independence Mall; autopsied children from the colonial Philadelphia Almshouse Burial Ground; free African Americans from the Tenth Street First African Baptist Church Cemetery; and thousands of nineteenth-century anatomical specimens from the morgue at the Blockley Almshouse. Collectively, the remains of these approximately 1,000 individuals reflect the everyday rigors of life for the common people of the “Athens of America,” providing information unavailable from any other source regarding their activities, health, diseases profiles, and deaths.

This paper will present the most salient results from the bioarchaeological projects conducted in Philadelphia over the past 25 years, focusing on the evidence of disease, violence and trauma, medical treatment, and surgical practice amongst people who lived and died between ca. 1700 and 1890, many of them invisible to the historical record but witnesses to the most historic events in America’s past.

#### **Dominance and inter-group relationships: Do group identity, group size and interaction location affect the outcome of between-group contest competition in *Cebus capucinus*?**

M.C. Crofoot. Dept. of Anthropology, Harvard University.

Between-group contest competition (BGC), which has been hypothesized to be the main pressure promoting group-living in primates, is comprised of two components: (1) short-term competition over access to specific food resources (sBGC), and (2) long-term competition over status among neighboring social groups (lBGC). Most empirical studies have not explicitly addressed this functional distinction between competing in interactions and competing in relationships, and have only investigated sBGC. However, primate social groups interact with a stable network of neighbors, so it is clear that BGC often presents opportunities for improving status within a long-term relationship. High status may yield important benefits to members of dominant social groups which would be missed by research that focused solely on sBGC.

Here, I test whether stable dominance relationships exist among six *Cebus capucinus* social groups living on Barro Colorado Island, Panama, and explore the effects of group size and interaction location on the outcome of between-group encounters. I used an Automated Radio Telemetry System (ARTS) to simultaneously track the movements of two radio-collared individuals in each study group. Dominance was assessed via approach/avoid interactions between groups. Although some group dyads had clear dominance relationships, many did not. However, location, but not relative group size, was an important predictor of winning an interaction. These results suggest that competition for status within long-term relationships may be an important and currently under-appreciated component of BGC.

#### **A comparison of cortical bone thickness of the radius between humans and two non-human mammals.**

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Identification of bone fragments as human or non-human is often a difficult task, particularly if avoiding destruction of the sample. It has been proposed that the thickness of the cortex of long bones may be used to differentiate between the bones of human and non-human mammals. However, it is not clear for which skeletal elements and which mammals this holds true. This study concentrated on one bone, the radius, comparing the human with two of the mammal taxa whose skeletal remains are most commonly confused with those of humans in Australia: kangaroos and sheep. The different body stances of the kangaroo and sheep (the kangaroo's weight mostly carried on the hind legs – like the human; the sheep's weight distributed between all four legs) result in different loading of the respective radii. As increased load tends to increase cortical bone thickness (Kontulainen *et al.*, 2003; Nanyan *et al.*, 2005), it was hypothesized that the sheep radius would show a relatively thicker bone cortex compared with the human and kangaroo. A difference between human and kangaroo would then perhaps indicate a more general human/non-human difference, unrelated to stance.

Radiographs, two projections per bone, were taken. From these, measurements of the bone diameter, medulla cavity and cortices were made, at three sites along the bone shaft.

The results obtained were more complicated than hypothesized. While significant differences exist in the cortical thickness at some sites tested, a range of variation was observed; possible reasons for which are discussed.

#### **Lemurs through time: using stable isotopes from modern animals to understand extinct communities.**

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Lemurs have evolved in isolation on Madagascar since the probable arrival of their common ancestor roughly 60 million years ago. The continued survival of the island's diverse forest communities and their resident lemurs is uncertain as what little remains of the island's natural habitat is highly fragmented. The majority of our current understanding of lemur diet and habitat use comes from observational data. New isotopic evidence will augment these data sets and will help to infer what the diets of extinct species and subfossils of extant species may have been. Using stable carbon, nitrogen and oxygen isotopes from bone, we examine the isotopic niches of multiple sympatric modern strepsirrhines at several localities and compare these results with

subfossil material. By evaluating isotopic signatures from subfossil and modern data, results from this research will help identify which species may have shifted their foraging strategies or ecological niche space since the arrival of humans 2,000 years ago. Results indicate that, despite a sometimes surprising amount of variation, multiple isotopes can separate taxa and that each genus occupies its own isotopic niche space.

Specimens were borrowed from the University of Massachusetts, Amherst (UMASS Amherst). Subfossil specimens were donated to UMASS by Dr. Alan Walker. Funding for this research was made possible through a Phi Beta Kappa Scholarship and a Tropical Research Grant from the Center for Tropical Research in Ecology, Agriculture and Development (CENTREAD) and NSF BCS-0129185 to DAB, William L. Jungers, and LRG.

#### **Differences in dental health by sex and status in Mesoamerica.**

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Sex and social status are important elements in the quality and quantity of dietary intake, which, in turn, represents one of the factors responsible for oral health. The social structure of the ancient Maya society was highly stratified, with few individuals ruling over large masses. This entailed a large disproportion between the social levels in the access to resources, at the same time that sex discrimination against women acted to increment differences within the various sectors of society. The present study addresses the subject of oral pathologies, as an indicator of quality and quantity of diet, to provide answers to the effects that sex and social differences had in the Maya society during the Classic period.

Oral pathologies have been analyzed in a sample of 150 skeletal remains from eight Maya sites dated to the Classic period, and pertaining to elite and commoners as well as individuals from sacrificial and problematical deposits. Elite males, with their reduced level of oral pathologies, clearly stand apart from commoners; on the contrary, female elites did not differentiate much from commoners, highlighting that some kind of sexual differentiation did exist in the very same elite cohort. In turn, no differences could be noted between low status males and females. More variable is the state of oral health in the group of sacrificial victims, which suggests that not all these individuals were fringe members of the society and their social status was more complex than indicated by the ethnohistorical sources.

**A comparison of salivary pH in sympatric lemur species (*Lemur catta* and *Propithecus verreauxi*) at Beza Mahafaly Special Reserve, Madagascar: Investigating feeding ecology, dietary chemicals, and primate tooth wear.**

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Chemical deterioration of teeth is common among modern humans, and has been suggested for some extinct primates. Dental erosion caused by acidic foods may also obscure microwear signals of mechanical food properties. A compounding variable is the potential buffering capacity of saliva. Ring-tailed lemurs at Beza often display severe tooth wear and subsequent tooth loss. In contrast, sympatric Verreaux's sifaka display far less tooth wear and infrequent tooth loss, despite both species regularly consuming acidic tamarind fruit, among other acidic foods. We investigated the impact of dietary acidity on tooth wear, collecting data on salivary pH from both species, as well as salivary pH from 25 ring-tailed lemurs at Tsimanampetse National Park.

Mean salivary pH for the Beza ring-tailed lemurs (8.05, n = 42) was significantly more alkaline (p = 0.0002) than Verreaux's sifaka (7.48 n = 26). Salivary pH of ring-tailed lemurs at Beza (mean = 8.05) and Tsimanampetse (mean = 8.08) did not differ (p = 0.8503). Regardless of the time between feeding and collection of pH data (from several minutes to nearly one hour), pH for all individuals across the three samples ranged from 6-9 (neutral pH = 7; human salivary pH is normally 6.5-7.4). Thus, despite feeding on highly acidic foods prior to capture, lemur saliva appears to have a strong buffering capacity, indicating the impact of acidic foods on dental wear is short-lived, and most likely has a limited effect on gross tooth wear. The patterns observed are discussed relative to ecological and species factors.

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#### **Skeletal biology and ecological diversity in northwestern North America.**

J.S. Cybulski. Archaeology and History Division, Canadian Museum of Civilization.

The Northwest Coast and adjacent Plateau present contrasting natural and cultural environments. The Coast is

physiographically challenging with its rocky shoreline and insignificant beach fronts especially in its northern and central portions. Yet, in the native period, this area was one of the most heavily populated and culturally complex in North America with a successful human maritime adaptation and primary dependence on marine dietary resources. By contrast, the Plateau was sparsely settled despite having a greater habitable land area. People were dependent on large and small game animals, plant foods and anadromous fish though the degree of dependence on land and aquatic sources varied according to habitat and proximity to major river drainages.

Ecological diversity is shown by the distribution of stable isotope signatures ( $^{15}\text{N}/^{14}\text{N}$  and  $^{13}\text{C}/^{12}\text{C}$ ) in human bone and disproportionate frequencies in dental caries and abscesses. Human skeletal remains vary in stature and limb robustness in apparent congruence with the ecological differences. Men of the Plateau were variably taller than those of the coast. Femora were longer and variably more robust, well adapted for hunting. Coastal humerus shafts were more robust than those of the Plateau, suitable, perhaps, for paddling canoes. Though these differences appear to have been present early in the human history of the two areas, evident variability throughout likely reflects small-scale human movements and other contacts between the Coast and Plateau.

#### **Primate tibiae from the middle Eocene Shanghuang fissure-fillings of Eastern China.**

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The joint field expeditions of Carnegie Museum of Natural History and the Institute of Vertebrate Paleontology and Paleoanthropology of the Chinese Academy of Sciences have recovered numerous mammalian fossil remains from Eocene fissure-fillings in Triassic limestone near the village of Shanghuang, southern Jiangsu Province, China. These fossil assemblages have been biostratigraphically correlated with the Irdirmanhan and early Sharamuruni Land Mammal Ages (approximately 45 Ma). Five distal tibiae from haplorhine primates have been recovered from these quarries. All are from animals estimated to weigh 50g or less.

Two types of tibial morphology are represented. In type 1, the tibia is fused to the fibula, and in type 2, the bones are separate. Both types exhibit features (lesser degree of malleolar rotation; tibiofibular joint

fused or syndesmoti; restricted mortise shape) which imply that flexion-extension movement between the crus and the tarsus was accompanied by less conjunct rotation than in strepsirhine primates or larger anthropoids. These characteristics are commonly found among small leaping primates. Tibio-fibular fusion is one obvious similarity of the type 1 tibiae to *Tarsius* or *Necrolemur*, however, in terms of the conformation of the tibiofibular mortise (the relative size, distal extent, and degree of sloping of the malleoli), the most striking resemblance of Type 1 is to anthropoids. On the basis of malleolar size and shape, the type 2 tibiae are most similar to those of North American omomyid primates.

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#### **Activity or biological affinity? Predictive equations for body mass in female collegiate athletes.**

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Predictive equations for body mass vary among populations. It is unknown if the variation is due to spatial temporal variance between populations or due to differences in habitual activity. This study seeks to control for the effects of physical activity to ascertain whether biological affinity is a primary factor that influences the selection of an optimum set of variables to predict body mass.

Regression equations were generated for elite female collegiate athletes subdivided by biological affinity (black [B] or white [W]) basketball players (n=27 B, 30 W) or track and field athletes (n=56 B, 60 W). Stepwise regression was used to determine the best combination of variables. Analyses were carried out on two sets of anthropometric variables: 1) soft tissue and skeletal, and 2) a subset limited to skeletally-determined dimensions.

Within each sport for both subsets of variables, predictive equations differed by biological affinity. When equations for black athletes were used for white track and field athletes, body mass was overestimated by 1 % and 6 % using all dimensions and skeletal dimensions, respectively. In contrast, the weights of white basketball players were underestimated by 5 % when all of the variables were considered and by 2 % with skeletal dimensions. When the equations for white athletes were applied to the black sample, regardless of sport or subset of variables, body mass was underestimated by 3-10 %. The results suggest that consideration of biological affinities is important in estimating body mass.

#### **The color of stress? Preliminary evidence linking sexual skin coloration with cortisol in free-ranging rhesus**

**macaques.**

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Previous physiological research on secondary sexual color has focused primarily on the role of sex hormones. To further assess the physiological basis of female sexual skin color variability in free-ranging rhesus macaques (*Macaca mulatta*), we conducted a feasibility study to examine the relationship between female facial and genital color and fecal glucocorticoid (fGC) levels in 12 adult females on Cayo Santiago from July-August 2005. Fecal samples were collected opportunistically between 0600 and 1000, to control for diurnal fluctuations, then extracted in the field for subsequent laboratory measurement of glucocorticoids using a corticosterone radioimmunoassay. Facial (n=32) and genital photographs (n=25) were taken within 24 hours of fecal sample (n=39) collection to correct for lag time between steroid secretion and excretion. Female color was measured via the RGB method; allowing objective quantification of hue, saturation, and brightness.

Our preliminary results show that both facial hue (r=-.37, n=32, p<.01) and genital hue (r=-.44, n=25, p<.05) are negatively correlated with fGC levels when controlled for the effects of age. Significant relationships between fGC and facial or genital saturation and brightness were not found. These preliminary data suggest that glucocorticoids may have a physiological effect on aspects of body color display, and may communicate information on individual health and stress to conspecifics.

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#### **Dynamics of terrestrial and arboreal locomotion in Bonobos.**

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Bonobos have a very extensive locomotor repertoire, including brachiation, climbing, orthograde scrambling, jumping, quadrupedal walking and bipedal walking. We analysed

the dynamics (kinematics, forces, plantar pressures) for a subset of such locomotor behaviors, in a large group of captive bonobos in the Animal Park of Planckendael, Belgium. Additionally, morphological data (segment properties and dissection data) were gathered. This allowed for an estimation of net joint moments and powers during different behaviors.

Kinematically, all analysed locomotor styles (quadrupedal walking, bipedal walking, jumping, climbing) differed when focusing on the hind limb, although these differences were most pronounced at the hip joint. However, external joint moments did not reflect this pattern, and in all cases, gross power and torque output was typically delivered at the hip joint, with relatively low powers (and sometimes low torques) at the knee and ankle joints.

These data suggest that, in bonobos, kinematically highly distinct locomotor modes may still bear resemblances with regard to musculo-skeletal function. Along with their Ageneralist@ anatomy (i.e. typically long muscle fascicle lengths), this may be the reason why bonobos are able to perform well for a broad range of locomotor modes.

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#### Diet and niche partitioning in *Dryopithecus* and *Anapithecus* from Rudabánya, Hungary.

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Rudabánya is among the handful of Eurasian Miocene fossil primate localities preserving both a hominid and pliopithecoid and as such, provides the unique opportunity to reconstruct the nature of sympatry and niche partitioning in these taxa. Although similar in positional behaviour and body mass, *Dryopithecus* and *Anapithecus* differ in many aspects of their paleobiology. While dental morphometrics and microwear analysis identify *Dryopithecus* as a soft fruit frugivore, reconstructing the dietary behaviour of *Anapithecus* has been more problematic. As a result, this taxon is interpreted to be more folivorous by some (Begun 1988, Andrews *et al.* 1996), and more frugivorous by others (Ungar & Kay 1995, Kay & Ungar 1997).

Here, we use *High Resolution Polynomial Curve Fitting* (HR-PCF) (Deane *et al.* 2005) to quantify and evaluate the labial and occlusal curvatures of incisor crowns representing *Pan troglodytes* (n=39), *P. paniscus* (n=39), *Gorilla gorilla gorilla* (n=35), *G.g. graueri* (n=43), *G.g. beringei* (n=16), Pongo (n=44), *Hylobates syndactylus* (n=20), *Hylobates* sp. (n=28), *Dryopithecus brancoi* (n=7) and *Anapithecus hernyaki* (n=5) to determine dietary differences among these taxa. Analysis of the resulting dataset suggests that *Anapithecus* and *Dryopithecus* are

primarily frugivorous and have similar dietary behaviour with considerable overlap, however, the former taxon consumes greater amounts of THV (terrestrial herbaceous vegetation) similar to extant seasonal frugivores (i.e., *G. g. gorilla*, *H. syndactylus*). We interpret these findings in light of the paleoecology at Rudabánya and conclude that additional THV may have been used by *Anapithecus* as a seasonal keystone resource to avoid resource competition with *Dryopithecus*.

This research is supported by General Motors Women in Science and Mathematics, OGS and the University of Missouri-Columbia

#### The short lifespan of data in physical anthropology: why the big problem with data access is not hominid fossils.

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The question of access to newly discovered hominid fossils has recently received attention from the media, AAPA, and NSF. The issue has been presented as one of data access. The NSF responded by requiring that physical anthropology proposals now include a data access plan. Despite this attention, a fundamental question has been overlooked: Are the numeric data underlying published reports available? I present here the results of an experiment designed to address this question. Ten articles were selected for each of five volumes of the AJPA (2004, 2000, 1995, 1990, and 1985). All 50 corresponding authors were sent requests for a specific (small) portion of the numeric data summarized in their publication. Follow-ups were sent as needed, and the experiment ran for 12 months. Of the requested datasets, 26% were obtained in full and 18% were obtained in part, while 46% were not obtained. Of all datasets, 16% were confirmed as destroyed and 22% were withheld for ownership reasons, while only 7% of the authors could not be confirmed as having been contacted. These data clearly should be available. That they are often not available does real harm to the science. This experiment provides empirical evidence that there is a need for new efforts to preserve and make accessible the numeric data underlying published reports, else it is likely to be destroyed. This is clearly a much more pressing need than worrying about the timing of access to hominid fossils already under study and safely secured in museum vaults.

#### Morphological integration in human long bones.

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Limb morphology in vertebrates in highly conserved, although limb specialization is predicted to break down the developmental integration of forelimb and hindlimb modules.

We sampled four archaeological groups from geographically dispersed populations to address morphological integration in human long bones: Inupiaq (Point Hope), Indian Knoll, Dynastic Egyptians, and Europeans (Iron Age). These individuals represent two distinct levels of mechanical loading: hunter-gatherer subsistence activities (Inupiaq and Indian Knoll) and socially-stratified agricultural activity (Egyptians and Europeans). Linear measurements were collected from the humerus, radius, femur, and tibia. We used these data to test hypotheses about integration of characters within and between limb elements. Specifically, we addressed integration of bone length, diaphyseal breadth, and epiphyseal breadth. *A priori* hypotheses were modeled using morphological integration connectivity matrices and evaluated using Mantel's tests. We addressed congruence in patterns of integration and identified deviations from common covariance structure by comparing matrices across all samples.

A positive correlation exists among all measurements in this analysis. However, as predicted, we found that correlation between maximum bone length and diaphyseal breadth was low. Articular and epiphyseal breadths were not strongly correlated with diaphyseal diameter. Patterns of integration across limbs vary between the samples from different subsistence strategies. Although between-limb integration was high in the agricultural individuals, integration between upper and lower limbs was low in the hunter-gatherer groups. Differences in between-limb integration observed across functionally-specialized groups of humans demonstrate plasticity in limb integration correlated with environmental, stereotypical behaviors

#### Activity pattern and habitat use of the Rio Mayo titi monkey (*Callicebus oenanthe*) in a premontane forest in the Alto Mayo, northern Peru.

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In this paper, I present the results of the first long-term study of the behavior and ecology of the rare and endangered *Callicebus oenanthe* in a high-altitude fragmented tropical forest in the Alto Mayo, Peru. I recorded data on one group of *C. oenanthe* using focal animal sampling, totaling 917 observation hours from October 2004 to September 2005. The study group was composed of an adult pair, two offspring, and an infant born during the study period. Observations were made at close range, and identification of all individuals permitted detailed analyses.

*C. oenanthe* used an area of approximately 2.5 ha. Their habitat consisted mainly of low secondary forest, and bamboo stands. The mean height of the trees used in the habitat was 6.8 meters. The titis spent over half the time in the subcanopy and understory layers. *C. oenanthe* utilized only five sleeping sites throughout the study period, and used three

of these almost exclusively (92%). Resting was the most common titi activity (29.1% of observation time), followed by moving (21.4%), eating (17.2%), foraging (16.3%), social activity (9.0%), other nonsocial activity (2.5%), and vocalizations (0.7%). Their diet consisted largely of insects (44.9%) and fruit (39.0%), with lesser portions of leaves, shoots, flowers, seeds, and bark. In nearly all cases, the foraging pattern was toward insects, and consisted of insect searching and insect capture attempts. Relationships between diurnal and seasonal variation in time budgets, and habitat use in a disturbed forest has important implications for titi monkey sociality.

This study was funded with grants from the Margot Marsh Biodiversity Foundation, the Lincoln Park Zoo Neotropical Field Research Grant, Primate Conservation, Inc., and the Fulbright Association.

**KB5223 from Kromdraai B: *Australopithecus robustus* or early *Homo*?**

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A recent report (Braga and Thackeray, CR Paleovol 2:269, 2003) has suggested that, based on morphological and metrical data, a specimen from Kromdraai B (KB5223) should be attributed to early *Homo* rather than *Australopithecus robustus*. Specimens of early *Homo* are rare in South Africa, and its co-occurrence with *A. robustus* has only been documented at Swartkrans and Drimolen. The potential existence of early *Homo* in Kromdraai B is therefore of importance for our understanding of hominin paleocommunity composition in the Plio-Pleistocene of South Africa.

KB5223 consists of several associated deciduous and permanent mandibular tooth crowns. This study documents the quantitative and qualitative characteristics of KB5223 in relation to *A. robustus* and early *Homo* juvenile specimens from Africa. Odontometrically the permanent incisors and canine of KB5223 group with *A. robustus*, evincing strong anterior dental reduction. The deciduous and permanent molars of KB5223 also consistently fall within the size range of *A. robustus*. Morphologically the occlusal margins of the incisors and canine closely resemble *A. robustus*. The reduced/absent hypoconulid and absent plesioconulid of the dm<sub>1</sub>, as well as the present postmetaconulid and absent tuberculum sextum of the dm<sub>2</sub> and M<sub>1</sub> of KB5223, were reported to be indicative of early *Homo*. However, the presence of these traits in other *A. robustus* specimens from Swartkrans and Kromdraai limits their diagnostic utility. Taken as a whole, the occlusal anatomy of the deciduous and permanent molars of KB5223 shows close correspondence with *A. robustus* in their cuspal arrangement and fissure patterning. Metrical and morphological data therefore

support a designation of *A. robustus*, and not early *Homo*, for KB5223.

**Foot dorsiflexion during vertical climbing in chimpanzees.**

Jeremy M. DeSilva. Department of Anthropology, University of Michigan.

Vertical climbing is an important part of the hominoid locomotor repertoire and has been suggested as a potential preadaptation to hominin bipedalism. Previous studies on vertical climbing in chimpanzees have focused more on the kinematics and morphological adaptations in the upper limb and torso and less on the hindlimb. A pilot study captured video data on the locomotor behaviors of wild chimpanzees in the Ngogo community of the Kibale National Forest in Uganda. Seventy-three separate vertical climbing bouts were recorded with a Canon 3CCD digital video camcorder, and the diameters of the trees climbed were measured on-site. Kinematic data on the degree of foot dorsiflexion during vertical climbing were assessed using the program Image J from lateral view stills of thirty-one climbing bouts from a minimum of 20 different individuals. The average diameter of trees climbed is 15.6 ± 7.2 cm, a larger value than that previously reported for chimpanzees in other African forests. Although kinematic data are difficult to obtain with precision in a wild setting, the maximum degree of foot dorsiflexion during vertical climbing in the Ngogo chimpanzees was estimated to be 45° (range: 34.1°-58.3°). This value far exceeds dorsiflexion of the human foot during normal gait (~20°) and is approximately the same as the failure angle in the human talocrural joint. Substantial dorsiflexion in the chimpanzee foot is possible because of skeletal correlates in the talocrural joint. These findings have implications for hypotheses regarding vertical climbing in the Australopithecines.

**Black Death Mortality: Selectivity with Respect to Frailty**

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This project investigates the epidemiology of the Black Death of 1347-1351 using large skeletal samples from the East Smithfield Black Death cemetery in London and non-epidemic cemeteries in Denmark. Using newly developed paleodemographic methods, and comparing the mortality patterns in the East Smithfield cemetery to those in a normal, pre-Black Death cemetery sample, this project seeks to answer the following question: Was the Black Death selective with respect to frailty? That is, were people who were already in poor health before the epidemic at a higher risk of dying from the Black Death, or did the disease kill people indiscriminately, as is often assumed? The results provide new information about the Black Death in particular and are informative about emerging diseases in general.

**A test of the generality of the association between molar flare and diet in anthropoid primates**

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The reconstruction of diet in fossil primates is possible only when analogies can be made with extant primates of known dietary categories. As such, hypotheses of morphological adaptation must be thoroughly tested in extant primates before they are accepted as a truism that is applicable across primate clades. Non-adaptive explanations should serve as the null hypothesis and adaptive explanations should only be accepted when the nonadaptive explanations have been rejected. Additionally, hypotheses of adaptation have to take into account phylogenetic, temporal, and allometric effects on morphology. The relative degree of molar flare has been suggested to be an adaptation to diet, specifically; highly flared molars have been associated with hard-object feeding. This study shows that a critical evaluation reveals little support for such a proposition across all anthropoids. The hypothesis of an association between molar flare and diet was tested in thirty one anthropoid species, with sample sizes for each species ranging from six to thirty. The hypothesis was tested using a two-way analysis of variance with diet, phylogeny, and an interaction term as predictors. The results of the ANOVA reveal that there is no consistent relationship between dietary category and the index of molar flare when platyrrhines and catarrhines are compared. The interaction term is however significant indicating that diet and phylogeny interact in a non-additive manner. Additionally, other hypothesized covariates of molar flare, such as shearing potential and relative enamel thickness, are shown to exhibit a minimal relationship to molar flare when phylogeny is considered.

**Site differences in orangutan (*Pongo spp.*) behavioral ecology: Implications for sociality and community structure**

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The orangutan's community structure appears to reflect behavioral flexibility in response to environmental factors. Adult individuals are generally semi-solitary although the degree of gregariousness varies between sites and over time within sites. However, examining the frequency of party formation and the nature of relationships can help us recognize higher social units. We report on association patterns as a function of ecological and demographic factors at the Cabang Panti and Ketambe research stations. Specifically, we hypothesized that resource availability and local population

density influence patterns of association and social behavior.

Based on ~1,500 focal hours of observations at each site, we find differences in mean monthly population density, the proportion of time spent feeding, and the time spent in a party per day. Furthermore, our results reveal a negative relationship between mean party size and day journey length, supporting the prediction that individuals form parties and travel bands when costs are reduced because of increased fruit abundance. At Cabang Panti, low local population density and infrequent associations among resident females during the study period preclude a thorough understanding of this community's social structure. In contrast, based on the higher levels of association between adult females at Ketambe, the findings support a hypothesis that orangutan community structure is characterized by individual-based fission-fusion societies based on female-female relationships.

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### 3D approaches in paleoanthropology: small steps beyond William White Howells

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WW Howells, among the first physical anthropologists to recognize the potential of multivariate analysis for skeletal population morphology, took advantage of the computers and programs available from the 1950s onwards to interpret mainly craniometric data using factor and discriminant analyses. He brought these approaches into his classrooms where students were led to consider them as the norm rather than exceptional. Building on this early exposure, Delson and in turn his students have been privileged to work with a variety of colleagues on projects which moved beyond multivariate analysis of linear interlandmark distances to 3D landmark analyses (which, unlike distances alone, retain the geometric relationships among the landmarks). Such geometric morphometric (GM) studies have often involved physical anthropology, in no small part because Bill Howells set the stage. The NYCEP Morphometrics Group (<http://www.nycep.org/nmg>) is working on two major projects. The first is a study of tibiotalar joint congruence using LANDMARK EDITOR to place semilandmark grids on

laser scans of joint surfaces, which are then analyzed using GM. With this approach we can differentiate human, gorilla and chimpanzee bones and approach a separation of elements from single individuals. The second uses GM to visualize evolutionary transformation in fossil papionins. It combines landmark data with laser surface scans to build "averaged" surface models of crania from taxa whose relationships are fixed by a dated molecular phylogeny. We can then calculate the morphology of hypothetical intermediates ("ancestors") along the tree and compare them to known fossils and other inferred morphotypes.

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### An analysis of the geographic patterning of limb segment length variability using the dynamic sum segment method

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Allen's rule states that to optimize thermoregulation limbs tend to decrease in length as temperature decreases. Thermoregulation models often treat limbs as static, unified segments rather than dynamic, jointed ones and consequently have not explained why the relative lengths of limb segments are not equally affected by adaptation. Failing to consider the dynamics of behaviours influencing thermoregulation has hampered our understanding of geographic morphological patterns. Indeed, Cross (2005) recently showed that each body segment has a unique displacement pattern in gait causing some segments, such as those of the arm, to have a relatively greater contribution to heat loss in hot climates.

With the above in mind, three predictions were made. First, there should be stronger latitudinal correlations with the lengths of limb segments that are displaced most during walking (eg. arm swing should result in arm segments having stronger latitudinal correlations than those of the leg). Second, in the arms, latitudinal correlations should be strongest with the length of the hand, forearm and upper arm, respectively. Third, leg segments have similar displacement rates and so we expect minimal segmental differences in latitudinal correlations.

Anthropometric and latitudinal data for human populations from five continents were collected from the literature and compared with 3D data of segment displacement during walking. Results were in line with all three predictions and thus, provide insight as to why some limb segments are preferentially modified for thermoregulatory adaptations. These findings underscore the importance of using a dynamic, segmented analysis of the thermoregulatory mechanisms influencing morphology.

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### Limb loading in nonlinear locomotion.

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Many laboratory studies of locomotion investigate only linear, steady-state locomotion, often on treadmills. It is not entirely surprising, therefore, that substrate reaction forces (SRFs) appear uniform in such studies. Similarly, *in vivo* bone strain studies indicate rather stereotypic bone deformation patterns. To evaluate the variation in SRFs that animals likely encounter in their natural environments, we measured SRFs in three ring-tailed lemurs as they performed a variety of motor tasks including turns, overground and branch locomotion. In particular, we documented the inclination of the SRF vector in the frontal plane. During linear locomotion, frontal plane force angles varied in a narrow range not exceeding 20°, while during turns this range nearly doubled to 50° for moderate turning angles of approximately 30°. This range will probably further increase for sharper turns. Angles were greater for the hind limbs, in accordance with higher reaction force magnitudes on these limbs. Both medially and laterally directed SRFs were recorded, with medial angles exceeding lateral angles. Turning force data were also collected for two patas monkeys performing 30° turns. Like in the lemurs, the inclination of the force vector varied, though the range of angles was smaller and more similar for fore- and hind limbs. Variation in SRFs probably generates variable limb bone bending regimes. This has important consequences for functional interpretations of bone shape adaptations. A considerable range of loads may explain why many long bone shafts have relatively circular cross sections, enabling them to resist variably-oriented loads.

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### The colonization of Savannahstan: issues of timing(s) and patterns of hominin dispersals across Asia in the Late Pliocene and Early Pleistocene.

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The paper begins with a critique of the Out of Africa 1 model, and suggests why it is no longer adequate or plausible as a model of the hominin colonization of Asia in the Late Pliocene and Early Pleistocene. Alternative scenarios are discussed, including the possibility that *Homo erectus* originated in Southwest Asia. The paper then discusses the climatic and environmental background to early hominin settlement in Asia. Key components here are the monsoonal weather system, the climatic record of Asia from the Late Pliocene to Middle Pleistocene, and the grassland habitats summarised as "Savannahstan" in an earlier paper (Dennell

and Roebroeks 2005). Following on from these sources of environmental evidence, it is suggested that early hominin dispersals across Asia were tightly constrained by climatic fluctuations between cold arid periods and ones that were warmer and moister. Most dispersals would have been regional, and inter-regional migrations would probably have been confined to periods equivalent to interglacials at higher latitudes. Additionally, early hominin dispersals were often constrained at a regional level by the availability of stone suitable for tool making. "Out of Africa 1" was therefore less an event that resulted in the permanent colonization of the Asian landmass, than a series of episodic, small-scale, regional, and occasional inter-regional dispersal events.

#### **Mammalian predator recognition via olfactory cues in wild brown mouse lemurs (*Microcebus rufus*).**

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Nocturnal mouse lemurs are subject to heavy predation. The ability to recognize predators early and accurately increases survival rates. Chemical predator cues may be especially useful for prey animals that are active at night. Mouse lemurs rely on olfaction for social communication and foraging and may use olfaction to reduce predation risk. At Ranomafana National Park, Madagascar, we presented wild brown mouse lemurs (*M. rufus*) with odors (feces, urine) of local (mongooses) and novel (fox and bobcat) mammalian predators, as well as the odors of non-predators (lemurs) and novel controls (soap). Twenty subjects were captured and then tested in a laboratory in separate four-minute trials. The occurrences of eleven 'fear' and 'non-fear' behaviors were recorded. More than half of the subjects displayed fear in response to local and novel predator odors, but none feared non-predator or novel odors. Significantly more subjects ( $p < 0.05$ ) feared odor of the largest local predator (fossa) than odors of smaller local and novel predators.

Findings suggest that the olfactory recognition of mammalian predators may be partially innate, and possibly based on the perception of metabolites from meat digestion. Individual variation indicates that odor recognition may be refined by experience. Odors are long-lasting, and experienced individuals may be able to make better judgments about risk based on the quality, quantity, or origin of the odor.

Funding provided by Conservation International, Primate Conservation, Inc. and Seneca Park Zoo.

#### **Ecological influences on red howler monkey density: A comparison of two Western Amazonian sites.**

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Investigating the determinants of primate abundance and density may lead to a better understanding of the processes of behavioral adaptation and to better support of conservation efforts. Previous research on primate biomass has primarily focused on folivores, because most of the variation in biomass exhibited in primate communities is accounted for by folivorous species. However, even though much work has been done on Old World folivorous primates, less attention has been given to their New World counterparts. This study investigated the ecological influences on red howler monkey density (*Alouatta seniculus*) at two Western Amazonian sites in Ecuador. Study sites were located close in proximity (40km) and were identical in their primate community, but differed in habitat type and howler monkey density. Plant samples of red howler monkey food and non-food items were collected during behavioral observations of groups at both sites from Feb-Dec 2005. Results from plant nutritional analysis indicate no significant differences in fruit macronutrients between the sites; however, leaf quality was found to be significantly higher in soluble protein ( $P < 0.01$ ), neutral fiber detergent ( $P < 0.05$ ), and overall protein to fiber ratios ( $P < 0.01$ ) for the site with the higher howler monkey density. These results support previous findings that correlate higher Old World folivorous primate density with higher leaf quality, suggesting South American folivores are limited by the same factors as Asian and African taxa.

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#### **Complex interactions between estrogen, strain, and exercise-induced periosteal bone growth.**

MJ Devlin, DE Lieberman

Understanding the relationship between bone strain and bone growth is critical for interpreting variations in skeletal robusticity. Recently we presented a model for interactions between estrogen, strain, and periosteal bone growth, in which high estrogen (E2) increases, and low E2 decreases, osteogenic responses to strain. We compared cortical growth in exercised and sedentary sheep (*Ovis aries*) with higher vs. lower estrogen levels, and showed that exercised animals with high E2 added substantially more bone than those with lower E2. However, without normal controls, it was unclear whether exercise-induced cortical growth was stimulated by high E2, suppressed by lower E2, or both. Here we present a broader test of interactions between E<sub>2</sub> levels (normal, low and high) and loading

(exercised and sedentary). Low E2 animals were vaccinated against GnRH to suppress estrogen, while high E2 animals received estrogen implants. After 45 days, periosteal bone growth was measured at hindlimb midshafts. The results support the hypothesis that estrogen upregulates strain-induced cortical bone growth: exercised, high-E2 animals grew 6-27% more bone than exercised animals with lower E2 levels, or sedentary animals ( $p < 0.05$ ). The effects of the anti-GnRH vaccine on bone growth are more complex. Assays showed that vaccinated animals had normal, not decreased, E2 levels, but grew 34-49% less bone in response to exercise than normal controls ( $p < 0.05$ ). This suggests the vaccine affected strain-induced bone growth without changing circulating E2, an unexpected finding. These results demonstrate that variation in E<sub>2</sub> levels may produce differential growth responses to similar mechanical loading through complex mechanisms.

#### **A comparison of paternal care in three socially-monogamous neotropical primates.**

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One of the prevailing hypotheses for the evolution of social monogamy in primates posits an adaptive advantage to males of remaining with a single female and helping her rear offspring, rather than attempting to pursue a mating strategy of roving polygyny. It is often assumed that this advantage accrues because males invest heavily in offspring care, which may increase the likelihood of survival of their offspring either directly or by reducing the energetic costs of reproduction for their partners. Amongst platyrrhines, titis (*Callicebus*), sakis (*Pithecia*), and owl monkeys (*Aotus*) all typically live in socially-monogamous groups. Using data from our long-term fieldwork, as well as from other studies, we review patterns of paternal care in these three taxa and evaluate these in relation to the above hypothesis for social monogamy. Despite their similar grouping patterns, these three platyrrhines differ dramatically in the extent to which males invest directly in offspring. In titis and owl monkeys, males are heavily involved in infant care from soon after birth, but saki males provide little to no direct investment. Male sakis may provide indirect investment, but they certainly do not mitigate the energetic costs of infant care for their partners to the same extent as either titi or owl monkey males. Male sakis thus apparently remain in socially-monogamous relationships for reasons disassociated from paternal care. We evaluate several alternative explanations for stable male-female associations in sakis and suggest that males may face ecological or physiological

constraints that prevent them from pursuing a roving male strategy.

Support for our fieldwork has been provided by the Wenner-Gren Foundation for Anthropological Research, the L.S.B. Leakey Foundation, the National Geographic Society, Primate Conservation, Inc., and IdeaWild.

#### **Why mating systems vary in cooperative-breeding lion tamarins.**

J.M. Dietz. Department of Biology, University of Maryland.

Golden lion tamarins are cooperative breeders and all adults help transport and provision group infants, usually twins born to each reproductive female. Mothers are the primary caregivers in the first few weeks postpartum. The extent and duration of paternal and maternal care is influenced by the number of offspring and helpers in the group. In this report I use 16 years of continuous demographic and behavioral data on 13 groups of golden lion tamarins in Poço das Antas Reserve, Brazil, to describe the effects of environmental factors on variation in the number of group offspring, breeders and helpers. Beginning in 1996, the rate of predation on lion tamarins in the study area increased three-fold. Increased predation reduced the mean number of adults per group from 3.75 to 3.00, the mean number of adult male helpers per group from 0.68 to 0.41, and the mean number of adult female helpers from 0.72 to 0.43. The mean number of adult males unrelated to the breeding female remained unchanged, but the number of females breeding per group year decreased from 1.12 to 0.96. The mean number of infants born per group year decreased from 2.61 to 2.01, and the mean number of infants surviving to one year of age decreased from 1.58 to 0.76. Overall, variation in predation resulted in changes in mating system, group size and productivity—all variables expected to influence parental work load.

Funding for this project was provided by the National Science Foundation and Copenhagen Zoo.

#### **Determining home range “volumes” in primates: why are we using two-dimensional measures for species that live in a three-dimensional world?**

L.J. Digby. Department of Biological Anthropology and Anatomy, Duke University

Measures of home range are an important part of the ecology of primate species. Changes in resource availability, competition from sympatric species, and changes in group size are all impact the use of space by a group. As such, accurate measures of home range use are important in understanding the basic ecology of a species. Yet, traditionally, home range use has been measured as a two-dimensional area, leaving out the third dimension, height. This study lays out a method for calculating and using three-dimensional home ranges using three species

of semi-free ranging lemurs housed in natural habitat enclosures at the Duke Lemur Center. Using focal animal sampling, animal location (determined by GPS) and height estimates were recorded at 5-minute intervals throughout the day. While home range areas did not vary greatly, height did vary resulting in homes ranges of distinct volume and shape. The use of three-dimensional home range volumes will allow for more accurate determinations of how ecological variables influence the costs of resource acquisition and protection from predators in a variety of arboreal species. New technologies that may enable the remote sensing of animal movements through the forest will also be discussed.

#### **Origins of the Old World monkeys: a molecular perspective**

T.R. Disotell. Center for the Study of Human Origins, Dept. of Anthropology, New York University and New York Consortium in Evolutionary Primatology (NYCEP).

An increasing array of molecular data, including whole mitochondrial genomes, long sex chromosome and autosomal sequences, and genomic events such as SINE and LINE insertions are yielding robust cercopithecoid phylogenies. As more components of the genome are analyzed, it is also becoming more apparent that they may have different histories. The phylogenies and divergence estimates derived from the proper analysis of molecular data form the basis for generating and testing phylogeographic scenarios of the evolution of the Old World monkeys. Taxonomic revision of several groups of Old World monkeys may be warranted based upon some of the clades inferred from these analyses. However, such revisions should only be based upon clades inferred from concordant analyses of different components of the genome. These data and new methods of analyzing them in conjunction with multiple fossil derived calibration points are providing divergence estimates with smaller confidence intervals for many of the lineages of interest. However, some researchers posit that the fossil record is absent for up to half the time depth of nearly all clades. Several relatively recent molecular hypotheses of ancient divergence times for various lineages putatively support this hypothesis. Neither of these views are supported by analyses of cercopithecoid data. Furthermore, some lineages hypothesized to be of recent divergence turn out to be older than previously thought.

#### **Variability of the Stature of the Central European Population from the Neolithic Age to Present**

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The aim of our contribution is to characterize the changes of the stature in adult populations that have lived in Central Europe from the Neolithic period up to the present. Our sample consisted of 802 male and 704 female skeletons. The evaluation was conducted taking into account the demographic structure of the groups studied. We confronted the findings with the living conditions of the populations known to have a significant impact on human stature, in addition to genetic factors. We thus considered the socioeconomic status of the populations that might have influenced the quality of nutrition.

We focused our attention on the socioeconomic aspect of populations of the early Middle Ages and the recent population. We compared socially higher placed part of the society with socially poorer classes (agricultural groups) (177 male, 178 female) in the early-medieval population of Great Moravia. No statistically significant differences were found among individual social groups.

To calculate the stature of last populations we used the regression equations developed by Breitiger (1937) and Bach (1965). The calculation was based only on the length of the femur that is directly involved in body length. The impact of the secular trend was evaluated in the recent population. We compared two autopsy skeletal samples from the beginning and ends of the 20th century (107 male, 53 female). Statistically significant differences between them was found. Finally, we proposed regression equations for calculating the stature of the contemporary Czech population usable in forensic practice. Research supported by VZPMMK00002327201

#### **Social cohesion and the evolution of facial expression in nonhuman anthropoids.**

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Facial displays provide information about what an individual is likely to do next. This information is essential for negotiation since the appropriate response to a facial display can inhibit aggression and/or promote affiliation. The “social cohesion hypothesis” posits that facial expression has been designed by natural selection to maintain cohesion among group members. The purpose of this paper is to test the comparative predictions of this hypothesis in diurnal anthropoids.

I used two measures of signal effectiveness: facial mobility, and published data on facial nucleus volume (N = 26). Facial mobility data were collected from video recordings of zoo animals. The facial-action coding system (FACS) was used to count the number of facial movements in each species



(N = 12). Socioecological, body mass, and additional brain component data were taken from the literature. Partial effects were examined using multiple regression analyses of independent contrasts. Body mass and group size were entered as predictor variables in the facial mobility analysis. Medulla volume, group size, and grooming time were used in analyses of facial nucleus volume.

The social cohesion hypothesis is supported by the results of this study. Facial mobility is positively correlated with group size in anthropoids, controlling for size and phylogeny. Similarly, facial nucleus volume is correlated with group size and grooming time. However, these effects are only significant after excluding platyrrhines and the outlier *Pongo pygmaeus*. Thus, while facial expression likely evolved for the purposes of social cohesion, this particular selection pressure may have been confined to catarrhines.

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**On using tooth enamel zinc concentrations as indicators of diet and nutritional status: insights from analyses of a contemporary Mexican sample.**

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The assessment and interpretation of hard tissue zinc (Zn) concentrations is complicated by the metabolic complexities of an essential trace element implicated in several important biological processes. Although Zn was initially used as an indicator of carnivory, researchers have since suggested that zinc's utility for paleodietary reconstruction is severely limited because it is under some homeostatic control by the body and does not undergo a clear trophic level separation. However, with an understanding of the nature of Zn physiology and local factors affecting bioavailability, it may yet be possible to utilize measures of hard tissue Zn concentrations in paleonutritional reconstruction.

Pre-and-postnatal enamel Zn levels were determined via LA-ICP-MS for 80 deciduous anterior teeth collected from 46 infants participating in a large longitudinal study (NCRSP) in Mexico during the mid-1980s. Relationships between enamel Zn levels and ~200 variables documenting maternal diet and infant growth, morbidity and cognitive development at the time of tooth calcification were explored. Statistical tests indicated that an individual's prenatal enamel Zn content is higher when the mother exhibits zinc deficiency during pregnancy. Prenatal enamel Zn is lowest for children who ultimately achieved higher scores in tests of cognitive development. These results suggest that the Zn content of dental enamel may not be useful in reconstructing the relative

quantity of food groups contributing to paleodiets. Rather, zinc may provide insights regarding paleonutritional quality and potentials for functional impairment later in life.

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**Mechanical properties of hominoid foods: II. Plant underground storage organs and the adaptive significance of molar enamel thickness.**

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Most models of hominin behavior include a discussion of molar enamel thickness and diet. The relatively thick enamel of some species – along with a variety of other cranio-dental traits, such as microwear – is most often associated with a diet of hard and/or abrasive foods, such as grass seeds or plant underground storage organs (USOs). Yet the concept of hardness is normally based on the subjective impressions of human observers. Here we present the second in a series of studies on the mechanical properties of hominoid foods, all of which use standardized techniques. The aim of the present study is to compare the Young's modulus, *E*, and fracture toughness, *R*, of putative hominin foods with foods consumed by *Hylobates lar*, *Pan troglodytes*, and *Pongo pygmaeus*. We studied over 90 species of USO-bearing plants across sub-Saharan Africa. Our results show that USOs form discrete mechanical groupings; in general, raw tubers and rhizomes are implausible foods for pre-cooking hominins. These results suggest that the current usage of the term USO is too broad – anthropologists may wish to emphasize bulbs and corms in future models. Importantly, the mechanical properties of bulbs and corms differed; corms were significantly more resistant to deformation than bulbs, as well as fruits consumed *Hylobates* and *Pan*, which have relatively thin molar enamel. The *E*- and *R*-values of corms resembled foods consumed by *Pongo*. These results are compatible with the hypothesis that bulbs and corms are relatively hard food objects, and that bulbs and corms were consumed to some extent by hominins.

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**West Indies Indentured Irish in the 17<sup>th</sup> Century: An Osteological Case Study.**

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In June 2003, human postcranial remains were discovered at the ocean's edge on Pinney's Beach, Nevis, West Indies. Analysis of the post cranial remains is undertaken to estimate the age, sex, and stature of the individual(s) and to place the remains within a spatial, temporal, and cultural context. This standard osteological evaluation relies on macroscopic inspection for identifying traits of a qualitative nature. Metric methods are applied in an attempt to quantify characteristics such as ancestry, sex, age and stature. Analysis of the data follows forensic anthropological protocols using such methods as decision tables, range charts, indexes, discriminant function formulae and regression equations.

Remains are found to be those of a (white) female aged 18 – 20 approximating 5' – 5'2" in height. Archaeological evidence associate the excavated remains with fortifications known to have been built in 1705, with burial predating the fort. The extended supine position (hands crossed over pelvis) of the remains are indicative of intentional burial. Skeletal markers of activity and early age at death suggest a lifestyle associated with labor and environmental pressure. In the absence of cranio-metric analysis, the presence of asymmetrical spinal deformities (scoliosis) may assist in identifying population affinity. Census data indicates that in 1678, the Irish made up ~35.0% of the population and females living on the island included n=700 English, n=120 Irish, n=8 Scots, and n=1,422 blacks. The physical state of this individual is likely to be linked to the indentured Irish servant class rather than the planter English elite.

**Can primary productivity explain skeletal robusticity in Pleistocene *Homo*?**

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Anatomically modern humans are skeletally less robust than Pleistocene hominins. It is often assumed that this difference is the result of improvements in tool technology that led to reduced skeletal loading. Alternatively, it has been suggested that robusticity correlates with climatic variables and that global climate change led to skeletal gracilization. When the climate changed, primary productivity increased, leading to decreased foraging and hunting levels for anatomically modern humans. This study evaluates the hypothesized relationship between postcranial skeletal robusticity and primary productivity in the genus *Canis*. *Canis* was chosen as a model organism because its diet is similar to diets inferred for northern latitude Pleistocene human foragers. Primary productivity measures

energy flow in an ecosystem and can be estimated using the proxy variables of latitude, mean annual temperature, and annual rainfall. On the basis of the hypothesized relationship between productivity and robusticity within *Homo*, the expectation of this study is that canids living in less productive environments will be relatively more robust than canids living in more productive environments. This expectation was tested using a sample of adult *Canis* from North America. Femoral robusticity, derived from cross-sectional dimensions and standardized for body mass and limb length, was compared to latitude. There was a strong relationship between the variables ( $r = 0.738$ ;  $p < 0.05$ ). Latitude alone explains much of the observed variation in robusticity. A more complete assessment of productivity that includes temperature and rainfall may be sufficient to explain variation in robusticity within *Canis*, as well as within *Homo*.

#### **The intergenerational implications of developmental programming.**

A.J. Drake. Endocrinology Unit, University of Edinburgh.

Epidemiological studies have demonstrated an association between low birth weight and an increased prevalence of cardio-metabolic disorders. One major hypothesis to explain this link between early life environment and later disease proposes that overexposure to stress hormones (glucocorticoids) may influence development and have long-term consequences. Additionally, evidence suggests that this phenomenon of 'early life programming' is not limited to the first generation offspring.

We have developed a model of programming in rats, in which fetal overexposure to excess glucocorticoid results in reduced birth weight, increased expression of the gluconeogenic enzyme phosphoenolpyruvate carboxykinase (PEPCK) and adult hyperglycaemia. Using this model we have shown that dexamethasone exposure can have intergenerational effects on birth weight, PEPCK and glucose tolerance and crucially, that these effects can be transmitted by either maternal or paternal lines.

The persistence of such effects in a second generation, transmitted by both maternal and paternal lines indicates the likely importance of epigenetic factors in the intergenerational inheritance of the 'programming phenotype'. Intriguingly, these features were no longer present in the third generation, suggesting that intergenerational effects may normalise in the absence of a continued external stimulus.

#### **Enthesis bilateral asymmetry in humans and African apes.**

M.S.M. Drapeau. Département d'anthropologie, Université de Montréal.

Entheses (skeletal muscle and tendon attachment sites) have often been used to infer activity variability among human populations or even individual handedness. However, the assumption that entheses reflect activity levels has been challenged. This study explores the effect of habitual muscular activity on entheses morphology in humans and African ape by testing for bilateral asymmetry in the forelimbs and hindlimbs of these species. Given that humans prefer the use of one hand over the other, it is expected that 1) human will have greater asymmetry in the upper limbs than the lower limbs; 2) humans will have greater forelimb asymmetry than apes; and 3) apes will be symmetrical in both forelimbs and hindlimbs.

The sample includes humans from pre-industrial populations ( $n=47$ ), and wild-shot *Pan troglodytes* ( $n=36$ ) and *Gorilla gorilla* ( $n=36$ ). Entheses of the right and left upper and lower limbs were scored for rugosity, lesions, and exostoses. Individual average asymmetry for the forelimb and hindlimb was calculated and compared among species.

Results show that humans are more asymmetric than African apes for both forelimbs and hindlimbs, perhaps reflecting more asymmetric activities, or simply an overall greater sensitivity in entheses development in humans. Rugosity scores are more asymmetric for forelimbs than hindlimbs in humans and, unexpectedly, in apes, while exostosis scores are more asymmetric for hindlimbs than for forelimbs. These inconclusive results when comparing forelimbs to hindlimbs suggest that entheses morphology does not indicate simple difference in muscle activity across the skeleton, but may also reflect site-specific responses to muscle contractions.

This research is supported by the Fond québécois de la recherche sur la société et la culture.

#### **Handedness and bilateral asymmetry: comparisons of humeral length and weight.**

K. Driscoll. Department of Anthropology, University of Tennessee.

Bilateral asymmetry observed in human skeletal remains has been explained as a possible product of handedness. Specifically, the maximum length and robustness of the humerus has been given as an indicator of handedness. For this study, these hypotheses were tested.

The William M. Bass donated skeletal collection was used in this study. Of those donated, a sample of 105 individuals with known (self-reported) handedness was utilized. Fifteen of the individuals reported being left-handed while the remaining claimed right-handed status. The maximum lengths as well as the weights of the paired humeri from each individual were collected from this sample.

Among those right-handed individuals, t-tests indicated that both the length and weight of

the right humeri were statistically different from the left. However, among the lefties, neither the length nor the weight was statistically different between sides. Also, it was not possible to differentiate the left-handed remains from the right-handed remains when the entire sample was analyzed. The total sample t-test mimicked those found among the right handed sample. Establishing the handedness of an unknown sample would prove very difficult unless it was a more unique sample than was available here.

#### **A phylogeographic analysis of haplogroup D5 and its implications for the peopling of East Asia.**

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While genetic studies have focused on the Altai region of South Siberia as a possible place of origin for Native Americans, it is also possible that it played a similarly significant role in the peopling of East Asia. A Siberian connection to other East Asian populations has already been proposed based on archaeological, linguistic and classical genetic marker evidence. In this study, we examined a rare and ancient haplogroup, D5c, in an effort to elucidate early population movements in East Asia. Previous studies suggested that D5 first emerged in China and spread northwards from there. However, given the number of D5c individuals (12) and the range of variation in D5 from the Altai region, it is conceivable that this haplogroup instead originated in South Siberia and spread from there during the initial movements of Paleolithic peoples. To test this hypothesis, we obtained complete mtDNA sequences for individuals represented by haplogroups D4 and D5 and acquired additional sequences available through GenBank and published literature. We then analyzed the entire dataset with the reduced median network approach and phylogeographic modeling. Our results suggest that Southern Siberia did play a critical role in the spread of the D5 haplogroup. This focus on relatively unique mtDNA lineages specific to certain populations allowed us to better understand the processes of ancient settlement and subsequent population movements that helped shape the current genetic landscape of East Asia.

#### **The effects of behavioral selection on skull shape and size: the case of Belyaev's domesticated silver foxes (*Vulpes vulpes*).**

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Domesticated animals have differently-shaped skulls than their wildtype ancestors, but we have little understanding of the mechanisms behind this phenomenon. One problem is the extent to which selection on behavior generates covariation in skull form via processes such as pleiotropy and linkage. We examined this problem using the Belyaev silver fox experiment in which controlled artificial selection on behavioral characteristics was used to breed tame (domesticated) versus aggressive silver foxes (*Vulpes vulpes*). To examine the effects of selection on skull form, 27 three-dimensional landmarks were digitized on a large sample of unselected, domesticated, and aggressive foxes. Generalized procrustes and principle component analyses were performed on the data. The preliminary results indicate that, despite dramatic differences in behavior and features such as pelage, the populations differ more subtly in skull shape. The first two principle components of shape (which account for 31% of the total variation) separate aggressive from both the tame and unselected populations (ANOVA  $p < 0.05$ ). Aggressive skulls have greater cranial and facial flexion, a relatively wider face, and a shorter and taller rostrum. Tame individuals, in contrast, have comparatively taller crania and wider anterior rostrums. These results confirm that behaviorally-selected characteristics such as tameness and aggressiveness do correlate with skull shape, but the effects are subtle, especially when comparing domesticated and unselected populations. Consequently, one should be cautious in extrapolating common selective explanations for morphological and behavioral differences among species or populations such as between bonobos and chimpanzees, or between recent and archaic humans.

#### **Sacrificial burials in a Mixtec sweatbath.**

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In the past 10 years bioarchaeologists have devoted considerable effort into discerning veneration and violation in mortuary contexts. One critical aspect of this problem is understanding the bases on which individuals were selected for special mortuary treatment. Recent excavations at the Mixtec site of Tayata in Oaxaca, Mexico discovered an Early Classic period sweatbath, the first to be excavated in the Mixtec area. The sweatbath contained 7 individuals from 6 interments who were buried at the drains of the sweatbath. This paper presents an osteological analysis of those remains in conjunction with ethnohistorical evidence to argue that child sacrifice had a specific role in Mixtec ritual and that the Mixtec may have targeted families for inclusion in such deposits. Two adults, one female from 25-35 years of age and one adult of unknown sex

over 35 years of age, were buried on the west side of sweatbath. Five children were buried on the east side. The children were the following ages: 10 years (+/- 48 months), 5 years (+/- 18 months), 4 years (+/- 12 months), 2 years (+/- 8 months), and 1 neonate. The ages of the children raises the question of whether or not one family was being targeted for burial in the sweatbath. The emphasis on children suggests that they were closely associated with water among the Mixtec as they were among the Aztec, who often drowned children in sacrificial ceremonies. This material is based upon work supported by the National Science Foundation under Grant No. 0431390.

#### **New tarsals of *Ourayia* and *Chipetaia*, omomyine primates from the Uinta Formation, Utah.**

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Since the publication of Dunn et al. (2006), new remains of *Ourayia* and *Chipetaia* have been found. These include two cuboids of *Ourayia* and a complete astragalus of *Chipetaia*. The cuboids were found at fossil localities which have yielded other material referred to *Ourayia* including an astragalus, entocuneiform and first metatarsal. The cuboids can be allocated to *Ourayia* based on proximo-distal elongation and the presence of a conical pivot on the plantar aspect of the cuboid facet. Both the degree of elongation and the morphology of the calcaneal facet strongly resemble those seen in extant cheirogaleids. The astragalus of *Chipetaia* was found at locality WU-18, the locality that has yielded all other specimens of *Chipetaia*. Other astragali of *Chipetaia* have been described, but all are lacking the head and neck. The neck is straight, resembling that of omomyids and extant leaping prosimians. The relative length of the talar neck and the angle of the neck to the trochlea are similar to values calculated for other omomyids including North American omomyines (*Hemiacodon*, *Omomys*, *Shoshonius*) and anaptomorphines (*Absarokius*) as well as European microchoerines (*Necrolemur*). The shape of the talar head also resembles that of other omomyids and extant primates including generalized leaping quadrupeds and specialized leapers. The new tarsals are consistent with the conclusions of Dunn et al. (2006), who reconstructed *Ourayia* and *Chipetaia* as habitual leapers on the basis of other elements of the hind limb.

#### **MicroCT of *Proconsul heseloni* metatarsals.**

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The midshafts of 29 metatarsals from six *Proconsul heseloni* individuals were scanned with microCT. Cross-sectional

properties were compared to those of 74 *Pan troglodytes* and 52 *Macaca mulatta* individuals. The *Proconsul* individuals represent a range of ages from infant to adult, so the extant sample is a cross-sectional ontogenetic one. Individuals were assigned to age groups based on dental development to allow for comparisons among species. Cross-sections of the extant sample were reconstructed using biplanar radiography combined with the latex cast method.

Patterns of strength properties across the rays differ between species. *Pan* metatarsals are all absolutely and relatively stronger than those of *Macaca* and *Proconsul*. *Proconsul* metatarsals 2-5 plot with *Macaca* in magnitude but the *Proconsul* first metatarsal plots between *Pan* and *Macaca* and, like in *Pan*, it is stronger than metatarsals 2-5 as opposed to the first metatarsal of *Macaca* which can be equal to metatarsal 3.

Patterns of cross-sectional properties are consistent with plantar pressure data for each metatarsal head in *Macaca* (data from Wunderlich, 1999) both for walking on the ground and on a horizontal pole. The pressure patterns for terrestrial and pole walking are different in *Pan* and the pattern of metatarsal properties aligns with terrestrial walking.

*Proconsul* is widely considered to have been a generalized arboreal quadruped, but detailed inferences about its arboreality based on the cross-sectional geometry of the metatarsals of *Macaca* and *Pan* may not be possible until vertical climbing pressures are available.

This research was supported by a grant from the Leakey Foundation.

#### **Black populations on St. Catherines Island, Georgia, 1760-1930.**

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St. Catherines Island is a 14,000 acre tract of land in Liberty County off the Georgia coast, fifty miles South of Savannah. The island has a long history of occupation by enslaved African populations and their descendants. As early as 1765, Button Gwinnett borrowed funds to buy seven individuals. Jacob Walburg began gaining control of the island in the early 1800s. Both immediately before and after the Civil War, St. Catherines experienced an influx of freed blacks. Under Sherman's Special Field Order 15, the Georgia Sea Islands was made a reservation for freed blacks. The island became the capital of the freed black nation with 369 settlers. After the reversal of Sherman's directive by Congress, there was a decline in the population numbers. The Island was bought in 1876 by Jacob Rauer and used as a hunting preserve and country estate. In 1920, Augustus Oemler, Rauer's

son-in-law, started an oyster factory on the island.

Census data from, 1850, 1860, 1880 and 1920 reflect three very distinct phases of black population's use of the island. Population pyramids from these three periods show interesting changes in the dependency ratios (percent age 0-14.9 + percent age 65 and over / percent age 15-64.9 X 100). The ratios of the enslaved population change dramatically 45.1 to 94.5 from 1850 to 1860. In 1880 the ratio drops to 74.8 and to 12.9 in 1920 when the island is occupied by those working in the oyster factory.

#### **Biogeographic and sex variation in external rib cross-sectional area and geometry.**

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This study examines the effects of sexual dimorphism and regional geography on the modern human thorax through analysis of external dimensions of rib cross-sectional area and geometry. Data were collected from the 4<sup>th</sup> and 8<sup>th</sup> ribs of three biogeographically distinct mixed sex populations: Inuit (n=22; American Museum of Natural History), Zulu (n=22; University of Witwatersrand) and Euro-American (n=33; University of Iowa). Measures were modified from Franciscus and Churchill (2002), with external rib shaft molding to calculate cross-sectional area and shape. Variables were tested for both sex and regional differences using MANOVA and stepwise discriminant function analysis.

A highly statistically significant level of both sexual dimorphism and geographic differentiation was present for both 4<sup>th</sup> and 8<sup>th</sup> ribs across all variables ( $p=0.000001$ ) with specific variable involvement fluctuating in accordance with rib level. On average, Inuits and Zulu of both sexes had larger values than did Euro-Americans, particularly with respect to measures of rib cross-sectional width. Regional group differences in males were primarily driven by differences in chest depth and rib shaft cross-section, with European males having the greatest A-P depth and more diminutive cross-sections at both thoracic levels. Group differences in females were found in midshaft cross-sectional area, though Inuits of both sexes repeatedly separated from the other groups owing to wider ribs at midshaft. These results are presented in the context of previous thoracic considerations of sexual dimorphism, climatic adaptation, and ethnohistoric activity levels (Jellema et al., 1993; Dupras and Pfeiffer, 1996; Franciscus and Churchill, 2002).

#### **Mystery skull: paleopathology and biological variation in an Indigenous Australian.**

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A cranium housed in the Biological Anthropology Collection at the University of South Florida was donated by an individual who claimed it was of "Aborigine" origin. The specimen has not been dated and the origin and history of the specimen is unknown; however, toothwear and taphonomy suggest historic or an older affiliation. Cranial and mandibular measurements were taken and preliminary classification using Howell's function in ForDisc 2.0, yields an Australian male classification. The specimen has had the calvarium removed, consistent with an autopsy and there are small holes, drilled in the squamous portion of both temporals and mandibular ramii suggesting it was curated as part of an anatomical collection. Further, pathological lesions are present throughout the face and cranial vault and are present on both endocranial and ectocranial surfaces.

The purpose of this paper is to describe the process of differential diagnosis using skeletal morphology, radiography, and probability analysis. The case study of the unproveniented Australian skull with osteolytic lesions is investigated. The osteolytic lesions are poorly defined and there is no sclerosis. Some have penetrated the diploe and one is only visible radiographically, as it is present internally but without obvious external defects. The possible disease categories for consideration include infectious disease (treponematosi and tuberculosis) and neoplasms (metastatic carcinoma or meningioma). Given the type, shape, and location of the osteolytic lesions throughout the cranium; infectious disease can be ruled out in favor of a neoplasm.

#### **More than meets the eye: LB1, the transforming hominin.**

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The specimen LB1 from Liang Bua Cave, Flores, is a singular model of seemingly great intraindividual diversity. It has been identified as the type specimen of a new species, and as a member of our own. Its cranial capacity of about 400 ml has been taken as normally representative of a new taxon, and as abnormally small (microcephalic) for *Homo sapiens*. Its skull vault has been described as long and low versus nearly brachycephalic. Its dentition has been represented as megadont, yet fitting norms for living humans. What has been figured and described as a right femur really is a left femur. Stature has been reconstructed as barely three feet and approximately four feet. Bones of its appendicular skeleton have been characterized both as robust and as exhibiting unusually thin cortical walls. This individual even has been characterized both as a female and as a male. In all of these

paired interpretive comparisons, the latter diagnosis is that made by our research group, with all of our determinations proceeding from direct observation and/or quantification, with some findings already published and summarized here as necessary, others proceeding from additional original data.

As a final element, the tools recovered from the Ling Bua Cave have been described as complex microblade-based and astonishingly advanced for a small-brained hominin, yet sufficiently simple as to closely resemble those inferred to have been made by *Homo erectus*. Neither of these characterizations is ours, but we demonstrate that the apparent contradictions are readily reconciled.

#### **Is there biological meaning to "Hispanic" in New Mexico?**

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The term "Hispanic" is used to group people from Central and South America and the Caribbean, combining disparate cultures, languages, and ancestry, and masking biological differences. Regional differences as well as historical and contemporary admixture patterns within these populations, with indigenous peoples, and with European-, African-, and/or Asian-derived populations complicate the biological picture. "Hispanic" may have little biological meaning, yet it is used widely in studies of immigration and settlement patterns, epidemiology studies and disease management, and forensic science. A local or regional approach that considers the historical, cultural, and political history of Hispanic-American populations will aid in the interpretation of biological data from this group.

To test whether New Mexico Hispanic-Americans are a population biologically distinct from other American groups, dental morphological data was collected on 1,548 individuals of European, African, and European-, African-, New Mexico Hispanic-, and Native-American descent. The mean measure of divergence was employed to indicate biological distance. Results showed that all African- and European-American samples are phenotypically more similar to the New Mexico Hispanic-American sample than are the Native-American samples. Additionally, recent Native American samples are less like New Mexico Hispanic-Americans than are their early Native American ancestors.

#### **A New and Comprehensive Analysis of the Taxonomy of East Africa's Threatened Mangabeys and its Importance to Conservation**

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Africa's mangabey taxa are among the most threatened and least resolved taxonomically. Within the Eastern Arc Mountains and Coastal Forests of Tanzania and Kenya Biodiversity Hotspot are three of these severely threatened mangabeys: Tana River mangabey, Sanje mangabey, and the recently discovered Highland mangabey. Recognizing that well-founded taxonomy is foundational to, and inseparable from, well-conceived and executed conservation actions, we present a comprehensive approach to resolving the debates focused upon the specific, and even generic, status of these endangered mangabeys. Field-collected fecal samples for all three taxa have been subjected to molecular analyses, recordings of loud-call vocalizations of each have been analyzed for sonographic distinctiveness, and additional morphometric data have been examined for cranial and dental variation. Results of the comprehensive comparative analysis of these multi-faceted data provide a significantly strengthened and validated taxonomic placement for these highly threatened mangabeys.

This analysis addresses the perplexing taxonomic/phylogenetic questions surrounding mangabey phylogeny, but also has application to our conservation efforts within East Africa's most important area for primate conservation. Taxa designated as *species* (1) dominate conservation assessments, (2) drive funding for long-term conservation, (3) influence establishment and management of protected habitat, and (4) support lobbying efforts for inclusion on lists that carry legal weight (e.g., Red List, CITES appendices). If taxonomies are unresolved, as is the case for all of the mangabeys, then each of the preceding become compromised. This elevates the results of comprehensive taxonomic analysis to indispensable, especially for primates as severely threatened as these mangabeys of East Africa.

The fieldwork component of this research has been supported by the Critical Ecosystem Partnership Fund.

#### **How to determine sex using the pubic bone even when it is not recovered.**

G. Eklics, J. Albanese. Department of Sociology and Anthropology, University of Windsor.

Recent research suggests visual methods (i.e. Phenice method) are not always reliable (Maclaughlin and Bruce 1990) while metric methods can be universally applicable (Albanese 2003). The pubic bone has been the focus of research for developing sex determination because of the high level of sexual dimorphism. However, the pubic bone is easily damaged in both archaeological and forensic cases and often impossible to

measure. This dilemma has led to the development of non-pelvic methods for sex determination. We approached this problem by developing a method to measure variation in the pubic bone when it cannot be analyzed. Differential growth of the symphyseal end of pubic bone in females is responsible for much of the sexual dimorphism in this bone, including the Phenice indicators and the length of the os pubis. Additionally, because of the mechanics of bipedal locomotion, the angle of the neck of femur is related to the length of the pubic bone. We present a method that is applicable in both archeological and forensic contexts for capturing variation in the femur neck to determine sex. Samples from the Terry and Grant Collections were used to develop several logistic regression equations. The allocation accuracy is approximately 90% when the method is tested on a diverse independent sample. Although we use data only from the femur, the method is actually assessing variation in two highly sexually dimorphic areas: the pubic bone and the joints of a long bone.

Funding for this research was provided by the Social Science and Humanities Research Council of Canada.

#### **Ecogeographic variation in Neandertal dietary habits: evidence from microwear texture analysis.**

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For over 100,000 years, Neandertals inhabited a variety of ecological zones across western Eurasia, between glacial and interglacial conditions. To elucidate the still poorly understood effects of climatic change and variability, and possible competition on the Neandertal subsistence patterns, this study employed dental microwear texture analysis to reconstruct the dietary habits of 54 Neandertal, Pre-Neandertal, and early Upper Paleolithic (EUP) modern human specimens from 28 sites in western Eurasia. Microwear signatures of 10 modern hunter-gatherer groups (n = 119) of known and diverse diets were analyzed for comparative purposes.

Microwear signatures of Neandertals and Pre-Neandertals are correlated with variation in vegetation-cover, such that individuals from cold-steppe/tundra vegetation had significantly less complex microwear surfaces than those from forested environments. No significant differences in microwear patterns were found between the various Neandertal and Pre-Neandertal groups and the EUP fossils (all from forested environments), which suggests that the latter had a more varied diet. In accord with the stable isotope results, microwear analysis classifies Neandertals as top-level carnivores. However, dental microwear analysis detected some subtle dietary differences. Thus, the microwear signatures of Neandertals and Pre-Neandertals from steppe/tundra

vegetation are similar to meat-eating Fuegians from comparable habitats, whereas those of Neandertals and pre-Neandertals from forested environments resemble the Chumash, who inhabited a Mediterranean-like environment. Neandertals from the deciduous forests of southern Europe have a microwear signature that falls within the ranges of Australian and African aborigines with mixed diets. EUP fossils have microwear signatures that resemble those of both the modern Chumash and Fuegians.

This project was funded by the National Science Foundation (BCS-0452155), Leakey Foundation, and Ruggles-Gates Fund for Biological Anthropology (The Royal Anthropological Institute of Great Britain and Ireland).

#### **Diet and reproductive function in East African chimpanzees (*Pan troglodytes schweinfurthii*).**

M. Emery Thompson, R.W. Wrangham. Dept. of Anthropology, Harvard University.

The availability of energy is a key limiter to reproduction in female primates. However, there are many different adaptive strategies for coping with energy shortage. Perhaps the most common and favorable strategy is to breed at a time such that offspring are produced when energy availability is highest. This strategy is not feasible for a species like chimpanzees that face particularly high reproductive costs and pursue high quality resources that are unpredictable, thus such species should only conceive when they have suitable energy stores to carry out a reproductive effort. Here, we test the hypothesis that reproductive capacity in female chimpanzees is limited by current energetic condition by analyzing data on diet, reproductive timing, and ovarian hormones in the wild chimpanzees in the Kanyawara community of Kibale National Park, Uganda. Within months, chimpanzees preferentially consumed the ripe pulp of a small set of drupe fruit species. Between months the frequency of females having sexual (estrous) swellings was positively related to the consumption of ripe drupe fruits. Estrogen levels of both cycling and non-cycling females increased significantly during high quality fruiting seasons. Conceptions followed months of high fruit consumption, while birth months had below-average fruit consumption. Females conceived after a significantly shorter time when average ripe fruit availability remained high. These results support the hypothesis that cycling and conception in chimpanzees is contingent upon high energy balance and suggest that humans and chimpanzees share a reproductive physiology with enhanced sensitivity to ecological conditions.

#### **Patterns of trauma in pastoralists of the Donghu culture in northern China.**

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Santa Barbara, <sup>2</sup>Research Center for Chinese Frontier Archaeology, Jilin University.

During the Warring States Period (476-221 BC), while Chinese agrarian states vied for power around the fertile Central Plain, pastoral nomadic societies emerged northward in the Mongolian steppe. Southern (Inner) Mongolia marked the frontier with China, a transitional zone that could support either nomads or farmers. This area served as a gateway through which Chinese goods flowed, and thus was an area of intense competition and political strife. Chinese states attempted to control this contentious zone through the construction of defensive walls that eventually formed the Great Wall.

Ancient skeletal remains of the Donghu people of northern China were studied to obtain insights into the living conditions of those inhabiting this economically transitional, politically contested area. Archaeological evidence suggests that during this period, the people shifted from an agropastoral to a pastoral nomadic economy, concomitant with a decrease in population density and larger settlements. A collection of 129 individuals from the site of Linxi Jinggouxi in eastern Inner Mongolia was analyzed for evidence of trauma of the skull and appendicular skeleton. Observations were made of traumatic injuries in the form of cranial and postcranial fractures, and for evidence of projectile wounds. The results of this work suggest that cranial and postcranial fractures occur at high frequencies relative to other Chinese samples. These skeletal data suggest that interpersonal violence was prevalent in northern China during this turbulent period.

#### **A cranial nonmetric study of archaeological and modern populations from Mongolia and Korea.**

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A cranial sample consisting of 210 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 as having high interobserver consistency 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 revealed one cluster for all the archaeological and modern populations from Mongolia, and a separate cluster for modern era Koreans. The modern Koreans were found to be distinct from all of the Mongolian populations. The Mongolian cluster subdivided further into two groups. The first group consisted of early Iron age and Bronze

age populations of Mongolia being closely related, also joined by the sample from the Neolithic period. The second Mongolian group indicated the Xiongnu and Mongolian period samples were closely related, with a subsequent link with modern Mongolians.

#### **Spatial organization and group composition in *Varecia variegata*.**

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The social system of ruffed lemurs, although flexible, is not fully understood, varying in some details from study site to study site. In this study we documented group composition changes and analyzed the spatial organization of a *Varecia variegata* community at the Vatoharanana site (Ranomafana National Park) from January 2001 to September 2003. We found that group composition changes were positively associated with changes in fruit availability. For example, during 2002 the average number of adults reached a high of 6 in study groups (Groups 1 and 2), as core members moved back and forth between groups and non-core individuals joined groups. However, by December 2002 members of Group 1 had died, disappeared, or helped form a new group (Group 3), and by September 2003, Group 2 was reduced to its original core members and the newly formed Group 3 dwindled in size from 3 to 1 adults. In terms of spatial organization we found that time spent in proximity was consistent over the study period and between the study groups for various contexts (combined average of 16.3% feeding, 23.1% resting, and 29.7% traveling), and that proximity was generally highest among core group members. Overall, our results support Vasey's (1997a,b) description of the *Varecia* social system as a network of cores, subgroups, and communities.

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#### **Establishing the nature of the differences between skull samples from two populations.**

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A sample of 1188 skulls from the Romano-British site at Poundbury shows differences from the 18<sup>th</sup> century sample of 822 skulls from Spitalfields. Both sites are in the south of England, but 1400 years apart in time. The differences between the sites could be due to immigrations over time and/or to adaptation to the environment. The aim of the study was to establish the nature of the differences, in particular the relative importance of genetic and acquired traits.

Frequencies of 22 selected non-metric traits in juvenile, female and male skulls were analysed. Initial logistic regression analyses established that there was a substantial difference between the two sites and between juveniles and adults, with some sexual dimorphism. The modified mean measure of divergence, used to calculate overall distances between the groups, showed the juvenile groups to be closer to each other than to adults from their respective sites. Across sites, males were most distant from each other. The largest distance was between Spitalfields juveniles and males. Principal coordinate analysis, followed by a jackknife stability analysis, revealed a pattern indicating that this came about through growth and adaptation. Omitting traits in turn, procrustes methods were used to identify the most influential, all of which were acquired through ageing or lifestyle. Without these traits there was no significant difference between the two juvenile groups and no sexual dimorphism.

These results show the importance of the behavioural environment in determining morphology, and the resilience of populations to genetic change.

#### **LB1 is not a microcephalic.**

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Because the cranial capacity of LB1 (*Homo floresiensis*) was only 417 cm<sup>3</sup>, some workers propose that its remains represent a microcephalic *Homo sapiens* rather than a new species. This controversial hypothesis is difficult to assess, however, without a clear understanding of how brain shape of microcephalics compares with that of normal humans. Here we compare three-dimensional computed tomographic (3DCT) reconstructions of the internal braincases (virtual endocasts that reproduce details of external brain morphology, including cranial capacities and shape) from 10 microcephalic humans and 10 normal humans. Discriminant and canonical analyses are used to identify two variables that classify normal and microcephalic humans with 100% success. The classification functions classify virtual endocasts from LB1 and a pathological *Homo sapiens* specimen (which, like LB1, represents an approximately 3-foot-tall adult female) with the normal humans and microcephalic humans, respectively. Although LB1's brain shape sorts with normal humans rather than microcephalic humans, its small brain size and numerous

derived cortical features are consistent with its classification as a separate species, *Homo floresiensis*. Despite the fact that microcephaly is genetically and clinically heterogeneous, we demonstrate that primary microcephalic humans have brains with protruding and proportionately large cerebella and relatively narrow, flattened orbital surfaces compared with normal humans. These findings have relevance for hypotheses regarding the genetic substrates of early hominin brain evolution, and may have medical diagnostic value.

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### **Mechanics of the masticatory apparatus favor muscle force production at wide jaw gapes in tree-gouging marmosets.**

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Common marmosets (*Callithrix jacchus*) and cotton-top tamarins (*Saguinus oedipus*) have similar diets, but divergent feeding behaviors. Specifically, common marmosets gouge trees with their anterior dentition at wide jaw gapes to elicit tree exudates. We combined skull and muscle architectural features to model and compare sarcomere length operating ranges (which dictate relative force production) in these two taxa.

Musculoskeletal models of the marmoset and tamarin masticatory apparatus were generated from formalin-fixed, intact skulls. Each skull was mounted in a custom jig, where temporalis and masseter excursion were measured from occlusion to 45° of gape (corresponding to the range of physiological gapes) with potentiometers and serial photographs. These data were combined with muscle architecture data allowing sarcomere length and relative tension (% maximum tetanic tension-P<sub>0</sub>) joint-angle relationships to be modeled.

Muscle length changes were larger in the tamarin (temporalis = 5.79mm, masseter = 6.90mm) compared to the marmoset (temporalis = 5.04mm, masseter = 4.79mm) from occlusion to 45° of jaw gape. Sarcomere length operating ranges were also larger in the tamarin (temporalis = 1.80–3.15µm, masseter = 1.50–2.98µm) than the marmoset (temporalis = 1.63–2.40µm, masseter = 1.66–2.62µm). These data translated into greater relative tensions in the marmoset at wide jaw gapes (temporalis:100%P<sub>0</sub>, masseter:91%P<sub>0</sub> at 45°) compared to the tamarin (temporalis:50%P<sub>0</sub>, masseter:65% at 45°). Thus, masticatory mechanics and muscle architecture allow the marmoset to operate

on more favorable portions of the length-tension curve at wider jaw gapes. This mechanical configuration facilitates tree gouging at large gapes in common marmosets.

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### **Making sense of sounds: The behavioral context of vocalizations in wild sifakas.**

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Information exists on vocal activity for a variety of lemur taxa, including *Propithecus spp.* However, little is known concerning the behavioral and social context behind such vocalizations. Data were collected on a population of the Milne-Edward's Sifaka (*Propithecus edwardsi*) in order to understand better their vocal repertoire. Specifically, the aim of this study was to determine how variables such as season, activity, group composition, group size, relatedness, distance, and age affect calling by sifakas.

Major hypotheses identify the function of vocalization in social mammals as predator deterrence, resource defense, mate attraction, and group cohesion. Different functions predict different call rates and responses according to sex, age, relatedness, season, and other aspects. Focusing on four well-habituated groups of *Propithecus edwardsi* (n=18) in Ranomafana National Park in southeastern Madagascar, we used all-occurrences and focal animal sampling over 2,183 animal hours over 128 days to determine the dominant factors affecting vocalizations in sifakas. We collected data on over 3,000 vocalizations, including contact and alarm calls, and found that call type, call rate, and response were correlated with the season, caller's individual characteristics, and its activity before and after the call. Our results help to further understanding regarding the function of specific vocalizations and the factors that contribute to particular calls and responses in lemurs.

### **Quantification of inter-observer error in 3D dental tissue measurements.**

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Micro-computed tomography (mCT) is becoming a well-established method for measuring dental tissues more accurately than possible using traditional 2D techniques. Unlike 2D measurements on physical sections, 3D mCT measurements are not yet "standardized" among researchers. mCT measurements involve some subjectivity, relating to removal of background noise and selection of pixel

values to segment tissues. Major works on aspects of dental measurement employ different techniques for locating the basal plane, a reference plane from which other measurements are produced. As mCT studies of the dentition become common, it is likely that data recorded by multiple researchers will be synthesized in larger analyses; such studies necessitate that the data being combined are comparable.

Two tests were performed to determine whether independent researchers record the same measurements using mCT. 1) Given the same basal plane, do different researchers filter and threshold the same? 2) Independently locating the basal plane, are measurements comparable?

Enamel and dentine volumes and surface areas were measured by each author on ten primate molars of varying size and enamel thickness. Given the same basal plane, researchers produced comparable results. When independently locating the basal plane, results were not as similar, underscoring the need for standardizing basal plane location protocols to ensure measurements from multiple researchers are homologous. Future research will determine whether there is an obvious advantage to using any one method of basal area location. Ultimately, data produced by different researchers may be combined only when a standardized method for locating the basal plane is established.

### **Female reproductive competition in western gorillas at Mondika Research Center, Central African Republic and Republic of Congo.**

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Access to a higher-quality diet is considered the key to variation in female reproductive success (RS) and, unlike the case for males, relatively little attention has been paid to how reproductive competition might influence female RS. However, females could potentially increase their RS relative to others by either gaining greater mating access to preferred males in multi-male groups or by preventing or delaying other females' mating access to the male in one-male multi-female groups, where sperm may be a limited resource. We examined the mating behavior of 6 adult females in a one-male group of western gorillas (*Gorilla gorilla*) during all-day focal follows on a nearly daily basis (917 of 981 days) from February 2003 through October 2005. Results indicate that pregnant females may mate throughout the entire gestation period beginning approximately 40 days after conception. However, the pattern among females varies greatly, from almost no mating to mating up to the day of parturition. A major predictor of mating is the presence of other copulating females. Pregnant females are significantly more likely to mate on days

when cycling females are also mating. This suggests that, at least in female western gorillas, strategic postconceptional mating may be used as a tactic to reduce the probability of conception of other females.

**Costs and benefits of paternal care in free-ranging owl monkeys (*Aotus azarai*).**

E. Fernandez-Duque. Department of Anthropology, University of Pennsylvania.

Owl monkeys (*Aotus azarai*) are small, territorial, socially monogamous primates that show intense infant care by the adult male in the group. It has been hypothesized that paternal care may be adaptive because it increases offspring survival and/or reduces the metabolic costs to the female of raising the offspring.

To evaluate the possible role of the adult male in infant survival we collected behavioral data from 10 male-offspring dyads and demographic data on infant survival from 20 pairs of owl monkeys between 2000 and 2005. To evaluate the metabolic costs of caring for the offspring we analyzed differences in body mass between males who did (n=25) and who did not care for offspring (n=28).

The male carries the infant most of the time, and also plays, grooms, and shares food with the infant. Infant survival was relatively high (88% n = 60 infants) and the replacement of a putative father by an intruder male was not associated with higher infant mortality rate. Males who provided infant care tended to lose weight.

Our observations suggest that infant owl monkeys may be primarily attached to the putative father as it has been described for titi monkeys. Paternal care may not increase infant survival directly. Still, there may be adaptive benefits if the males are absorbing the metabolic cost of infant carrying which could otherwise impinge on the female's reproductive potential.

This research project was funded in part by the L.S.B. Leakey Foundation, the Wenner-Gren Foundation, the National Geographic Society and the Zoological Society of San Diego.

**If you give a monkey an onion: An introduction to fur rubbing in human-commensal white-fronted capuchin monkeys (*Cebus albifrons*).**

M.Y. Field. Dept. of Anthropology, The Ohio State University. Universidad San Francisco de Quito, Ecuador.

All species of capuchin monkeys typically apply substances such as plants and insects to their bodies. This behavior is hypothesized to repel insects, prevent skin infections, or stimulate the skin. The goal of this study is to explore fur rubbing in a group of human-commensal *Cebus albifrons* and to compare fur rubbing in this group to that of other *Cebus* species.

During data collection for a long-term study on the effects of human commensality on a group of *Cebus albifrons* in Misahualli, Ecuador, ad libitum video data was collected on all fur rubbing bouts observed. From November 2005 to September 2006, 57 bouts (*sensu* Baker 1996) were recorded. The video was analyzed to determine for each bout: the material used, bout duration, the participants, and whether the participants were rubbing alone or in contact with others ("social fur rubbing").

The capuchins were observed using both red and green onions (*Allium* spp.: 66.7% of bouts), DEET-based insect repellent (10.5%), powdered chlorine bleach (5.3%), cigarettes (5.3%), hot peppers (*Capsicum* spp.: 3.5%), *Citrus* spp. peel (1.8%), liquid soap (1.8%), and cologne (1.8%). In two bouts (3.5%) both citrus and onions were used.

Fur rubbing items used in this study contain compounds with insect repellent, antibacterial/anti-fungal, and stimulatory properties, following the pattern found in other *Cebus*. However, several of the items used by the monkeys in this study have potentially serious teratogenic effects. Results for duration, participant identification, and social dynamics will be discussed in relation to fur rubbing reported for other *Cebus* species.

**Formation of localized hypoplasia of the primary canine.**

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For some time we have been trying to better understand the mechanisms underlying the formation of an enamel defect, LHPC, that appears on deciduous canine crowns. We are now certain that LHPC does not represent a wholly different phenomenon with its own separate etiology, as has been claimed by some, but that it part of the larger 'family' of hypoplastic surface defects (LEH). The underlying mechanism that produces LHPC is similar to other LEH, and internally identical to that which produces a neonatal line, Wilson bands, and striae of Retzius. We believe that these features are all produced by a systemic disruption to enamel formation; what differentiates one from another is the nature of the stress trigger that disturbs matrix secretion.

We present the results of an intensive study of LHPC carried out on teeth from European, Asian, and several New World populations. Our sample includes dentitions that have at least one canine with LHPC as well as other deciduous teeth that were developing coevally, but which show no evidence of any form of LEH. The surfaces of all teeth have been studied with a stereo microscope and a scanning electron microscope. All teeth have also been thin sectioned and studied internally and the formation time of Wilson bands established

using odontochemistry. Results indicate that the initiation of LHPC occurs in early infancy, within the first six months of life, and they support our hypothesis that the defect is systemic.

**Comparing Primate Crania**

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William Howells made a major contribution to our understanding of human evolution with his quantitative analyses of cranial diversity among modern and fossil humans, and he compiled a data set that remains the basis of many studies of human cranial evolution. Comparable broad analyses of Primates as an Order are notably absent. In honor of Professor Howells, we present the modest, initial results of a project aimed at providing a multivariate comparison of the major patterns of cranial shape change during primate evolution, and quantitative assessments of cranial diversity among different clades.

We digitized a set of 17 landmarks designed to capture overall cranial shape on male crania representing 66 genera of living primates. The landmark data were aligned using a Generalized Procrustes Analysis and then subjected to a Principle Components Analysis to identify the major axes of cranial variation. Cranial diversity among clades was compared using multivariate measurements of variance.

The first two components account for 41 and 22 percent of the total variance respectively. The first principle component reflects differences in cranial flexion and relative neurocranial volume. In general it separates strepsirrhines from haplorhines. The second component reflects differences in relative cranial height and snout length. In the overall plot of the first two axes, *Eulemur*, *Mandrillus*, *Pongo* and *Homo* are among the extremes in cranial shape.

Hominoids show the highest variance in cranial shape among extant primate clades. Anthropoids and haplorhines show a higher variance than prosimians or strepsirrhines, and catarrhines have a higher variance than platyrrhines.

**(In)congruence between molecular and morphological phylogenies in the Papionini.**

K.E. Folinsbee. Department of Biology, University of Toronto at Mississauga.

Phylogenetic relationships of the papionin monkeys are of great interest to evolutionary primatologists, and vital to understanding how morphology, behaviour and biogeography have changed within the clade. Since the 1970s, molecular geneticists have generated a great deal of genetic data for most of the Old World monkey species, and numerous molecular phylogenies have been produced.



Morphological character sets have also been used in phylogenetic analyses. The topologies (both within and between types of analyses) are rarely identical. Some have suggested they differ significantly enough (due to homoplasy in the morphological data) to warrant the exclusion of morphological characters in phylogenetic analysis for this clade.

I compared the topologies of trees generated using molecular data to those based on morphological characters to see if there were consistent and statistically significant differences between the patterns of relationships. While some clades appear to be poorly supported overall, there are few consistent differences between published molecular and morphological trees. The junctures at which they conflict may be instances where the hypothesis of speciation by bifurcation is refuted. Rather, we can begin to test hypotheses such as reticulated speciation events (hybridisation) or multifurcations (true polytomies). With the accumulation of more data, both morphological and molecular, for the Old World monkey clade, we can cautiously suggest that we are approaching the 'true' topology of the evolutionary tree.

#### **Lack of special relationships between male and female mantled howling monkeys (*Alouatta palliata*).**

R.T. Ford. Biological Anthropology and Anatomy, Duke University.

Male and female reproductive strategies often conflict. Because these strategies operate simultaneously, it is difficult to determine whether mating behavior represents the action of male or female strategies. In particular, females may be prevented from associating with some males during estrus because of male-male competition. To assess whether female mantled howling monkeys show preferences for particular males, proximity patterns were examined when females were not sexually receptive and presumably not restricted in their choice of proximity partners. Eight adult females in a social group of mantled howlers containing five adult males were observed from March – July 2006 using focal animal sampling. During observations, the amount of time a male spent within 3m of the focal female was recorded. The proportion of time in proximity to each male was calculated each month, and an analysis of variance was performed for each female to determine if the female spent significantly more time with a particular male. There were no significant differences among males in time spent in proximity to any females. This finding is consistent with observed mating behavior. Four females were observed in estrus during at least two months. Three of the females spent a significantly greater proportion of time in proximity to one male than the other males. In all three cases, the male received the most proceptive behavior from the female and was her most frequent copulatory

partner. However, male behavior, not female choice, appears to dictate which male is in proximity to the female.

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#### **Primate Predation by Harpy Eagles in the Central Suriname Nature Reserve.**

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Harpy eagles (*Harpia harpyja*) are the largest avian predators in the world. Beyond a fondness for monkeys and sloths, however, their predatory patterns remain obscure. We report the findings from four years of kill residues collected from beneath a Harpy nest site in the study area of the ongoing Monkey-Forest Project at Raleighvallen, in the Central Suriname Nature Reserve. Activities of nest occupants and prey brought to the nest were also monitored.

Analysis of the remains indicates an abundance of sloths, particularly two-toed sloths (*Choloepus didactylus*) and primates. However, the range of prey documented was more diverse than reported elsewhere, indicating that preferred prey was supplemented with highly opportunistic prey harvests. Prey species were primarily arboreal, and comprised a fairly narrow size range. The estimated body size of only a few prey specimens fell outside a one-to-eight kg range. Harpys preyed on all eight species of sympatric species of primates in the reserve, but predominately on capuchins and pitheciines. There was a strong bias to upper body parts of sloths but lower body remains of primates being brought back to the nest. We compare prey harvests at Raleighvallen with prey reported from other Neotropical Harpy populations. Raleighvallen Harpys also exhibit disparities to the hunting behavior of the largest African avian predator.

Major support for the Monkey-Forest Project at Raleighvallen comes from US National Science Foundation grants (SBR-9722840, BCS-0078967 and BCS-0352316 to SB).

#### **Midfacial intermediacy in post-contact Amerindian skeletal samples and European-Amerindian admixture.**

A.D. Foster, J.C.M. Ahern, C.R.F. Meyer. Department of Anthropology, University of Wyoming.

Measurements of breadth and projection of the midface have been classically utilized in forensic applications due to their high accuracy in differentiating North American populations. Therefore it can be hypothesized that measurements of the midface can be used to identify admixture in skeletal samples. In order to test this hypothesis, this study examines pre- and post-contact Amerindian, late medieval European and

Euroamerican skeletal samples. The null hypothesis for this study posits that post-contact Amerindian and Euroamerican populations are not morphologically intermediate between their pre-contact ancestral populations.

Through discriminant function analysis using Mahalanobis distance, it is found that two post-contact Amerindian samples represented by Chirikoff and Mandan/Arikara cluster in an intermediate position relative to pre-contact Amerindian despite being treated as separate populations. Additionally, Euroamericans cluster with Europeans. The correct placement of 86.6% of the individuals demonstrates the accuracy of the discriminant functions. Additionally, the data is analyzed using a phenotypic covariance matrix derived from cranial metrics producing an unbiased minimum  $F_{ST}$  value following Williams-Blangero and Blangero (1989). It is found that the  $F_{ST}$  value increases from pre-contact to post-contact periods from 0.0811 to 0.3711.

Findings of intermediate clustering as well as an increase in phenotypic covariation through time likely reflects admixture between these two populations. However, since Euroamericans largely cluster with Europeans, this may reflect the degree of genetic swamping on the part of European settlers that occurred but may also be the result of the samples utilized in this study.

Portions of this study have been funded by a graduate fellowship at the NMNH through the Smithsonian Institute Fellowship Program.

#### **Diet and taxonomy: fossil cercopithecoids from Makapansgat.**

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Three sympatric fossil cercopithecoid genera (*Cercopithecoides*, *Parapapio* and *Theropithecus*) are found in Members 3 and 4 at the Makapansgat Limeworks hominin locality, South Africa. The presence of such a variety of sympatric and contemporaneous primate taxa in a single ecosystem suggests a degree of ecological and/or dietary differentiation between taxa. This research explores this possibility by using stable isotope (<sup>13</sup>C/<sup>12</sup>C, <sup>18</sup>O/<sup>16</sup>O) and trace-element (Sr, Ba, Ca) techniques for paleodietary analysis to investigate variation in dietary ecology in these genera, focusing on the possibility of subtle niche separation between the more closely related, morphologically similar taxa of the genus *Parapapio*. Because taxonomic uncertainties exist in this sample, and such uncertainties can impede the interpretation of dietary data, craniometric analyses were also performed to ground the dietary interpretations in a morphological context.

Dietary analyses indicate two widely differing dietary ecologies within the *Cercopithecoides williamsi* sample. Results for *Theropithecus darti* indicate a predominantly  $C_4$  grass diet. Two overlapping dietary ecologies were found within the genus *Parapapio*. The morphological analyses found no clear taxonomic signal in the craniometric data for the *Parapapio* sample. The *Parapapio* sample was no more variable morphologically than a single geographically circumscribed extant chacma baboon sample. To sum, while biogeochemical dietary indicators suggest distinct dietary ecologies within and between genera, disjunctions exist between the dietary categories and the taxonomic assignment of specimens within the genus *Parapapio*. Given these results, and in light of the taxonomic concerns highlighted by the craniometric investigation, reinvestigation of papionin taxonomy at Makapansgat may be warranted.

#### Temporal and geographical patterning of mandibular corpus dimensions in *Homo* using Mantel tests.

R.G. Franciscus, N.E. Holton, S.D. Maddux, H.E. Marsh, R.L. Ciochon. Department of Anthropology, University of Iowa.

In this study, we use Mantel and partial Mantel tests on pairwise distance matrices of individual mandibular corpus dimensions at M1 (breadth, height, area, and the breadth/height index), against time (chronometric yrs BP), km distance (curvilinear geographical distance), and latitude and longitude separately (degrees) compiled for all available fossil *Homo* (i.e., *H. sp.*, *ergaster*, *erectus*, *heidelbergensis*, *neanderthalensis*, *sapiens*; maximum total  $n=125$ ) to evaluate the relative strengths of temporal and geographic associations with corpus measurements. All tests incorporated 10,000 matrix element permutations to test the significance of the Mantel correlation. The strongest correlation was between corpus breadth and time ( $r=0.357$ ;  $p=0.00010$ ). Corpus breadth and latitude were less strongly associated but still attained significance ( $r=0.181$ ;  $p=0.0090$ ). The correlation between corpus breadth and time remained significant when holding the effects of latitude constant ( $r=0.324$ ;  $p=0.00010$ ), while the correlation between corpus breadth and latitude became insignificant when holding the effects of the time constant ( $r=0.085$ ;  $p=0.07349$ ). No significant correlations were found between corpus breadth and either km distances or longitude. Additionally, no significant correlations were found between corpus height and time or any geographical distance measure. Corpus index and corpus area are also significantly correlated with time, and these remain significant when the effects of the various geographic differences are held constant. These results are considered in light of previous assessments of temporal variation in hominid mandibular dimensions that have focused on corpus size, robusticity, and

breadth to height scaling relationships for sub-generic taxonomic assessment and evaluation of craniofacial adaptive trends.

#### Dietary reconstruction of Early Pliocene Bovids from Gona Project Area, Ethiopia.

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During seven field seasons in the Early Pliocene (4.3-4.5Ma) Sagantole Formation deposits located in the Gona Paleoanthropological Research Project area of Ethiopia, over 2700 fossils were collected. The majority of these fossils (~30%) are bovids, although many other taxa, including the hominid *Ardipithecus ramidus*, were collected. Significant to our understanding of the early hominid environment is a reconstruction of the diets and substrate preference of associated species. We collected the following data on the bovid fossil teeth and post-crania: low-magnification enamel microwear, mesowear of maxillary molars, isotopic sampling of the enamel, and pedal ecomorphology. Ultimately, these data will enable us to develop a better contextual understanding of *Ar. ramidus*.

Alpha taxonomic studies are still underway, but, of the species identified, *Tragelaphus* cf. *kyaloae* ('kudu') and Aepycerotini gen. et sp. indet. ('impala') contribute approximately 80% of the bovid teeth from the hominid stratigraphic levels. Additional species include Bovini, Reduncini, a smaller *Tragelaphus*, and possibly Alcelaphini. Low-magnification microwear analyses of the tragelaphine and aepycerotine teeth showed a degree of separation between the two dominant species in terms of pit and scratch frequency. Mesowear comparison also show differences, again with the tragelaphine have a browsing signal and the impala a more mixed feeding strategy. This difference is also revealed in the <sup>13</sup>C isotopic signature of the enamel, with a lower value in the tragelaphines than the aepycerotines. The other bovids also provided a grazing signal. Taxonomic identification of the postcranial elements is problematic, therefore a taxon-free analysis of all of the elements best classifies them as deriving primarily from forest-adapted bovids.

#### Social organization in two sympatric lemur species: a lack of dominance.

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Although female dominance and matrilineal social organization exists among ringtailed lemurs, such organization occurs less often in other lemurs. Crowned lemurs (*Eulemur coronatus*) and Sanford's lemurs (*Eulemur fulvus sanfordi*) share core areas and form polyspecific associations in the northern Madagascar humid forest of Mt. d'Ambre. Neither species exhibits canine nor body size dimorphism. During a thirteen month study both species formed similar multimale/multifemale groups (1:1.1-1.4 sex ratio, avg.grp.size=5.4-7.7). Both sexes emigrated. Although both species lived in spatially cohesive groups, one crowned lemur group subgrouped significantly more time daily than did the other ( $\Delta 52.1\%$ ,  $p<0.05$ ). The average daily distance between focal animals and nearest neighbors did not differ significantly between the species (Crowned: 1.54-1.99m; Sanford's: 1.36-1.58m;  $p>0.05$ ). For both species, neither sex had prioritized access to resources, routinely lead group movement, nor lead group defense. Agonism occurred only once daily per focal animal, usually in the contexts of sleeping and grooming. Crowned lemurs responded agonistically to intragroup agonism; males often withdrew from male-initiated agonism. Sanford's lemurs withdrew from intragroup agonism; males often simply did not respond to agonism. Dominance did not readily appear within groups of both species. These results differ from initial reports at other sites, and point to remarkable within-species behavioral variation. Differences in these species' social organization may relate to resource distribution and individual study subjects.

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#### Peopling of the Pacific: resolving the controversy.

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For the past decade, the genetic evidence concerning the origins of Polynesians and their relationships to Island Melanesians and Southeast Asians has been contradictory and controversial. The mitochondrial DNA evidence has suggested the (maternal) ancestors of Polynesians primarily derived from Aboriginal Taiwanese populations (~3,500 YBP), and moved rapidly through Island Southeast Asia and Melanesia, with little intermixture with local populations there, to settle the formerly uninhabited islands of the central Pacific. On the other hand, the Y-chromosome evidence indicated extremely weak (paternal) ties between

Polynesians and Aboriginal Taiwanese or Southeast Asian populations, but suggested instead that the Polynesians derived primarily from Island Melanesian populations.

Our survey of mitochondrial DNA, Y-chromosome, and over 600 short tandem repeat polymorphisms and 200 insertion-deletions from over 40 Pacific populations indicates Polynesians have their genetic origins to both Melanesian and Taiwanese (Southeast Asian) populations in significant degrees. In Island Melanesia, there is a small but clear ancient genetic footprint in certain Oceanic-speaking populations (i.e., linguistically related to Polynesian). The survey results underscore the extraordinary diversity of Island Melanesian populations from one language group to another, and from island to island. This is the result of the small sizes of the populations and the very long extent of modern human settlement there (over 30,000 years).

Supported by grants from the National Science Foundation, Wenner-Gren Foundation, National Geographic Exploration Fund, and the National Institutes of Medicine (to the Marshfield Clinic).

#### **Ecogeography of cranial volume in *Macaca fascicularis*.**

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At least since Darwin, some biologists have noted that human brain size increases with latitude, usually for adaptive intelligence. Recently, Rushton stated the hypothesis as K-selection. Data from nearly ubiquitous Asian macaques are used to test this hypothesis. Fraught with inadequate subadult representation and intolerance or obstruction from university colleagues, this preliminary study only examines data from 500 specimens of *Macaca fascicularis*. Data included cranial volume and external measurements. Limited museum somatic data required a facial index as body size proxy. From the equator to 18.3N male brain size varied clinally more than 7cc, or about 10%, with most *t*-tests having <0.01 to <0.001 significance levels. Gradients sometimes were comparable for elevation or even greater on oceanic islands.

There also appear to be systematic growth variations. Three sequential, equatorial age classes showed no significant brain differences; at higher latitudes or altitudes, these differences ranged to *t*-values of 6.69! While complicated by seasonal mating, this implies delayed growth with latitude. Correspondingly, somatic growth shows steeper slopes of male adolescent growth spurts; even females slightly demonstrate apparent catch-up growth. Both growth trajectory variations suggest equatorial precociality and increasing altriciality with latitude perhaps in direct response to increased seasonal cycles, rather than intelligence for seasonal planning. Among macaque species, moreover, the equatorial

Sulawesi species have very large cranial capacities and abrupt male growth spurts, but brain growth is still precocial. Clearly, there is need to tease many independent variables apart with more data.

Appreciation is extended to the collection managers at the A.M.N.H., M.C.Z., U.S.N.M., and Field Museum.

#### **Late Miocene Cercopithecidae from the Middle Awash, Afar, Ethiopia.**

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A sample of cercopithecoid fossils was recovered from the late Miocene sediments of the Western Margin and Central Awash Complex of the Middle Awash. A detailed description of this material is currently underway. At least three, and possibly four, species are present. Specimens from the Kuseralee Member of the Sagantole Formation are attributed to both *Pliopapio alemui* and *Kuseracolobus aramisi*, and a yet unnamed larger species of colobine. The first two taxa were first described from the 4.4 Ma sediments of the Aramis Member. Fragmentary fossils were also recovered from the Asa Koma Member of the Adu-Asa Formation. These are tentatively allocated to *K. aramisi*, *P. alemui*, and a larger colobine. A species smaller than either *P. alemui* or *K. aramisi*, which cannot be identified to subfamily, is also present, represented by a single premolar. No postcrania were found directly associated with any of the cranial material, but a few elements can be assigned to cf. *P. alemui* and cf. *K. aramisi* based on a combination of size and shape. Their functional implications are considered. This sample is important as late Miocene cercopithecoid fossils are rare in sub-Saharan Africa, and it adds considerably to known diversity.

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#### **Behavioral ecology of two Barbary macaque groups in a highly anthropogenic environment in Gibraltar.**

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The Barbary macaques of Gibraltar (*Macaca sylvanus*) have a history of interaction with humans. Over 230

macaques reside in the Upper Rock Nature Reserve and portions of the population have been interacting with humans on a daily basis for over 50 years. Here we report basic ecological and behavioral patterns from over 500 hours of observational data gathered during two field seasons (2004 and 2006), with a focus on two of the six groups in the population. The two groups, Ape's Den group (AD) and Prince Phillip's Arch group (PPA) have approximately 35 and 60 individuals respectively, range over 3.4 and 7.2 hectares, and interact with tens of thousands of humans annually. The larger group (PPA) is partitioned into two minimally overlapping subgroups and the smaller group (AD) experiences range overlap and conflict with a neighboring group (formerly a subgroup). Although they are provisioned by management staff and tourists nearly one quarter of the feeding observations in these groups come from over 32 species of wild plants and insects, with immature macaques foraging on non-provisioned vegetation substantially more than adults. While hundreds of humans are present within the groups' ranges on a daily basis, approximately 88% of all observed interactions are between macaques only. Both macaque-macaque and macaque-human interactions are predominantly affiliative, but aggression does occur. However, physical aggression resulting in wounding, is extremely rare in both intra- and interspecific interactions. These macaques overlap with multiple mammalian and avian species with relationships ranging from tolerance to commensalism to conflict.

#### **Coca chewing and social inequality in the Moche Valley, Perú.**

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The Moche of north coastal Perú were among the earliest New World state societies. Prior to the establishment of the Southern Moche state (AD 200-800), a series of less hierarchical polities were present in the valley. Moche iconographic images depicting elites chewing coca leaves suggest that the use and control of coca were important loci of power and thus were central to the development of social inequality.

Coca chewing is associated with alveolar resorption and carious lesions of the exposed tooth roots because of the stimulant qualities of coca and the corrosive nature of the lime with which the leaves are chewed (Langsjoen 1996; Indriati 1997; Indriati and Buikstra 2001). Leaf fragments can also become embedded in dental calculus. The link between coca chewing and social inequality was explored by examining the dental remains of 288 adults excavated from the site of Cerro Oreja, the political center of the Moche valley prior to and during state development.

Although there was no clear indication of status differences in coca use at Cerro Oreja, a significant decrease in coca use was found

early in the sequence. Furthermore, during the period of state consolidation, female use of coca continued to decline while male use increased. These findings suggest that control and use of coca were important elements in state formation. Additionally, it appears that the creation of gender hierarchies provided the basis for the development of social inequality in the Moche valley.

**Multivariate studies of cranial form: the impact of Howells' research on defining *Homo sapiens*.**

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In his famous trilogy of Peabody Museum monographs, WW Howells quantified modern human cranial variation. His 1973 discriminant analysis revealed important differences between groups in cranial breadth, facial height, and prominence of orbital margins. Factor analysis determined that similar measures of the face and vault contribute heavily to within group variation, so population differences are an extension of individual differences. This worldwide sampling allowed Howells to set limits to human variation and describe its patterns. His 1989 book searched for distinctions among 28 populations representing major geographic regions. Far Eastern people exhibit facial flatness, Europeans show expanded vaults, and Africans possess narrower skull bases. However, the differences are relatively small. A key discovery is that modern humans are homogeneous in cranial form. This constellation of morphologies cannot accommodate skulls older than ca. 35,000 years. The 1995 monograph used recent crania as a framework for classifying test specimens of Pleistocene antiquity. Many are distant from all moderns, and Neanderthals and African "archaics" are quite off the map.

In our view, these findings underpin and strengthen current views regarding modern humans as a distinct species. Howells' 28 regional populations clearly stand apart from ancient specimens. Certain later Pleistocene robust skulls are probably also "modern," but it is not possible to trace our roots much earlier. This evidence is consistent with a recent origin for our species, and there is no morphological basis for recognizing intraspecific grades. In important ways, Howells' analyses anticipate later work emphasizing cranial form in definitions of *Homo sapiens*.

**Demographic simulations of the admixture between foragers and farmers in central European Neolithic.**

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Although it is generally accepted that farming spread into central Europe from the Near East (5700-5500 BC), disagreements prevail about the relative contribution of newly arriving farmers of Linearbandkeramik culture (LBK) and indigenous foragers to the formation of farming communities. Although the problem of relative importance of population movement versus cultural diffusion has been approached from various positions, little attention has been paid to demographic modeling.

In our study, demographic simulations were performed to assess the demographic conditions that would allow the LBK farmers spread across central Europe without any admixture with Mesolithic foragers. We constructed a stochastic demographic model of the changes of farming population size. Model parameters were constrained by the data from human demography, archaeology, and human ecology.

Results of our simulations show that the level of LBK population growth necessary for the colonization of central Europe without admixture with foragers is beyond the potential of human populations. The colonization would be possible if (1) the LBK spread took more than 200 years, (2) population density decreased during this process to less than 50%, or (3) more than 65% of women would survive to mean age of childbearing. These results contradict current archeological and demographic models. In conclusion, our study supports the view that the foragers significantly contributed to the spread of farming in central Europe.

**Experimental field study of handedness in wild tufted (*Cebus nigritus*) and white-faced (*Cebus capucinus*) capuchins: Evidence for individual and species differences.**

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In this field investigation we used an identical experimental research design to compare the degree to which wild capuchins in Brazil and Costa Rica exhibit laterality or handedness during visually-directed tasks that required reaching to remove a large leaf covering a food reward, grabbing the food reward, and manipulating a tool (pushing or pulling a wooden dowel) in order to obtain access to a hidden or embedded food reward. Both handedness and tool use have been associated with hemispheric specialization in humans.

The experimental design involved the construction of a series of feeding platforms located within the home range of our study groups. In a series of experiments, platforms

contained either real or sham bananas concealed by a single large leaf. Olfactory cues were equalized between reward and nonreward platforms. In the tool use experiments platforms contained a plexiglass box with bananas inside. Three of eight white-faced capuchins and five of seven tufted capuchins exhibited a significant hand preference during individual tasks, but there was no evidence of a consistent individual preference across all tasks. Population level handedness was evaluated by calculating a handedness index (HI) for each individual. White-faced capuchins did not show population level handedness in any task, whereas tufted capuchins showed a significant bias toward the use of the right hand in one task only (removing a leaf,  $t_{(7)}=4.153$ ,  $p=0.0043$ ). The strengths and weaknesses of using capuchins as a model for examining questions of handedness and tool use in humans and apes are discussed. Funded by a grant provided by the University of Illinois.

**The incomplete juvenile: cranial vault thickness as an aging technique for juvenile skeletal remains.**

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An age dependent, clinically normal reference database for cranial vault thickness (CVT) of juveniles has not been established in the anthropological literature. As part of an ongoing study in preparation, CT data were collected from juvenile (0-15 yrs) crania from the Smithsonian Institution National Museum of Natural History (NMNH) and the Bosma Collections, held at Penn State University. The NMNH sample includes dental- and long bone-aged archaeological Native North and South American, African American, and modern European juvenile crania (N=100); the Bosma sample contains chronologically- and developmentally-aged modern juveniles (N=30). Crania were scanned using the NMNH Siemens Emotion CT scanner (slice 1mm interpolated at 0.5mm, medium sharp algorithm, mAs 83, voxel 0.375x0.375x1mm). Triangulated CVT measurements were taken within 1cm of easily identifiable points on the parietal, at Bregma and the parietal eminence. Initial results indicate that CVT can be used as a predictor of developmental age in human juveniles ( $r^2=0.769$ ;  $p<0.001$ ).

Pragmatically, caliper measurements can be used as a proxy, enabling aging of complete and incomplete crania given presence of landmarks. CVT is most salient for age estimation of highly incomplete and poorly preserved juvenile remains typical of archaeological and forensic contexts, as well as adding to the arsenal of standard aging techniques for more complete remains.

Additionally, it may prove useful for paleodemography to improve the age profile of past populations as well as a standard reference of CVT to aid in the differential diagnosis of pathological conditions such as scurvy and anemia.

**A practical method for estimating age-at-death through quantification of changes in the chest plate.**

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Age-at-death estimation from the sternal rib is a common technique in physical and forensic anthropology. In forensic settings it often requires removal of soft tissues to expose the diagnostic areas. Laboratory processing is time consuming and sometimes problematic, often requiring permission from the appropriate agencies and legal representatives.

McCormick (1988) proposed an alternative methodology not requiring soft tissue removal, based on the assessment of costal cartilage ossification from radiographic chest plates. Although this method can provide reliable age estimates, it is difficult to replicate, and may be subjected to high inter-observer errors. Barres (1989), proposes a similar but more simplified radiologic technique, following a regression approach. Still, inter-observer error may be affected in this second method by its dependence on a complex, not always clear, photographic template, and a lack of written descriptions, making consistent character-state identification difficult.

The present study tests the accuracy of the Barres (1989) method, and proposes more precise definitions of photographic templates and trait descriptions, aimed at reducing inter-observer error and increasing replicability. The comparative sample consisted of 105 chest plate radiographs from males and females, collected from autopsies performed at the Broward County Medical Examiner's Office, Florida. Following independent examination by each author, new diagnostic photographic templates and written descriptions were proposed and tested. Overall, the Barres (1989) method showed to be a simple technique which can be easily applied in forensic settings, when clearer standard photographic templates and more precise trait definitions are provided.

**Feasting on the dead? Butchery of humans at Domuztepe, a late Neolithic settlement in southern Anatolia.**

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We report on the analysis of human skeletal remains recovered from a pit containing over 10,000 human and animal bone fragments at Domuztepe, a large

Neolithic site in south central Turkey. The presence of distinctive painted pottery, round structures and stamp seals in strata dating to between ca. 5700 and ca. 5450 BC (calibrated) demonstrates strong cultural ties with Halaf peoples, the early agriculturalists who practiced dry farming and herding throughout the region of ancient northern Mesopotamia. Taphonomic analysis of the approximately 3000 identifiable human bone fragments (MNI = 38, representing both sexes and all age categories) indicates that thorough corpse processing, possibly accompanied by intentional killing and cannibalism, preceded deposition of the fractional and fragmented remains. Evidence of these behaviors includes: 1) blunt force trauma to the head, abundant cutmarks, percussion marks, impact fractures, and thermal damage to human bones; 2) commingling of human and processed animal bones (NISP ~3700); 3) pit stratigraphy indicating a short deposition period; and 4) recovery of a ceramic sherd likely depicting some aspects of the butchery activities. We explore explanations for this dramatic event and its significance as an indicator of emerging Halaf social complexity in the Late Neolithic.

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**New primate tali from the middle Eocene of Asia.**

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Joint field expeditions by the Institute of Vertebrate Paleontology and Paleoanthropology (Beijing) and the Carnegie Museum of Natural History (Pittsburgh) have recovered more than sixty primate tarsals from the Shanghuang (China) fissure-fillings, dated to approximately 45 mya. We described four haplorhine morphological varieties in 2001. Here we describe three additional specimens. Two are estimated to come from 40 g primates morphologically similar to North American omomyines. These two specimens differ from previously figured IVPP V 11857, a more anaptomorphine looking talus. The third specimen is the smallest primate talus ever reported estimated at 17 g. It differs from both the anaptomorphine and omomyine types, and shares some similarities with *Necrolemur*. Lastly, we comment on the morphological diversity of tarsals at Shanghuang and its implications for haplorhine evolution.

**Plantar fascia micro-architecture at the ball of the hominoid foot.**

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Previous studies of human and great ape feet have focused largely on gross musculoskeletal contrasts, but very limited exploration has been directed at the soft tissues of the plantar sole pad. Bipedal locomotion imposes peak compressive and shear forces on these soft tissues of the human foot. The skeletal framework creates a longitudinal arch with an adducted hallux that concentrates peak plantar pressures beneath the heel and the ball, or thenar region. In response to these peak pressures, the tissues of the thenar region of human foot have adapted by increased thickness and more complex connective tissue macro-architecture in contrast with the great ape foot, as demonstrated previously (Bauer and Meldrum, 2005). Here we examine the micro-architecture of the thenar region of the hominoid foot, contrasting the features associated with the uniquely adapted human ball. Full thickness samples of the plantar superficial fascia were excised from the balls of cadaveric human, and cadaveric captive chimp and gorilla feet (male and female). The tissues were thin-sectioned and differentially stained using a Mason's trichrome method for visualization of general morphology and by Van Gieson's methods for elucidation of collagen and elastin fibers. A Silver impregnating stain is also employed to reveal density and distribution of sensory nerve endings within the thenar region. The architectural morphometrics determined also included density, distribution, and orientation of elastin and collagen fibers, thickness and orientation of fascia, and differentiated area of stratified and compartmentalized adipose tissue.

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**Breathing life into the study of the dead: a Maya example**

Pamela L. Geller. American University

Elision of the individual in many bioarchaeologists' studies results from limited research questions and a reticence to integrate social theories. Accordingly, much about the past goes unexplored. Here, I draw on theories that connect identity, personhood, and corporeality in order to reconstruct the life history of a pre-Columbian Maya individual. Bioarchaeologists have illuminated the lives of charismatic individuals who have significantly impacted the larger populace. I, however, attend to the life of an individual from a seemingly marginal locale in Belize, who has much to reveal about Maya practices and beliefs linked to medicine and social interactions within the local community.

**Cracking the color code: What information male color might convey to female rhesus macaques (*Macaca mulatta*).**

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Experimental evidence shows that male facial coloration is salient to female rhesus macaques (*Macaca mulatta*). To address what color conveys, we examined whether male sexual skin coloration changes in 19 free-ranging adult rhesus macaques were related to changes in social interactions with females throughout a mating season. Multiple P-Type principal components analysis indicated that three pairs of color components co-varied over time: (1) facial saturation and lightness, (2) scrotal saturation and lightness, and (3) facial and scrotal hue. While facial saturation-lightness showed temporal stability ( $b=.009$ ;  $SE_b=.009$ ;  $\beta=.055$ ;  $p=.287$ ), scrotal saturation-lightness ( $b=-.041$ ;  $SE_b=.009$ ;  $\beta=-.240$ ;  $p<.001$ ) and facial-scrotal hue ( $b=-.030$ ;  $SE_b=.009$ ;  $\beta=-.175$ ;  $p=.001$ ) decreased. Color factors were not related to age or dominance rank. Growth curve analyses indicated that high baseline facial saturation-lightness was related to fewer muzzle-up displays; a threatening behavior, directed toward females ( $\beta=-.202$ ,  $p=.033$ ), and more time spent in close proximity to females ( $\beta=.812$ ,  $p=.035$ ) over time. High baseline facial-scrotal hue was related to less non-contact aggression received from females ( $\beta=-.264$ ,  $p=.024$ ) throughout the mating season. Higher facial-scrotal hue throughout the mating season was related to less time spent in close proximity to females ( $\beta=-.725$ ,  $p=.025$ ) and more muzzle-up displays ( $\beta=.166$ ,  $p=.035$ ) over the study period. As proximity to females was associated with sexual activity, these results suggest that higher facial saturation-lightness is less threatening and perhaps more attractive to females; whereas higher facial-scrotal hue is more threatening, and perhaps less attractive to females.

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**Cranio-mandibular morphology supporting the molecular African papionin clades and the identification of "*Cercocebus*" *antiquus*.**

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Previous studies have noted skeletal and dental differences supporting the molecular African papionin clades. Documented postcranial and dental characters are congruent with molecular data and thus support a close relationship between *Cercocebus* mangabeys and mandrills (*Mandrillus*) on the one hand and *Lophocebus* mangabeys with baboons (*Papio*) and geladas (*Theropithecus*) on the other. Most of these characters, however, are postcranial and difficult to assess in the fossil record because associated material is rare, especially for the African papionin fossil record. In order to assess the African papionin fossil record and determine the evolutionary history of this group, cranial characters must be relied on most heavily.

Here, a set of cranio-mandibular morphologies is documented that broadly support the molecular African papionin clades (i.e., *Lophocebus/Papio/Theropithecus* vs. *Cercocebus/Mandrillus*). These morphologies include relative premolar size, temporal line shape, nuchal line shape, nasal bone position, lingual mental foramina position, maxillary and mandibular fossae development, and petrous process orientation. Furthermore, these characters are then used to identify a series of fossil crania from Taung previously referred to as "*Parapapio*" *antiquus* as probable representatives of the *Cercocebus/Mandrillus* clade, a taxon here termed "*Cercocebus*" *antiquus*. Paleocological reconstructions suggest that an ecological relationship between *Cercocebus* mangabeys and African crowned eagles has existed for approximately the last two million years. In addition, the occurrence of a *Cercocebus* ancestor in South Africa suggests a much larger distribution than the extant genus currently occupies and suggests that *C. torquatus* retains the most primitive morphology among the extant *Cercocebus* mangabey taxa.

This work was generously supported by a research grant from the L.S.B Leakey Foundation as well as a Graduate Council Fellowship from Stony Brook University.

**Hunting by chimpanzees at Kanyawara and Gombe: a test of the 'meat-for-allies' hypothesis.**

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The 'meat-for-allies' hypothesis proposes that one incentive for hunting by chimpanzees (*Pan troglodytes*) is to strengthen male alliances by sharing meat. This suggests that when males encounter a prey group, they should be more likely to hunt when they are in the presence of allies. We tested this prediction with > 40 years of

data on the Kanyawara (Kibale National Park, Uganda) and Kasekela (Gombe National Park, Tanzania) chimpanzee communities. Using data on association patterns and coalitions we identified several adult male alliances. We analyzed >1500 encounters with red colobus monkeys (*Colobus badius*) at the two study sites, and used multiple logistic regression to test whether males were more likely to hunt if their ally was present, statistically controlling for party size. Our results show that male-male alliances can be satisfactorily operationalized and persist over the long term, and that their contribution to promoting hunting success is statistically detectable.

**William White Howells: A physical anthropologist in the making.**

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The demise of Earnest A. Hooton after his last class in the spring semester 1954 suddenly vacated the most visible position in American physical anthropology. William White Howells was called, as they liked to say, by Harvard University from his full professorship at the University of Wisconsin to fill this bully pulpit. His death in 2005 ended an expansive association with Harvard—as an undergraduate and graduate student, faculty member for 20 years, and emeritus professor for 30 more. Howells continued the Hooton tradition of encouraging graduate students to follow their own paths in physical anthropology. The many students mentored by Howells easily had interests as diverse as Hooton's students, and remember him as fondly as I found Hooton's did.

Both Howells and Hooton spoke to a general audience as well as academics during their careers, but in different ways. Hooton may have been better known to the public in his day, in part from his mischievous book titles and willingness to contribute something provocative to most any periodical. Howells, on the other hand, produced elegant, accessible books that burnished his reputation as an articulate, evenhanded advocate of anthropology as an encompassing human science.

It is in his research, however, that Howells' ascendancy is secure. He pioneered the use of multivariate statistics in morphometric analysis and left us a legacy of broad interpretations of hominid variation. While doing so he provided us with an enormous cranial measurement database he made freely available, and a career model in which research productivity—*mirabile dictu*—increases with age.

**Skeletal and dental measures relating to the transition from foraging to herding in the Eastern Cape Province, South Africa.**

J. K. Ginter. Department of Anthropology, University of Toronto

2000 BP marks a significant event in South African prehistory: the arrival of herding into areas previously occupied exclusively by foragers. The foraging lifestyle was not completely replaced by herding, but rather continued to exist alongside herding for many centuries. Archaeological, linguistic, genetic, and ethnographic evidence have informed the debate over the mechanisms responsible for the introduction of herding: a migration of people or a diffusion of ideas. Skeletal differences relating to body mass, asymmetry and robusticity, and positional behaviour have been identified in Later Stone Age (LSA) populations inhabiting various parts of the Cape region, but the relationship between foragers and herders has not received much study. In the Eastern Cape, the presence of variation in burial patterns confirms the presence of some herder occupations. This research explores the mechanisms surrounding the arrival of sheep herding in southernmost South Africa from a skeletal perspective. In an attempt to quantify the potential similarities or differences in the skeleton as a whole, craniometric, osteometric, and odontometric data was collected on a sample of 72 radiometrically dated LSA adult skeletons from the Eastern Cape region of South Africa, dating between 8000 BP and 300BP. The results do not provide any solid indication as to the mechanism responsible for the arrival of herding, but do suggest an increase in skeletal variability began to occur just prior to 2000 BP, increasing in magnitude after 2000 BP. The inclusion of additional skeletal information may help to better understand the factors responsible for this transition.

#### **The history of hominin occupation in Central Asia in review.**

M. M. Glantz. Department of Anthropology, Colorado State University.

The timing and pattern of hominin colonization of Asia is poorly understood. Although site distribution provides a general schema of hominin locations, the lack of a well controlled and regionally integrated chronological framework prevents clear resolution of the timing and trajectory of hominin migrations and subsequent colonization of specific regions of Asia. This problem further obscures the ability to understand hominin population dynamics in Asia as well. The purpose of the present study is to examine the degree to which an autochthonous evolutionary trajectory initiated during the terminal phases of the early Pleistocene and extending to the early Upper Paleolithic is supported in Central Asia. Archaeological and human paleontological evidence from the region is reviewed and its character compared to that of the neighboring regions of the Near East, the Altai and China. This review informs a

more detailed analysis of the Central Asian Middle Paleolithic record. Prevailing theoretical models suggest that Central Asia was inhabited by Neandertals migrating from the west to seek refuge from expanding modern human populations during the Middle Paleolithic. Morphological analyses of the newly discovered Obi-Rakhmat hominin and a re-evaluation of the Teshik-Tash child, both sites from Uzbekistan, provide a test of this model. Results indicate that the morphological pattern that typically describes European Neandertals is absent in Central Asia. Although both Obi-Rakhmat and Teshik-Tash express some Neandertal features, their morphologies also suggest some admixture with local populations and/or those migrating into Central Asia from the North and East.

#### **Trauma risk in the neolithic community at Çatalhöyük, Turkey.**

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The Neolithic represents a period of considerable transition in which economies, and social life changed on both local and regional scales. The effect that these physical and social changes may have had on the prevalence and risk of injury is a matter of long standing debate. We suggest an analytical framework for the investigation of skeletal injury in limited and often fragmentary human remains while also introducing some preliminary evidence on the healed infra-cranial fractures identified in the Neolithic skeletal sample from Çatalhöyük, Turkey. The Çatalhöyük skeletal sample is currently comprised of over 200 human skeletons recovered between 1995 and 2006. The site and its associated skeletal sample are important sources of data on early Anatolian agricultural settlements and the people that inhabited them.

Preliminary risk assessment results based on fracture prevalence data and probability models indicate an average of 1.2 bone fractures per individual at Çatalhöyük with an estimated 36% chance of sustaining a least one bone fracture and a 30% chance of never experiencing a fracture. Fractures as events are randomly distributed amongst individuals of the sample. The gross long bone fracture rate is 33.6 per 1000 individuals and when broken down further 24.4 per 1000 females (n = 41 complete long bones) and 15.2 per 1000 males (n = 66). The odds of long bone fracture among Çatalhöyük females are slightly greater than among males but the association is only moderately weak. We conclude that risk of infra-cranial skeletal injury at Çatalhöyük appears to be relatively low and homogenous in the population. Research supported by Social Sciences and Humanities Research Council.

#### **4-dimensional diffeomorphic modeling: A novel approach for investigating human embryonic brain development.**

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Detailed knowledge of human embryonic brain development is of fundamental importance to a wide range of questions from the underlying causes of normal and abnormal neuroanatomical variation to how developmental processes mediate the transformation of brains in evolution. However, the embryonic development of the brain involves complex sequences of tissue growth and movements (morphogenesis) occurring in 4-dimensions (4D) (i.e., in 3-dimensional (3D) space and in time) that have been impossible to analyze rigorously with traditional 2-dimensional (2D) histology-based methods (O'Rahilly and Müller 1999; Yamada et al. 2006).

To overcome these limitations, this project develops a novel methodological approach that synthesizes several cutting-edge computational techniques: (1) digital microscopy; (2) 3D digital reconstruction and de-warping; and (3) 3D diffeomorphic image registration (DIR) with 4D graphical interpolation. An empirically-based pilot model is presented using 5 whole, serially sectioned brains of different stages of development from the Carnegie Collection of Embryology. 2D sections for each brain were digitized, reconstructed in 3D, and de-warped. 3D specimens from one stage of development to the next were registered, sequentially, with DIR (e.g., stage  $i \rightarrow$  stage  $i + 1 \rightarrow \dots$  stage  $i + n$ ). The model provides unparalleled cellular/tissue contrast, 3D and 4D structural quantifiability, and the ability to graphically interpolate the 4D morphogenetic continuity that links successive stages of brain development. This model also provides a novel framework for non-invasive testing of evolutionary-developmental hypotheses, cross-species development comparisons, integration of 3D gene expression models, and exploration of theoretical morphospace via user-defined manipulation of morphogenetic variables.

#### **Handedness and Directional Asymmetry of Lower Limbs: Testing the Hypothesis of the Crosse Symmetry Pattern in Articular Dimensions**

Sabrina, AF Gloux, Department of Anthropology, University of Montreal

Directional bilateral asymmetry in human gross skeletal morphology is largely attributable to differential mechanical loading during growth. While much has been done in the way of identifying directional asymmetry in the diaphysis of the upper limb, comparatively little research has



focused on asymmetry in lower limb. In most studies of the lower limb, the crossed symmetry pattern is taken as a premise but has rarely been directly investigated. This research proposes to investigate the hypothesis of a crossed symmetry pattern in humans, more particularly in bone lengths and articular surface dimensions. The sample consists of 86 non-pathological adult individuals from the osteological collections of the Canadian Museum of Civilization. The identification of bilateral asymmetries was first assessed using raw measurements, and only dimensions with significant bilateral asymmetries were kept for analysis. Percentages of Directional Asymmetry (%DA =  $[2*(D - G) / (D + G)] * 100$ ) were calculated for each dimensions and used to test for crossed symmetry (Chi square). Results reveal that 50% of the measurements are significant for directional asymmetry, mostly for the upper limb. For the lower limb, articular surface dimensions are more asymmetric than bone lengths. Upper-limb measurements are consistent with a systematic right-bias, while only articular dimensions of the pelvic girdle and some of the foot bones indicate a systematic left-bias consistent with a crossed symmetry pattern. Only 7 sets of measures out of 15 yielded significant results. Only the shoulder and pelvic girdles revealed crossed symmetry, while the long bones revealed same side asymmetry.

#### **An adaptive perspective on the developmental origins paradigm.**

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The developmental origins (DOHaD) paradigm links environmental cues acting during early life to an altered risk of later diseases including type 2 diabetes, and obesity. The early observations focussed on the relationship between low birth weight and later disease risk leading to the development of the “thrifty phenotype” subsequent data showed that developmental consequences could occur in the absence of fetal growth impairment and that insulin resistance develops well after birth. The preservation of “programming” across species and within the normal range of fetal growth suggests a physiological basis. It is underpinned by epigenetic processes. A consistent feature is that the phenomenon is magnified when there is environmental “mismatch” between early and later life. We propose that the developing organism can make two types of potentially adaptive response – an immediate survival response which may include altered growth and maturation and a predictive response which evolved to tune the phenotype to the anticipated future environment. Mismatch between the early environment cueing these responses and the later environment is more likely when there is faulty transduction of

environmental information by the mother (because of maternal or placental ill health) or because the processes of maternal constraint (which allow humans to survive the developmental bottleneck of birth) limit the environment that can be forecasted and thus make mismatch in an energy rich environment more likely. The mismatch model can explain the greater risk of obesity and lifestyle disease in situations of greater maternal constraint and in populations undergoing rapid nutritional transition.

#### **The relationship of Nubians with their neighbors, the Egyptians.**

By, K. Godde. Department of Anthropology, University of Tennessee, Knoxville.

For decades, Nubian skeletal remains have been examined in order to determine how biological evolution occurred within their population. Nubia was, in part, located in Upper Egypt and extensive contact occurred between the peoples of the area. This study sought to assess the biological relationships between the two populations in order to look at the population history of Nubia and how it relates to Egypt. Data on ten cranial nonmetric traits were analyzed on each of six subpopulations of Egyptians and six subpopulations of Nubians. Mahalanobis D<sup>2</sup> with a tetrachoric matrix was run and a distance matrix was produced. Principal components analysis (PCA) was also conducted and the first two principal components were plotted. PCA revealed that the Egyptian and Nubian groups were separated from one another, but not by a great distance. Analysis of the individual Mahalanobis scores showed there were some Egyptian groups that were similar to Nubian groups. However, the overall trend was for Egyptian and Nubian groups to be less related to each other than to groups within their population. These results were consistent with the “in situ” hypothesis (noted by Adams 1968, 1977 and proposed by Carlson and Van Gerven 1979) where Nubian biological evolution occurred within the population and was not a result of contact with other population groups. However, these findings are specific to these particular subgroups and caution should be used when making statements about these populations as a whole.

#### **In memoriam: The megafauna of Madagascar.**

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One of the most dramatic of late Pleistocene and Holocene extinction/extirpation events occurred on the island of Madagascar. At the time of human arrival, the primate communities of Madagascar were ecologically and taxonomically diverse. There were eight families of Malagasy lemurs; three have disappeared completely, and an additional two have lost their largest-bodied members. This paper examines the broad ecological consequences of the extinctions – particularly the question of the existence on Madagascar today of ecological anachronisms (large-seed trees with adaptations for endozoochory, but no extant disperser). Which plant species are likely to be suffering most from recent faunal extinctions, and which of the megafaunal species were likely most critical to dispersing those plants? Ecological investigations of the dispersal and recruitment patterns of Madagascar's large-seeded flora are needed to better address the first question, but it is evident that some large-seeded trees (certain borassoid palms, certain baobabs, *Dilobea*, etc.) may fit the bill. We use a variety of tools (including dental microstructure and microwear analysis, stable isotope analysis, fecal pellet analysis, etc.) to reconstruct the life histories and lifeways of the extinct species, and thus address the second question. Within the Order Primates at least, the benign-frugivore guild on Madagascar was not much larger in the past than it is today, including only two additional members (*Pachylemur insignis* and *P. jullyi*). However, there is excellent reason to believe that these species played a pivotal role in large-seed dispersal, and that their disappearance is having an adverse effect on Madagascar's forest regeneration.

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#### **Dental pathology of the Jemez region of New Mexico.**

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The decades at the end of the thirteenth century and throughout the fourteenth century were characterized by massive depopulation and migration occurring throughout New Mexico. It was during this time of migration that the Jemez region first became populated. The Jemez provided a refuge with a wide variety of easily accessible and fertile natural resources. Consequently, it may be argued that the people in the Jemez region were better off than many of their peers elsewhere in the Southwest. It is the purpose of this research to examine the dental pathology of the prehistoric Jemez people in order to assess their health relative to neighboring areas in the Southwest. Frequencies of dental caries, abscesses,



enamel hypoplasias and skeletal pathological conditions among prehistoric Jemez human remains (N=260), dated between AD 1300-1450, were compared to neighboring sites in order to elucidate Jemez dental health relative to other Southwestern groups. Additionally, odds ratio analyses were carried out between skeletal and dental pathological conditions to assess the relationship between dental and skeletal pathological conditions. The most common pathological condition among the Jemez is dental caries, followed by abscesses, enamel hypoplasias and skeletal deficiencies. The results demonstrate that the prehistoric Jemez inhabitants did not deviate significantly from other Southwestern groups. Furthermore, the presence of skeletal pathology does not increase the probability of a co-occurring dental pathology, with the exception of dental caries. Consequently, this provides evidence that the Jemez were in relatively good systemic health despite the dental insults related to a cariogenic rich diet.

### The Phylogeography of Haplogroup N1a

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Recent studies have revealed a complex geographic distribution of haplogroup N1a. This rare and distinctive lineage is widely distributed across Eurasia and Africa, but always found at very low frequencies. However, despite its rarity, the genetic diversity within N1a has remained relatively high ( $h=0.9605$ ). The reduced median network of N1a haplotypes not only reflects this level of diversity, but also exhibits several relatively well-defined branches. The distribution of N1a is intriguing because of revealing previously unrecognized connections between populations. What makes N1a even more interesting is the prevalence of this lineage in ancient European populations. Haak et al. (2005) found that 25% of their European Neolithic samples belonged to N1a and dated to ~5000 BCE, whereas the frequency of this lineage in contemporary Europeans is only ~0.2%. In addition, an Iron Age skeleton from Kazakhstan had an N1a haplotype, suggesting the existence of this lineage in the Altai Republic in ~5000 BCE (Ricaud et al. 2004). Indeed, we found several haplogroup N1a mtDNAs in indigenous Altaians and Altaian Kazakhs. To further elucidate the phylogeography of this lineage in Central Asia, we sequenced the whole mtDNA genomes of our N1a haplotypes, and analyzed the resulting data with several quantitative methods and simulation programs to estimate their expansion times and spatial distribution in Eurasia. Our findings suggest that there are two well-defined sublineages within N1a, and that the dispersal of this haplogroup could be associated with the Neolithic expansion and with prehistoric

interactions between Central Asian and European populations.

### Two and Three Dimensional Analysis of Cortical Bone Microstructure from the Human Juvenile Mid-Shaft Femur

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Little is known about microstructural variability in human bone during growth and development. A better understanding of the accrual of bone during childhood is critical for understanding resultant adult structure and properties, as this early bone development has lasting biomechanical effects throughout life. We undertook an exploratory study using a combination of 2D light microscopy and 3D micro-CT techniques to visualize histological organization and vascular spaces in an autopsy sample (n=10) consisting of complete mid-shaft femur blocks of individuals ranging from age 1 – 19 yrs. Blocks (each ~5mm in thickness) were embedded in PMMA, surface polished and imaged in polarized, reflected light microscopy (LM) using a 5x objective lens. Blocks were then scanned in their entirety using MicroCT (Skyscan 1172) at a 15µm voxel size.

LM observations indicate posterior cortical drift in the toddler group vs. a pattern of radial expansion later in childhood. Even into the late teenage years, regional variations in the vascularity and organization of primary bone (including areas with a fibrolamellar organization) are evident, suggesting regional and episodic variability in growth rate. Micro-CT images highlight an abundance of radially oriented vascular canals at forming periosteal and endosteal surfaces, and a clear demarcation in vascular canal size and orientation between primary vs. secondarily remodeled areas. Early teenage samples were characterized by a high degree of intracortical remodeling and resultant porosity, which vary based on anatomical location. These results have significant implications for human life history studies, as well as for our interpretation of microstructural variability in adults.

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### The Development of Craniofacial Sexual Dimorphism in Humans

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This study identifies metric trends associated with sex differences in the growth

and development of the human craniofacial skeleton. Lateral cephalometric radiographs housed at the University of Michigan School of Dentistry were randomly selected to create a cross-sectional sample. The sample size consisted of 598 manually traced cephalometric radiographs representing juveniles ages 5-16. From the tracings, eight craniometric landmarks were identified. From these landmarks, 37 linear and angular dimensions were measured. Metric data collected from this sample were subjected to a multivariate canonical discriminant function analysis to identify sex differences in human craniofacial growth.

The results of this investigation demonstrate the existence of sexual dimorphism in the growth of the human craniofacial complex. Sex differences are primarily allometric and derive from heterochronic influences. The pattern of sexual dimorphism presented in this study is the product of an early culmination of female craniofacial growth and of an extension of male craniofacial growth.

Craniofacial sexual dimorphism results from differences in ontogenetic developmental pathways, in which size is the primary factor influencing sex differences. Early in development, sex differences are most evident in the neurocranium and result from variation in brain growth. Consequently, males tend to have a longer and taller neurocranium. Puberty marks a transition from advanced female growth to advanced male growth. Males experience an advanced rate of craniofacial growth, in which secondary sexual characteristics develop in the face. In general, variation in the onset and cessation of growth produces craniofacial sexual dimorphism.

### Human Origins Database (HOD): managing published data and specimen information for fossil and comparative collections.

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Data management is becoming increasingly important in comparative analyses of fossil hominins, including managing published measurement data and collections information. We address two issues in particular. First, comparative analyses are often hindered because of the time it can take to track down all of the sources of data. Second, determining whether a particular museum collection has enough material to merit a visit is difficult without information about the presence/absence and the condition (e.g., articulated, free of connective tissue, post-mortem breakage) of particular skeletal elements, and oftentimes the only available information is the presence or absence of a skin, skull, or skeleton. We have developed a flexible Access database in which we have entered contextual information and published data for the fossil

hominins from the Turkana Basin and for *Paranthropus boisei* hypodigm, and detailed specimen information for the great ape collection at the Smithsonian's National Museum of Natural History. So, for example, a query can be run which produces all the fossil hominin specimens with a particular measurement (e.g., third mandibular molar crown area) for a particular set of taxa. We can also search the database for all specimens (fossil and extant) for which a particular element is present (e.g., talus of either side) and provide information on the condition of that element as well as any age-related specimen data (e.g., tooth eruption, degree of epiphyseal fusion at long bones). A copy of the database will be available for demonstration.

#### Functional morphology of the primate cochlea.

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The mammalian cochlea functions both as an acoustic transducer and a hydromechanical frequency analyzer. Because the cochlea is housed in a bony cavity within the petrosal, its gross dimensions can be quantified using CT data. Here we evaluate the functional relationship between cochlear volume, cochlear shape, and hearing abilities in primates. Cochlear volume (CV) and shape were measured from micro-CT scans of 33 primate species. A cochlear shape index (CSI) was calculated as:  $100 \times (\text{Cochlear Height}/\text{Cochlear Width})$ . We compared CV and CSI with hearing parameters extracted from published audiograms ( $n=10$  species). Regressions of CV on high frequency limit (HFL) and low frequency limit (LFL) of hearing were significant at  $p < 0.05$ . Comparable results were obtained for CSI. However, body mass explains a significant amount of the variation in CV (80%), CSI (47%), HFL (46%), and LFL (71%). When partial correlation analyses were used to factor out the influence of body mass, a significant result was obtained for CV and HFL ( $p < 0.05$ ). This finding indicates that as cochlear volume increases, the high frequency limit of hearing tends to decrease irrespective of changes in body mass. These results suggest that cochlear volume may constrain the high frequency limit of hearing in primates, perhaps due to a resonant effect of cochlear fluid mass. In addition to this functional relationship, we also observed phylogenetic differences in cochlear shape. Specifically, lorisiforms tend to have higher CSIs than lemuriforms and haplorhines of comparable body mass.

#### *Hapalemur* on the edge—at Tampolo Forest Station, eastern Madagascar.

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In July, 2005, we surveyed Tampolo Forest Station on Madagascar's east coast. This 500-ha. dense rainforest is divided into transects of approximately 500 square meters, with one wide main path and numerous, narrower side paths. During survey walks of all paths, the majority of sightings of *Hapalemur griseus* (15/18) occurred on the main path, rather than on the more cryptic side paths. The main trail is more dangerous for such small-bodied lemurs (700-1000gms), as they are more vulnerable to predation in this exposed area, yet *Hapalemur* was primarily observed feeding on bamboo both terrestrially and arboreally at the edge. To assess whether an edge effect existed, with greater occurrence of bamboo on the main path edge, we measured bamboo density in 2 meter-long samples at the edge, and at 2,10,20 and 30m in from the edge in areas where *Hapalemur* were sighted. No significant difference existed between frequency of bamboo growing along our main trail edge samples compared with edge samples from side trails ( $p=0.39$ ), nor were there differences in density of bamboo plants found along our 2 meter samples at 2,10,20, or 30m inside the forest from the main trail compared with 2,10,20, and 30m in from the side paths (2m,  $p=0.28$ , 10m,  $p=0.31$ , 20m,  $p=0.35$ , and 30m,  $p=0.78$ ). Since bamboo was not more abundant along the main path edge, *Hapalemur* may have spent more time on main edges for reasons of thermoregulation, as July is the coldest month in this area, and the main path received more sunlight.

#### Testing the resource dispersion hypothesis as a socioecological model for the folivorous primate, *Hapalemur griseus*.

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Although the Ecological Constraints Model is the prevailing socioecological model used to explain primate social structure, this model often fails to explain group size in folivorous primates. Alternately, the Resource Dispersion Hypothesis (RDH) states that if resources are heterogeneously distributed in time and space, then territory size for a breeding pair may be large enough to sustain additional individuals at a cost lower than expected. Data collected over 12 months (1277 hours) on three groups of *H. griseus* in Ranomafana National Park, Madagascar were used to test this model. I found good preliminary support for the major predictions of the RDH: 1) There was no correlation between group and home range size. 2) Food items varied in their spatial and temporal availability. The availability of food sources such as fruit and leaves varied throughout the year but the dietary staple of bamboo was readily available year-round. This particular resource may be thought of as renewable and

non-depleting. 3) The group inhabiting the home range with the greatest botanical diversity, measured by the number of tree species, had the largest group size. 4) There is evidence for female dominance, dominance relationships within the sexes, and variation in group spread. For example, on average individuals maintained proximity ( $< 5m$ ) only about 50% of the time, and least often while feeding. While feeding, neighbors were further than during resting and traveling. These results illustrate the need for further testing of this model in this species and other folivorous primates.

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#### Hormonal correlates of fatherhood in Jamaica

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Relatively little research has investigated the hormonal correlates of human fatherhood. Through new research conducted in Jamaica, we extend that small literature and situate results in a Caribbean cultural context of fatherhood. We recruited 43 men between the ages of 18 and 38 differing in relationship status. Participants provided minimally invasive biological samples (saliva, finger prick blood spots and urine) for hormone assay. Men also completed questionnaires and engaged in 20 minute behavioral tests (single men resting while fathers interacting with a partner and young child). Preliminary results indicate that salivary testosterone levels differ among groups of men ( $p=0.006$ ), with fathers having lower testosterone levels than single men ( $p=0.002$ ). Salivary cortisol levels did not differ among groups of men ( $p>0.05$ ). Finger prick blood spot prolactin and urinary oxytocin and vasopressin results will be incorporated when assays completed. These results further implicate lower testosterone levels in fathers as a common hormonal correlate of human fatherhood. We discuss results in light of the high prevalence of "visiting" relationships (in which fathers live separately from their partners and children) in Jamaica and the Caribbean generally. Supported by Center for Human and Primate Reproductive Ecology, Yale University.

#### Molecular sequence data from *Treponema pallidum* elucidate the possible evolutionary histories for three human pathogenic subspecies.

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Understanding the timing and nature of the spread of human diseases provides insights on past human activity as well as greater comprehension of the co-evolution of humans and pathogens. Several evolutionary trajectories based on skeletal morphology and archaeological remains have been suggested for the three subspecies of the human pathogen *T. pallidum*: *T. p.* subsp. *pallidum*, *pertenue* and *endemicum*, the causative agents of human venereal syphilis, yaws and bejel, respectively. Under the original Columbian hypothesis, venereal syphilis originated in the Americas and was brought to Europe by returning explorers, while an alternative Columbian hypothesis suggests that syphilis evolved *in situ* after its introduction to Europe. The Pre-Columbian hypothesis suggests that all treponemal diseases evolved outside the Americas but were diagnosed incorrectly. Finally, a Unitarian hypothesis suggests that the three subspecies are environmentally mediated variants of the same disease.

We performed phylogenetic and AMOVA analyses to determine the evolutionary relationships among the three subspecies of *T. pallidum* using over 10 kb of sequence data from six genes (*tpcC*, *D*, *G*, *I*, *J*, and *K*). The classification of the human treponemes into three distinct subspecies is supported by significant among-subspecies variation at several loci in the AMOVA and generally high bootstrap values for monophyletic subspecies clades. Within *T. p.* subsp. *pallidum*, numerous gene conversion events are detected, which is inconsistent with a very recent origin of this pathogen. Distinct subgroups are observed within this subspecies, which may correspond to geographic or historical separations. Thus, molecular data are incompatible with two of the four evolutionary theories and tend to support a relatively concurrent origin of all three subspecies.

#### Metacarpal proportions in *Australopithecus africanus*

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Recently, there has been considerable revision to our knowledge of the anatomical, locomotor, and behavioral characteristics of the genus *Australopithecus*, such as the assertion that *A. africanus* possessed more ape-like, forelimb dominated limb proportions than *A. afarensis*. Here, we test whether the intra-hand proportions of *A. africanus* were similarly ape-like, specifically if *A. africanus* had a short and narrow first metacarpal (MC1) relative to the other metacarpals.

MC1 breadth - geometric mean (GM) of articular and midshaft measurements - was compared to the GM of metacarpals 2-4, and

MC1 length was compared to MC3 length. A randomization procedure imposed sampling constraints on the extant sample, producing composite intra-hand ratios for comparison with the incomplete *A. africanus* fossil record (11 attributed metacarpals). Randomized ratios were not significantly different from actual extant ratios, demonstrating the methodological appropriateness of this technique.

*A. africanus* did not significantly differ from the apes for relative breadth ( $p \geq 0.287$ ) but did significantly differ for relative MC length ( $p \leq 0.028$ ). Conversely, *A. africanus* was significantly different from modern humans in relative breadth ( $p = 0.037$ ), but not so in relative length ( $p = 0.809$ ). *A. africanus* MC1's were thus relatively more ape-like in breadth, while being relatively more human-like in length, consistent with previous work on australopithecine hand proportions. The relatively longer thumb would have enabled opposition of the thumb and fingers, which is critical for precision grips. Nevertheless, the relatively slender, ape-like first metacarpal suggests that *A. africanus* did not place the same mechanical demands on the thumb as later hominins.

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#### Children of God: subadult weaning, mortality, and isotopic associations with monastic diet in Byzantine Jerusalem

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Previous isotopic studies of skeletal remains at the Byzantine (5<sup>th</sup>-7<sup>th</sup> C AD) monastery of St. Stephen's in Jerusalem have examined aspects of adult dietary intake and subadult breastfeeding and weaning patterns. To complement these earlier studies, carbon stable isotope analysis using mass spectrometry was performed on the right femora of infants and juveniles ( $n = 56$ ) to determine  $\delta^{13}C$  values throughout the breastfeeding and weaning process. Like nitrogen, carbon displayed a trophic level effect, peaking at between six to nine months of age with an enrichment of approximately 1‰. The gradual decline of subadult  $\delta^{13}C$  values to adult monk levels after this peak occurred by two to three years of age and suggests that these children consumed a similar,  $C_3$ -based diet to that of the monks and those breastfeeding them.

The biocultural implications of this research are significant in elucidating the presence of children in a monastery. Those breastfeeding the infants shared a diet akin to the monks as inferred from the carbon trophic level effect, indicating that either the mothers of the community or potentially the wet nurses of the monastery ate foods comparable in  $\delta^{13}C$  content to the monks. Thus, these children may either have been cared for in a monastic hospital or orphanage by wet nurses, or they

were raised and breastfed by their mothers in the community and were simply buried at the monastery in proximity to holy figures.

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#### The functional morphology of the bifid cervical spinous process.

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Most textbooks describe the bifid spinous process as a feature of the typical cervical vertebra. Somewhere later they may acknowledge that the cervical spine is not always bifid, and that the two tubercles may be asymmetric. Comparative anatomy reports that the incidence of bifidity is much lower, although not unknown, in non-human primates. A high incidence of bifid cervical spinous processes may be a human characteristic although, because of known racial variation, it may not be a very good one. Yet rarely can one find an attempt to explain the functional basis for this feature. This project explores this question in human anatomy.

The cervical spines of about 50 individuals from the Hamann-Todd collection housed in the Cleveland Museum of Natural History were evaluated using the techniques of geometric morphometrics. That analysis was used to guide observations of human dissections to disclose the relationship of muscular and ligamentous attachments to the shape of the spinous process. Observations from these investigations do not support hypotheses that suggest development (age) or cervical lordosis may be the cause of the bifid spine. Instead, the tubercles appear to develop in response to muscular pull. The incidence of muscular asymmetry in the cervical region corresponds well with the incidence of the asymmetry of the spinous process. It appears that the variation of this bony feature may be the result of variations of cervical muscular anatomy. The question remains, why should there be such wide variations in cervical musculature? The answer to that question will have to be the focus of a future investigation.

#### Genetic variation and the peopling of northeastern North America.

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This study addresses the origins of both Iroquoian- and Algonquian-speakers of northeastern North America using mitochondrial DNA sequence data from modern and ancient populations. Specifically, it tests hypotheses generated from linguistic and archaeological data. The first is whether modern day Iroquois-speakers descended from a group that

occupied their geographic range over the last two millennia or from a more recent immigrant population. The second is whether or not Algonquian-speakers originated in the Pacific Northwest, migrated to a temporary homeland in the Great Lakes region, then split into the different Algonquian-speaking groups of the Northeast.

We sequenced 983 bp of hypervariable regions I and II of the mitochondrial genome from a Canadian group of Mohawk (N=205), who are Iroquoian-speakers. We also sequenced short segments of hypervariable region I from ancient samples from Michigan archaeological sites Juntunen, Bugai, Younge, Fort Wayne Mounds and West Twin Lakes.

Previously, the Mohawk were thought to be genetically anomalous among Iroquoian-speakers, based on haplogroup frequencies determined by RFLP data, with an excess of haplogroup B. Preliminary results from sequence data, however, show haplogroup frequencies more in line with other Iroquois groups (A=0.59, B=0.01, C=0.31, D=0.03, X=0.07). Preliminary data from the ancient Michigan samples show a relatively large percentage of haplogroup X, resembling published data from modern Algonquian-speaking groups.

#### **Hand preference and tool use in captive chimpanzees (*Pan troglodytes*), North Carolina Zoological Park, Asheboro, North Carolina.**

D.M. Griffin, LD Wolfe. Department of Anthropology, East Carolina University

Observations of spontaneous hand preference and tool use on ten female and two male chimpanzees ranging in age from 9 to 37 chimpanzees were made between June-August 2005 in the BB&T Kitera Forest Exhibit of the North Carolina Zoological Park (NCZP). Using focal animal sampling, the chimpanzees were observed for seven predetermined behavioral categories: foraging, eating, contact with glass, manipulate objects, termiting, grooming and carry. Tool use was observed on spontaneous occurrence and the most frequently displayed tool behaviors were ornamentation, container, rake, termiting, paint and weapon. All twelve chimpanzees showed individual hand preference. The Handedness Index (HI) indicates bias for each of the seven categories with five chimpanzees preferring their right hand, five preferring their left hand and two being ambidextrous. The NCZP chimpanzees were also observed engaging in spontaneous tool use using items found within their environment. The study of hand preference and tool use in a chimpanzee population is important because it may indicate cerebral asymmetry. The correlation of hand preference observation with that of spontaneous tool use in a captive population expands the current knowledge available by observing these behaviors in a spontaneous, semi-naturalistic environment.

#### **Comparative forefoot bone architecture in extant hominids.**

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The human forefoot plays an important role during the push-off stage of bipedal gait. However, researchers disagree over the use of metatarsophalangeal morphology to make inferences about foot function in early hominins. Therefore, further research of higher primate metatarsophalangeal joint postures is critical to improving the understanding of early hominin locomotion.

The first purpose of this study is to reconstruct the three-dimensional trabecular bone structure near the metatarsophalangeal joint in order to compare trabecular anisotropy, orientation, and density among extant hominids. The second goal is to use a simple method for measuring dorsal canting of proximal phalangeal bases to test for differences in extant hominid joint orientation.

Three spherical volumes of interest (VOI) were taken along the dorsoplantar axis of epiphyseal regions forming the metatarsophalangeal joints. Preliminary results of the proximal phalanges suggest that trabecular strutting in the dorsal aspect of the human base (n = 10) is more stereotypically oriented along the bone's longitudinal axis than in the chimpanzee. These data support the hypothesis that trabecular architecture in the dorsal region of the human metatarsophalangeal joint directly relates to the toe-off mechanism during gait, a characteristic that has not been observed in extant hominids.

Results of measuring phalangeal bases confirm previous studies that those of modern humans are more dorsally canted than those of other hominids (Mann-Whitney U test,  $p < 0.001$ ); and suggests this method can be used to quantify relative joint orientation in fossil hominin phalanges.

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#### **Using functional morphology to compare morphological diversity of Early Miocene catarrhines and modern anthropoids.**

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Early Miocene catarrhine primates are a diverse group that differed from modern catarrhines in many of their adaptations (Fleagle, 1983; Rose, 1983). While numerous studies have focused on the morphology of certain taxa (e.g. MacLatchy et al., 2000; Napier and Davis, 1959) few have examined

morphological diversity in this group. Morphological correlates of behavior are useful to examine diversity in extant primates (Grossman and Fleagle, 2005) and may be used to compare patterns of diversity in the past to those of modern primate.

This study uses morphological correlates of behavior in the distal humerus to compare patterns of primate diversity of Early Miocene catarrhines to modern anthropoids. Indices quantifying functional morphology of the distal humerus are used because the functional morphology of this element is understood and because it is preserved well in the fossil record. The data were analyzed using principal components analysis. Results suggest that a) there is a large overlap in diversity between Early Miocene catarrhines and modern anthropoids; b) some Early Miocene catarrhines differ from modern anthropoids; c) Overall, modern anthropoids are more morphologically diverse; and d) no Early Miocene catarrhines are particularly similar to living hominoids in the morphology of the distal humerus.

#### **Lower Paleolithic land use: allometric and spatial analyses of population size and range area at Koobi Fora, Kenya.**

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Numerous researchers have produced estimates of the home ranges, population densities or population sizes of early hominins, but none have related these values to the archeological record in a consistent, informative way. The aim of this paper is to produce composite estimates of these variables via allometric constants, spatial analyses, and an interpolation procedure, and to relate these figures back to the record from which they are derived.

Site maps are digitised, allowing the precise locations of specific localities to be extracted as Cartesian coordinates. A variant of Ripley's *K* statistic is then used to estimate a total range area sufficient to encompass all localities. This area is multiplied by an allometric estimate of species-specific population density to produce a population size estimate and, finally, is converted to a probability density function via normal bivariate kernel analysis to produce a detailed map of land use. Application of this method to the archeological sites and associated hominin remains of the Koobi Fora formation, Kenya, demonstrates the value of the proposed synthesis of paleoanthropological and archeological data. The results are the most detailed reconstructions of Lower Paleolithic land use yet produced, allowing for the delineation of specific density contours and core areas and the production of realistic local population size estimates.

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#### **The physical dimension of warrior status in Early Medieval England.**

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The inclusion of weapons in some burials in Early Medieval England (c AD 500-1000) suggests that these individuals may have held warrior status. This study tested the archaeological evidence for this warrior role by examining skeletal material from two sites in Northern England; Norton Mill Lane, North Yorkshire and Castledyke South, North Lincolnshire. The prevalence of osteoarthritis, Schmorl's nodes, enthesopathies and the degree of humeral asymmetry was compared between adult males buried with and without weapons.

Males with weapons were more frequently affected by Schmorl's nodes and enthesopathies on the left side of the upper limb, and had significantly more osteoarthritis in the elbow and wrist. While the humeri of males with weapons at Castledyke were more symmetrical than those without weapons, at Norton this pattern was reversed. This difference may be due to variations in the weapon assemblages found at the two sites; both sites had spears but shields were only present at Norton.

Carrying a shield means the spear must be used single-handed, but without a shield it can be used as a two-handed weapon. If these men used the weapons they were buried with, for fighting or for training or display, then these variations in burial assemblage may represent differences in the use of weapons, leading to different risks of developing markers of activity related stress.

This study shows that weapon burial may indicate not only a symbolic social role but also the undertaking of a level of physical activity beyond that of other males.

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### Buccal lateral enamel formation in Neandertal molars in comparison to two modern human population samples.

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Perikymata are surface manifestations of enamel growth layers which form with periodicities of 6-12 days in African apes and humans. This study compares the number of perikymata on Neandertal (N=78), Northern European (N=96), and southern African (N=122) molar buccal lateral enamel. If consistent with recent analyses of anterior teeth in these same groups, Neandertal molars would be expected to have higher perikymata counts than southern African molars.

With crown height as a covariate, ANOVAs for perikymata counts were conducted

separately for the buccal lateral enamel of seven molar cusps. Population was a statistically significant source of variance only for UM1 and LM2 mesiobuccal lateral enamel. Bonferroni-adjusted pairwise comparisons of mean perikymata counts revealed that for UM1, the Neandertal mean was significantly greater than that of southern Africans but not Northern Europeans. For LM2, the Neandertal mean was significantly greater than both the Newcastle and southern African means. Furthermore, the strongly predictive relationship between perikymata counts and periodicity for southern African LM2 mesiobuccal lateral enamel made possible the prediction of periodicities for the Neandertal LM2 under the assumption of equivalence to southern African enamel formation time. Under this assumption, periodicities for several Neandertal LM2s would fall below the known lower limit (6 days) of periodicities in African Apes and humans.

These data therefore suggest that, as with Neandertal anterior teeth, the buccal lateral enamel formation time of Neandertal molars falls within the modern human range of variation. Implications of these data for Neandertal life history will be discussed.

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### Patterns of positional behavior among atelines: a comparative analysis of *Alouatta seniculus*, *Lagothrix lagotricha*, and *Ateles belzebuth* in Ecuador.

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Atelines exhibit a diverse spectrum of positional behaviors, ranging from the least suspensory *Alouatta* to the more suspensory *Ateles* and *Brachyteles*. *Lagothrix* is typically described as behaviorally intermediate. However, methodological differences in the definitions of positional behaviors have made it difficult to make direct comparisons between ateline genera. In this study, data on the positional behavior of *Alouatta seniculus* are presented. These data were collected using the sampling methods and behavioral descriptions of Cant *et al.* (2001, 2003) and Youlatos *et al.* (in prep) in their comparison of *Ateles belzebuth* and *Lagothrix lagotricha* positional behavior. Data on all three species were collected on populations in the rainforest of Ecuador and statistically analyzed using resampling methods. The similar methodologies allows for meaningful comparisons across all three species. *Ateles*, *Lagothrix* and *Alouatta* differ significantly from one another in the frequency of suspensory locomotor behaviors and suspensory feeding postures, confirming *Lagothrix's* intermediacy in terms of suspensory adaptations. Similarly, all three differ significantly from one another in terms

of bipedalism. *Ateles* uses these orthograde behaviors most frequently while *Alouatta* uses more pronograde behaviors. *Lagothrix* is significantly more likely to utilize drop/leaps and *Alouatta* is more likely to use ascents/descents to negotiate their environment. Overall, *Alouatta* exhibits a more limited locomotor repertoire, reflecting their lack of suspensory and orthograde specializations. In addition to differing frequencies of positional behaviors, these species perform categorically similar behaviors in different ways. Implications for analyzing their positional behavior through a video based study of wild atelines will be discussed.

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### Inter- and intraspecific differences in primate carpal morphology

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Research has shown that there are significant differences in positional behaviour between primate species of the same genus (e.g., Doran, 1993). Positional behaviour is also known to vary between sexes of a single species when sexual dimorphism is high (e.g., Sugardjito and van Hooff, 1986; Doran, 1993). Our study aims to test whether these more subtle inter- and intraspecific differences in positional behaviour are reflected in carpal morphology. Many researchers have shown that carpal morphology reflects broad locomotor categories among primates (e.g., Jenkins and Fleagle, 1975; Richmond, 2006). If differences in carpal morphology correlate with more detailed differences in positional behaviour, it will enable more informed reconstructions of the functional morphology of the fossil carpals. We analyse the carpal morphology of three carpals in extant hominoids, some cercopithecoids and a variety of fossil Miocene hominoids. Linear variables of the scaphoid, capitate and hamate were analysed using multivariate analyses. Results indicate that the morphology of all three carpals reflect broad, primate locomotor categories to varying degrees. Carpal morphology distinguishes among species and subspecies of *Gorilla*, *Hylobates* and, to a lesser extent, *Pan* and *Pongo*. There are significant differences in carpal shape between the sexes, even when sexual dimorphism is relatively low, and females tend to have larger carpals than males once the effect of body size is removed. These results can be used to better interpret the positional behaviour in fossil hominoids.

### 3D reconstruction and study of a new late Middle Pleistocene Hominid: Biache-Saint-Vaast 2, Nord, France.

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The Middle Pleistocene open-air site of Biache-Saint-Vaast (Nord, France) has been dated between 170-250 kyears (MIS 7 and early MIS 6). It delivered a mousterian industry and some human cranial remains mixed with a moderate/cold fauna (A. Tuffreau, 1988). A posterior portion of neurocranium was discovered in situ (Biache-Saint-Vaast 1) and previously studied (B. Vandermeersch, 1982, H. Rougier, 2003). We present the study of other human cranial remains (Biache Saint-Vaast 2) identified during the study of fauna assemblages. They include three fragments of the same skull: (i) a fragmented anterior portion of the frontal bone, (ii) the lateral squama of the left parietal bone in connection with the temporal bone and the greater wing of the sphenoid bone, (iii) the anterior portion of the occipital bone.

After X-Ray CT scanning of each bone, we performed a virtual 3D reconstruction of the skull. The frontal bone fragments were isolated and repositioned. The left osseous block was articulated with the frontal bone. Its spatial position was based on several 3D references (X-Ray CT and 3D morphometric characteristics of other European Pleistocene hominids). The anterior occipital bone fragment was positioned approximately due to the lack of anatomical connection.

The 3D anatomical and morphometric study of Biache-Saint-Vaast 1 and 2 clearly shows morphological similarities with the "Classical" Neandertals (i.e. beginning of a lambdoid flattening, reduced mastoid, elongated temporal bone, depressed external auditory meatus, supraorbital torus shape). These similarities support the hypothesis that Biache-Saint-Vaast fossils are part of the earliest Neandertals in Western Europe.

#### Early Upper Paleolithic human dental remains from Ucagizli Cave (Hatay, Turkey).

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Human skeletal remains associated with the early Upper Paleolithic in Eurasia are extremely scarce. Ucagizli Cave (Hatay, Turkey) contains a sequence of early Upper Paleolithic levels more than three meters thick. The sequence spans the period between approximately 30,000 and 41,000 (uncalibrated) radiocarbon years before present. Both early Ahmarian and Initial Upper Paleolithic (IUP) technocomplexes are represented by abundant archaeological remains. This presentation describes the human dental remains from Ucagizli Cave.

A total of 10 human teeth have been collected from archaeological deposits at Ucagizli Cave. The sample includes 2 incisors, two canines, one premolar and five molars. One tooth comes from the earliest part of the Initial

Upper Paleolithic, three from the end of the IUP, and six from the Ahmarian layers. Most of the specimens are healthy, permanent teeth. The teeth are in a variety of states of wear, from nearly unworn to heavily worn. Based on the stratigraphic dispersal and variation in wear it is likely that each specimen represents a different individual. On the whole, the human teeth from Ucagizli Cave are consistent with *Homo sapiens*, but possible Neanderthal traits are present in at least one specimen.

#### The taxonomy of the Flores hominin: An historical perspective.

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The announcement in October of 2004 of the discovery of a new small-bodied hominin from Flores was remarkable not simply as a result of the species' unanticipated morphology, but also because it was alive so recently. The holotype, a skeleton designated LB1, was estimated to be a mere 18,000 years old. Predictably, various interpretations regarding taxonomy and phylogeny followed, with the discoverers opting to erect a new species within the genus *Homo*. In contrast, other scientists suspect that the individual was a pathological modern human, as distilled in a recent *PNAS* article (Jacob *et al.* 2006).

That an unprecedented hominin morphological pattern is the result of pathology, and does not represent a novel taxon, is not new in paleoanthropology. This study examines primary historical literature, documenting several cases in which non-modern looking fossils were variously interpreted as genuine new species versus pathological *Homo sapiens* (e.g. Neandertal and *Pithecanthropus*). In addition, this study examines related controversies in which purported new hominin forms were alternatively interpreted as extinct ape species closely allied to the living hominoids (e.g. Taungs and *Pithecanthropus*).

Both scenarios reflect the ongoing polarization of scholars into those that tend to "lump" hominin diversity into existing categories, and those that "split" the same morphological diversity into a much broader adaptive radiation. These taxonomic philosophies clearly belie divergent views of the evolutionary process itself.

By placing the Flores discovery within the context of these prior controversies, it is possible not only to better understand the nature of the debate but also to surmise the likely resolution.

#### Was sexual dimorphism in early *Homo erectus s.l.* as large as in *Gorilla*? A reassessment of the ER-1813 cranium in the light of hominoid allometries.

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The taxonomic affinities of cranium ER-1813 from Koobi Fora have been debated ever since its discovery; usually it is tentatively included in *Australopithecus* or *H. habilis*. Recently, Gathago *et al.* (2006) placed ER-1813 in the KBS-Member, the same stratigraphic context/age as early *H. erectus s.l.* crania from the same area, thus increasing the plausibility of the specimen's attribution as a female of the taxon.

We present a geometric morphometric study that explores shape-allometry of east African *Homo* specimens in the context of hominoid growth-allometries, using new reference-based reconstructions of ER-1813, ER-1470, ER-3733, ER-3883, OH-9 and WT-15000. Our comparative sample comprises 417 recent specimens of *Gorilla*, *Pan*, *Pongo* and *H. sapiens* of both sexes, whose ages range from infancy to adulthood. We also included the *A. africanus* crania Taung, Sts71, Sts5 and Stw505, and four *Paranthropus* crania.

On each specimen we measured 3D-coordinates of 47 craniofacial landmarks and 300 semilandmarks and converted these to shape-variables by Procrustes superimposition. The allometric trajectory of each group was calculated by regressing shape on the logarithm of centroid-size in Procrustes-form-space. When size is ignored, ER-1813 plots close to *H. erectus s.l.*, whereas in form-space the *H. erectus s.l.* specimens cluster to the exclusion of ER-1813. If the latter indeed represents a female form of *H. erectus s.l.* then the size difference between the *H. erectus s.l.* 'males' and ER-1813 implies that sexual dimorphism was as large as in *Gorilla* and *Pongo*. We discuss these intriguing results in the light of the recent findings in Dmanisi.

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#### Population level differences in overall linear enamel hypoplasia frequency, sexual dimorphism and lesion location in the permanent dentition: inferences on the adaptive significance of three development models in the Yucatan Peninsula.

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Over all linear enamel hypoplasia (LEH) frequencies, LEH sexual dimorphism and lesion location within teeth were compared between populations and generations to evaluate the adaptive significance of three development models in present day Yucatan

Peninsula. The first strategy in the Maize region of Yucatan combined subsistence agriculture at home with salaried work in the cities of Merida and Cancún. The other two combined subsistence with commercial agriculture. Peasants from the Citrus Region in Yucatan kept direct control of the marketing and distribution of their commercial crops while those in Calakmul, Campeche had access to the market only through intermediaries known as *coyotes*. No sexual dimorphism and an almost even LEH distribution within a tooth may be seen in highly stressed populations with over all LEH frequencies greater than .8. None stressed pre-vaccination campaign peasant populations on the other hand will show over all LEH relative frequencies of .8 and .5, and female LEH frequencies will be significantly lower. Sexual dimorphism will disappear again in these populations after vaccination campaigns who will also exhibit a significant relative increase in the LEH's found in the middle portion of the central incisors. These populations will show over all LEH frequencies between 50 and 10%. Finally, overall LEH frequencies will be less than 10% in affluent modern peasants with access to modern day health care. Most of their LEH's will be found in the central part of the tooth and there won't be any differences in overall frequencies between the sexes.

#### Human counter-exploitation of plant neurotoxins: Towards resolving the paradox of drug reward.

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On first exposure to commonly used plant neurotoxins such as nicotine, arecoline (betelnut), and caffeine, most people experience nausea, vomiting, and other aversive reactions. It is therefore puzzling that many first-time users continue to consume these 'recreational' neurotoxins. Numerous invertebrates and vertebrates, however, have evolved to sequester dietary toxins for their own chemical defense against predators. Furthermore, there is increasing evidence that primates use toxic plants to self-medicate, and it has been proposed that the ubiquitous use of spices is an adaptation to exploit plant alkaloids to combat bacteria in food.

Some recreational drugs attack human pathogens. Of the world's three most popular alkaloid drugs, for example, two—nicotine and arecoline (in the form of nicotine sulphate and arecoline hydrobromide)—are potent commercial anthelmintics used in animals, and orally ingested nicotine and arecoline are seen as efficacious anthelmintics in humans. Like nicotine, modern anthelmintics such as levamisole and the tetrahydropyrimidines target nicotinic acetylcholine receptors on somatic muscle

cells, inducing spastic paralysis of the parasite and leading to its expulsion. Recently developed neonicotinoid flea-control agents also target nicotinic receptors. Thus, the widespread recreational use of plants producing nicotine and arecoline could be an evolved response to endemic infections of helminths, or other parasites with nicotinic or muscarinic receptors, in ancestral human populations. We investigate the hypothesis that the widespread use of nicotine and arecoline use stems not from incidental activation of a general reward mechanism but rather from an evolved propensity to self-medicate using these or related compounds.

#### Botanical medicines for blood pressure regulation.

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Medicinal plant products have been administered for a wide range of health problems cross-culturally since prehistoric times. The safety and effectiveness of herbal medications for blood pressure regulation were evaluated with original data collected from blood pressure tests and interviews with adults from Caribbean (N=286) and Caribbean-American (N=290) populations, questionnaires administered to traditional healers and professional herbalists in these communities (N=13), and a survey of 89 medicinal plant shops ("*botanicas*") in Miami, FL.

Experimentation by ethnomedical practitioners has produced an extensive inventory of plant species with precise preparation methods to treat high blood pressure and low blood pressure or to induce diuresis. Pharmacological assays reported in the literature on many of the botanical specimens indicate the presence of curative bioactive phytochemical constituents demonstrated to modify blood pressure as claimed (e.g. alstonine, arecoline, coreximine, protopine, gamma-amino-butyric acid, linoleic acid, linolenic acid, digitoxin, methanol, quercetin, rutin, reserpine, and vincamine). These substances are classified as vasodilators, anticoagulants, diuretics, nervous system depressants, antiadrenetics, cardiac glycosides, and electrocardiac modifiers. Preparation procedures serve to potentiate phytochemical bioactivity and to neutralize or reduce possible toxicity. Anecdotal reports, case studies, and scientific evidence indicate that phytotherapy represents a relatively safe and effective approach to blood pressure management. Further testing is warranted on this longstanding and widespread modality.

#### The Developmental Basis for Morphological Integration and the Structure of Variation in the Skull.

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The skull is a developmentally complex and highly integrated structure. The developmentally determined patterns of integration in the skulls of primates allow the maintenance of function across ranges of intraspecific variation. As these patterns of integration structure the phenotypic expression of genetic variation, they may also influence evolutionary transformations that separate related species. Our understanding of the degree to which covariation structure represents constraints on evolutionary significant variation in primates is hampered by our poor understanding of how covariation structure is developmentally determined. We present a theoretical framework for the developmental basis of morphological integration and the evolution of covariance structure of the mammalian skull and illustrate this model through morphometric analyses of samples of embryonic, neonatal and adult mice that have mutations that influence development in known ways. We argue that the patterns of covariation seen in many complex structures such as skulls result from the overlaying of variation introduced by developmental and environmental factors at different stages of development. Much like a palimpsest, the covariation structure represents the summed imprint of a succession of effects, each of which leaves a distinctive covariation signal determined by the specific set of developmental interactions involved. Covariance evolves either by altering the variance of one of these sequential effects or through the introduction of a novel covariance producing effect. This model also demonstrates the central importance of developmental process-to-phenotypic outcome relationships in understanding the developmental basis for evolutionary change.

#### Exploring diachronic change in the group specific vocalizations of chimpanzees (*Pan troglodytes*).

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Chimpanzees (*Pan troglodytes*) have long been documented as using group specific vocalizations. Human dialects change substantially during periods of social instability (Labov 1999) and emotional shifts within a population (Kienast et al. 2001). To determine if these conditions are a similar catalyst for chimpanzee vocalizations, a survey was performed on a group of captive chimpanzees who, two years prior, had been separated. Seven of the group had gone to a different zoo (creating presumed initial emotional stress as well as a new social hierarchy). Both groups had their vocalizations, along with the accompanying



behaviors, recorded. The recordings were analyzed, via spectrogram, and an average for each member was calculated for the categories of structure, duration, frequency, and amplitude. For the original parent group, a standard deviation from these categories was drawn for each behavior. Vocalizations from members of the new group was then compared, for each behavior, to see if they deviated from the standard deviation of the parent group. Then vocal recordings made from the group ten years ago were compared to the new recordings to determine the scope of change during periods of stability versus instability. Preliminary data shows that chimpanzee vocalizations change in these situations. This shows that phonological changes, during times of emotional and social upheaval, in chimpanzee vocalizations may mimic what occurs in human dialect under similar conditions.

#### **The use of digital X-ray technology in the identification of radiopaque transverse lines.**

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Since the 1920s, radiographs have been a valuable tool in physical anthropology. One of their primary uses has been in the study of stress in past populations through the examination of radiopaque transverse lines (Harris lines). In this study, a series of femora and tibiae were x-rayed using both standard and digital radiographic technology. These images were compared to show the differences in the quality of the data that can be collected using different technology, including accuracy of measurements, identification of landmarks, and identification of growth stress indicators such as radiopaque transverse lines.

The digital images used in this study were taken at the University of New Mexico Hospital using a Philips digital x-ray machine and analyzed using Philips Medical Systems PACS Image Viewer R10.1. The toolset included in the software package includes zoom, magnification, a calibrated distance measure (to the nearest 0.1mm), and edge enhancement. Additionally, these images can be readily copied and pasted into other software packages. The standard x-rays were taken on a HP faxitron x-ray machine at the Human Identification Lab at California State University, Chico. Digital x-rays provide a superior quality image over standard radiographs, and also allow for improved analytical capabilities. The higher quality images and the imaging technology allowed radiopaque transverse lines to be identified that would not have been visible on a traditional x-ray. Additionally, the distance feature allowed for more accurate measurements and thus a more accurate assessment of the age of formation for the lines.

#### **Metabolic scaling and social network structure: The fractal organization of hunter-gatherer populations**

Marcus J. Hamilton. Department of Anthropology, University of New Mexico.

Like all biological species, hunter-gatherers harvest resources from the environment to meet metabolic requirements. The metabolic rate not only sets resource demands but is also a major determinant of ecological relationships at multiple levels of organization. In mammals, including humans, scaling relations between population size and territory size describe the complex interactions between individual space use, population structure, and metabolic demand. We show that the territory sizes of hunter-gatherer populations scale allometrically as the 3/4-power of their population sizes rather than isometrically as might be expected on the basis of individual resource demands. Using network theory, we then show that this non-linear scaling results from the self-similarity of hunter-gatherer population structure. This social structure forms a network of energy, material, and information exchange that increases the efficiency of resource extraction from the environment and facilitates the flow of fitness-related commodities among individuals. Our results offer insights into human ecology by considering the non-linear relationships between metabolic demand, space use, and social networks. We argue that the set of fundamental physical and biological processes that lead to the formation of self-similar fractal-like networks in many complex systems lead to similar structures in human systems.

#### **Nonmetric dental variation of Sakishima Islanders, Okinawa, Japan: a comparative study among Sakishima and neighboring populations.**

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Twenty-four nonmetric tooth crown traits of Sakishima (Miyako and Ishigaki) Islanders, from the southernmost Ryukyu Islands, Japan, were investigated and compared with those of other neighboring populations. The frequency of double-shoveling of Sakishima, and especially, Ishigaki, is lower than Atayal and main-island Japanese.

The frequencies of protostylid and cusp 6 in Miyako and Ishigaki are comparable to those in Hokkaido Ainu and lower than in main-island Japanese and Atayal, Taiwan. Miyako and Ishigaki, as well as other Ryukyuan are basically more similar to main-island Japanese than to Ainu, while being situated between main-island Japanese and Ainu in

terms of both MMDs and R-matrix methods (Relethford and Blangero, 1990). However, Ishigaki and Miyako are relatively close to Hokkaido Ainu among Ryukyu people and main-island Japanese, as suggested in some previous preliminary studies. The estimated *F*<sub>st</sub> (the ration of among-group variation to total variation), using an average heritability rate = 0.55 for the nonmetric tooth crown traits used in this study, displayed low levels of interregional variation, as already indicated in analyses of genetic, cranial and dental metric data. Meanwhile, the relatively large diversity of Ryukyu Islanders based on *F*<sub>st</sub> suggested isolation or poor contact among islands throughout history in the Ryukyu Islands. The lesser observed variation compared with the expected variation in most Ryukyu samples using Relethford and Blangero's (1990) method may reflect a larger genetic drift in the Ryukyu Island chain.

#### **Energetics of climbing in mammals: Where do primates fit in?**

J.B. Hanna. Dept. of Anatomy, WVSOM.

Data on energetic costs of locomotion are important for understanding daily metabolic requirements, how muscles power movement, and the structure and function of the locomotor system. Although most animals live and move in a three-dimensional environment, locomotor energetic research previously has focused on movement in the horizontal plane. Little is known about the energetic cost of locomotion on arboreal supports. Studying energetic costs of vertical climbing in highly arboreal animals such as primates offers a unique opportunity to fill this gap. Moreover, primates span a wide a range of body masses, such that determining the relationship between energetics and body mass during climbing is possible.

Oxygen consumption data were collected on 5 species of primate (ten individuals of four strepsirhine species, two individuals of one haplorhine species; 0.160kg-1.42kg) climbing on vertical rope treadmills. Data were compared to the energetics of incline locomotion in other mammals.

Results show that movement in the vertical plane is more expensive than previously thought (~118 J kg<sup>-1</sup> m<sup>-1</sup>). Primates exhibit climbing energetics similar to that found in other mammals during incline locomotion. Additionally, large primates in this sample use absolutely more energy to climb than smaller ones, while the relative amount of work accomplished per unit energy is proportional to that seen in small primates. It is suggested, based on differences in muscle length allometry, that large primates exhibit a decreased muscle volume recruitment during climbing compared to small primates. In this way large and small primates are able to climb with similar relative costs.

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### Feeding competition and cheek pouch use in *Macaca mulatta*.

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The cercopithecine cheek pouch is an elaborate feeding adaptation and a defining characteristic distinguishing this group from other monkey subfamilies. Recent studies on cheek pouch use in cercopithecines have demonstrated that the role of this structure is primarily to mitigate feeding competition among conspecifics and less so as an adaptation for predator avoidance (Lambert, 1998; Lambert and Whitham, 2001; Lambert, 2005). This study investigates whether social or ecological variables are associated with the occurrence and degree of cheek-pouching behavior. We assess differences in cheek pouch use by feeding priority, proximity of conspecifics, distance from center of food source, time of day (as a measure of resource depletion) and size and location of group ranges from data on fifty-six subject from three social groups.

The data were collected from rhesus macaques (*Macaca mulatta*) at the Caribbean Primate Research Center's Cayo Santiago Field Station in Puerto Rico using focal animal follows. The Cayo Santiago population is an introduced free ranging population of approximately 800-900 individuals in 6 social groups restricted to a 15.2 hectare island. There are no predators on the island and population is stocked with 0.23kg of monkey chow per individual per day at three different locations each morning. The monkeys also eat a variety of plant and animal matter found on the island. The majority of cheek-pouching behavior and agonistic events occurred when feeding on monkey chow. Differences in cheek-pouching behavior are found by feeding priority and proximity to conspecifics, but are more pronounced when considering ecological variables.

### The role of epigenetics in developmental plasticity and developmental induction of risk of adult disease

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Epidemiological and animal studies show that small changes in the environment during development, e.g. in nutrient provision or balance, induce phenotypic changes which affect an individual's responses to its later environment. These may in turn alter the risk of chronic disease resulting from inadequate responses, e.g. to a rich environment leading to metabolic syndrome or cardiovascular disease. Recent work demonstrates an important role for molecular epigenetic processes in producing such effects, processes which are targeted to promoter regions of specific genes in specific

tissues but which also include changes in histone structure and post-transcriptional processes involving miRNAs. Such fine control of gene expression endorses the view that the mechanisms have been retained through evolution as a result of the adaptive advantage which they confer, rather than representing extreme effects of developmental disruption akin to teratogenesis. There may be adaptive advantage in a developmental cue inducing a phenotypic change in generations beyond the immediately affected pregnancy, and there is now a range of human and animal data which support this concept. Such effects – which might be termed non-genomic inheritance – may be mediated by a range of effects including alterations to maternal adaptations to pregnancy in successive generations or behavioral influences. Recent data however also show that epigenetic effects such as DNA methylation can be passed to successive generations. This suggests that they might persist through meiosis. Moreover there is now evidence for transmission via the male lineage which may also involve miRNA-mediated effects. Current research in this area is important for mechanistic understanding but also emphasizes the long-term multi-generational effects which appropriate interventions may confer to reduce the risk of chronic disease in subsequent generations.

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### Are musculoskeletal markers indicative of biomechanical stress? A test using individuals of known occupations.

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In many bioarchaeological analyses the hypertrophic development of muscle insertion sites is considered to be indicative of habitual activity patterns. While this assumption may be valid, it is not testable using prehistoric archaeological samples. This study tests the hypothesis that disparities in the development of musculoskeletal markers are associated with differential mechanical loading.

The musculoskeletal markers of 51 males of known occupation from the William M. Bass Donated Skeleton Collection at the University of Tennessee were assessed for robusticity. The sample was divided into two categories based on likely levels of occupational stress: sedentary occupations (N=20) and physically demanding occupations (N=31). Individual markers were scored on a scale of zero to three.

Cluster analysis and discriminant analysis indicated differences in musculoskeletal marker development between the two occupational subgroups. While these results demonstrate that increased occupational stress is connected to

the elevated robusticity of muscle insertion sites, other factors including age, body mass, and biomechanical stresses not related to occupation, must be considered.

### Understanding human races: the retreat of neutralism.

Henry Harpending. Department of Anthropology, University of Utah.

Discussion and debate about human races has been dominated for decades by neutral theory and statistics. Since this literature never posed a real question, it has never produced an answer. Lewontin's 1972 paper with its claim that a value of 1/8 of a statistic like *F<sub>st</sub>* is "small" and that this means that human race differences are insignificant is a staple of our textbooks. Recently geneticists have had a closer look and pointed out that *F<sub>st</sub>* of 1/8 describes differences among sets of half sibs and few claim that half sibs are insignificantly related. Anthony Edwards has shown that the significance of differences is in the correlation structure of a large number of traits, again denying the Lewontin assertion that human differences are small.

Alan Templeton in 1998 claimed that human races were less differentiated than races of some other large mammals, but he compared human nuclear DNA statistics with statistics from mtDNA in the other species. An appropriate comparison shows that human are more, not less, differentiated than other large mammal species.

Since neutral differences are a passive record of demographic history they are not very significant for issues of functional biology. Newly available data sources allow us to study the natural selection of race differences instead of their drift. It appears that there is a lot of ongoing evolution in our species and the loci under strong selection on different continents only partially overlap. Human race differences may be increasing rapidly.

### Linear diaphyseal growth in southern African forager children.

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Adult Khoe-San peoples of the Kalahari and their ancestors from the Cape region of southern Africa, are well-documented as typically short in stature and gracile in physique. Archaeological and stable-isotope evidence suggest that Later Stone Age peoples of the Cape exploited a wide range of plant and animal resources in a hunter-collector-fisher (forager) lifeway that was nutritionally sufficient, though challenging. This study examines the process of growth in prehistoric southern African forager children through linear skeletal dimensions.

Diaphyseal lengths for approximately 65 Later Stone Age juveniles are reported, along with cross-sectional distance curves for femur length based on dental estimated ages at death. Using Denver Growth Study data as a

benchmark, the growth trajectory of Later Stone Age juveniles is compared to those of other archaeological populations including delayed- and direct-return foragers, and sedentary groups. Growth tempo is evaluated using percentage of adult femur length achieved at a given age relative to the population-specific adult mean femur length. Though small in absolute size, Later Stone Age children display no episodes of stunting or catch-up in the cross-sectional trajectory, and fare better than most other groups relative to the modern (Denver) benchmark. Linear diaphyseal measurements suggest that forager children were growing well in the southern African Cape.

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#### Evaluating C peptide as a measure of net energy gain in *Colobus guereza*.

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Net energy gain influences both primate reproduction and behavior. It plays important roles in the regulation of ovarian function, and in many species, positive energy balance coincides with either conception or lactation, and can additionally coincide with weaning. Differences in net energy gain among individuals and/or groups likely reflect particular types and strengths of feeding competition and ultimately influence patterns of social behavior and dispersal. Few studies of wild primates, however, have attempted to estimate net energy gain, most likely because of the difficulty of precisely assessing energy intake rates and the lack of data for most species on energy output rates for various activities.

C peptide is a molecule that is cleaved from proinsulin, occurs in a 1:1 ratio with insulin, and is excreted in urine. We examine the potential of C peptide for assessment of net energy gain in wild female black and white colobus monkeys (*Colobus guereza*), which are folivorous foregut fermenters. We find that both food intake levels and distance moved in a 24-hour period before sample collection predict C peptide levels for females experiencing ovarian cycles, and to some extent, for pregnant and lactating females. Therefore, assessing C peptide levels in urine may be a promising method for estimating net energy gain. We will discuss potential benefits and drawbacks of using this method, describe what questions remain unanswered about its effectiveness as a measure of net energy gain, and provide recommendations for researchers wishing to investigate C peptide in other primates.

#### *Mesopithecus sivalensis* from the Late Miocene of the Siwaliks.

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Fossil cercopithecids were first reported from the Middle Siwaliks in 1878, when Lydekker described a partial maxilla of *Macacus sivalensis*. Pilgrim termed additional specimens *Semnopithecus asnoti* in 1910, but later (1915) transferred the material to *Cercopithecus*. Remane (1965) and Simons (1970) correctly recognized that Pilgrim's specimens were colobine and termed them *?Presbytis asnoti*. Szalay & Delson (1979) combined all the fossils into *?Presbytis sivalensis* and noted that they differed little from western Eurasian *Mesopithecus*. Additional unpublished specimens have been recovered by Pilbeam, working with the GSP. We here review the entire sample from the "Dhok Pathan" faunal assemblage, dated ~7-5 Ma.

Most of the Middle Siwalik cercopithecid specimens can be referred to a single species of colobine, which differs from extant taxa in its unique combination of features: relatively large high-crowned canines, small size differential between upper and lower M1 and M2, lower M3 relatively large, molars with low cusps and relatively marked buccolingual flare. Comparisons with fossil colobines show that the Miocene Siwalik cercopithecid is most similar to *Mesopithecus monspessulanus* from the Pliocene of Europe and western Asia, but it differs in having narrower molars with lower cusps, and probably larger canines. We provisionally attribute this Siwalik colobine to *Mesopithecus sivalensis*.

Previous workers have postulated a zoogeographic barrier between the Siwaliks and the southwest Asian faunal province, which led Szalay & Delson to conclude that the Indo-Pakistan fossils should not be linked with *Mesopithecus*. However, recent studies downplay the significance of this barrier, and our results support that reinterpretation.

#### Intraspecific scaling of preferred bite size in strepsirrhines and a narrow allometric comparison of preferred bite size in a frugivore and a folivore.

A. Hartstone-Rose, and J.M.G. Perry. Department of Biological Anthropology and Anatomy, Duke University.

Interspecific scaling of preferred bite size (PBS), the maximum food size that an animal consistently ingests whole, relative to body size shows that PBS scales isometrically or with slight negative allometry in strepsirrhines (Perry and Hartstone-Rose, this volume). In that study, the frugivorous taxa exhibited absolutely and relatively larger PBS than the folivorous species. This study examines the relationship between PBS and body size in the frugivorous *Varecia rubra* compared to the folivorous *Propithecus*

*coquereli*. We measured PBS in three foods (melon, sweet potato, and carrot) in *Varecia* (N=8) and *Propithecus* (N=8) at the Duke Lemur Center. Intraspecific scaling of PBS relative to body size is used to evaluate the robusticity of the interspecific regression. RMA regression showed no relationship between PBS and body mass within each species for any food type. Mann-Whitney U-tests revealed that *Propithecus* ingested cubes that were significantly smaller than those of *Varecia* (1.27 vs. 10.56 cm<sup>3</sup> carrots, 1.62 vs. 11.22 cm<sup>3</sup> sweet potatoes and 2.68 vs. 38.39 cm<sup>3</sup> melons) (U=64, P < 0.001 for all comparisons). Thus, the folivorous *Propithecus* has an absolutely smaller PBS across all food types and eats only slightly larger pieces of soft food than hard food. The frugivorous *Varecia* eats significantly larger pieces of all food types especially the soft melon. These results support the idea that the short chewing muscle fibers and short faces of *Propithecus* limit gape, whereas the long muscle fibers and faces of *Varecia* allow them to ingest large food items.

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#### Evolution of Middle-Late Pleistocene human cranio-facial morphology: a three-dimensional approach.

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The relationship among the Middle Pleistocene (MP) European and African fossil humans and with subsequent Late Pleistocene (LP) Neanderthal and modern human populations is one of the most intractable problems in paleoanthropology. *H. heidelbergensis* is often proposed to encompass both African and European MP specimens based on broad similarities between the two, and to be ancestral to both later taxa. However 'incipient' Neanderthal features in the morphology of MP Europeans argue for their inclusion in the Neanderthal lineage. Consequently, MP Africans should be considered as a separate taxon strictly ancestral to modern humans.

We conducted a 3-D geometric morphometrics (GM) analysis so as to quantitatively evaluate craniofacial shape variation among MP-LP hominids and help shed light on these issues. GM allow better representation and analysis of an object's geometry, intuitive visualization and, most importantly, quantification of qualitative features. Samples comprised 3 African Pliocene, 7 African MP-LP, 3 Near Eastern LP, 3 European MP, 7 Neanderthal, 8 Eurasian Upper Paleolithic and 129 recent human specimens. Two separate analyses were conducted, one on the face (21 landmarks) and one on the neurocranium (74 landmarks/semilandmarks). Semilandmarks were resampled and 'slid' along their curve; landmarks and semilandmarks were then superimposed using generalized Procrustes

analysis. The fitted coordinates were analyzed with principal components analysis, Mahalanobis  $D^2$  and Procrustes distances.

Preliminary results suggest that African MP-LP fossils show greater facial variability and a shift toward modern-like neurocranial morphology when compared to the European MP-LP specimens. The implications of our results for MP-LP human evolution are discussed.

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#### **Standards for univariate metric sex discrimination in prehistoric Fremont.**

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While morphological markers of sex in the innominate and skull tend to be the preferred method of sex estimation for human skeletal remains, metric analyses provide a reliable alternate technique. Metric sex determination standards are essential when morphological markers are completely absent. But in order to provide reliable estimations of sex concordant with inherited biology, metric analyses must be population specific (Isçan and Miller-Shaivitz 1984). In fact, the limited number of population specific metric sex discrimination standards for prehistoric Native American groups represents a large methodological hole that needs to be addressed. In order to renew an interest in compiling databases of population specific metric standards, this study presents a univariate method for discriminating sex in the prehistoric Fremont culture of the Great Basin and Colorado Plateau (400-1300 A.D.). Univariate sex discrimination standards were calculated from measurements of the humerus, femur, and tibia collected from 64 Fremont individuals sexed in previous studies using morphological markers of the innominate (Novak n.d.). Results indicate a high level of sexual dimorphism with standards accurately discriminating between sexes in up to 94% of cases. Because no metric methods were available to estimate Fremont sex when the innominate and skull were absent previously, researchers used standards developed for prehistoric Native Americans from Central California (Dittrick and Suchey 1986). The use of metric sex standards for populations from Central California misassigns nearly half of all male Fremont individuals to the female sex and further reiterates the importance of population specific methodology in bioarchaeological analysis.

#### **The origin of primate skeletal traits: Insights from studies of a pedigreed baboon colony.**

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The origin of primate skeletal traits is central to studies of human evolution and primate variation that rely on accurate interpretations of data derived from the examination of such traits. The skeletal end products that we observe and interpret originate from a genetic template. But individual-, population-, and species-level variation most often stems from complex interactions between genes and environment, requiring that, for each trait or group of related traits, we assess to what degree the end product reflects environmental factors that influence the phenotype either directly, or by interacting with genes that mediate or direct environmental effects. The pedigreed colony of baboons at SNPRC/SFBR provides an opportunity to formally test for and quantify the additive effects of genes on skeletal traits important to studies of primate evolution, adaptation, and variation using methods of variance component decomposition. Such studies have led to valuable insights into the degree to which femoral shape, tooth morphology, and craniofacial traits are heritable (due to the additive effects of genes). Heritability of bone histomorphometry and biomechanical properties are also underway. Characterization of genotype-by-environment interactions influencing skeletal variation has also been successful including not only age- and sex-specific genetic effects, but also those relating to important life history variables (e.g. reproductive history). Additionally, tests for shared genetic effects among traits have led to a better understanding of the evolutionary relationship between functionally or otherwise related traits. Such studies have great potential to better inform our use of skeletal traits to reconstruct primate relationships and behavior.

#### **Acceleration of adaptive evolution in modern humans.**

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Humans vastly increased in numbers during the past 40,000 years. Recent surveys of human genomic variation have suggested a large surplus of recent positive selection, indicated by excess linkage disequilibrium and skewed SNP frequency spectra. We applied estimates of prehistoric and historic population sizes to estimate the importance of population growth in explaining the number of recent adaptive mutations. Our estimates are consistent with genomic evidence in suggesting that the rate of generation of positively selected genes has increased as much as a hundredfold during the past 40,000 years.

Do skeletal features reflect this genomic evidence of selection? Under positive selection, rapid appearance of new variants during the terminal Pleistocene and early Holocene would cause maximal phenotypic

change during the last 2000-4000 years. We compared original and published series of Holocene cranial data from Europe, Jordan, Nubia, South Africa, and China, in addition to Late Pleistocene samples from Europe and West Asia, to test the hypothesis that the genomic acceleration in positive selection correlates with phenotypic evolution during this time period. A constellation of features in the face and cranial vault, notably including endocranial volume, changed globally during this time period and documents common patterns of selection in different regions. Holocene changes were similar in pattern and chronologically faster than those at the archaic-modern transition, which themselves were rapid compared to earlier hominid evolution. In genomic and craniometric terms, the origin of modern humans was a minor event compared to more recent evolutionary changes.

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#### **Patterns of admixture in Mexican Americans assessed from 101,150 SNPs.**

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It is widely recognized that Mexican Americans are highly admixed with historical genetic contributions from the Spanish and Africans to indigenous Amerindian populations over the last several centuries. Previous admixture estimates from classical markers and microsatellites suggest 60-65% European ancestry, 30-35% Native American ancestry, and 5-10% African ancestry. We genotyped >116,204 single nucleotide polymorphisms (SNPs) using the Affymetrix 100K chip set in 603 Mexican-Americans from Starr County, TX for a genome-wide association study of type 2 diabetes. Since population substructure can yield spurious case-control associations we investigated the patterns of admixture in this population and report the results herein.

Genotypes for the 100K SNPs from the hapmap populations ( 60 Europeans, 60 Africans, and 90 Asians) were used as training sets in *structure* to estimate proportions of ancestry for each individual. After removing SNPs monomorphic in the entire data set, we divided the SNPs into 10 equal, independent subsets of 10,115 SNPs to reduce the degree of linkage disequilibrium between SNPs and to reduce computational time. No significant differences were observed between the 10 subsets, allowing us to average the admixture estimates across the subsets: 68% European, 27% Asian (as a proxy for Native American), and 6% African. The proportion of African ancestry estimates across individuals were relatively constant (<1-9%), while the European and Asian

estimates were greatly varied (18-95% and 3-67% respectively). No significant differences were observed between the cases and controls. Proportions of European ancestry decreased from east to west by place of birth in Mexico.

#### **The impact of geography, ecology and language on native South American genetic structure.**

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Elucidating the nature and causes of the global pattern of human genetic diversity is a central goal of genetic anthropology. Recent publications suggest geographic distance to be the principle determinant of genetic differences between human groups. However, Ramachandran and colleagues (2005) showed that the Americas do not conform to this trend, finding that genetic distances within the Americas, as well as between American and non-American populations, fail to fit predictions based on geographic distance. While this study examined only three South American populations, these deviations are interesting because the continent represents the last major region to be colonized by humans. Additionally, South America is comparatively complex ecologically and linguistically. Together, these factors demonstrate the unique opportunity South America offers for the examination of human biological and cultural adaptation. In order to further address the reasons for South America's unique genetic pattern, we collected published and unpublished mtDNA d-loop sequences from more than 30 populations. We formally tested the fit of these data to the isolation by distance model and then examined the deviations from the model in terms of ecological and linguistic cultural variation. Our findings include substantial deviations from the IBD model, but suggest that these can be explained using a combination of geography and the other factors investigated. We conclude by considering the implications of our results for human biological and cultural adaptation in new environments.

#### **The Problematic Papionina of Sterkfontein Member 4, Gauteng, South Africa.**

J.L. Heaton. Department of Anthropology and the Stone Age Institute, Indiana University, Department of Biology, Samford University.

In the early twentieth century, commercial exploitation of lime deposits resulted in the unearthing of fossil mammals in South African caves. At Taung, the discovery of fossil baboons drew the attention of Raymond Dart, in effect, leading to the first discovery of *Australopithecus* remains. Since then, fossil cercopithecoids have served as useful taxa indicating the presence of hominid fossils in South African cave sites

and providing valuable evolutionary data from the African Plio-Pleistocene.

The aim of this study was to conduct a complete taxonomic reanalysis of the fossil cercopithecoids from Sterkfontein, focusing upon the craniodental remains of the Papionini from Member 4 (~2.6 Ma). This analysis included all specimens attributed to *Parapapio* and *Papio*, genera closely related to modern mangabeys and baboons, respectively.

Discrete and non-discrete craniodental data were examined, and classifications as to genus-species were made, if possible. Consequently, a suite of reliable morphological characters used to differentiate the fossil papionin species was identified, and *Parapapio whitei* was concluded to be an invalid taxon based upon similarities to other pre-existing species. Results suggest the existence of three sympatric papionin species, *Parapapio broomi*, *Parapapio jonesi* and *Papio izodi*, during the accumulation of Member 4, rather than six to seven species as suggested by earlier analyses. Overestimates of primate biodiversity were found to result from two conditions: (1) an artificial bias in the pre-1966 primate collections and (2) simple misidentifications of fragmentary specimens. As a result, the fossil data now overwhelming supports the genetic evidence for the origins of modern *Papio*.

#### **Gender, wealth, and status in Bronze Age Central Asia: a dental pathology investigation.**

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Excavations at Tepe Hissar (Iran) and in North Bactrian Oasis (Uzbekistan) yielded large numbers of artifacts and human burials. Differences in the number and quality of grave goods and the presence of artifacts in common suggest the populations inhabiting these Bronze Age sites were socially stratified and interlinked in trade. Jarrige suggested trade led to interregional homogenization of social behaviors. Yet, greater numbers and higher quality grave goods led Schmidt to suggest that males enjoyed greater social status than women at Tepe Hissar. The opposite pattern was found by Bondioli in the North Bactrian Oasis.

Dental pathology affliction was assessed among 235 and 179 individuals from Tepe Hissar and the North Bactrian Oasis, respectively. Tepe Hissar males, with lower prevalence for four pathologies, experienced better dental health than females. With lower prevalence for five pathologies, North Bactrian Oasis females enjoyed better dental health than males. Such results suggest sexual division of labor in food preparation cannot account for differences in dental health.

Assessment of dental disease relative to social status yields evidence of status-based differences in diet at Tepe Hissar and the North Bactrian Oasis. Regardless of sex,

those buried with high-quality grave goods tend to have better dental health. At Tepe Hissar, females of mid-level social status suffered far poorer dental health than their male counterparts. By contrast, North Bactrian Oasis females of all social status levels experienced better dental health than males. These results contradict Jarrige's assertion of homogenization and illustrate the impact of gender roles on health.

#### **Qualitative and Quantitative Assessment of Musculoskeletal Stress Markers**

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Entheses, soft tissue attachments to bone, are frequently used by physical anthropologists to assess the physical load experienced by an individual *in vivo*. In this context they are commonly called musculoskeletal stress markers (MSM). Abnormalities at these sites are used to indicate excess musculoskeletal stress. The same visual criteria are normally used to record all entheses. Anatomical research indicates that there is a spectrum of entheses types and that this affects their normal visual appearance on skeletal remains. Biochemical studies have demonstrated that these are not purely visual differences: the chemistry of the extracellular matrix itself differs. These differences are thought to be related to mechanical loading requirements. It is hypothesised that anatomical differences will affect the type of abnormalities most commonly seen.

Medieval skeletons from the north of England were studied qualitatively in terms of visual appearance and quantitatively in terms of surface topography. Only fibrocartilaginous entheses of the upper limb were studied. Visual recording noted the type of lesion: proliferative or destructive. Quantitative analysis involved a novel method of digitising the surface two-dimensionally. This digitised line was then transformed into a quantification of surface roughness using mathematical techniques commonly applied in materials science. Both the qualitative and quantitative results support the hypothesis that entheses vary in their response to injury. This indicates that the anatomical structure of entheses must be taken into consideration when recording and interpreting data on MSM. The digitisation of the surfaces also allows data to be stored and re-analysed after reburial.

#### **Preliminary Results of Cercopithecidae Dental Microwear from the Gona Project area, Ethiopia.**

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Bloomington, <sup>5</sup>Department of Geology, University of Utah.

Low-magnification microwear, a new technique for molar use-wear analysis, is applied to samples of three species of fossil cercopithecidae (*Theropithecus oswaldi* and cf. *Cercopithecoides williamsi*, and Early Pliocene *Kuseracolobus aramisi*) from the Gona (Ethiopia) project area. These include *Theropithecus oswaldi* and cf. *Cercopithecoides williamsi* (both Early Pleistocene in age) and *Kuseracolobus aramisi* (Early Pliocene). This technique uses reflective light microscopy to identify use wear features on the occlusal surfaces of molars counted under low magnification (35X) using a standard stereo microscope, an approach that has been used successfully to study the enamel of fossil primate and ungulate teeth for dietary reconstruction. Specimens were only included in this study if use-wear features could be clearly distinguished from taphonomic or diagenetic ones. Here we draw preliminary dietary inferences for the three fossil cercopithecid taxa. *Theropithecus oswaldi* shows use wear consistent with a grass consumer similar to extant *T. gelada*. Both colobines, cf. *C. williamsi*, and *K. aramisi*, have wear that does not match exactly that of sampled extant primates, but is consistent with a browsing diet. Understanding the paleodiets of these species will prove a significant step towards reconstructing the paleoecology of the Gona region. Additionally, as low-magnification microwear is related to the mechanical properties of dietary particles, it forms an important compliment to other approaches, including isotopic data where available. These results must be considered preliminary as sample size was limited due to the state of preservation of the fossil enamel.

#### Dietary practices of Southern French Neolithic populations: new stable isotope data.

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The goal of this research is to reconstruct subsistence practices of French Neolithic populations using isotopic data. Osteological materials were excavated in seven archaeological sites in Pyrenean and Languedoc-Roussillon regions in the South of France. Archaeological sites are dated from the Middle Neolithic period (ca. 4500-3500 BC). Throughout this period, archaeological and faunal markers converge toward a specific development of territory and resources management involving breeders and agriculturalists populations.

Carbon and nitrogen stable isotopes analyses were performed on bone collagen from 73 human and 63 faunal remains. Information on protein consumption, thus obtained, allows evaluation about the environment from which individuals draw their resources as well as their status along the trophic web. Isotopic results are compared to biological (sex, age) and archaeological (funeral practices) data to understand individual food choices and possible economic distinctions between ecological areas and social status.

Results provide evidence for social division in animal protein consumption, particularly between male and female. Results also distinguish two discrete groups probably in relation with the local environment. No significant differentiation between the breeders and the agriculturalists is seen. No marine food seems to be part of the daily diet even though populations lived near by a marine environment. These results are important for the knowledge of social relations between individuals and between human groups during the French Neolithic period. Dietary practices of Southern French Neolithic populations should have been influenced by economic context as well as by social factors as is known for other Neolithic populations.

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#### Three-dimensional analysis of temporal bone pneumatization patterns in olive baboons.

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While most cercopithecines lack paranasal sinuses, extensive pneumatization is present in the baboon temporal bone. Since pneumatization is used as a character in phylogenetic analysis, understanding normal patterns of morphological variation and symmetry in temporal bone pneumatization is necessary. This study is a portion of a larger investigation of evolutionary change in pneumatization patterns in the cercopithecine lineage.

The study sample consists of the skulls of female (N=20) and male (N=5) adult *Papio hamadryas anubis* specimens. High resolution computed tomography scans were acquired from left and right temporal bones for each specimen with slice thicknesses approximating 70 microns. Using Amira, surface areas and volumes of pneumatized spaces were collected from the entire temporal bone and specific regions within the temporal bone. Spherical volumes of interest were cropped from specific regions using Quant3D software and analyzed for bone volume fractions and anisotropy using the star volume distribution method.

Results indicate that bony struts within pneumatized regions of baboon temporal bones tend towards isotropy. This pattern is unlike those recorded for extant African ape species showing anisotropy of bony struts

indicative of localized biomechanical necessity. The tendency towards isotropy in *P. h. anubis* demonstrates that biomechanical requirements in the baboon temporal are not unidirectional and suggests biomechanical patterns for baboon temporal bones differ from those characteristic of other African ape species. Moreover, these results suggest that patterns of organization and structure of pneumatized spaces in the temporal bone can be used to differentiate *P. h. anubis* from other primate species.

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#### Methodological issues in comparing dental pathology profiles of human populations past and present.

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What distinguishes most archaeological dentitions, in comparison with the present day, is very heavy wear. The wear rate varies, but it is consistently much higher than for the living people reported in clinical literature. This pattern was well established even in childhood and by middle age many of the teeth in the mouth were worn down into the roots. As wear progressed, the teeth were erupted continuously into the mouth, mainly by remodelling of the bone in the jaw and migration of tooth sockets upwards towards the crest of the alveolar process. This high wear rate had a marked effect on dental pathology. The occlusal surfaces of molars and premolars were lost early in life, contact points between teeth were modified, and root surfaces exposed above the line of the gums. This changed the sites on the tooth at which carious lesions could develop, and had a strong effect on the age-related progression of both caries and periodontal disease. So, for example, in most living people, dental caries affects particularly molar occlusal fissures and the contact points between tooth crowns, starting in childhood. Root surface carious lesions become important later in life, but tooth crown lesions. In many ancient high wear-rate ancient populations, children were less affected and caries was a disease largely initiated on root surfaces of heavily worn teeth in adults. These differences complicate epidemiological comparisons between archaeological assemblages and living people. Further complications are added by the variable preservation of teeth and jaws in archaeology.

#### Bioarchaeology of prehistoric pastoralists of northern Kenya.

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The dependence on livestock and herding produced profound social and economic

changes in human cultural systems. In East Africa, adoption of pastoralism is thought to have impacted human biology, social organization, landscape usage, overall mobility, and mortuary practices. However, information regarding the continuity between the biology of prehistoric and living pastoralists is limited due to the paucity of human remains.

This paper presents the results of bioarchaeological analyses of human remains associated with the archaeological site of Nakeidi in Samburu District, Kenya. Nakeidi, situated near the highland town of Maralal, consists of numerous cairns and stone circles consistent with other prehistoric pastoralist sites. Our multidisciplinary anthropological work investigates the relationship between Nakeidi and living pastoralist populations in the region. Some local Samburu elders suggest that numerous local cairns represent monuments associated with warfare and cattle raiding, while also identifying cairn areas like Nakeidi with mortuary practices no longer performed by living pastoralists.

The preliminary archaeological work at Nakeidi surveyed and identified more than 40 cairns. Surface collection and excavation of a small sample of cairns yielded skeletal evidence of at least 18 individuals representing adult men and women as well as several children. Osteological analyses indicate no evidence of trauma related to interpersonal violence, a low percentage of non-specific stress indicators, and stature values higher than those seen in living pastoralists. These observations along with culturally-derived dental modification, burial positioning, and the lack of grave goods provide supporting evidence for some continuity with historical predecessors of living Samburu.

#### **Milk composition and yield in primiparous and multiparous rhesus macaques (*Macaca mulatta*).**

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Variation in nursing behavior, maternal care, and infant outcome has been extensively studied in non-human primates and differences between primiparous and multiparous mothers are well established. However the influence of parity on milk composition and yield is less understood. Here I present data from 21 primiparous (mean age= 3.9 yrs, mean wt =7.2 kg) and 24 multiparous rhesus macaques (8.5 yrs, 9.0 kg) socially housed at the California National Primate Research Center. Milk samples were collected once between day 90 and day 120 postpartum. Multiple regression and t-tests were conducted using SPSS 12 with significance set at  $p < 0.05$ . No differences in percent fat, protein, sugars, or total gross energy (GE) of milk were observed between

the two groups. Milk yield, estimated from sample volume, was higher for multiparous mothers as a function of maternal weight ( $p=0.005$ ). Similarly as a function of maternal weight, energy transfer (GE \* yield) was higher for multiparous mothers than primiparous mothers ( $p=0.005$ ). For multiparous mothers energy transfer was associated with infant weight ( $p=0.046$ ), but not for primiparous mothers. However, primiparous mothers produced more concentrated milks for sons than daughters ( $p=0.021$ ), with significantly higher fat and protein concentrations, and sons of primiparous mothers weighed more than daughters ( $p=0.038$ ). These data indicate that although primiparous and multiparous mothers produce milk of similar composition, other aspects of milk production differ between the groups.

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#### **Fossil colobines from Asa Issie, Ethiopia and Lemudong'o, Kenya.**

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The Colobinae are relatively unknown from the African middle to late Miocene. When they appear in the Pliocene they are unambiguous and already fairly diverse taxonomically, geographically, and ecologically. Their early evolutionary history remains somewhat of a mystery. However, recently recovered fossil material from Lemudong'o, Kenya and Asa Issie, Ethiopia yield new insight to this period of colobine evolution.

The primate fauna from Lemudong'o is dominated by colobines, and therefore represents one of the richest fossil assemblages yet published of this subfamily 6 mya. At least three species of colobine are represented in this collection, including a new species of *Paracolobus*. Given the paleoecological reconstruction for Lemudong'o Locality 1, and the posterian morphology of the cercopithecids, colobines in this area were occupying a relatively closed habitat and exhibiting a primarily arboreal habitus, which contrasts with previous hypotheses suggesting that colobines prior to the Pliocene were terrestrial and occupying more open habitats.

Discoveries from Pliocene sediments in eastern and southern Africa document a radiation of large-bodied colobines very different from those known today. Paleontological research at the early Pliocene site of Asa Issie has recently led to the discovery and identification of another large-bodied colobine species. This new species is larger than but morphologically very similar to its sister taxon *Kuseracolobus aramisi*, an older taxon also described from the Middle Awash. This new species has significant implications for our understanding of the Pliocene colobine adaptive radiation.

#### **Canine dimorphism, dental growth, and the evolution of anthropoid mating systems: the platyrrhine angle.**

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Canine dimorphism is one of the best morphological indicators of mating systems in primates, being closely tied with male-male competition. Thus its evolution is important to understanding the evolution of social behaviors. These histories are difficult to parse, however, as size changes within teeth have a number of possible epigenetic routes and homoplasy is probably common.

Recent histological analyses have used enamel growth to help overcome this barrier, seeing growth patterns as potential developmental homologies. For example, these studies have discerned unique patterns differentiating catarrhine and notharctine primates, and have thus argued that anthropoids and notharctines achieved canine dimorphism independently. However, this "anthropoid" picture is incomplete due to the fact that these interpretations were limited to catarrhine data. Accordingly, the present study extends this work to other anthropoids by analyzing enamel growth in platyrrhines (*Cebus*, *Saimiri*, *Alouatta*, and *Ateles*) which show high canine dimorphism and varying degrees of male-male competition. By comparing enamel secretion rates and crown formation times, this analysis shows that dimorphic platyrrhines achieve larger canine sizes via faster growth rather than extended growth, contrary to the catarrhines. Since the evidence suggests that notharctines evolved dimorphism independently of anthropoids, as platyrrhines did of catarrhines, it seems that the monomorphic tarsiiforms are indicative of the haplorhine ancestral condition. This means that ancestral anthropoids may also have been monomorphic, setting the stage for parallel evolution of dimorphism in platyrrhines and catarrhines. This result paints a more complicated (albeit incomplete) picture of the possible pathways of anthropoid social evolution.

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#### **Dental microwear of the mandibular canines of Neolithic and early modern Japanese**

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Features of dental microwear of the striations and pits on heavily worn occlusal surfaces of teeth have been analyzed

comparatively to clarify the differences of foods. In the present study SEM (scanning electron microscopy) micrographs were taken at x500 from the high-resolution casts (Hojo, 1989, 2005, 2006; Teaford, 1988, 1994) of the canines of Neolithic and early modern Japanese of West Kyushu seacoast, and analyzed by Microwear Image Analyzing Software Version 2.2 $\beta$  (Ungar, 1996). Measurements in microns were as follows. On the labial mesial area of the Neolithic canine, the striations: n = 34, the mean length = 41.6, the mean breadth = 3.3; the pits: n = 8, the mean length = 17.0, the mean width = 11.9. On the canine of an early modern Japanese, the striations: n = 12, the mean length = 85.8, the mean breadth = 1.9; and no pit was observed. The mean length of the striation of the canine of an early modern was statistically significantly longer ( $p < 0.001$ ) than that of Neolithic, and the mean thickness of the striation of the canine of an early modern was statistically significantly thinner ( $p < 0.01$ ) than that of Neolithic. These features of the Neolithic canine may show coarse grain sizes of sand in foods.

**Sahara passage: the post-glacial re-colonisation of North Africa by mitochondrial L\* haplotypes.**

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The field of anthropological genetics has seen numerous studies examining North African genetic diversity, especially with regard to connections between North Africa, Iberia, and the Near East (see Plaza *et al.* 2003). However, as of yet the genetic relationship between North Africans and sub-Saharan Africans has not been adequately explored, even though nearly 30% of haplotypes among North Africans are sub-Saharan L\* haplotypes. The examination of the origin in space and time of sub-Saharan L\* haplotypes in North Africa, with particular emphasis on the genetic diversity of Libyans, is the primary focus of this research.

We analysed mtDNA sequences of native Libyans (N = 111) in concert with previously published North African sequences. We then determined the genetic relatedness between each distinct population. Finally, we calculated a coalescence date for the origins of the L\* haplotype, L3e, in our North African dataset. Our results show high genetic diversity among Libyans, as well as low genetic distances between Libyans and populations west of Libya. Our analysis also finds a coalescence date of 10.5 ka for the L3e haplotype. We conclude the arrival of L3e in North Africa confirms archaeological evidence of a post-glacial re-colonisation of the Sahara during the Holocene, and infers a prehistoric the arrival of L\* haplotypes into North Africa. Future research will include an analysis of Y-chromosome sequences, to examine any

potential sex bias, as well as analyses from the Sahel, in order to give a comparative picture of mtDNA diversity immediately south of the Sahara.

**A test of the relationship between health status and body proportions.**

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The relationship between trunk height and leg length has been central to the debate about modern human origins. Like modern African populations, the earliest modern humans in Europe have long legs relative to trunk height, in contrast with Neandertals, who exhibit arctic proportions. This difference in body shape has been widely interpreted as evidence that modern humans evolved in Africa.

Comparing Mayan children raised in Guatemala with those raised in the US, Bogin and Rios (2003) found that the latter have longer legs relative to trunk height, a difference they interpret as the effect of improved nutrition. They further argue that this link between body proportions and nutritional status may explain the difference between modern humans and Neandertals.

We tested the hypothesis that lower health status results in decreased leg length to trunk height ratio with a sample of low socioeconomic level (Blacks from the Terry Collection). Trunk height (STH) was estimated as the sum of vertebral dorsal body height and leg length was measured as femoral and tibial length. The sample was also scored for presence of hypoplasias, as a measure of health status. We found no significant difference in leg length/STH ratio between individuals with and without hypoplasias. Finally, we compared the Terry sample with a West African sample. The Terry sample had a significantly higher leg length/STH ratio than the African group, contradicting expectations that low socioeconomic status should result in decreased leg length. We discuss the significance of this find and future tests of this hypothesis.

**Characterization of palatal strains in *Sus domesticus*: implications for the mechanical behavior of the primate palate.**

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Mastication loads both the mandible and hard palate, and while the strain environment of the mandible is well documented, complementary data for the palate is sparse. The purpose of this study is to document in vitro strain patterns in the pig palate under controlled loads in order to inform theoretical models of the primate palate. In comparative studies, the palate is

usually modeled as a tapered beam (in bending) or as a tapered cylinder (for twisting), providing straightforward predictions of strain magnitudes and gradients, but at an unknown expense of accuracy.

Strain gages were bonded to multiple sites on the palate, including the midpalatal suture, of a *Sus domesticus* cranium exposed to cantilever bending and twisting. While idealized geometrical representation of the face and palate suggests a more or less constant strain gradient along the length of the palate, we did not observe monotonic increases or decreases in strains along its anteroposterior axis. Thus, neither tapered model is particularly informative for describing the palate's mechanical behavior.

The presence of sutures further complicates characterization of the strain environment of the upper jaw. Our data support the hypothesis that sutures experience a significantly larger amount of strain than the surrounding bone. At the midpalatal suture, strains are approximately an order of magnitude larger than the strains arising in adjacent bone.

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**Common origins: commensalisms between humans and chimpanzees in southeastern Senegal.**

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Conservation efforts surrounding nonhuman primates play an extensive role in supporting both the work of biological anthropologists and the populations in which they study. For many species of nonhuman primates, humans are an important environmental and ecological pressure whose impact must be considered. In southeastern Senegal the intensification of human contact with the Fongoli community of chimpanzees (*Pan troglodytes verus*) highlights the utility of integrating ethnoprimate research techniques with conventional behavioral data collection. Burgeoning human populations have led to the modification of landscapes and intensive extraction of resources key to chimpanzee survival. In this study, 52 interviews were conducted May-August 2005 with permanent residents from four culturally distinct human communities. These human societies live sympatrically with four species of diurnal primates including chimpanzees, vervet monkeys (*Chlorocebus aethiops*), patas monkeys (*Erythrocebus patas*), and Guinea baboons (*Papio papio*). Interviews assessed the interplay between human and nonhuman primates in this region while simultaneously addressing public health conditions inside and outside the villages. These interviews indicate that attitudes towards the nonhuman primates in this area vary and are affected by local folklore, religious beliefs and economic variables. For chimpanzees, the local traditions and stories appear to provide a protective status. The interviews also

revealed that the local people lack potable water sources and sanitary waste management. Available natural water resources tested positive for coliform and are thought to be exploited by each primate species. This exploitation draws all species into closer contact and may increase the likelihood of pathogen acquisition.

#### **Understanding the Origins of Millet Agriculture: Stable Isotopic Evidence**

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It is generally believed that millet agriculture, *i.e.*, cultivation of foxtail millet and broomcorn millet, originated in China, but precisely when and where is still debated. The earliest occurrences of millet agriculture, as evidenced by carbonized millet grains, phytoliths, and agricultural tools are associated with sites of the Peiligang, Cishan, Dadiwan, Houli, and Xinglongwa cultures, dating to nearly 8,000 years ago. Carbonized millet grains were recovered by means of flotation during recent excavations at the Xinglonggou Site, Inner Mongolia, dating to 8000 BP. Therefore, millet agriculture in the Early Chinese Neolithic took place not only in the middle and lower Yellow River Valley but also in the Western Liao River District. In this study, the stable isotopic composition of animal and human bones from two archaeological sites in the lower Yellow River Valley dating to about 8000 years ago was analyzed to investigate the contribution from millet, a C<sub>4</sub> plant, to human and animal diets. The results show that only about 20–30% of the protein consumed by humans was derived from C<sub>4</sub> sources, mainly millet or millet-consuming animals. This implies that millet agriculture was of limited importance during the Early Chinese Neolithic and still in an early stage of development. After comparison with isotopic data from other archaeological sites, it can be suggested that millet agriculture reached its acme somewhat later, during the Yangshao period. Finally, the origin of domesticated pigs in northern China is also discussed.

#### **Comparison between Yearly Attrition Rates and Skeletal Marker Aging in Four Samples**

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This study explores the feasibility of using tooth wear attrition method to determine age at death. Molar wear was assessed using the Scott method (1979). A population specific yearly wear rate is calculated, and an age scale is applied to the tooth wear using a modified Miles method (1978). The calculated age at death was compared with the available skeletal marker age at death estimates (e.g. pubic symphysis, auricular surface, cranial sutures, epiphyseal fusion, dental development, and dental eruption patterns).

Attrition rates were calculated in four samples—from Hierakonpolis 43, Egypt (n=177); Naga-ed-Dêr, Egypt (n=80); Mesheikh, Egypt (n=35); and Crenshaw, Arkansas (n=277)—to determine the consistency of this method. The mean ages at death are 38.5 years, 36.9 years, 32.7 years, and 47.9 years respectively. The dental attrition ages are consistent with traditional skeletal aging markers, except at Hierakonpolis, in which previously recorded skeletal aging results are dubious. Funded by NSF grant BCS-0119754.

#### **Assessing stress duration by means of linear enamel hypoplasias: a methodological comparison.**

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There has long been debate over methods for assessing the duration of stress episodes represented by linear enamel hypoplasias (LEH). The two principal methods in the literature include (1) the measurement of defect widths and, (2) the counting of perikymata (growth increments in enamel that form with regular time dependency) within defects. Though recent research favors perikymata counting, poor preservation of perikymata in archaeological samples complicates their use. Conversely, measurements of defect widths in archaeological samples can usually be made but their relationship to stress episode duration is ambiguous because perikymata are not uniformly spaced on the tooth crown. Using Hillson and Bond's (1997) suggestion that perikymata have characteristic spacing in approximate thirds of the tooth, this study investigates whether defect widths are good statistical predictors of the number of perikymata within defects when perikymata spacing is controlled.

130 dental casts from the Irene Mound Site, Georgia were observed for presence or absence of defects and the bilateral expression of LEH. Defect widths were measured and perikymata counted within defects in which they were visible. The fact that fewer than 20% of the defects exhibited perikymata underscores the difficulty with this method. The results of the statistical analysis indicate that width measurements and perikymata counts are strongly correlated when tooth region (*i.e.* perikymata spacing) is controlled. R-square values

increased 20 to 30% when tooth region was considered, which suggests that defect widths can be used in studies of stress episode duration provided that perikymata spacing is controlled.

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#### **Tooth shape and enamel thickness variation in primate teeth: An approach using topographic thickness maps.**

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Two processes constrain the form of a tooth: its formation and its function. Enamel thickness of unworn teeth reflects the first (the morphogenesis), while the form of the enamel surface determines the second. The description of function and the description of morphogenesis thus tap different aspects of the same surfaces. Information about the dento-enamel junction and the occlusal surface can be combined from microCT in a quantitative pattern analyses of the enamel all along both its surfaces.

To this end we present a method for computing and visualizing the enamel thickness based on hundreds or thousands of measurements, not just a few. While thickness is tricky to measure for volumes bounded by curving surfaces in general, a shortcut is feasible for the considerably simpler geometry of the enamel. We approximate by computing the 2D medial axis (Blum, 1973) on many planes through a perpendicular to the occlusal surface through its center. The 2D medial axis, defined as the locus of centers of circles inside the enamel that touch its edge at two or more distinct points, is approximated in turn by a chain of bisecting lines.

Double the altitudes to these bisecting lines approximate the thickness of the enamel accurately enough for our purposes. When the normal sections are woven back together, the separately computed radii fuse in a thickness-field on the medial surface that can be visualized by conventional color-graphical methods. In the present study we will demonstrate this method on several different teeth of hominids and compare it to another current method.

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#### **The Effects of Incomplete Selective Sweeps on the Site Frequency Spectrum.**

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The hitchhiking effect of complete selective sweeps elevates the number of high



frequency derived mutations, the presence of which can provide important clues to the history of a locus. Here, we examine the strength of the hitchhiking effect in various models of incomplete selective sweeps where the positively selected variants have not and may never reach fixation. We find that the site frequency spectrum for all models of incomplete sweeps is stochastically larger than the neutral spectrum with the magnitude increasing in tandem with both the strength and duration of selection. Balancing and frequency-dependent selection are characterized by a lack of rare mutants and an increase in common mutants, while directional selection is characterized by an increase in both rare and high frequency mutants with a reduction of common mutations. In general, the hitchhiking effect on the site frequency spectrum is much stronger at the level of an exon for incomplete sweeps than for complete sweeps. To assess the potential for detecting selection from the site frequency spectrum, we apply two goodness-of-fit tests to simulated data, Kolmogorov-Smirnov and Anderson-Darling, along with three classic tests for positive selection: Ewens-Watterson, McDonald-Kreitman, and Hudson-Kreitman-Aguada (HKA). While the goodness-of-fit tests outperform the McDonald-Kreitman and HKA tests, the Ewens-Watterson test provides equivalent power for frequency-dependent selection and higher power for directional selection. Though the site frequency spectrum of incomplete sweeps is informative, we conclude that the Ewens-Watterson test probably captures most of this information and is well suited for detecting very recent positive selection.

#### Seasonal variation in testosterone and cortisol in juvenile male, captive chimpanzees.

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Seasonal variation in hormones reflects physiological decisions as to how limited energetic resources can best be allotted to physical and behavioral needs. Many primates exhibit seasonality in testosterone and cortisol, usually in association with a seasonal pattern of reproduction. Seasonality in testosterone and cortisol has also been reported in humans, although not universally, despite the fact that humans are not seasonal breeders. We hypothesized that young, captive chimpanzees ( $n = 17$ , ages 5 to 9), living at the New Iberia Research Center in Louisiana, would not show seasonal variation in these hormones as chimpanzees are not seasonal breeders and because our sample consisted of pre-reproductive animals. Urine samples were collected between September 2000 and April 2001 and assayed for testosterone ( $n = 318$ ) and cortisol ( $n = 530$ ) using tritium (cortisol) and  $I^{125}$  (testosterone) radioimmunoassay. Contrary to our expectations, we found that testosterone levels were significantly lower in

the fall than in the winter, while the converse was true for cortisol. A practical application of this significant result is that longitudinal studies should plan for the possibility of seasonality in hormones, even in nonseasonal breeders. Furthermore, we suggest that primates living in seasonal environments may experience seasonality in hormone levels even if that species does not breed seasonally in the wild. These results may reflect the costs associated with maintaining high hormone levels year-round, and may also help us understand the causes of seasonality in hormones in humans.

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#### Analysing the taphonomy and palaeoenvironment of *Dryopithecus* and other vertebrate specimens excavated from the fossil forests of Rudabánya.

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This paper analyses the taphonomical and sedimentological data captured during recent palaeoanthropological excavations in the Grey Marl of the R2 locality at Rudabánya. Despite intensive excavation and research undertaken on the overlying Black Mud, relatively little is known about the underlying sediments, their fossils and the palaeoenvironmental conditions that prevailed during this early phase of deposition.

Vertebrate specimens (including frequent assemblages of micro-mammal bone fragments and teeth) were recovered from a laterally heterogeneous sedimentary 'transition' horizon found at the base of the Grey Marl. This horizon is characterised by a wood-mat consisting of randomly orientated, compressed trunk and log material that directly overlies the Lower Lignite. In the northwest, lacustrine claystones (Grey Marl) overly and infill depressions created by this wood topography. Recovery in 2006 of both *Dryopithecus* and *Anapithecus* confirm the presence of both primate taxa in this level. Towards the east, black claystone (Black Clay) was deposited by ponded water to the southeast of a large, southwest-northeast trending trunk. Transported bone material, in addition to occasional gastropod shells, collected and were preserved within these wood-mat depressions.

Preliminary analysis of the lateral extent and thickness of these sediments, together with the position and alignment of fossil material (both in association with the underlying wood) support a palaeoflow direction from southeast to northwest and west during the time of Grey Marl deposition. This is consistent with earlier assessments based on more limited data, and will serve to facilitate further association of specimens attributable to specific individuals.

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Sciences and Engineering Research Council of Canada grant.

#### Social coordination and gestural communication in a captive group of white-cheeked gibbons (*Hylobates concolor*).

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Extensive information now exists on the variation, structure, and ontogeny of gestural communication in the great apes and some monkeys, but much less is known about the use of gestures for communicating among the gibbons. 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. This study is based on more than 35 hours of preliminary observations of *Hylobates concolor* conducted at the Roger Williams Zoo in Providence, RI, during May-July 2006. The group consisted of one adult male, one adult female, and one infant female, approximately 9 months old, thus approximating a gibbon family from the wild. Both adults were experienced parents and had a long-term relationship with each other. Observations consisted of focal animal follows, all observed occurrences of gestural communication, and instantaneous timed samples. Observed gestures included facial expressions, body orientation, and specific actions such as holding out an arm to another individual. These gestures were used in various contexts including coordinating movement, approach, grooming, feeding, and play. The infant was engaging in increasing behavioral independence during the study period, providing many opportunities to observe the coordination of movement between her and the mother, as well as frequent play interactions with the father. While preliminary, these observations indicate that this species of gibbons does engage in a range of gestural communication, especially in the context of coordinating social movements.

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#### A 'Garden of Eden' in the Western Desert? Good health and long life among the Neolithic Egyptians of Gebel Ramlah.

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Against a backdrop of complex architecture, megalithic alignments, and sophisticated calendar circles, 67 sets of remains from three Final Neolithic (5,500-5,700 BP) cemeteries near Gebel Ramlah, in Egypt's Western Desert, suggest the populace of this formerly 'lush' region enjoyed

appreciable wealth, and gender- and age-based egalitarianism; the latter assumptions are based on an equal abundance of elaborate offerings in burials of both sexes and all ages. Allied with or perhaps as a result of this seemingly idyllic setting, is a lack of hard tissue pathology and trauma, and a high average age at death relative to many time-successive Egyptian and Nubian samples. For example, contra Gebel Ramlah, skeletal and dental pathology/trauma is common among predynastic Egyptians from Hierakonpolis, Kerma Nubians from the Northern Dongola Reach, and Late Paleolithic Nubians from Jebel Sahaba, among others.

Additional factors augmenting the Neolithic population's well-being include evidence for a semi-nomadic lifestyle and a herding/intensive-collecting economy. Nomadic peoples are, of course, often healthier than permanently settled groups, and the food-gathering strategy used here likely enhanced diet diversity and caloric intake, while avoiding the nutritional deficiencies inherent with the dietary specialization of agriculturalists. Thus, assuming that the present sample is representative of the general populace, and poor preservation and high attrition are not major factors in masking the incidence of skeletal and dental disorders, then the apparent good health and long life experienced by many Gebel Ramlah individuals suggest they were fortunate enough to have inhabited a very favorable place and time.

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#### **Effect of habitat and sex on body mass and morphometrics of diademed sifakas (*Propithecus diadema*).**

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Forest fragmentation often leads to the extirpation of many primate species, and has been shown to cause significant shifts in diet, ranging and social behavior in those that persist. However, those species that do persist in the short term may suffer fitness consequences due to behavioral shifts, and may represent population sinks in the long term. Few studies have demonstrated direct links between habitat fragmentation/degradation and body condition or fitness; such data would aid in understanding threats and setting conservation priorities. In this study we present body mass and morphometric data from live capture of wild sifakas (*Propithecus diadema*) at Tsinjoarivo, eastern Madagascar (intact forest: n=16; fragments: n=16). For adults, body length does not differ between

habitats, but animals are heavier in intact forest. The sexes do not respond equally to fragmentation: females show a small and non-significant reduction in fragments while males show a more striking and significant reduction. These trends are mirrored (and exaggerated) in "body condition index" (mass divided by body length). Additionally, same-aged immatures are generally heavier in intact forest and lighter in fragments (n = 16 captures; range 1.4 to 5 years). These data suggest that living in fragments ultimately leads to reduced body mass and condition; the proximate mechanisms remain unclear but reduced food quality and increased parasite burden are possible culprits. The fact that males and immatures suffer the greatest effects may be because the social dominance of adult females allows them to retain access to higher-quality resources in lower-quality environments.

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#### **Patterns of geographic variation in hands and feet of *Pan* and *Gorilla*.**

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The study of geographic variation in African apes provides important insight into the divergent evolutionary histories of *Pan* and *Gorilla*. Research on variation in craniodental morphology and genetics has revealed substantial geographic patterning within each genus, as well as differences between genera in the extent of variation between geographic groups. Greater distinctiveness between subspecies and populations has been found in *Gorilla* than in *Pan*. This study addresses whether this difference between *Pan* and *Gorilla* in patterns of geographic variation is reflected in postcranial morphology.

Thirty-two linear measurements were collected from five bones of the hand and foot in samples of *Pan* (n=211) and *Gorilla* (n=209). Using discriminant analyses of twenty-two measurement indices, distinctiveness between groups was assessed at the species, subspecies, and population levels within each genus. Separate analyses were conducted for males and females, and for hands and feet. Higher rates of correct classification were found in *Gorilla* groups than in *Pan* groups, especially at the subspecies level.

Potential relationships between body size and discrimination of subspecies were examined using Pearson correlation analysis of three body size proxy measurements and canonical scores from subspecies-level discriminant analyses. All significant correlations were weak; body size differences do not appear to drive morphological differences between subspecies.

Based on hand and foot bone morphology, greater geographic variation is seen in

*Gorilla* than in *Pan*. This difference, also seen in craniodental and genetic studies, may reflect demographic and ecological differences which have shaped the divergent histories of the two genera.

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#### **Monkeys in the ecosystems of Koobi Fora through time.**

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The Old World monkeys from the Koobi Fora succession provide important insights into the evolution of the group and the ecological roles played by different species. The first concerns the rise of the large-bodied colobines from about 2.3 – 1.6 mya. This assemblage is remarkable because it consists of mostly terrestrial species, which bore anatomical similarities to modern, large-bodied Asian colobines and disappeared from the Turkana Basin about 1.6 mya. The second is the story of the "*Theropithecus* dynasty", from putative early Pliocene origins, to the rise and fall of *T. brumpti* in the Pliocene, the ascent of *T. oswaldi* in the late Pliocene, and the dominance of *T. oswaldi* through the Middle Pleistocene. The third relates to the ecological relationships between the colobines, *Theropithecus* species, and non-primate herbivores. The Koobi Fora record indicates that monkeys declined in their diversity and ecological dominance by about 1.5 mya, and that the niches they occupied were largely taken over by non-primate herbivores that could travel greater distances to forage. The fourth concerns the emergence of the a mostly modern cercopithecoid fauna comprising *Theropithecus oswaldi*, and a true colobus monkey, and a near-modern mangabey by the Middle Pleistocene. The final important insight relates to the rise of *Papio* baboons. The absence of *Papio* baboons from the Koobi Fora Formation is significant. Subspecies of *Papio hamadryas* are the dominant terrestrial primates in Africa today, but their appearance in East Africa in the Middle Pleistocene was sudden, coincided with the final disappearance of *T. oswaldi*, and can be traced to southern Africa.

#### **The effects of observer presence on the behavior of three groups of *Cebus capucinus* in Area de Conservación Guanacaste, Sector Santa Rosa, Costa Rica.**

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Although habituation is a vital preliminary activity to collecting behavioral data on wild primates, very little is known

about the process of habituation and the long-term effects of observer presence on behavior. We report on behavioral responses of *Cebus capucinus* to observer presence over four weeks. Prior to our study each group was habituated to varying degrees: (1) CP group: behavioral studies began in 1984 and continue to present; (2) EX group: focus of a one-year study on males from 1998-1999, and; (3) BH group: never studied/observed but the group has been exposed to researchers working on other projects in their home range. As expected, BH displayed significantly more observer directed behaviors (looks, watches, threat faces, threat displays) than the other two groups and showed a significant decrease in the frequency of looks and the duration of watches throughout the study. EX did not differ significantly from CP for any of the behaviors measured, although they did show a marked, but non-significant, decrease in observer directed behaviors over time. CP displayed only minimal responses to observer presence (lowest number of looks and threat faces, lowest duration of watches, and the only group without a threat display), and their responses were constant over time. Scan data collected on group state (calm vs. agitated) also supported our expectation that repeated exposure to observers lessens the response of subject animals; over time both BH and EX displayed an increase in the proportion of group scans that were calm, while CP showed no change.

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#### **The role of social learning in the acquisition of foraging skills in wild Bornean orang-utans (*Pongo pygmaeus*).**

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Most studies of learning mechanisms rely on laboratory experiments, yet to resolve the debate on the existence of animal cultures, we need studies from the wild. In an extensive observational field study of wild Bornean orang-utans, we examined the age trajectory of acquisition of adult diet and foraging skills among immatures, and the relative importance of individual exploration and vertical social transmission in this process. Based on almost 1700 hours of focal observation, we found, first, that infants selectively watch the mother when she performs a task that is difficult for them and subsequently practice these tasks, allowing them to learn about complex foraging techniques. Second, infants selectively beg, and mothers selectively share foods that infants find difficult to process, providing infants with information about the affordances of such food items. Third, infants hardly ever discover novel food items on their own but follow their mother before they can select food independently. As a result, by the

age of weaning, diets of mothers and infants are virtually identical. Thus, wild orang-utans appear to learn both the composition of their diet and the feeding skills used, socially, through local enhancement, food sharing, selective observational learning and practice. Their education, like that of other great apes, is characterized by curiosity and motivation to imitate by the infant, supported by high social tolerance by the mother. This system of vertical skill transmission probably is the foundation from which culture evolved.

#### **Skeletal height estimation in precontact and postcontact adult populations in northern coastal Peru**

G.J. Jakubowska – The Ohio State University, Department of Anthropology

Skeletal height estimation is one of the components of an individual's biological profile and can provide insight into the past conditions that influenced health and quality of life. The Fully method incorporates all elements of a skeleton directly contributing to skeletal height; this method was applied to estimations of skeletal heights of precontact and postcontact males and females living in northern coastal Peru. Percentage contributions of body segments to skeletal height were computed and missing values were calculated based on these computations. Furthermore, regression equations estimating skeletal height from bicondylar femoral length, maximum femoral length, standard tibial length and foot height, or the combination of any of these segments, were developed for a sample of precontact males and females, postcontact males and females and a combined sample of males and a combined sample of females. This study tested the hypothesis that precontact individuals had higher skeletal height than postcontact individuals. The results contradict the hypothesis due to human variation, poor preservation, osteological paradox, errors stemming from percentage calculation or the combination of any of these factors. The results show that the sample of combined males was, on average, 9.5 cm taller than combined sample of females; postcontact males were 1.5 cm taller than precontact males; postcontact females were 2.86 cm taller than precontact females. The results also indicate that postcontact females were less affected by detrimental social and political conditions during the early years of contact because the skeletal height difference was decreased in that sample, as compared to precontact sample.

This research was supported by a Wenner-Gran Foundation for Anthropological Research dissertation fieldwork grant awarded to Haagen Klaus (The Ohio State University, Department of Anthropology) (GR 7302).

#### **A comparison of mitochondrial diversity in the Papua New Guinea Highlands, islands in the Bismarck Archipelago, and Easter Island.**

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Developing mitochondrial DNA (mtDNA) surveys in different regions of the Pacific are revealing highly significant differences in molecular variance across the populations. The likely determinants of these differences are a) length of time since first settlement, b) the comparative isolation of particular islands or regions since initial settlement, and c) the effective sizes of settlement areas (e.g., island sizes). The populations compared in this study are from a) the Eastern Highlands of New Guinea, b) four islands of Island Melanesia of different sizes (Manus, New Britain, New Ireland, and Bougainville), and c) Easter Island in eastern Polynesia. While there is some confounding of these explanatory variables, the results of our analysis indicate that the last two variables explain more of the pattern of variance than the length of settlement time.

#### **The effects of ethnicity and oral contraceptive use on diurnal electrolyte regulation over the menstrual cycle.**

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Altered renal electrolyte handling over the day has been suggested as a key element in the ethnic differences in blood pressure pathology between African American (AA) and European American (EA) women. Oral contraceptive (OC) use has also been shown increase the level of hormones that regulate electrolyte excretion during the day. There is little information as to whether OC use affects electrolyte balance differently in AA and EA women. The purpose of this study was to compare PRA, and urinary sodium, potassium and aldosterone excretion measured in contrasting daily environments (at work, at home and during sleep) in the follicular (day 7-10) and luteal (day 19-25) phases of the menstrual cycle in 24 AA (age=34.4±7.7) and 31 EA (age=36.2±6.3) women who were either taking (5 AA, 6 EA) or not-taking (19 AA, 25 EA) OC. The results of repeated measures ANOVA revealed that overall AA had lower PRA (p<.007), women taking OC had higher PRA (p<.001) and that OC disrupted normal PRA changes over the menstrual cycle (p<.023). Sodium excretion increased from the follicular to luteal phase for AA and EA not on OC and EA on OC, but among AA on OC it declined (p<.036). Ethnic differences in potassium excretion were unaffected by OC. Finally, Aldosterone levels were increased among EA on OC but not among AA on OC in both phases and in all daily environments (p<.003). These results suggest that OC may influence electrolyte

balance and regulation differently in AA and EA women.

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**Predator detection and the evolution of primate sociality: insights from experiments on a rain forest primate.**

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Predation risk is a common fact of life for most primates, and is often suggested as one of the factors favoring social living. A major possible mechanism to reduce individual predation risk in groups is anti-predator vigilance, but published data on vigilance patterns in the wild primates yield contradictory results. Problems of studying the effectiveness of anti-predator vigilance in the wild arise from 1) the difficulty in assigning purpose to specific bouts of vigilant behavior, and 2) the rarity and incomplete observation of predator encounters with primates. I have studied the ability of wild group-living capuchin monkeys to detect ambush ('sit-and-wait') predators in a subtropical forest in Argentina, using inanimate models of the predators to mimic the detection situation. Results from three field seasons show that detection of such predators by capuchins is extremely difficult. An individual capuchin has to approach to within less than 2m (horizontal distance) from an ocelot to detect it 50% of the time, and within 4m of a perched hawk-eagle. Detection of moving predators by capuchin monkeys is much better, with detection occurring half the time at 8m and 12m for ocelots and hawk-eagles, respectively. These data imply that capuchins, and perhaps other forest primates, should not be able to detect predators until they are mobile, probably during an attack. Because of the speed of predator attacks, the interval between detection and the arrival of the predator is likely to be very short, thus strongly limiting the benefit of early warning to other group members.

**Body proportions in recent Native Americans: Do they really follow ecogeographical rules?**

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Since the early work of D. F. Roberts, and later M. T. Newman, patterning of Native American body size and proportions in relation to climate has been accepted as an expression of the ecogeographical rules of Bergmann and Allen. Investigation of ecogeographical patterning has been hampered by lack of data. That lack has been partially remedied by the discovery of Boas's anthropometric data of Native Americans, including approximately 7,000 adults from all over North America. Boas's data do not include weight, so weight or BMI cannot be

addressed. However linear dimensions and proportions, specifically trunk length-leg length relationships can be examined in greater detail than has heretofore been possible.

This paper examines the patterning of height and trunk-leg length relationships in relation to January minimum temperatures and July maximum temperatures. Native Americans display extreme variability. In relative sitting height (SH/S) they overlap with the entire rest of the world. Groups with relatively long legs include those from the Northeast, Southeast and Plains, some of which approach African populations. Groups with relatively short legs include those of the Arctic and Northwest Coast, which are in the Asian range. Some of the variation can be explained by the positive allometric relationship between leg length and stature. Tall groups tend toward low relative sitting heights, while short groups have high relative sitting heights. There is a relationship between relative sitting height and temperature, but it is complicated. It is likely that population movements have influenced size and proportions to a greater extent than climate.

**Inter-individual variation in levels of reproductive hormones in human females: Genotype-diet interaction.**

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Inter-individual variation in estrogen levels in women of reproductive age results from variation in developmental conditions, adult lifestyle factors, and genes involved in sex-steroid biosynthesis, for example *CYP17*. In Polish women those with *A2/A2 CYP17* genotype had 54% higher mean estradiol levels in menstrual cycles than women with *A1/A1* genotype ( $p = 0.0001$ ) and 37% higher than women with *A1/A2* genotype ( $p = 0.0008$ ). Heterozygous *A1/A2* women had 13 % higher E2 levels than homozygous *A1/A1* women. Therefore, the presence of the A2 allele seems to be beneficial since high estradiol levels are linked to higher ability to conceive. However, in all studied populations, the alleles coding for high estrogen levels occur with lower frequency than alleles coding for low estrogen levels. I propose that alleles coding for high levels of steroid hormones became beneficial during human evolution only after the origin of agriculture, when humans began to consume large amounts of foods potent to reduce levels of steroid hormones. Introduction of agriculture increased consumption of phytoestrogens. In addition, agriculture-based diet provided favorable, high-carbohydrate intestinal environment, rich in bacteria, which aid in phytoestrogen synthesis from dietary precursors, and consequently increasing circulating levels of high potency phytoestrogens. Phytoestrogens show high affinity for estrogen receptors and can also interfere with estrogen synthesis, and consequently phytoestrogen consumption

may reduce levels of endogenous steroids hormones. Reduced levels of ovarian steroids lead to reduced fecundity and also to estrogen-dependent health problems (such as cardiovascular, bone, and immune function).

**Brain ontogeny in infant baboons (*Papio hamadryas*).**

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Different ontogenetic pathways in primate brain development may have profound implications for understanding primate life history and cognition. Advances in magnetic resonance imaging (MRI) technology resolve numerous limitations of traditional data on brain size ontogeny and life history, enabling unprecedented insights into the dynamics of brain ontogeny.

This study investigates brain growth patterns in captive baboons (*Papio hamadryas*) using MRI, testing the hypothesis that brain growth occurs primarily in the first year of life. To test this hypothesis, we obtained longitudinal MRI data using a 3T scanner from five infant baboons (16 observations obtained under strict IACUC-approved protocols). Total brain volume and gray/white matter volumetric changes were measured. Ages span 12 days to 32 weeks.

Results indicate that total baboon brain volume increases from 85 cm<sup>3</sup> to 130 cm<sup>3</sup> by 32 weeks (83% average female adult size, 70% adult male size). Myelination occurs rapidly, comprising approximately 5% of total brain volume by 2 weeks, 25% by 32 weeks. The brain growth curve is characterized by rapid non-linear acceleration of growth in the first weeks of life.

These results support the hypothesis that baboons reach adult brain size quickly, and further suggest that adult neural architecture is achieved at a rapid pace. MRI findings are compatible with field observations associating rapid cognitive development with complex physical and social environments. The implications of these patterns for primate cognitive and life history evolution are discussed.

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**A quantitative trait locus study of the mouse femur: investigating the genetic basis of characters relevant to hominid evolution.**

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The genetic basis (if any) of skeletal characters must be characterized before they can be used to make inferences regarding function or phylogeny. The interpretation of femoral morphology in fossil hominids, from *Orrorin* through Neanderthals, has been complicated by the lack of information on the degree of genetic control over femoral dimensions. To provide such data, we carried out a quantitative trait locus (qtl) mapping study of the mouse femur. QTL studies compare phenotypic and genotypic variation across individuals to identify genetic markers that co-vary with the traits of interest. Our sample consisted of ~200 mice (UM-HET3), each of which was genotyped for 100 markers. Three phenotypic traits of the femur were examined using micro-CT scans: neck-shaft angle, neck length, and total length. For neck length, we found two significant loci on two chromosomes. For total length, we found eight significant loci on five chromosomes. No loci were identified for neck-shaft angle. These results provide insight into the genetic basis, and independence, of these femoral features in mice. Given the generally conserved nature of the genetic architecture, these results can be used with caution to draw inferences regarding the genetic basis of these features in other mammals (e.g., hominids). Even so, additional work is needed to identify the specific genes involved and extend the work to primates.

#### **Bioarchaeological analysis of motives for pre-Columbian Peruvian trepanation.**

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Trepanation is considered the oldest recognizable form of surgery, but reasons for its practice remain obscure. Evidence from pre-Columbian Peru suggests trepanation was practiced as a therapeutic treatment for cranial injuries sustained in combat (Hrdlička 1914; Stewart 1958). This evidence includes cases of trepanation associated with cranial fracture, reports that adult men are trepanned more frequently than adult women, and suggestions that trepanations are more frequently located on the left side of the skull, presumably due to a blow from a right-handed assailant. However, much of this evidence is based on isolated cases or small samples (Verano and Williams 1992). Where large samples have been used, the percentage of trepanned individuals with associated cranial fracture remains relatively low (e.g., Verano 2003).

The current study uses bioarchaeological evidence to assess motives for trepanning in pre-Columbian Peru. A sample of 53 pre-Columbian Peruvian trepanned crania from the Hrdlička Collection at the San Diego Museum of Man is analyzed for evidence of fracture and pathology. Eighteen specimens (33.96%) have at least one trepanation

associated with fracture, while one specimen exhibits non-traumatic pathology. Chi-square analysis reveals there is no significant difference in the frequencies of trepanned adult males and adult females, nor is there a significant difference in the distribution of trepanation locations on the cranial vault. Therapeutic treatment of cranial fracture may have been a primary motive for trepanning in pre-Columbian Peru, but other motives cannot be ruled out. Methods for evaluating magicotherapeutic and magicoritualistic motives using skeletal evidence are explored.

#### **The effect of ecology on the muscle and skeletal anatomy of two macaques.**

L.E. Johnson. Department of Anthropology, University of California, Santa Cruz.

The locomotor behavior and ecology of an organism is hypothesized to exert a strong selective pressure on its muscular and skeletal anatomy. For instance, P.S. Rodman (1979; Skeletal differentiation of *Macaca fascicularis* and *Macaca nemestrina* in relation to arboreal and terrestrial quadrupedalism; Am. J. Phys. Anthropol. 51: 51-62) observed skeletal adaptations of *M. fascicularis* that support climbing and leaping, whereas *M. nemestrina* possessed skeletal adaptations in support of cursoriality. Here I further test the association between macaque anatomy and locomotor behavior. I conducted a muscle by muscle dissection of *M. fascicularis* and *M. mulatta*, a species with locomotor habits intermediary between *M. fascicularis* and *M. nemestrina*. My results show that *M. mulatta* exhibits traits that are associated with versatile locomotor behaviors. This result is consistent with behavioral observations, which report that *M. mulatta* spends approximately 28% of their time in an arboreal context. My results also support Rodman's conclusion that *M. fascicularis* exhibits traits that are associated with frequent climbing and leaping. An additional cross-sectional analysis of a random sample of individual muscles was performed to count fiber numbers. These results will be discussed along with the implications of this study for modeling the locomotor behavior and ecology of primates in the fossil record.

#### **Lack of inbreeding avoidance and reduction of alliance formation in matrilineally-housed bonobos (*Pan paniscus*).**

E.M. Johnson. Evolutionary Anthropology Graduate Program, Washington State University.

Wild bonobo females transfer at sexual maturation into groups without kin. Non-related females perform GG rubbing and grooming to form alliances, and females may mate indiscriminately without risk of incest. The present study investigated social dynamics of a captive bonobo group with a

matrilineal core: three adult sisters, their offspring, and an unrelated adult male. It was predicted that these females might demonstrate reduced alliance formation with one another as measured through time spent in proximity and GG rubbing, and that incest might occur because females were housed with their sister's adult sons. 79 hours of 10-minute focal animal samples were collected at San Diego Wild Animal Park in January and June 2006. GG rubbing was absent between sisters, as well as between mother-daughter pairs. Maternal females divided their time equally between their sons (28% of total focal observation time) and their sisters (27%). The largest percentages of total grooming time were between the dominant maternal female and the unrelated male (19%) and between the lower ranking mother and her son (17%), suggesting that alliances were strongest between male-female pairs. Adult sons of two of the sisters formed extended sexual relationships with their own aunts (n1= 22, n2=16). Sexual interactions also occurred between males (n= 8 bouts), father and daughter (n1=6, n2=4) and brother and sister (n1=12). These findings suggest that matrilineal groupings result in reduced sociosexual interaction between females, and that female bonobos may lack behavioral incest avoidance mechanisms for males other than their own sons.

#### **Relationship of childhood socioeconomic conditions and cohort (historical microenvironments) to adult nutritional status in Blackfeet women.**

S.L. Johnston. Department of Anthropology & Sociology, West Chester University.

Variation in adult nutritional and reproductive status within populations provides a potential opportunity to examine the long-term effects of childhood experiences that vary with socioeconomic (SE) conditions. As reported elsewhere (Johnston 1999), Blackfeet Indian women of Montana demonstrate cohort variability in some measures of adult body size/composition. This paper examines the influence of childhood SE factors on measures of adult nutritional status in this group.

A probability sample of 150 women ages 18-93 was surveyed in person in 1995-96. Interviewers collected complete reproductive histories; sociodemographic data, including details about the childhood home, living conditions, and parental tribal affiliations; and primary and secondary sources of food in childhood. Anthropometric measurements were obtained using standard techniques. Analyses employed ANOVA, ANCOVA, and regression to examine the influence of variables considered to reflect childhood SE conditions.

In stepwise models, larger BMI was associated with participant's mother being fully Indian-identified and childhood home having fewer rooms, controlling for parity and age (model R<sup>2</sup> 0.09). Greater sum of skinfolds was associated with the same variables plus

younger age at interview ( $R^2$  0.14). Mid-upper arm circumference was associated with mother's tribe and fewer rooms, controlling for age ( $R^2$  0.09). ANOVA and ANCOVA models incorporating cohort and one or more of these SE variables produced higher  $R^2$ 's.

These results suggest a possible enduring influence of childhood SE factors on adult body habitus in Blackfeet women. The findings are interpreted and discussed in a biocultural context, including the notions of historical microenvironments and the canalization of poverty.

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### Ecology, history and society as determinants of hybrid zone structure in baboons.

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The many allotaxa of baboons (*Papio*) are variously classified into one, two, five, or multiple species. More interesting than their formal taxonomy is the nature of their interactions -- including taxon-structured hybridization -- where their natural ranges meet. Information from two baboon hybrid zones: the two-taxon zone in Awash National Park, Ethiopia (hamadryas and anubis baboons; *P.hamadryas* and *P.anubis*), and the three-taxon zone in the Luangwa Valley, Zambia (Chacma, Kinda, and yellow baboons; *P.ursinus griseipes*, *P.cynocephalus kindae* and *P.c.cynocephalus*, respectively) lends partial support to four theoretically-derived predictions about hybridization in general, and baboon hybrid zones in particular: 1) that zones of contact and hybridization in baboons tend to occur at ecotones 2) that hybrid zones in general tend to stabilize in areas of relatively low habitat productivity 3) that in male-dispersal species the distribution of mtDNA variation tends to be more sharply defined than that of nuclear genetic variation, and the phenotypic characters it determines 4) that hybridization between taxa that differ in body size and/or social behavior will tend to be asymmetrical.

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### The OY ratio for a large late prehistoric site.

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The methodology used by Caspari and Lee in their 2004 paper on longevity has been met with criticism. They create an old adult to young adult (OY) ratio for

australopithecines, early *Homo*, Neandertals, and early modern humans, and state that an increase in these ratios through time is evidence of increased longevity. This presentation will create an OY ratio for Averbuch, a Mississippian site in Tennessee, which can then be compared to Caspari and Lee's ratios.

The Miles method utilizes the molars from the juvenile portion of a skeletal assemblage to determine a tooth wear rate that may be projected into adults to determine age. The Miles method was applied to Averbuch using molar wear scores from the 761 individuals with teeth and dental development ages of the 254 juveniles in the sample. Transition analysis was performed using the NPHASES2 program on the juvenile portion of the sample, providing the number of years it takes to transition from one wear score to the next. These functional ages were then added to the eruption age of teeth, specifically the third molar, providing adult age. Using these ages, the OY ratio calculated for the Averbuch site is 0.51, which is vastly different than the Caspari and Lee ratio for early modern humans of 2.08. Averbuch is more closely aligned with the Neandertal ratio of 0.39. Therefore, it seems unlikely that what Caspari and Lee are calculating is longevity since individuals in the same taxonomic group should have similar OY ratios.

Data collection was supported by NSF grant number BCS 9307693.

### Early life pollutant exposure of enslaved Africans in colonial New York: a microspatial analysis of dental enamel lead

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This paper focuses on the infant and childhood lead burdens of enslaved Africans who were buried at the 18<sup>th</sup>-century New York African Burial Ground (NYABG). For this study, we asked: (1) who was most at risk for high-level lead exposure; (2) at what age did earliest exposure occur; and (3) how did these factors influence observed health outcomes? We assessed early life exposure by analyzing first molar enamel, which archives elemental exposures from ~ birth to 4 years, after which their crowns are fully developed. Micro-spatial analysis of enamel allows chronological reconstruction of exposure events and, using laser ablation-inductively coupled plasma-mass spectrometry (LA-ICP-MS), we were able to achieve sampling resolution at the micrometer scale.

We analyzed first molars of 40 individuals including children and adults with and without culturally modified teeth (CMT) that are indicative of African natality. Individuals from all groups experienced distinct periods of elevated exposure that began, in some cases, at or before birth.

Elevated lead concentrations in children without culturally modified teeth affirms that they most likely were born into the relatively lead-enriched colonial American environment. The mean lead concentrations for children (5.9  $\mu\text{g/g}$ ) is approximately six times that of adults with CMT (0.9  $\mu\text{g/g}$ ) and for "nonmodified" adults (1.0  $\mu\text{g/g}$ ). Children's enamel lead distribution patterns were also more variable, suggesting more acute exposure events. Ongoing research includes obtaining lead isotope data to help discern lead sources. We discuss these and other findings and explore potential sources and health consequences of lead exposure for enslaved Africans in colonial New York. Financial support provided by NSF-CRUI #9978793.

### Secular trends of the European male facial skull from the Migration Period to the present.

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We examined secular trends in the facial skull over three Central European samples spanning more than 13 centuries. Data are 43 conventional cephalometric landmark points for samples dating from 680–830 CE, from the mid-19<sup>th</sup> Century, and from living Austrian young adult males. Methods of geometric morphometrics demonstrate shape differences across the samples, and also differences in allometry. There is a strong interaction between these, so that group mean differences are different for small and large individuals (equivalently, allometry is different from period to period). The oldest sample, from the Migration Period, exhibits allometric features that may possibly be Turkic. There are implications for the craniofacial biologist interested in growth trends or growth predictions in ethnically mixed populations. There are also implications for the discussion concerning the morphology of the Avars (an ethnic group of probably Central Asian origin who conquered large parts of Central Europe during the Migration Period and who interbred with other incoming groups after their conquest by Charlemagne), and also the relation of these findings to current thinking on gnathic reduction trends.

### Violence and death in Mongol Altai mountains during Iron Age.

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Pazyryk civilization was a nomad population with probable Middle-East origin that inhabited the Altai Mountains (Mongolia, Russia, Kazakhstan and China) during the Iron Age. They could be the ancestors of the present-day inhabitants of this region, who differ cultural and biologically from the majority of Mongolia population.

An archaeological mission, set up by a multidisciplinary team from Spain, France and Mongolia and lead under the aegis of the European Union since 2004, took place during the months of June and July of 2006 in Mongol Altai mountains with the aim to excavate Pazyryk graves. The analysis of funerary rituals, the demographic and paleopathologic analysis as well as the study of skeletal activity marks and population origin, will contribute to enhance the current knowledge about this ancient culture.

At the end of the mission 6 tombs were excavated and the skeletal remains of 8 human and 8 horses were recovered. The necropolis consists in privileged inhumations, majority adult men, deposited in a funerary room at approximately 3 meters of deep with some artifacts (gold, iron knife, combat pick, ceramic, sheep bones). Close to the funerary room, at north side, a sacrificed horse was also deposited. By the moment, the most relevant founding was the signs of violence and ritual manipulation observed in some skeletons that suggest violent practices in Mongol Altai Mountains during the Iron Age. Perimortem incise injuries probably related with the cause of death were observed in cranial, thoracic and pelvic region of some skeletons.

#### **Skeletal evidence of aggression in humans and African apes: An evolutionary perspective.**

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Human osteological data gathered from Central Californian and Sudanese Nubian samples are compared with large skeletal collections of African great apes: *Pan troglodytes troglodytes* (N=127), *Pan troglodytes schweinfurthii* (N=14), *Pan paniscus* (N=56), and *Gorilla gorilla gorilla* (N=136). The most reliable osteological evidence of intraspecific aggression are craniofacial fracture and weapon wounds. Fracture prevalence varies in the human samples (2.7% in California, 0% in Nubia). Chimpanzees and gorillas are more involved (7.8% in chimpanzees and 11.0% in gorillas); bonobos have 3.6% involvement. Weapon wounds (embedded projectiles) in the California site (Ala-329; N=237), are found in 5.1 % of individuals. Apes also use anatomical "weapons" to inflict bite wounds;

such injuries occur in 3.1% of chimpanzees, 3.7% of gorillas, and 0% in bonobos.

From an evolutionary perspective, the most salient feature of these lesions is the sex distribution. At Ala-329 males have all 6 fractures ( $p = .03$ ), and more projectile injury involvement, but this difference is not significant ( $p = .52$ ). For the entire ape sample (N=333), there is an anatomically complex pattern, with 100% of vault injuries in females, and 89.0% of facial lesions in males ( $p = .001$ ). In apes, males have all eight instances of bite wounds ( $p = .002$ ). For all facial injuries in apes, males show 90% (18/20) of all involvement ( $p = .001$ ). As seen in these skeletal data, and, as well-documented in contemporary epidemiological data, male-male aggression is significantly more common. Given the close genetic relationship of humans and African apes, a long evolutionary legacy explaining aspects of human aggression is evident.

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#### **Cranio-dental morphology and variation in the earliest Indonesian hominids.**

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Hominid remains from the lower stratigraphic levels of Sangiran (the Grenzbank/Sangiran assemblage) are the oldest sizable hominid fossil collection so far known from eastern Eurasia, and thus hold the key to searching for the origin of the earliest settlers of this region. Furthermore, this is one of the few sizable collections of earlier *Homo*, along with the African and Georgian collections, and is important for the understanding of the paleobiology of earlier groups of our genus. In this paper, we summarize cranio-dental morphological characteristics of this Sangiran collection, and attempt to interpret them within the wider context of the Afro-Eurasian fossil records.

The Sangiran remains are characterized by a combination of relatively primitive (narrow dental arcade, large tooth size, root morphology, etc.), advanced (cranial capacity, well-developed supraorbital torus), and their own unique features (thick cranial bones, robust mandibular body). One notable observation is that all the East African, Georgian, and Javanese collections of earlier *Homo* show considerable degrees of morphological variation, at least in their masticatory apparatuses. One plausible explanation for this trend is that the crania of earlier groups of *Homo* were highly sexually dimorphic in nature, but there seem to be some difficulties surrounding this simple interpretation. Their patterns of dimorphism inferred from the small available samples are not consistent across the collections. Within

the Sangiran assemblage, the characteristics of robust and gracile specimens are not necessarily concordant respectively with the diagnostic male and female features of living humans and apes.

#### **Predicting within-species variation in primate behavior and ecology: A quantitative approach using comparative methods.**

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With the increasing amount of quantitative data from several populations of a species, biologists have recently used within-species variation as a powerful test of adaptation. In primates, many species have been well-studied at various sites, yet we have little knowledge of the factors responsible for among-site variability. The objective of this project was to test several hypotheses explaining the amount of within-species variability in primate social organization, diet, and activity budget. Data for a total of 275 populations from 37 primate species were collected from the literature. Multivariate techniques were employed to calculate the amount of within-species variation in each of the three behavioral datasets for each species. Species' data were transformed into phylogenetic independent contrasts and used in generalized linear multiple regressions for hypothesis testing. The results showed that species living under varied environmental conditions and in large groups displayed the highest levels of within-species variability in social organization and diet. In addition, species that typically lived in seasonal habitats displayed the highest amounts of within-species activity budget variation. These results stress the importance of environmental and demographic factors influencing primate behavioral and ecological flexibility and have significant implications for primate socioecology.

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#### **Roman Gladiators - The Osseous Evidence.**

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Skeletal remains from a mass grave in ancient Ephesus (Turkey) were investigated by forensic osteopathology and trace element analysis, providing unique insights into cause of death and living conditions of Roman gladiators.

At least 67 individuals were identified (all males, aged 20 to 30 years, except one 45 to 55 years). Calculated mean body height 169 cm (+/- 3 cm) was within the range of ancient Romans.

Osteopathology revealed single perimortal cranial traumata in 10 individuals (15%), and 29 acute postcranial traumata in

all skeletal remains. Types and distribution of traumata confirm the reported protective gear and weaponry, as well as the very strict combat rules for gladiator fights by the absence of multiple perimortal traumata in individuals. Well-healed antemortal cranial traumata (n=16) in 11 individuals, and altogether 16 postcranial traumata were found. Examples of a reduced, perfectly health radius fracture, and a clean femur amputation point to a well developed medical care for the expensive fighters. Enlarged muscle markers on arm and leg bones give evidence of an extensive and continuous exercise program.

A two-fold strontium content in the gladiator's bones, as compared to contemporary Ephesians could be detected. A likely explanation is the reported gladiator diet of barley and beans, plus drinking of plant or bone ash solutions, serving as extraordinary mineral substitution. An increased frequency for acute caries might be explained by this humdrum, pulpy diet and the reduced salivation associated with frequent psychical stress.

#### Paternal heritage for the Indonesian peoples.

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To investigate the origins and relationships of Indonesian populations, 1897 males from 12 western and eastern Indonesian islands were typed for eighty single-nucleotide polymorphisms (SNP) and fourteen microsatellites on the Y chromosome. These data were compared with similar data from samples representing Mainland Asian, Papua New Guinean, Melanesian, Micronesian and Polynesian populations. Indonesian islands differed greatly with respect to the frequency of Y chromosome haplogroups, resulting in one of the highest FST values for any regions in the world (0.435). However, unlike many other isolated indigenous groups the majority of Indonesian populations did not demonstrate reduced haplogroup diversity. A trend of Ychromosome sharing is apparent with Western Indonesian islands being more similar to Mainland Asia and Eastern Indonesians being more similar to Papuans.

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#### Behavioral responses of *Propithecus edwardsi* to an experimental multiple-predator community in Ranomafana National Park, Madagascar.

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Ecological systems in which prey are at risk of predation by more than one type of predator have sometimes been shown to experience enhancement or reduction of predation risk greater than would be expected from a linear summation of single-predator effects. This enhancement or reduction of predation risk is often mediated by prey behavioral responses to the predators. Lemur species in Ranomafana National Park (RNP), Madagascar, face predation from a multiple predator community, including terrestrial carnivores and diurnal raptors. A model predator exposure experiment was conducted on four groups of the Milne-Edward's Sifaka, *Propithecus edwardsi*, in RNP to more closely examine if 1) the anti-predator tactics of this species might lead to trade-offs and enhancement of predation risk in a multiple predator environment, and 2) if male and female sifaka exhibit different responses to predator exposures. Results show that this lemur species used predator-specific alarm calls, escape responses, vigilance, height choices, and activity levels. These predator-specific responses have been shown to lead to enhancement of predation risk in other multiple predator communities. There is evidence of a trade-off in vigilance levels and activity patterns for *Propithecus* in a multiple predator versus single predator context that may lead to enhancement of predation risk. Male *Propithecus* provide valuable services to the social group by mobbing model predators and spending more time in anti-predator behaviors than females.

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#### Was it worth digitizing all those curves? A worked example from craniofacial primatology.

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Lately, geometric morphometrics has focused considerable methodological ingenuity on data from curves and surfaces in-between landmark points. Here we discuss not the algebra of these so-called semi-landmark methods, an algebra that is nearing consensus at the present time, but

rather their scientific yield for the kinds of questions anthropologists and paleoanthropologists ask. One typical investigative design asks questions about size allometry in a context of species differences and sexual dimorphism. It is worth asking whether answers based on conventional landmark point data, optimally analyzed, are altered much when "additional" information from curves or surfaces enters the analysis.

Our example re-uses part of a Vienna data set of 372 skulls that has already been the source of several dissertations using semi-landmarks: data from 32 landmark points and 7 ridge curves totalling 161 semi-landmarks, from the skulls of 37 adult chimpanzees and 47 adult bonobos. There are clear effects of species and centroid size on the landmark configuration. We unwarped each of the 84 specimens to the pooled average shape and examined the information content of the curving semi-landmarks after the unwarping. The 161 normalized semi-landmark locations convey modest additional information about pattern analysis of sex, species, and size. Semi-landmark sex effects are specific to the zygoma and the canine root, while size effects dominate species in the orbital region. The method of testing by unwarping fails completely toward the back of the skull, where landmarks are sparse and semi-landmarks correspondingly necessary. There are implications for the investment of time in these complex extended data sets.

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#### Life and death of a mother and child from a 19th century pioneer cemetery in Ontario, Canada.

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Excavation of a small historic cemetery, in use between 1825 and 1894, included a mother, aged 25 years, and her daughter, aged 22 months. Stable isotope analysis was carried out on bone samples from all of the 15 individuals interred in the cemetery. The stable nitrogen isotope value for the mother is 11.2 ‰ while that of the child is 14.1 ‰. Stable carbon isotope ratios for mother and child are -18.3‰ and -18.9‰, respectively. The baby died on Sept. 1, 1848 and the mother died 11 days later and they were buried side by side. Genealogical records indicated that the mother died of fever. There was no evidence of pathology from the skeletal remains (Keenleyside and Clark-Wilson, 1991). The high stable nitrogen isotope ratio from the child, which is 3 ‰ higher than that of the mother, indicates that she was still nursing.

The fact that the mother and child are identified, with known age, sex and, for the



mother, cause of death, provides a window into the lives of early settlers to southern Ontario. The results of stable isotope analysis from bone collagen on identified individuals provide support for interpretations of nursing behavior in earlier undocumented skeletal samples. Since bone collagen is the most commonly sampled tissue from prehistoric contexts and since bone collagen is not directly analogous to tissues easily sampled from the living (i.e., hair and fingernails), such studies provide important verification of studies carried out on undocumented samples.

**White matter pathways in the brain of a gorilla revealed by high-field diffusion MRI.**

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Cerebral white matter consists of organized bundles of axons that provide long-distance connections between different cortical regions, and between cortex and sub-cortical grey matter structures. Traditional methods for tracing long-distance fiber tracts require terminal injection procedures or focal lesion and degeneration studies, both of which are impractical and unethical for controlled experimentation in humans and apes. Diffusion-weighted magnetic resonance imaging (DW-MRI) is a new, non-invasive means of obtaining data on brain connectivity. Within any particular voxel, DW-MRI provides a quantitative measure of the coherence of axon fibers – a property termed fractional anisotropy – as well as the principal orientation of those fibers in three-dimensional space. Tract-tracing algorithms use these diffusion data to track fiber pathways from voxel to voxel.

Here we demonstrate the use of DW-MRI and fiber tractography to trace long-distance connections in the brain of a gorilla. We scanned a formalin-fixed gorilla brain using a 9.4 Tesla MR imaging system to obtain ultra-high-resolution structural images (250µm isotropic voxel size) and high angular-resolution diffusion images (72 diffusion directions; 1mm isotropic voxel size). Using probabilistic fiber tractography, we are able to parcellate cerebral white matter into major fiber tracts such as the optic radiation, cingulum, corticospinal tract, and longitudinal fasciculi, as well as interhemispheric commissural pathways. We believe that by applying this technology in a comparative context across primate species, quantitative comparisons of the strength and distribution of cortical connections may reveal distinct specializations related to the evolution of the human brain.

**Dental pathology and diet at Apollonia, a Greek colony (5th-2<sup>nd</sup> centuries BC) on the Black Sea.**

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As an indirect source of information on diet, dental pathology has the potential to provide insight into the composition of the diet and to reveal dietary differences based on age, sex, and social status. Ancient literary sources indicate that the Greeks relied heavily on terrestrial resources and that their access to certain types of foods varied by sex and status. The dentitions of 162 adult skeletons from the Greek colonial site of Apollonia on the Black Sea coast of Bulgaria were analyzed for various forms of dental pathology in order to assess the prevalence of dental pathology in the population, compare the dental pathology data from Apollonia to dietary data derived from ancient literary texts and from previous stable isotopic analysis of the colonists' remains, explore variations in dental disease with respect to age, sex, and social status, and compare the prevalence of dental pathology in the Apollonians with that of other Greek populations. The composition of the diet, as indicated by the dental pathology data, is consistent with the stable isotopic evidence from Apollonia and with the ancient literary texts, both of which indicate the consumption of a relatively soft, high carbohydrate diet. The lower prevalence of caries among the colonists compared to other populations also suggests the consumption of marine resources, as indicated isotopically. Sex differences in several forms of dental pathology hint at dietary differences, while the relationship between dental pathology and social status among the colonists cannot be ascertained.

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**Diet during imperial influence in ancient Peru: The impact of the Wari Empire on Nasca populations (AD 750-1000).**

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The Wari Empire influenced the agricultural Nasca (AD 1-750) of south coastal Peru during the Middle Horizon (AD 750-1000), but the specific nature of this relationship is unclear. To determine the impact of this incursion on the diet of local Nasca from the Río Grande de Nazca drainage, we analyze stable carbon and nitrogen isotope ratios of human bone collagen from individuals living before and during imperial influence.

Overall Nasca diet consists of a mixture of C<sub>3</sub> (beans, squash, peppers, peanuts) and C<sub>4</sub> foods (maize) and camelid and guinea pig meat, supplemented with little marine resources. The stable isotope data indicate that a significant shift toward the increased

consumption of maize did not occur during the time of Wari influence in the region. Moreover, no dietary differences appear in association with status, sex, or by "trophy" individual. A few imperial period individuals consumed more C<sub>3</sub> plants, perhaps of highland origin, and others ingested slightly more meat or marine resources. No dietary differences, however, were found between those buried with imperial ceramics and those buried with local ceramics, suggesting that control of this valley by direct Wari emissaries was unlikely.

These findings suggest that an overarching authority did not control Nasca access to food, its distribution, or agricultural labor. Thus, the Wari imperial influence on the Nasca in this valley was dissimilar to other regions of direct imperial control in ancient Peru and in Spanish Florida and California.

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**Nonmetric sex determination using the sternal end of the fourth rib.**

B.J. Kemp. University of Pittsburgh

Sex determination from incomplete or fragmentary skeletal remains is particularly challenging, and therefore alternative elements are required for analysis. Radiographic clinical analyses of the sternal rib end have defined common male and female patterns of costal cartilage ossification and have successfully determined the sex of an individual, however, this method has not been applied to dry ribs. The purpose of this research is to apply these radiographic methods of nonmetric sex determination to the sternal end of dry ribs.

Iscan et al. (1984 & 1985) also commented on variation between the sexes at the sternal end of the rib. As well as noting the common male and female patterns of costal cartilage ossification, they also described plaque-like deposits, wall flaring, and a central arc as female traits. The current study assesses these features defined by Iscan et al. using the right fourth rib of 159 EuroAmericans of the Hamman-Todd Osteological Collection. The traits appeared infrequently in this sample: male pattern (10.7%), female pattern (21.4%), plaque-like deposit (1.3%), wall flare (8.2%), and central arc (3.8%). The overall percent of cases that were correctly predicted by the logistic regression model was only 57.2%. Because ossification of the costal cartilage commences from inferior to superior, future tests of lower ribs may produce different results.

**Population expansion in the American Southwest: A case for the study of ancient DNA in the region.**

B. M. Kemp. Vanderbilt University

In a large study of mitochondrial DNA (mtDNA) variation in Native American populations from North America a clear

signature of a population expansion in the American Southwest was detected. Namely, an expansion of haplogroup B from an ancestral haplotype carrying transitions at nucleotide positions 16111 and 16483. In the Southwest, this derived form of haplogroup B is exhibited by 52% of individuals belonging to the haplogroup (or on average 29% of individuals belonging to any Southwest population). The large number of individuals ( $n=130$ ) that belong to this derived form of haplogroup B permitted a tight estimate of nucleotide diversity in the subclade ( $\pi=0.002\pm <0.000$ ). Consequently, the accuracy of dating this expansion is overwhelmingly dependent on the choice of the rate of mtDNA evolution (i.e. phylogenetic vs. pedigree based rate) and its accuracy. Application of a pedigree based rate of 47.5%/site/myr (99.5% CI 26.5%-76.5%) suggests that this expansion occurred approximately 2,105 YBP (99.5% CI 1,273-3,773 YBP), while a phylogenetic based rate suggests an expansion dating to the Archaic period. However, the more recent date is better supported by the archaeological evidence of an agricultural expansion within the Southwest, following the introduction of cultigens from Mesoamerica around 4,000 YBP. If correct, this evidence lends supports the notion that traditional phylogenetic based estimates of mtDNA evolution are inappropriate for relatively recent prehistoric population events. Analyzing ancient DNA in the Southwest holds promise to resolve this issue through the ability to precisely date the age of remains that exhibit haplotypes of interest.

#### **Heritability of subtrochanteric femur shape (platymeric index): Implications for human postcranial variation and evolution.**

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Platymeric Index (PI), the degree of anterior-posterior subtrochanteric flatness of the femur, has been used to study ancestry in human populations. Variation in PI has been attributed to both genetics and to environment (e.g. habitual biomechanical forces that the femur endures). However, until now, the hypothesis that the additive effect of genes influences PI has not been tested. Using femora from 175 pedigreed baboons (*Papio hamadryas*) (53♂, 120♀; 2 to 33 years) we estimated the heritability ( $h^2$ ) heritability of PI and tested for significant age and sex effects on this trait. Maximum likelihood-based variance decomposition methods were implemented in SOLAR v.4.0.5. PI ranges from 75.1 to 99.7 (mean = 90.29± 3.79), within the range reported for humans. Age and sex effects were not significant, corresponding to studies in humans that report only slight, if any, age and sex effects. PI does, however, show a substantial genetic effect. The observed  $h^2$

estimate of 0.47±0.24 ( $p = 0.0015$ ) indicates that nearly half of the variance in this trait is attributable to the additive effects of genes. This result demonstrates that both genes and unmeasured environmental factors contribute significantly to PI variation and that species- and population-specific trends in PI are likely attributable both to shared genetic effects and to shared environment. Given the significant heritability of subtrochanteric shape, its variation among Pleistocene hominids and recent humans is of use in interpreting evolutionary relationships and evolutionary biomechanics.

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#### **Origins of and variation in human behavior.**

K.K. Kidd. Genetics Department, Yale University

Much of the behavior that is largely unique to humans is related to our larger and more complex brains. Though lacking in information on fine neuroanatomy, the fossil record nonetheless documents a recent and relatively rapid increase in human brain size. This suggests that relevant "genes" (functional elements in the broadest sense) may have evolved rapidly just in the human lineage. Recent research is pointing to some strong candidates—genetic segments conserved in most mammals that have several human-specific variants and are expressed in the brain.

Several candidates are also being identified as involved in variation in behavior among modern humans. Both functional and nonfunctional genetic variation exists at many of those genes. For example, the dopamine D4 receptor gene (DRD4), the serotonin transporter gene (SLC6A4), and the catechol-O-methyltransferase gene (COMT) all have genetic variation that is believed to alter function. That variation differs significantly around the world while the frequencies of the neuropsychiatric behaviors believed associated do not always differ in a concordant manner. To what degree the specific genetic variants control variation in behavior remains an open question but one actively pursued.

As neuroscience develops better understanding of the genetic regulation of development and function of our brain, our ability to study the recent molecular evolution of primates and to look at modern genetic variation can be directed to all aspects of the genetic architecture of human behavior.

#### **A baboon analogy to the pubic morphology of later *Homo*.**

M.A. Kilberger. Department of Anthropology, University of Texas at Austin.

Pubic morphology in Late Pleistocene *Homo* and especially in the Neandertals has been robustly studied primarily due to the preservation of this region and its "uniqueness." It is now argued that the ascending elongated pubic ramus of Neandertals is a plesiomorphic trait found in most of the earlier hominins. However, Neandertal males have absolutely longer pubes than females, a trend not observed in *Homo heidelbergensis*, anatomically modern humans, or in recent humans. This study uses the Bramblett Savanna Baboon Collection, a skeletal collection of *Papio cynocephalus* with associated body mass ( $n=28$ ), to compare acetabulo-symphyseal length relationships to body size in baboons to these measurements found in the human fossil record. In this work, baboons are good analogies because of their great sexual dimorphism, similar cephalo-pelvic proportion, and comparable pelvic and body mass correlations. The hypothesis that in highly sexually dimorphic primates such as baboons, males will have absolutely longer pubes than females (Schultz, 1949; Rosenberg, 1988) is supported. Sexual dimorphism in estimates of Neandertal body mass are significantly different than that in actual body mass of living humans while not different than estimates of other Later *Homo*. Interestingly, the non-Neandertal specimens of Later *Homo* are not shown to be significantly different from the actual body mass of living humans. Neandertals appear to show at least slightly greater sexual dimorphism in body size approaching values of more sexually dimorphic primates as well as exhibit differences in pelvic dimorphism from that found in modern humans.

#### **Ecogeographical patterning and postcranial variation in pre-contact North America.**

K.A. King. The University of Tennessee

Biological adaptation to varying climatic conditions has often been cited as a causative factor in the development of human morphological variability. Ecogeographical patterns in humans are often explain in terms of Bergmann's (1847) and Allen's (1877) rules, which describe the expected body proportions of homeothermic species in specific environments.

The indigenous populations of the Americas present a unique situation in which to examine climatic adaptation. The relatively recent colonization of the Americas, followed by expansion into numerous and diverse environments, subjected the founding populations to novel ecogeographical stresses. Under such pressures, it is likely that environmentally specific adaptive changes in body proportions occurred.

Postcranial metric data for 1,753 individuals from geographically diverse regions are analyzed to assess patterns of variation in bone length, epiphyseal dimensions, and diaphyseal robusticity. Results indicate that bone lengths in the appendicular skeleton do not exhibit clear ecogeographical patterns, arguing that this sample does not adhere closely to Allen's (1877) arguments about relative appendage length and heat conservation. Bergmann's (1847) rule on body size and climate was supported through clear associations between climate and epiphyseal and diaphyseal measurements. Additionally, the brachial and crural indices indicate that foreshortening of the distal segment is greater in colder climates than in more temperate ones. These results suggest that climatic stresses had some effect on the development of postcranial morphology in pre-contact Americans, but the patterns of morphological variation likely also were influenced by a variety of non-selective forces.

**And the band played on: maintaining dental function across the life span in *Hadropithecus stenognathus*, an extinct giant lemur from Madagascar.**

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Teeth can suffer dramatic changes in topographic relief without the loss of dental function. To maintain dental function, some functionally important design feature must be held relatively constant despite wear-related changes in dental morphology. For example, King et al. (2005) showed that, in *Propithecus edwardsi*, due to a concomitant increase in 2D crest length as relief is lost, 3D crest length remains roughly constant until around age 20, after which the crests shorten significantly. This results in dental senescence (or compromised dental function), which carries potential reproductive consequences.

Species with different dental morphology will not necessarily maintain dental function in similar fashion. Discovering how dental function is preserved in an extinct species necessitates identifying those characteristics that persist despite tooth wear. Our GIS-based analysis of molar topography in the extinct *Hadropithecus stenognathus* demonstrates that 3D crest length is not maintained; indeed, whatever crests may be present in unworn molars are quickly lost and replaced by flattened enamel bands as the teeth wear. Total enamel band area does remain relatively constant over a prolonged period, and we infer that its maintenance was critical to masticatory competence in *Hadropithecus*.

Data on dental developmental chronology (inferred ages at eruption of M1 and M2) in

*Hadropithecus*, when coupled with data on the relative wear of the first and second molars of single individuals, allow us to estimate individual ages and reconstruct the pattern of molar wear over the life span, and, on this basis, to draw life history inferences for this unusual giant lemur.

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**Skeletal evidence for trauma in infant chimpanzees.**

C.A. Kirchhoff. Department of Anthropology, University of Minnesota.

Several case studies of trauma to young chimpanzees are examined. Chimpanzee skeletons analyzed for this study are part of the primate collection at the Powell-Cotton Museum in Birchington, Kent, UK. The collection dates to the 1930s and is composed of free-ranging chimpanzees, mostly from Cameroon. Sub-adult chimpanzees were examined for signs of trauma, disease, and other types of physiological stress. Seven out of the approximately two hundred individuals in the collection show significant healing of a severe wound; most cases are head wounds. The location of the wound and degree of healing are documented. Analysis of wound location and type as it relates to possible cause of the injury is undertaken. These examples of serious trauma were all sustained early in life, likely during the period of dependence on the mother - a factor which probably contributed to the extended survival of these individuals after being wounded. The adult crania in this collection typically do not show evidence of the same type of trauma. This is probably due either to death subsequent to the wound in some individuals (and failure by researchers to recover the body), or the complete remodeling of old wounds in others. It was not possible at this time to determine the cause of injury, as insufficient evidence is available to distinguish between attempts at infanticide (by other chimpanzees) versus predation (by carnivores).

**Intrinsic hand proportions of plesiadapiforms and extant euarchontan mammals.**

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Arboreal primates have distinctive hand proportions compared with many other mammals. Within Euarchonta, platyrrhines and strepsirrhines have longer manual proximal phalanges relative to metacarpal

length than colugos and terrestrial tree shrews. This trait is part of a complex of features allowing primates to grasp small-diameter arboreal substrates. In addition to many living and Eocene primates, relative elongation of proximal manual phalanges is also present in some plesiadapiforms. In order to evaluate the functional and phylogenetic implications of manual similarities between crown primates and plesiadapiforms, we measured the lengths of the metacarpal, proximal phalanx, and intermediate phalanx of manual ray III for 128 extant mammal species (n=687 individuals). These data were compared with measurements for hands of six plesiadapiform species using ternary diagrams and phalangeal indices. Our analysis reveals that some arboreal tree shrews, rodents, metatherians, and carnivorans have manual ray III proportions similar to those of arboreal primates. By contrast, terrestrial tree shrews have hand proportions most similar to those of other terrestrial mammals, and colugos are uniquely derived in having relatively long intermediate phalanges. Phalangeal indices of arboreal species are significantly larger than those of terrestrial species, reflecting the utility of having relatively long digits in an arboreal context. Among plesiadapiforms, *Carpolestes*, *Nannodectes*, *Ignacius*, and a new micromomyid have manual ray III proportions that are most comparable to various species of extant arboreal primates and squirrels. These results offer additional evidence that many plesiadapiforms were arboreal, and support the hypothesis that Euarchonta originated in an arboreal milieu.

**Nitrogen beyond collagen: new sources of isotopic data**

K. Kirsanow, N. Tuross. Harvard University.

Nitrogen stable isotopes have been widely utilized in the recovery of palaeodietary and palaeoecological information from fossil material. Because the primary reservoir of nitrogen in palaeontological and archaeological material is bone and dentin collagen, it is thought that a nitrogen isotopic value is no longer obtainable once this protein has been destroyed. Here we present data indicating that a source of analytically useful nitrogen persists in mammalian enamel, and describe factors affecting the preservation, recovery, and robusticity of this nitrogen signal. Enamel nitrogen values in fossil rhinoceros and hyena samples from late Pleistocene levels at Kent's Cavern were observed to segregate by species, indicating that enamel nitrogen may be analytically comparable to nitrogen values obtained from collagen. Possible protein sources of enamel nitrogen are also discussed.

**JCV Mutation Rate and Demographic History Estimation**

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JC virus (JCV), a human polyomavirus, has been considered a potentially useful haploid genetic marker for inferring human population history. Previous research has identified substantial geographic structure of JCV lineages that suggests a regional co-divergence of JCV and its human host despite significant discrepancies between the basal topologies of JCV and human mtDNA and Y-chromosome phylogenies. Our research questions the validity of using the co-divergence assumption by directly comparing internally and externally calibrated coalescent-based estimates of the JCV mutation rate.

We assembled a dataset of 92 previously published coding region JCV DNA sequences (~4850bps) with known sampling dates. We used a Bayesian skyline coalescent model to estimate an externally calibrated JCV mutation rate under the assumption that the TMRCA of the JCV dataset was ~100,000 years ( $\square=1.356 \times 10^{-7}$  sub/site/year). Using a similar coalescent model that incorporated the associated sampling dates of each JCV sequence without an external calibration point, we estimated an internally calibrated JCV mutation rate ( $\square=3.642 \times 10^{-5}$  sub/site/year) that is two orders of magnitude faster than the externally calibrated rate. We tested the support for the internal rate by calculating Bayes factors from the posterior distributions of Bayesian skyline analyses under coalescent models that include and exclude sampling dates. This resulted in significant support for the inclusion of sampling dates, and thus support for the internal rate over the external rate. Our results suggest that the phylogenetic and demographic histories of JCV inferred here and elsewhere are significantly more recent than assumptions of human-virus co-divergence would allow.

#### Do male black howler monkeys (*Alouatta pigra*) assess the fighting ability of individual rivals during inter-group encounters?

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Fighting is costly to winners and losers in a contest; thus, evolutionary game theory predicts animals will use reliable indicators of fighting ability to assess opponents and avoid contests they will likely lose. Experimental playback techniques simulating inter-group contests demonstrated that male Belizean black howler monkeys (*Alouatta pigra*) used loud howling bouts to assess numeric odds (relative number of males in two groups), and avoided contests when they were outnumbered (Kitchen 2004). In a post hoc analysis of playback stimuli,

acoustic and temporal features of howling bouts correlated with subject responses, but only when numeric odds were even. Thus, male howlers seemed to assess an individual rival's fighting ability most when contest outcome was least clear based on group-level fighting ability. During natural encounters observed, contests ended with a draw (or with group containing the smaller dominant male winning) when dominant male contenders were most similar in size. Hence, body size seems related to male fighting ability. We examined natural howling bouts and found that body size correlated with call features including duration of 'roars' and loud calling rate. Therefore, there is information in a howling bout that reliably indicates body size. Finally, to examine whether males attend to these features, we altered the loud calling rate of recordings to mimic small-, medium- and large-sized intruders (keeping numeric odds even). Following game theoretical predictions, recordings simulating average-sized opponents elicited the strongest response by subjects; males apparently escalated contests when outcome was least clear based on relative body size.

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#### Development but not ancestry explains large lung volumes in female Peruvian Quechua at high altitude and sea-level.

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High altitude natives have enlarged vital capacities and residual volumes. However, the extent of the genetic or developmental components of lung volumes is still debatable. In order to test the effect of development on lung volumes, we obtained vital capacities (VC), total lung volume (TLV) and residual volumes (RV) for a sample of 71 females (18-34 years) with a mixture of Quechua and Spanish origins. Residual volumes were obtained via a closed-circuit oxygen dilution method. We measured RV twice and reported the average. Native American ancestry (NAA) for each individual was assessed using a set of 22 ancestry informative markers. Group 1 consists of sea-level born and raised females (N= 36) and group 2 consists of high-altitude born and raised females (N=37). In both groups, the NAA proportion is considerably high (group 1= 93.3%; group 2 =91.9%) and it is not statistically different ( $p=0.39$ ). Group 2 had significantly higher VC ( $3.81 \pm 0.40$  l;  $p<0.01$ ), RV ( $0.96 \pm 0.24$  l;  $p<0.01$ ) and TLV ( $4.77 \pm 0.52$  l;  $p<0.01$ ) than group 1 (VC=3.36

$\pm 0.34$  l; RV=  $0.71 \pm 0.15$  l; TLV=  $4.073 \pm 0.38$  l). NAA was not significantly associated to any component of the lung volumes in our sample, after controlling for the effects of height and age; but, our study may not have had sufficient power to detect associations with ancestry. In sum, our results indicate that birthplace (i.e., developmental exposure to altitude) constituted an important factor in all lung volumes.

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#### Health, conquest, and adaptive transition: the bioarchaeology of the late pre-Hispanic and postcontact Lambayeque Valley, north coast Peru (AD 900-1750).

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The last 10,000 years have witnessed a handful of major adaptive transitions, the most recent and violent of which was contact between Native Americans and Europeans that irrevocably altered global population biology and cultures. This paper presents the results from the first five years of the Lambayeque Valley Biohistory Project, a long-term, regional, and multidisciplinary study of biocultural evolution on the north coast of Peru. Synthesizing bioarchaeological, archaeological, and ethnohistoric data, we test the hypothesis that indigenous Mochica Indian health was negatively impacted by European contact. Demographic, health, diet, physical activity, and metabolic stress data were collected from 255 late pre-Hispanic and 459 Colonial-era Lambayeque skeletons spanning AD 900-1750.

Paleodemographic analyses suggest postcontact Lambayeque experienced lowered female fertility. Application of odds ratios indicate a statistically significant, elevated prevalence of degenerative joint disease especially in the shoulder, elbow, wrist, and knee, probably stemming from Spanish labor extraction. Dramatically elevated rates of periosteal infection correlate to increased population density in *reducciones*. Lowered prevalence of enamel hypoplasias point to a shift from episodic precontact childhood stress to acute, high-mortality epidemic-related stress. Growth was also impacted, with postcontact terminal adult stature depressed by nearly 10 centimeters. Oral health was evaluated using a G-statistic, and a rise in carious lesions and antemortem tooth loss suggest a dietary shift involving greater exploitation of starchy carbohydrates. Increased postcontact morbidity is demonstrated by these findings, and serves to shed light on an unprecedented turning point in the dynamic biocultural evolution of Lambayeque valley populations.

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American Studies, and The Ohio State University Department of Anthropology.

**The 'St. Bees Lady': a medieval osteobiography.**

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In 1981, human burials were uncovered by archaeologists investigating architectural details of the 12th-century Priory church of St. Mary and St. Bega in St. Bees, Cumbria, United Kingdom. As well as earthen graves, the excavations in a now ruinous side chapel of the monastic church uncovered an ashlar tomb containing two individuals: the so-called 'St. Bees Man' and a female companion inserted later. The Man had been wrapped in a honey/wax-treated shroud and then placed within a sheet of lead before his interment. The remains of 'St. Bees Man' are still the best-preserved human remains dating to the Middle Ages found to date, providing unique insights into his health at the time of his death and revealing new information about medieval funerary treatment. A length of long human hair had been placed around his neck, the origin and meaning of which remain obscure. This contribution concerns the detailed analysis of the lesser known and previously unpublished skeletal remains of the woman found next to him and within the same tomb. Historical, archaeological, palaeopathological, and isotopic studies are marshalled to help identify this woman. Her burial reflects not only aspects of her life history and social status but also provides a unique perspective on the late medieval socio-political climate of the North of England. Her identity also sheds further light on the identity of the better-preserved St. Bees Man.

**Trabecular and cortical architecture of captive versus wild specimens of *Loris tardigradus* and *Callithrix jacchus* using micro-computed tomography.**

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Studies of the morphology and structure of the primate skeleton make use of museum collections, many of which contain individuals who lived in zoos during their lives. Environmental differences such as diet, ranging area, and substrate availability vary between zoo and wild habitats, resulting in differences in skeletal structure, and consequently these specimens are usually excluded from morpho-functional studies. This study measured aspects of cortical and trabecular architecture in captive and wild specimens of the slender loris (*Loris tardigradus*) and the common marmoset (*Callithrix jacchus*) using micro-computed tomography (microCT). MicroCT scans were created of the left femora of six *L. tardigradus* individuals and six *C. jacchus* individuals, of which three of each species

were known to have come from zoos. Bone volume fraction (BV/TV) was found to be significantly higher in zoo specimens versus wild specimens of *L. tardigradus*, likely due to dietary differences between zoo and natural environments (i.e. availability of high quality food, regularity of feeding, etc.). Results for BV/TV for *C. jacchus* were similar to *L. tardigradus* in direction and magnitude, however, significance was not attainable here due to the small sample size. Degree of anisotropy (DA), or the structural organization of trabecular bone, was also determined to be significantly higher in zoo specimens of *L. tardigradus*. This was interpreted as having arisen from more uniform loading regimes experienced in captivity. Overall, this research provides preliminary support for the current practice of excluding zoo specimens from morphological studies of the primate skeleton.

This study was partially funded by the Boston University Undergraduate Research Opportunities Program and the Department of Anthropology.

**Sexual Coercion and Mating Strategies of Wild Bornean Orangutans.**

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Orangutans are unusual among the apes for their high degree of forced copulations. Such copulations are reportedly the predominant strategy of unflanged males whereas flanged males are thought to usually mate cooperatively. However, new data from Gunung Palung, Borneo, suggest more complexity. Data were collected from 9 years and over 47,000 hours of observation. All orangutan researchers report ambiguity in distinguishing between forced and cooperative copulations. Thus, here we coded female and male behavior along 4 different axes: female 'pro-sexual' behavior, female resistance, female attractiveness and male aggression. Males were divided into 3 categories, Flanged Prime, Flanged Past Prime and Unflanged. Urinary steroids were analyzed to assess female ovarian status and conception risk. Females were classified as peri-ovulatory (POP), non peri-ovulatory (non-POP) or pregnant.

Results show that female resistance is significantly related to the interaction between female ovulatory status and the 'type' of male. Females mated significantly more with Prime males during the peri-ovulatory period and mated significantly more with unflanged males during non-POP. Females were significantly less resistant during pregnancy. Females in POP were significantly more attractive and more 'pro-sexual'. Prime males were significantly more aggressive and unflanged males were least aggressive, a pattern that is different from other sites. Male aggression was significantly

related to female resistance. We discuss the significance of these results for understanding male and female mating strategies.

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**Patterns of female dispersal in an Asian colobine monkey.**

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In nonhuman primates, female dispersal appears to be quite common in prosimians, platyrrhines, colobines, and hominoids. For colobines in particular, female dispersal has been linked to infanticide avoidance rather than feeding competition. Here we describe the patterns of female dispersal in Phayre's leaf monkeys (*Trachypithecus phayrei*), a population in which infanticide has yet to be reported. We analyzed the correlates of disappearances/emigrations and immigrations (N = 50) based on data derived from five groups observed since July 2001 at Phu Khieo Wildlife Sanctuary, Thailand. Most females dispersed as juveniles (ca. 4 years of age), but 44% of the cases concerned adult females (nulliparous and parous). Given that adult females were much more numerous in the population, juvenile dispersal occurred significantly more often than expected (G-test,  $P < 0.05$ ). At the time of emigration groups were mostly of average size. In the majority of cases (61%) major fights preceded females disappearing or emigrating or we had observed females with injuries. Adult females left after having lost their infant, left their infant behind or disappeared together with their infant. Immigrations were most common in juvenile females (70%). Females preferably immigrated into groups of average size with more than one adult male, several juvenile females, and fewer than average adult females. Even though females did not necessarily leave large groups, the behavior indicates competition for group membership, a pattern rather unusual for folivorous primates. The ideal group for immigration seems to consist of multiple males and approximately four adult females. Supported by NSF (BCS-0215542, 0452635, 0542035), American Society of Primatologists, Leakey Foundation, Stony Brook University, and Wenner-Gren Foundation.

**Selection of variables for discriminant analysis of human crania for determining ancestry.**

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An almost endless number of measurements may be made of the human cranium. Most anthropologists use only a small standard set of measurements. These only require spreading and sliding calipers, relatively inexpensive instruments found in most biological anthropology laboratories. Unconventional cranial measurements require costly instruments such as the radiometer and coordinate caliper that are not common in laboratories. These measurements also are more difficult to complete. Which cranial measurements are best for classifying when constructing a discriminant function? Will the use of variables requiring more time, training, and equipment improve discrimination?

65 measurements were taken from 155 crania of European American, African American, and Coyotero Apache ancestry. Measurements were separated into four subsets for statistical analysis: (1) FD2 (1996), (2) Howells (1973), (3) Gill (1984), and (4) All Measurements. Forward stepwise methods were used to develop a predictive discriminant analysis using SPSS 14.0. Classificatory power of discriminant functions was determined using the Leave-One-Out hit-rate estimates for each subset: (1) 85.5%, (2) 90.3%, (3) 61.9%, (4) 93.5%. Results lead me to suggest that biological anthropology laboratories should purchase radiometers and coordinate calipers. They record data missed with spreading and sliding calipers. In addition, standard measurements may be combined with non-standard measurements to produce more powerful discriminant functions for determining ancestry.

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#### **Nonmetric cranial variation of the ancient Okhotsk cultural people around the Okhotsk Sea coast.**

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From the 5th to 12th century A.D., the prehistoric Okhotsk culture was distributed about Sakhalin, the Okhotsk Sea coast of Hokkaido and the Kurile Islands. The people of the Okhotsk culture are believed to have developed a considerable maritime infrastructure.

Diversity of the Okhotsk cultural people was investigated in terms of nonmetrical cranial traits. The incidences of the transverse zygomatic suture vestige in the Okhotsk series are high among the populations compared, while the frequency of the supraorbital foramen of the Okhotsk is as high as those of the comparative samples except for the Ainu.

The MMD based on the 22 nonmetric traits between the northern and eastern Okhotsk

was small but significant. The northern Okhotsk was closest to the Sakhalin Ainu. The multivariate analyses based on the MMD matrix showed the peculiarity of the eastern Okhotsk. The estimated  $F_{st}$ , using an average heritability rate = 0.55 for the nonmetric cranial traits used in this study, displayed low levels of interregional variation, as already indicated in analyses of genetic, cranial and dental metric data. The greater observed variation compared with the expected variation in the northern Okhotsk sample was calculated using the Relethford and Blangero's (1990) method. It seems that the northern Okhotsk had experienced some gene flow from outside.

#### **Paleodemography under duress: Growth and sexual dimorphism of the minimum femoral circumference.**

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Paleodemographic analyses often must rely on fragmentary and incomplete skeletal material. In these cases, Black (1978) suggested that midshaft femoral circumference could be used for adult sex estimation, and Konigsberg and Frankenberg (1984) considered minimum femoral circumference for subadult age estimation when dental development was unobservable. In this study we examine the utility of the minimum femoral circumference for both subadult age estimation and adult sex determination using a large sample of individuals from the Mississippian Averbuch site (40DV60).

The subadult sample consists of 135 individuals with minimum femoral circumferences less than 68 mm who also have Moorrees, Fanning, and Hunt (1963) ages. The squared-correlation coefficient between dental age and femoral circumference is 0.80, indicating that the femoral circumference can be used as an age estimator in paleodemographic analyses when the dentition is unavailable.

The adult sample consists of 376 individuals, 110 of whom have unambiguous sex assignments based on two or three Phenice (1969) characteristics. We fit a mixture model to the 376 individuals using a log-normal distribution for each sex and estimating the mixing proportion. We then find the posterior probability for each case from five parameters (the proportion of females, and a log-mean and log-standard deviation for each sex). Sex assignments from the mixture model agree with the Phenice-based estimates 81% of the time. We show that the minimum femoral circumference can be used successfully for proxy estimates of subadult age and adult sex when one must do "paleodemography under duress."

Data collection supported by NSF BCS-9307693.

#### **A control bone for trabecular architecture variation**

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While it is widely believed that trabecular bone reflects habitual loading history, there is no "control bone" that establishes the variations in trabecular architecture that would be expected in a known load history. The sheep calcaneus was selected as a potential "control bone" based on in vivo data showing that it is relatively simply loaded in bending. We hypothesized that differences would be found between the compression vs. tension regions of this bone, possibly reflecting the well known disparity in the mechanical properties of trabecular bone in tension (weaker) vs. compression (stronger). The parameters included: trabecular number, thickness, separation, connectivity, and volume fraction. Eleven mature sheep calcanei were Micro-CT scanned at 46-micron resolution and analyzed (MicroView program) in 3mm cubic regions from compression and tension regions at 20%, 30%, 40%, and 50% of diaphyseal length. Parameters at each location were analyzed using paired T-tests. Although statistically significant differences were inconsistent at the locations examined, several trends were found: 1) trabecular number, thickness, and connectivity density all decrease in the compression aspect and increase in the tension aspect between 20-50% locations, 2) bone volume fraction decreases for both compression and tension regions between 20-50% locations, and 3) there may be evidence of trabecular adaptation to mixed loading (20-30% locations) vs. pure bending (40-50% locations). In view of these results, we will also discuss how additional measures of trabecular morphology, and morphology of the surrounding cortex, should also be considered when attempting to determine how a bone's morphology correlates with its load history.

#### **An allometric approach to maxillary sinus growth in *Pongo* and *Pan***

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Despite substantial variation in maxillary sinus morphology, it has been suggested that the maxillary sinus volume (MSV) in adult hominoids scales isometrically with measures of the craniofacial skeleton. Since recent studies indicate that variation in the craniofacial morphology of adult forms of primates is due, in part, to differences in

postnatal growth trajectories, this study explores the differences in the postnatal growth pattern of the maxillary sinus between *Pongo pygmaeus* and *Pan troglodytes*.

Dry crania of a mixed-sex sample of *Pan troglodytes* (N = 45) of different ages were CT scanned. The contours of the maxillary sinus were digitized and their volumes were calculated using the WinSurf Software. These data were compared with cross-sectional data of *Pongo pygmaeus* from an earlier study (Koppe et al., 1995, *Okajimas Folia Anat Jpn* 71: 311-318). Reduced major axis analysis was used to describe the growth pattern of the MSV as well as to investigate the relationship between MSV and different external cranial dimensions. The differences in the slope of the regression lines between males and females as well as between *Pan troglodytes* and *Pongo pygmaeus* were tested with the 2-tailed t-test. Basicranial length was used as a measure of cranial size.

Results suggest that there is a close link between the size of the facial skeleton and MSV, suggesting a structural role of the maxillary sinus. Comparing the relative growth of the maxillary sinus of *Pan* with a cross-sectional data set of *Pongo pygmaeus* revealed that MSV of *Pongo pygmaeus* enlarges postnatally faster than in *Pan*. Although more data are needed, the results of this study suggest that the interspecific variation in maxillary sinus size of hominoids cannot be explained on the basis of a simple allometric model.

#### **The relationship of fecal glucocorticoid levels with self-grooming rates and frequencies of being displaced in female rhesus macaques (*Macaca mulatta*)**

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Stress is an inevitable trade-off to living in a complex social world. Those individuals most adept at limiting emotional strain through effective stress management achieve the most success in both fitness terms and health (Sapolsky, 1989). Maestripietri et al. (1992) proposed self-directed behaviors might serve as an indicator of anxiety in primates, but to date no one has established a link between a stress hormone and these behaviors. We investigated whether a stressful social event, the frequency of being displaced by other individuals, might affect fecal glucocorticoid (fGC) levels in free-ranging female rhesus macaques (*Macaca mulatta*). We also used fGC to evaluate the physiological basis of self-directed behaviors

such as self-grooming, which might have a self-palliative effect in high-stressed individuals. Concurrently with continuous focal sampling to collect behavioral data (115 hours), fecal samples (n=129) were collected opportunistically from 19 adult females between 0600 and 1000, and extracted in the field for subsequent laboratory measurement of glucocorticoids using a corticosterone radioimmunoassay. Our results indicate that frequencies of being displaced ( $r=.517$ ,  $p<.05$ ) and initiation of self-grooming ( $r=.469$ ,  $p<.05$ ) are both correlated with averaged fGC levels using a parametric test. In addition, while rank was strongly correlated with displacements ( $r=.673$ ,  $p<.005$ ), it did not show any correlation with fGC levels ( $r=.158$ ,  $p=.52$ ). These results suggest that the experience of being regularly displaced is a stressful event for female rhesus macaques independent of rank, and that self-grooming might serve as both an honest signal of anxiety and a self-palliative coping strategy.

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#### **Trabecular orientation in the calvaria of perinatal rabbits with familial coronal suture synostosis.**

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Calvarial deformities and abnormal trabeculae orientation are seen in individuals with craniosynostosis. However, it is unclear whether trabecular orientation is a primary deformity in bone regulation causing synostosis or a secondary, functional response to altered brain growth following synostosis. The present study was designed to answer this question. Preserved calvaria were obtained from 111 New Zealand White Rabbits with familial craniosynostosis, ranging in age from 21 to 41 days post-conception (term=31 days), and included: wild-type controls (WTC) (n=26); in-colony controls (ICC) (n=62); delayed-onset synostosis (DOS) (fusion around 73 days pc) (n=65), and; early-onset synostosis (EOS) (fusion around 21 days pc) (n=69). Calvaria were examined under a stereomicroscope and trabecular divergence was measured on the bilateral coronal sutures (n=222) using Northern Eclipse software. Results revealed that rabbits with EOS had trabeculae running parallel to the coronal suture (mean angle=30.42°) compared to more perpendicular-running trabeculae for WTC (mean=73.42°), ICC (mean=70.39°) and DOS rabbits (mean=66.90°). ANOVA revealed that rabbits with EOS had significantly ( $F=113.10$ ;  $p=0.00$ ) smaller angles than the other three groups. No significant differences ( $p>0.05$ ) were seen among the other 3 groups. No significant ( $p>0.05$ ) correlations were noted among trabecular angles and age in

any group. These results demonstrate that trabecular orientation patterns are established very early during development in both normal and synostotic rabbits. Data suggests that abnormal trabecular patterns may play a primary role in the etiopathogenesis of premature suture fusion in this model, although early functional factors may still influence trabecular orientation.

#### **Mating promiscuity, energetics, and reproductive strategies in black and gold howler monkeys (*Alouatta caraya*).**

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In several primate species, females are reported to be promiscuous and adult males peacefully co-reside in the same social group. Under these conditions, individual males and females may rely on a range of social strategies to increase reproductive opportunities.

We investigated the mating behavior of *Alouatta caraya* on Isla Brasilera, (27° 20' S-58° 40' W), Argentina. Two groups were followed for 5 complete days a month between April 2003 and November 2004. We registered 216 copulations for 8 females (32% were extra-group copulations [EGC] and 62% intra-group copulations [IGC]), and 156 copulations for 14 males (31% were EGC and 69% were IGC). Females copulated with a greater number of males during fertile periods (3.4±0.9 males/month), than during gestation (1.5±0.7 males/month) or lactation (1.6±0.5 males/month) ( $p<0.05$ ). Although we observed some instances of mate guarding and serial copulations (accounting for 74% of the group's total copulations), males were not able to monopolize female mating behavior. Similarly, females did not restrict their mating activities to a single male partner during periods of conception.

We suggest that female promiscuity serves an important social function in reinforcing bonds between resident females and males. We observed that male residents of the same group co-operate in intergroup encounters (95% of days sampled) through coordinated howling and chasing of nonresident males. In contrast, resident males were highly tolerant of the mating activities of males and females within their group. Additional relationships between male and female mating strategies, patterns of social affiliation, and the energetics of female promiscuity are discussed.

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#### **Geometric similarity in primates as assessed from long bone lengths.**

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The dynamic similarity (DS) hypothesis has been used to control for limb length when comparing the locomotor parameters of primates. Questions have been raised about the validity of DS among species, especially whether the requirement of geometric similarity (GS) (that all the lengths of one creature scale isometrically with those of others) is met. The issue is particularly important when extant primates are used as models for extinct groups.

To compare GS among and between primate groups, we gathered long bone skeletal lengths from the historical physical anthropology literature and forensic databases and measured the long bones of nonhuman primates held in the skeletal collections of the University of Washington and the Smithsonian Institution. Modern humans were used as the referents and average long bone lengths for men and women were calculated from a randomly-selected sub-sample. The GS factor was calculated as the ratio of an individual's left humeral length to the left humeral length of the referent. The factor was then used to predict the long bone lengths of that individual (under a premise of isometry) by scaling the referent by the factor. Predicted lengths were then regressed against actual lengths. Populations were deemed geometrically similar when the 95% CIs of all their regression slopes ( $\beta_1$ ) included 1.0. Humans are geometrically similar ( $\beta_1 = 0.93-1.06$ ) as are nonhuman primate groups ( $\beta_1 = 0.98-1.01$ ), but they differ from humans ( $\beta_1 = 0.81-1.41$ ). Whether or not this observed degree of GS is sufficient to maintain the validity of the DS hypothesis requires further investigation.

#### **Form and anatomical incongruity of the glenohumeral joint in primates**

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The majority of primates forage in the discontinuous network of branches in a highly structured arboreal habitat, where naturally unstable supports and the ratio between body size and support diameter reflects a particular challenge on the locomotor apparatus. Several unique characteristics of primate locomotion are suggested to be adaptive for arboreal quadrupedalism on narrow branches. A highly protracted forelimb, for example, is assumed to be advantageous for gait compliance and reduction of branch oscillations. Accordingly, primates use a much broader range of shoulder joint excursion than other arboreal mammals. Objective of this study is the investigation of the glenohumeral joint morphology related to

limb excursions and the various degrees of forelimb loading in primates.

Several parameters describing the form of the glenohumeral joint surface areas were determined through direct surface area measurements by using an optical three-dimensional digitizer. About 150 specimens belonging to 34 primate species were examined.

As expected, form and incongruity of glenohumeral joint surface areas result in a highly significant difference between quadrupeds in general and specialized brachiators and vertical clingers and leapers. Within quadrupeds no difference in glenohumeral joint incongruity could be detected between terrestrial and arboreal species. Only the comparison of parameters describing the form of the glenoid fossa of arboreal and terrestrial primates of same body weight always results in a broader glenoid fossa in terrestrials. It is suggested that the broader glenoid fossa of terrestrial primates serves for an effective load transmission, because it was shown that terrestrial primates often carry more weight on the forelimbs than arboreal primates of similar body size.

#### **Nonmetric traits and the identification of family groups: a test using the Christ Church, Spitalfields collection.**

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This project evaluated nonmetric traits as indicators of familial relationships. Some researchers postulate that nonmetric traits can identify biologically related individuals, while others argue these variants are too vulnerable to environmental influences. If nonmetric traits are inherited with sufficient genetic control to resist environmental influences, they should occur with higher frequencies among genetically related individuals. This hypothesis was tested with 41 dental and infracranial traits in 863 individuals, including a subset of known related and unrelated individuals, from the Christ Church, Spitalfields, collection at the Natural History Museum, London, England. Trait definitions were based on Finnegan (1978), Saunders (1978), and Turner et al. (1991) and scored on ranked scales. Fisher's Exact Test with a conservative sequential Bonferroni statistic was used for data analysis. No intraobserver error or correlation between dental traits with age and sex were found. Only a few correlations between infracranial variants and age/sex were present. Traits were determined to be rare (<1%), uncommon (1-4.9%) or common (5%) for the population by using the known unrelated individuals. No rare or uncommon trait was shared by known related individuals. Twenty-eight pairs of known related individuals shared at least one pair of common nonmetric traits, with ten pairs sharing more than one. Sharing trait pairs was as likely to be due to chance than familial relationship, as evidenced by known

unrelated persons sharing multiple common pairs. Nonmetric traits could not identify known related individuals in this sample. Reasons, including preservation, Huguénot descent, endogamy, and trait heritability, are discussed.

#### **Analysis of Harris lines from the working-class cemetery at Hierakonpolis, Egypt.**

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Intact adult tibiae from the working-class cemetery at Hierakonpolis (HK-43), a Late Predynastic Egyptian site were analyzed to study the association between the frequency of Harris lines and demographic parameters (age, sex and cultural horizon). The rise of the state at the cost of the underprivileged raises the expectation of a poor health index while having received sufficient nutrition to maintain high levels of economic output. A preliminary study (Ward, 2004) reported lines in 94.1% males and 92.6% females. Continued analysis reported here reveals an average of 7.0 lines for males and 5.55 for females. This is in keeping with the expectation that the growing male is more susceptible to stress than the growing female, perhaps due to greater nutritional needs and smaller reserves (Goodman and Clark, 1981). Randomly distributed Harris lines in agriculturists have been interpreted as reflecting disease and periods of poor nutrition while a lower incidence of lines is considered indicative of healthier populations (Hughes, Heylings and Power, 1996). Data from the Hierakonpolis sample are compared with those from the workers' cemetery at Old Kingdom Giza and medieval Kulubnarti, Nubia. Only 57.6% males, 81.2% females from Giza, 65.7% males and 59.5% females from Kulubnarti have lines. Our results suggest that while inhabitants of Hierakonpolis suffered periodic trivial stresses during childhood, resources were sufficiently good to allow recovery of growth. However, the comparative populations were so inured to stresses that minor ones did not elicit an aggressive response from the body.

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#### **Binary cranial contrasts and hypothetical species demarcations versus sources of real intrapopulation variation: LB1 and other test cases.**

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The only known skull, LB1, from Liang Bua Cave, Flores, Indonesia, commonly is figured next to a recent human skull of unspecified origins, presenting a striking



visual contrast that conditions an impression of validity for the hypothetical species distinction. This procedure is standard practice among many paleoanthropologists, as illustrated also by juxtaposition of KNM-ER 406 with KNM-ER 1470, the Toumaï skull with Taung, and others. Quantitative data, when reported at all, commonly comprise few dimensions, often of only partial comparability. Such visual contrasts and associated taxonomic distinctions more often than not ignore extensive continuous intrapopulation and intralineage variation attributable to differences in sex, age, microevolutionary time trends and clinal distribution, as well as abnormalities arising from disease or injury.

Here we present quantitative craniofacial data from papionine primate populations sampled over Eurasia and Africa. Included are both sexes of 42 conventionally-recognized taxa, including  $\geq 66$  dimensions on each of 1348 subjects. Although the study populations are broadly interfertile, their ranges of craniofacial dimensions frequently exceed by wide margins measurements and indices that are used to support taxonomic distinctions among hypothesized hominin species and higher taxa. For example, the difference in postorbital cranial breadth between KNM-ER 406 and KNM-ER 1470 is exceeded slightly by the absolute range in a combined sample of 60 male *Macaca irus* plus 22 male *M. nemestrina*, males and females of which are reciprocally interfertile. Support for this investigation was provided by the Australian Research Council and the Pennsylvania State University Kinesiology Department's Davis Fund for the Encouragement of Innovative Research.

#### **Body size reconstruction in a small-bodied sample: applicability of current methods.**

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Body size (e.g. stature and mass) estimates are integral to understanding adaptation of past populations. For skeletal samples, it is critical to match the body proportions of the study sample to those of the reference sample; however, the availability of known-stature reference skeletal samples is limited. Body size estimation of an archaeological skeletal sample can be problematic when the body size or proportions of the population are distinctive. One such population is that of Later Stone Age foragers from southern Africa. With small stature (mean femoral length = 405 mm, n = 53) and narrow pelvis (mean = 211 mm, n = 35), adult body size/shape is distinctive, making it difficult to identify appropriate body size estimation methods.

Stature estimates based on skeletal anatomical linear measures (the Fully method) and estimates based on femur length are compared, along with body mass estimates derived from morphometric (bi-iliac breath-stature) and biomechanical (femoral head diameter) methods, using a skeletal sample from the Later Stone Age (n = 53) from the Southern, South-western, and Eastern Cape regions of South Africa (radiocarbon dates from ca. 250 to 5600 BP). When body mass estimates derived from morphometric and biomechanical approaches are compared, the methods yield results that are more similar for female skeletons than for male skeletons. Stature estimates vary with the formula used, highlighting the need for formulae derived from short-statured reference samples to expand the reliability of methods to a wider range of body sizes.

#### **Early life nutritional cues, developmental plasticity and human life history: new evidence**

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The finding that the conditions of the intrauterine environment have wide-ranging effects on adult biology and disease has increased interest in the evolutionary origins and possible function of these modes of developmental plasticity. Findings in both human populations and animal models have led to the hypothesis that the fetus could use maternal cues to modify metabolic, growth and reproductive settings in an anticipatory fashion. While human and animal studies of disease outcomes provide indirect evidence in support of this hypothesis, few studies have explored this proposal using outcomes that are both metabolically costly and have unambiguous implications for reproductive strategy or genetic fitness. To clarify the possible adaptive role of intergenerational and early life developmental plasticity in humans, this paper will test the hypothesis that 1) markers of maternal/prenatal nutrition during pregnancy will be positively related to indices of testicular function in adult offspring as measured in plasma and salivary samples, and 2) any changes in testosterone will be correlated with differences in costly testosterone-sensitive traits, including stature, lean mass and grip strength. Data come from a longitudinal birth cohort study that includes roughly 900 21-22 year old males living in the Philippines who have been followed since their mothers were pregnant with them in 1983. Implications for models of male reproductive ecology and life history will be discussed.

#### **Feeding the children: Isotopic evidence for weaning practices in the ancient Greek colony of Apollonia (5<sup>th</sup>-2<sup>nd</sup> centuries BC).**

C. Kwok, A. Keenleyside. Department of Anthropology, Trent University.

Previous biochemical weaning studies in the Classical world have been confined to the Roman period, while ancient Greek weaning practices remain largely unexplored. This is the first study examining infant feeding practices in the ancient Greek colony of Apollonia (5<sup>th</sup>-2<sup>nd</sup> centuries BC) on the Black Sea coast of Bulgaria using stable isotope analysis. Collagen from the ribs of 66 subadults, ranging in age from birth to 15 years are analyzed for stable nitrogen and carbon isotopes to determine the general age at which weaning was initiated and terminated, and the types of foods onto which infants were weaned. From the stable isotopic evidence, weaning was observed to begin between 6 months to 1 year, and completed between 2 and 4 years of age. However, there is also variation in the weaning pattern. Furthermore, the subadult diet is also compared to that of the adults to investigate whether the children consumed a different type of diet than the adults of Apollonia. In addition, the stable isotopic data is integrated with the paleopathological and archaeological evidence as well as ancient literary sources to further explore infant feeding practices at Apollonia. Finally, the Apollonian weaning pattern is discussed within the context of other Classical biochemical weaning studies. Overall, this study shows the potential of incorporating evidence from multiple sources to draw a more complete picture of ancient Greek lifestyles and childrearing practices.

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#### **Feeding outside the forest- Importance of crop raiding and an invasive species in the diet of gallery forest *Lemur catta* following a cyclone at the Beza Mahafaly Special Reserve, Madagascar.**

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While examining feeding and nutrition of male and pregnant female *L. catta*, I collected data on crop raiding and foraging on an invasive weed. Previously, a cyclone swept through the forest when *Tamarindus indica* was flowering, which consequently almost completely failed to fruit; leaving *L. catta* without this major food resource during the both dry and reproductive season. I followed two distinct groups (Red and Green) and saw both ventured outside of the forest reserve to secure food. The home range of Red group included a farmer's crop, from which the animals fed daily on both *Convolvulaceae* sp. leaves (an agricultural product) and *Argemone mexicana* L. (an invasive weed). The home range of neighboring Green group did not include the crop; they did however, feed daily on *A. mexicana* L., which also grew in the dry river bed (outside of the forest). When compared to the forest, Red group had no significant difference between the time spent foraging or the amount consumed in the crop, however Green group did show

differences in the time spent foraging in the river bed ( $p=1.9 \times 10^{-5}$ ) and amount consumed in the river bed ( $p=2.8 \times 10^{-6}$ ). As such, it appears that although *A. mexicana* L. was an important food for both groups, *Convolvulaceae* sp. was an especially important resource for Red group. Implications include insight into the plasticity of primates when foraging in an ever changing environment, benefits of crop raiding, and on the use and proliferation of an invasive floral species.

**Plasticity in gut function and its implications for understanding species coexistence and evolution of Cercopithecinae dietary niches.**

J.E. Lambert. Department of Anthropology, University of Wisconsin-Madison.

Phenotypic plasticity refers to the capacity of a single genome to generate a range of environmentally-induced phenotypes, and may involve both irreversible and more labile phenotypic components. Plasticity facilitates adjustments to changes in ecologic conditions on a more rapid timescale than can be accommodated by genetic change, and thereby may facilitate initial movement into novel niches (West-Eberhard 2003). In this paper, I explore the implications of phenotypic plasticity in digestive biology and propose a model to explain the evolutionary success and species coexistence of the Cercopithecinae.

Data on digestive retention and gut function were collected (1995-2006) on captive *Cercopithecus*, *Allenopithecus*, *Miopithecus*, and *Macaca* spp; feeding data were collected in *Cercopithecus* and *Lophocebus* spp in Kibale National Park, Uganda (1997-2002). In sum, these cercopithecine species have digestive retention times that are significantly longer ( $p < 0.05$ ) relative to body size than virtually all other non-cercopithecine primate taxa. Importantly, they also exhibit considerable plasticity in response to shifts in dietary fiber fraction and total energy, suggesting a mechanism for facilitating flexible feeding and a broad feeding niche axis.

At an ecological scale, I suggest that digestive plasticity has consequences for how multiple cercopithecine species can coexist despite greatly over-lapping diets. At an evolutionary scale, I suggest that digestive flexibility is part of an overall pattern of adaptive plasticity facilitating Cercopithecinae success. I conclude by suggesting that plastic gut function is one feature in a larger suite of traits serving to mitigate the effects of occupying crowded feeding niche space over time.

**Wild male chimpanzees preferentially affiliate and cooperate with maternal but not paternal siblings.**

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Male chimpanzees are often used as textbook examples of the influence of kinship on animal social behavior. Nonetheless, prior research has found no evidence for preferential relationships among genetic relatives. Instead, male chimpanzees form close social bonds with others who are similar in age and dominance rank. However, to date this research has relied on mitochondrial DNA, which gives only a crude indication of maternal relatedness. The finding that males bias their behavior towards age mates, who may be paternal siblings if male reproduction is heavily skewed, indicates that paternal relatedness must also be reliably ascertained to fully elucidate the role of kinship in male chimpanzee social behavior.

To investigate the role of maternal and paternal relatedness in male chimpanzee behavior, we conducted field observations and performed extensive molecular genetic analyses on the chimpanzees of the Ngogo community in Kibale National Park, Uganda. Our results show that male chimpanzees at Ngogo preferentially associate, maintain close spatial proximity, groom, form coalitions, share meat, and perform joint territorial boundary patrols with their maternal siblings. This pattern of preferential affiliation and cooperation among maternal siblings holds after similarity among dyads in age and rank is controlled, suggesting that nepotism among maternal siblings is not merely a by-product of other factors. In contrast, males do not bias their behavior towards paternal siblings. We hypothesize that this lack of nepotism among paternal siblings may occur because age proximity is not a reliable cue for identification of paternal siblings in chimpanzees.

***Homo erectus* taxonomy: A reconsideration of the single-species hypothesis.**

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Recent discoveries have expanded the range of variation in *Homo erectus*, leading some to split the hypodigm into two or more species. An opposing argument suggests that the degree and pattern of metric variation can be accommodated within one species. The latter viewpoint is based largely upon studies which have focused on metric and non-metric variation in the neurocranium and basicranium. Although largely necessary because of poor fossil preservation, such narrow focus limits the ability to discover taxonomically diagnostic differences.

To reassess the taxonomic integrity of *H. erectus*, metric data were assembled for the brain, neurocranium, teeth, basicranium and face for specimens commonly attributed to *H. erectus*, *H. sapiens* and several fossil comparative samples. Bootstrapping methods were used to resample coefficients of

variation (CVs) for size and shape variables in the fossil and comparative samples, and principle components analyses (PCA) were used to explore patterns of variation within each character complex.

With the exception of dental data, the addition of Dmanisi and Ngandong to the test sample extends the range of size variation in *H. erectus* beyond those normally encountered in *H. sapiens*. However, cranial variation in shape is no greater than expected for *H. sapiens* or any of the comparative samples. Arguably, these results are consistent with a single-species attribution for these specimens.

**Infant care and activity patterns of adult male and female siamangs (*Symphalangus syndactylus*): implications of male care for adult energetics.**

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Reports from wild and captive siamangs describe extensive male care of older infants. However, the effects of male care on male and female energetics are not well-understood. I collected longitudinal data on adult activity patterns in five wild siamang groups for 14-24 months following the birth of an infant to assess the relationship between infant care and adult time budgets, to detect periods of high male and female investment in offspring, and to shed light on the strategies adult siamangs employed to minimize energetic stress during periods of high investment in infant care.

Females provided almost all care for infants aged <10 months. The timing of peak male care and the quantity of care provided varied dramatically between males. Adult diets, mean daily path lengths, and mean active periods did not vary with changes in infant developmental state or patterns of infant care. Most adult carrying of infants >10 months old occurred during travel. Therefore, adult costs of locomotion probably increased due to the infant's additional weight. However, both males and females spent significantly less time feeding and more time resting while carrying infants, even if time spent traveling is excluded. This suggests that the energetic costs of infant carrying may be non-trivial. As females receiving more male help spent less time providing care for infants, male care likely reduced the energetic costs of reproduction for females. Funding was provided by the Leakey Foundation, Sigma Xi, Fulbright, the Margaret and Herman Sokol Foundation, and New York University.

**Speed of infant development in Phayre's leaf monkeys: A mother's influence.**

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Primate growth rates, maturation, and reproduction are influenced by multiple factors. A mother's nutritional condition, which may depend on her social integration or rank, is particularly influential in the first months of an infant's life, when milk is usually the sole or primary source of nutrients. However, it is often difficult to determine growth rates of arboreal primates, especially infants. In addition, rank effects on infant development are commonly not expected in folivorous, female dispersal primates. To approach both aspects, we investigated the interrelations of speed of infant development, female physical condition, and dominance rank in two groups of Phayre's leaf monkeys (*Trachypithecus phayrei*) in Phu Khieo Wildlife Sanctuary, Thailand. To quantify infant development we recorded changes in conspicuous natal coat and skin coloration (13 infants), scoring the beginning, end, and duration (29 measures). Physical condition (PC) was documented monthly (7-point scale, 19 females), and rank was based on agonistic interactions. There was considerable variation in infant development (e.g., total change varied by 21 weeks) and in female physical condition. Duration of skin color change was strongly ( $P < 0.01$ , one outlier excluded) correlated with a mother's PC; and, in 86% of the measures, mothers in a better PC had infants that changed color more rapidly (Binomial test,  $P < 0.001$ ). In addition, female rank and PC were significantly correlated ( $P < 0.05$ ). These results show that better condition and higher rank may offer benefits for females. While the former is not necessarily surprising, the latter indicates contest competition even in a female dispersal species.

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#### Misconceptions about the postcranial skeleton of *Homo floresiensis*.

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The discovery of diminutive hominins with tiny brains living until 12,000 years ago on the island of Flores has been met with both interest and skepticism in the anthropological community. While most debate has focused on brain size, two recent reviews cite postcranial features of the Liang Bua 1 (LB1) skeleton as evidence that it was not from a distinct species of hominin, but rather was an atypical modern human. Richards (2006) argues the Liang Bua fossils represent a *Homo sapiens* group that became dwarfed through hypothetical genetic changes in growth control factors, and claims that the distinctive features of LB1 are also found in modern human pygmy populations.

Jacob et al. (2006) conclude that LB1 displays regional characteristics of Australo-melanesian *H. sapiens* populations but with developmental abnormalities. In particular they report that the postcranial elements of LB1 display evidence of weakened muscles, thin cortical bone, enlarged medullary cavities, and marked right and left asymmetries.

We have examined the Liang Bua fossil material and find the analyses of the LB1 postcranial material by Richards (2006) and Jacob et al. (2006) to be incorrect on nearly all counts. Contrary to both Richards and Jacob and colleagues, both limb proportions and stature reconstruction for LB1 are completely outside ranges ever observed in modern humans, including the smallest "pygmoids." Previous studies have shown that muscularity cannot be deduced reliably from muscle scars. In addition, Jacob et al. (2006) exaggerate the degree of left/right asymmetry in LB1, and cortical bone thickness is perfectly normal and well within modern ranges.

#### A comparison of mitochondrial DNA and Y chromosome DNA variation on Manus Island.

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Human mitochondrial (mtDNA) and Y-chromosome (NRY) genetic variation in Island Melanesia has recently been shown to be highly geographically structured, with a number of ancient autochthonous haplogroups. The coalescence dates for the oldest set are in the 30,000-50,000 year range, compatible with archaeological estimates of initial settlement. It has even been possible to locate the origins of some of these old haplogroups in particular islands there.

The island of Manus presents an intriguing situation for investigation from this background. It was first settled ~21,000 B.P., in one of the earliest human long-distance voyages known. There is archaeological evidence of continuous occupation that persisted, with relatively little outside influence, until a considerably later in-migration of agriculturalists at ~3,400 B.P. These migrants spoke Austronesian languages that originated a few thousand years before in the Taiwan/Southeast Asia region, and carried a very distinctive set of genetic variants. The languages spoken today on Manus are all Austronesian, but given its long settlement history, it is reasonable to think the population there represents considerable admixture from this ancient time period.

This presentation will show the extent of male and female mediated contributions to the contemporary Manus gene pool from a) the Southeast Asian/Taiwan region, b) New Guinea, c) New Britain, d) New Ireland/New

Hanover, and e) Micronesia. This is possible because of the very different genetic profiles of populations from each of these regions. Perhaps most surprising is the lack of a major Southeast Asian/Taiwan genetic signature in the current population, particularly in the NRY.

#### Calculating the stochastic population growth rate in a wild population of lemurs (*Propithecus verreauxi*) using long-term rainfall data.

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A lot of research in demography seeks to characterize the nature of stochastic population dynamics. In some cases, populations fluctuate due to their dependence on an environmental factor (e.g., food or rainfall) that is itself stochastic. The effects of such environmental stochasticity are wide-ranging and are assumed to shape life history schedules as well as influence a population's potential for extinction. In this study, we use 50 years of rainfall data to parameterize a stochastic model of the environment. We connect this stochastic model of the environment to a five-stage matrix population model of wild Verreaux's sifaka. The data for both models draw from a long-term study of Verreaux's sifaka at Beza Mahafaly Special Reserve in southwest Madagascar. By connecting a stochastic model of the environment to a demographic model of the sifaka life cycle, we are able to use stochastic simulations to determine how rainfall influences the stochastic growth rate of the sifaka population. Specifically, our matrix population model is written such that survival in each life-cycle stage is a function of annual rainfall. Our results indicate that the stochastic population growth rate is 0.9849 (95% CI = 0.9357-1.0037), suggesting that the population is roughly at equilibrium (i.e., births each year balance out with deaths each year). Our model implies that the variance in annual rainfall is not sufficiently erratic to bring about the possibility of extinction in this population. We discuss these results in terms of life history evolution and conservation.

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#### The pair bond in brown titi monkeys (*Callicebus brunneus*): male and female reproductive interests.

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Close male-female bonds in primates are thought to relate to three categories of sex-specific benefits: joint resource defense, male mating exclusivity, and the delivery of male

services that increase female reproductive success. This project differentiated among these potential benefits by examining the sensitivity of bonds between pairmates of brown titi monkeys (*Callicebus brunneus*), a predominantly frugivorous species characterized by strong attraction between the pairmates in each group. I studied seven sets of pairmates in a Peruvian rainforest, using observational sampling and playbacks of unfamiliar calls (simulating intruders) to quantify behavioral indicators of pair-bondedness that have been suggested by captive studies. I correlated changes in these behaviors with differences in the physical environment (fruit abundance, territory location) and social environment (proximity of a sexual competitor to the subject's pairmate). Both males and females exhibited more affiliative and arousal behaviors in the presence of real or simulated intruders. Results support a territory-defense function for the pair bond: both sexes exhibited more monogamy-maintaining behavior when fruit was least abundant and in high-use versus low-use areas. Both sexes were also equally responsible for the maintenance of proximity and grooming bouts. There is limited support for a male mate-guarding function: in general males exhibited more arousal behavior and vocalized more when a simulated pair was closer to (vs. farther from) the subject's pairmate. Males services did not appear to serve as a basis for the pairmates' bond.

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#### Examining polymorphism and divergence in non-coding features of craniofacial genes.

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Until the molecular factors underlying primate craniofacial size and shape change are understood, knowledge of hominid skull evolution remains limited. Craniofacial development involves hundreds of genes, organized into networks, creating and shaping the whole in space and time. Because many of these genes are also involved in development of other structures, their coding sequence is highly conserved. Non-coding regions are less conserved and are good for understanding molecular evolution. Non-coding regions also contain regulatory modules that may be more important for understanding the genotype / phenotype interface than coding sequence. Gene expression studies reveal heritable differential expression among humans, and regulatory modules are known to undergo adaptive change.

We modified the standard McDonald-Kreitman test to examine non-coding feature evolution for genes known to affect craniofacial development using polymorphism data (intra-human) and divergence data (human-chimp and human-macaque). Additionally, we examine evolutionary change within predicted *cis*-regulatory modules in the vicinity of these genes. Analyses to date reveal an excess of polymorphism to divergence relative to a neutral proxy in 1kb non-coding flanking regions of 50 craniofacial genes. Predicted *cis*-regulatory modules within these regions show a lower polymorphism to divergence ratio than the surrounding sequence. These results will be used to investigate overall patterns of change, contributing to our knowledge of the molecular factors underlying craniofacial evolution.

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#### Trabecular, articular and cortical asymmetry in the human second metacarpal.

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The genus *Homo* is arguably the only primate exhibiting species-level laterality (handedness). The origin of handedness is presently unknown, but is of great evolutionary interest as it has been suggested that it is part of a suite of behavioral and cognitive characteristics apomorphic for *Homo*, including tool use, manufacture involving fine manipulation and language capacity. However, identifying handedness in the fossil record requires understanding how lateralized behaviour is manifested in skeletal remains.

We report here the results of a microcomputed tomographic and osteometric / geometric study of directional asymmetry across multiple bone compartments (trabecular, articular and cortical) in the head, base and shaft of  $n = 29$  paired second metacarpals. The left - right difference for articular breadth and depth, midshaft cross-sectional geometry and trabecular microarchitecture is tested against the null hypothesis of symmetry (right - left = 0) using a one-sample t-test and correlation analysis. Directional asymmetry is seen to be much more evident in the metacarpal head than in the base, particularly with respect to trabecular microarchitecture, with most but not all differences having a right hand bias. All significant aspects of cortical asymmetry (total area, torsional rigidity and midshaft diameter) favored the right side. Significant correlations were found among variables

within, but not across, the different bone compartments.

These results are consistent with (1) a structure modeled as a cantilevered beam with greater degrees of freedom (and thus loading) distally; and (2) current models of functional adaptation and constraint in articular, trabecular and geometric morphology (Pearson and Lieberman, 2004). Natural Sciences and Engineering Research Council of Canada (RAL).

#### Alaskan Eskimo and Polynesian Island population skeletal anatomy: The "Pacific Paradox" revisited through surface area to body mass comparisons.

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This project is an attempt to re-examine the "Pacific Paradox", as proposed by Philip Houghton (1996), through various morphological measurements on two climatically different populations, Alaskan Eskimo and Pacific Island groups. The "Pacific Paradox" has been widely discussed, but research using direct comparisons between this Pacific population and cold climate groups has received little attention. The methods employed are those performed by Ruff et al (1991, 1994, 2004, 2005) and Houghton (1996) to create the most accurate determination of overall body form in both populations. Eight measurements (maximum length of the femur, tibia, fibula, humerus, radius, and ulna, as well as maximum bi-iliac breadth and maximum femoral head diameter) were used to construct variables (stature, body mass, surface area, surface area to body mass ratios, and stature to body mass ratios) to create an accurate portrayal of overall body shape. These measurements were taken on Alaskan Eskimo populations spread throughout the entire region of Alaska and on Polynesian populations from a wide variety of Pacific Islands.

The results illustrate that the overall comparisons reveal similarities in the two body mass estimations; the bi-iliac breadth measurement and maximum femoral head diameter, and in the overall stature to body mass ratios, except in the males who are significantly different in every measurement apart from surface area to body mass ratios and stature to body mass ratios. The results of this study generally demonstrate a correlation of morphology between Remote Oceania populations, in its warm climate, and Alaskan populations, living in cold environments.

#### Cercopithecoid assemblages in the Koobi Fora Formation, Omo-Turkana Basin, northern Kenya.

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Cercopithecoid assemblages in the Koobi Fora Formation, northern Kenya, show a succession of species that reflect both evolutionary trends and changes in

paleoecology largely resulting from a general trend towards opening and drying of environments with time. Deposits in the Koobi Fora Formation are largely fluvial but with some lacustrine influence as a series of short-lived lakes periodically filled the basin adding sediments of lacustrine, lake-margin and deltaic origin. The early assemblages, (~3.95~3.45 myr) are dominated by primitive papionins assigned to species of *Parapapio*, but small bodied colobines were also present. After this time, *Theropithecus* dominates all assemblages. Between (~3.4~2.5 myr), *Parapapio* species are replaced by *Theropithecus brumpti* (which likely evolved from an early papionin) as well as several species of larger-bodied colobines. These colobines mark the beginning of a radiation of large bodied colobine species which largely disappeared by ~1.6 myr. Between 2.35 and 1.94 myr, an interval that is not recorded in the Koobi Fora Formation, *Theropithecus brumpti* replaced *T. oswaldi*, the dominant cercopithecoid throughout the remainder of the fossiliferous sequence. Two modern genera of monkeys, *Lophocebus* and *Colobus*, first appear in the KBS member and become more common in the Okote Member (1.5-1.4 myr). *Cercopithecus*, the most common genus of African cercopithecoid monkey today, is rare throughout the sequence. This genus first appears in the Tulu Bor Member (~3.3 myr), but is more prevalent above the KBS tuff.

#### The biological affinities of populations from China and Mongolia: dental nonmetric trait evidence from the Neolithic through the modern period.

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One in five people today claim descent from populations originating within China and Mongolia. However, few studies have systematically traced the microevolution of these populations across modern day political boundaries, and through time. Three major cultural divisions have previously been recorded archaeologically and historically, the Chinese and proto-Chinese, Northern Asian nomads (Mongolians, Xiongnu, Xianbei), and Caucasians (Turkic, Scythian, possibly European). Thirty-five dental nonmetric traits were recorded from over 1,400 crania. The data was divided into 20 samples representing Neolithic (3500-2000 BC), Bronze age (2000-400 BC), Iron age (400 BC-AD 500), Imperial period (AD 500-1500), and Modern period (AD 1500-2000). The mean measure of divergence statistic was used to compare samples. Neolithic populations were found to be one interrelated group (Dawenkou, Yangshao). Bronze age populations separated into three geographic clusters, central Mongolia/central China, western Mongolia (Caucasian), and eastern China (Inner Mongolia). Iron age population dynamics were the most complex, with four separate areas, central Mongolia (Xiongnu), western China (Caucasian), central China

(Chinese), and eastern China (Xianbei). The Imperial and Modern periods revealed a reduction in population complexity, with only two divisions, Mongolian and Chinese. The results support population continuity in Mongolia from the Bronze age to Modern period (Slabgrave-Xiongnu-Mongol-Mongolian). The results also support population continuity in China from the Neolithic to Imperial period (Dawenkou-Xiajiadian-Longxian-Zhenzishan). This research was supported by a Wenner-Gren dissertation fieldwork grant.

#### Characterization of mitochondrial DNA variation and population structure of Papua New Guinea.

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Situated along a corridor linking the Asian continent with the outer islands of the Pacific, Papua New Guinea has recently become the center of attention on human migration and expansion into Oceania. Initial human migration into the Southwest Pacific is suggested to have occurred around at least 40,000 years ago with a more recent expansion into the islands of Polynesia at around 3,000 years ago. While the exact homeland of these recent migrants remains unclear, discussions continue on the route of dispersal and the degree of interaction with the ancient settlers in Papua New Guinea and surrounding regions, commonly known as Melanesia. Papua New Guinea also exhibits a vast diversity in languages and unique geographical environments that present intriguing anthropological perspectives on human biology and culture. This study presents novel mitochondrial DNA D-loop sequences of approximately 100 individuals from the northern coastal highland region of Papua New Guinea. Most are identified as belonging to haplogroups P and Q. In addition to haplogroup characterization, statistical methods are used to infer population structure throughout the mainland and its surrounding islands in correlation with geography and language. Results indicate a complex scenario of genes, languages and geography in Papua New Guinea and insights into the peopling of the Pacific.

#### Exploring STET: a new method for examining variation and species

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One of the questions most often asked in paleoanthropology is whether the amount of variation in a fossil sample is too much to be from a single species. STET (STandard Error Test) uses standard error of the coefficient from a linear regression model relating a pair of specimens. Previous studies used this

method to ask if variation in a fossil sample needs to be explained by multiple species (Lee and Wolpoff 2005; Wolpoff and Lee 2001, 2006). In this paper, properties and limits of STET are explored using skeletal data of known sex and species.

Data include 53 cranial and postcranial measurements of modern humans (n=87) and chimpanzees (n=43). STET values are calculated for all possible interspecific (n=3,741) and intraspecific pairs (n=4,644) to generate distributions of STET. Results show that interspecific STET values are always greater than intraspecific STET values when all 53 variables are used. When variable numbers are arbitrarily decreased by random sampling, STET becomes less effective. Random sampling of variables are repeated 1,000 times to assess the effectiveness of STET. The amount of over-lap between interspecific and intraspecific STET values is used as error rates from 0.01 to 0.10. Minimum number of variables necessary for STET to be effective ranges from 30 (0.10 error) to 48 (0.01 error). Examples of STET applications using hominid fossil data are presented.

#### Weight and time matter: determinants of ape social system and biogeography.

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Despite the fact that all African great apes live in similar habitats and have overlapping diets they differ substantially in their biogeographical range: gorillas are much more limited in their distribution than chimpanzees. Furthermore, while chimpanzees live in large communities with a fission-fusion social system (i.e. they regularly split into smaller subgroups), gorillas occur in much smaller but more cohesive groups. In this study we use a modelling approach to identify the factors responsible for these differences. We use a time budget model to analyse the relationship between climate, group size, body weight and time available for various activities, demonstrating that time acts as a limiting factor that determines if individuals can survive in a given habitat. Our model shows also that body weight together with diet and feeding group biomass are critical determinants for group size and ape biogeographical distribution. We further suggest that chimpanzees split into smaller subgroups to reduce travel times, thereby enabling them to live in larger groups than otherwise possible. Our model thus confirms and expands previously suggested hypotheses about ape social evolution. Additionally, it enhances our understanding of the relationships between climatic conditions, individual behaviour, morphological constraints and a species' biogeographical distribution, which has strong implications for our understanding of ape and human evolution.

This project was supported by the British Academy.

### Life History Theory, Early Childhood Risk and Adolescent Behavior in Colombia

D. Lende. Notre Dame

Life history theory predicts that early exposure to risk can lead to different behavioral strategies in adolescence, for example, childhood stress promoting earlier initiation in sexual behavior (Belsky et al. 1991, Chisholm 1993). The research presented here will examine the impact of three types of early risk—quality of attachment, traumatic events, and experience of low social status—on adolescent sexual behavior, substance use, and delinquency. The sample consisted of 267 adolescents (70% male, mean age 16.05) surveyed at a school (n=154) and a drug treatment center (n=113) in Bogotá, Colombia. The survey was based on previously validated epidemiological work on marijuana use in Colombia (Brook et al. 1998), with additional scales on attachment and traumatic events (Chisholm 1999). The subjective social status variable, created in this research, asked about perception of family status during childhood and being made to feel inferior by childhood peers. Significant correlations ( $p < .01$ ) appeared between all types of childhood risk and adolescent behaviors, and initial regression analysis shows that early trauma is a significant predictor ( $p < .01$ ) of age of initiation in sexual behavior. Further regression analyses will be used to examine the impact of all early experiences on the initiation and level of adolescent “risk” behavior. Contributions include an expansion of the life history approach to adolescent decision making through the study of both male and female adolescents, data from an unstudied area, the examination of sexual and non-sexual behaviors, and the development of a scale to measure the subjective sense of early disadvantage.

### Ecological correlates of the initial spread of hominids from Africa.

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Recent evidence suggests that the initial spread of hominids out of Africa into other parts of the Old World was quite rapid. Estimates of diffusion coefficients for the migration of *Homo ergaster/erectus* into Indonesia and Georgia indicate much faster dispersal rates than for other fossil primate species. These rapid migration patterns for early *Homo* appear to be attributable to major changes in land use patterns. An animal's territorial needs (home range) are strongly correlated with body size, foraging behavior and ecosystem structure. Here we draw on comparative data from extant

primate species and modern human hunter-gatherers to model the influence of changes in body size, dietary patterns and overall ecological productivity on home range size with the emergence and evolution of *H. ergaster/erectus*. We find that the changes in body size observed with the evolution of early *Homo*, coupled with modest shifts in diet and environmental productivity predict dramatic increases in home range size relative to the australopithecines. These analyses allow us to quantify the relative influence of different behavioral and ecological factors in shaping the initial movement of hominids out from Africa.

### A study of decomposition rates in eastern North Carolina.

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Estimating time since death (or postmortem interval) via postmortem changes is crucial in forensic cases involving decomposed human corpses. Several environmental and taphonomic factors affecting decomposition rates such as ambient temperature, rainfall, humidity, and insect activity can vary drastically even within a small geographic region. The present study involved observing the decomposition of two domestic pigs within two microenvironments to better understand factors affecting human decomposition rates in eastern North Carolina. Subjects were placed a cool, shaded area and in direct sunlight with the expectation that the exposed subject would reach maximum bloat and decay more rapidly than the shaded subject. Data on the temperature, rainfall, and humidity and insect activity in addition to biomass loss and girth of the subjects were gathered at each site from August 2005 until January 2006.

This study discovered that factors affecting insect activity, such as ambient temperatures and sunlight exposure, strongly influenced decomposition rates in eastern North Carolina. The exposed subject achieved maximum bloat two days before the shaded subject but did not progress as quickly through subsequent decomposition stages. After an initial rapid loss of the exposed pig's biomass due to warmer temperatures, prolonged exposure to high temperatures and direct sunlight dehydrated the exposed subject's soft tissues. This mummification resulted in decreased insect activity, and as a result, slowed decomposition in the post-bloat stages compared with the shaded subject. These data will allow biological anthropologists and law enforcement officials to better estimate the postmortem interval of deceased individuals in eastern North Carolina.

### A comparative analysis of internal cranial anatomy in the Hylobatidae.

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This is the first comparative analysis of internal cranial anatomy of the Hylobatidae based on substantial samples from all four currently recognized genera: *Bunopithecus*, *Hylobates*, *Nomascus* and *Symphalangus*. The goal is to establish the primary anatomical differences between the hylobatid groups in basicranial flexion and facial kyphosis in light of the recent taxonomic revisions of this family.

I calculated the orientation of the posterior cranial base (PCB), the Frankfort horizontal (FH), the midface, and the neutral orbital axis (NOA) from lateral view radiographs. Interspecific adult mean angular values were compared using T-tests.

The four hylobatid taxa significantly differ from each other in degree of PCB flexion and FH orientation. *Symphalangus* has the most extended posterior skull base and least inclined FH from the NOA of the hylobatids, while *Nomascus* has the most flexed base and least inclined FH. *Bunopithecus* and *Hylobates* are intermediate. The groups do not differ in midfacial orientation.

These results show morphological differentiation of internal cranial anatomy between the primary groups of hylobatids. They generally support the findings of external craniometric hylobatid studies and provide documented concordance between internal and external cranial anatomy. The results may also have functional implications relating to the effects of soft tissues, specifically the brain and laryngeal air sacs, on basicranial flexion and facial kyphosis.

### The efficiency of stone and bone tools for opening termite mounds: implications for hominid tool use at Swartkrans.

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Stone and bone tool artifacts have been recovered from Swartkrans cave deposits in The Cradle of Humankind World Heritage Site, dated to the early and middle Pleistocene. It has been suggested that bone tools were used for digging up tubers of edible plants, excavating termite mounds, or as multipurpose tools. Here we present results of experiments on the efficiency of both bone and stone tools for the excavation of modern termite mounds. Efficiency of penetrating a termite mound crust is defined by relating the mass of a tool to the mass of termite mound excavated, controlling for the number of strokes used. It is demonstrated that large stones are more effective in opening up termite mounds than any of the inherently smaller bone tools. Bone tools were more effective than stone tools that shared similar masses. The light weight, efficiency, and the nature of polish and wear on some Swartkrans artifacts makes it probable that selected bone tools were being carried by hominids and used for numerous purposes in addition to termite foraging.

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#### The cranial vault in fossil hominids: Computerized shape analysis.

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Two views of human evolution are currently held. These are: [1] the "out of Africa" scenario and [2] the "multi-regional" theory. Which theory is correct has remained elusive. The purpose of this research is to try to resolve the controversy using cranial vault data.

A new approach, *computational shape analysis* (CSA) was applied. This approach is based on a Fourier-wavelet representation consisting of: [1] elliptical Fourier functions (EFFs) and [2] continuous wavelet transforms (CWTs).

Three fossil vault samples were used: *H. erectus* (n=30), *H. neanderthalensis* (n=22) and *H. sapiens* (n=54). A lateral jpeg of each vault was pre-processed with Photoshop to insure standardization. The vault region was limited with a line drawn from Nasion (*Na*) to the external auditory meatus (*eam*) superior margin and extended posteriorly until it intersected the occipital. Each image was then rotated making the *Na - eam* line horizontal. The rotated image was then submitted to a specially-written routine that digitized 72 points along the cranial vault boundary. Each cranial vault was then fitted with EFFs standardized for size.

The results demonstrated statistically significant differences between *H. sapiens* and *H. erectus* as well as between *H. sapiens* and *H. neanderthalensis*. There was no statistical significance between the *H. erectus* and *H. neanderthalensis*. It is suggested that *H. erectus* and *H. neanderthalensis* probably represent an ancestor/descendant relationship; that is, a single evolving lineage. In contrast, *H. sapiens* seems to represent a separate evolutionary development although its origins still remain uncertain due to the paucity of fossil evidence.

#### Female power in lemurs: A new framework for understanding "female dominance"

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Many lemurs are reported to be female dominant. While primatologists agree that the phenomenon known as "female dominance" exists, researchers have argued for decades about how to define it and why it

evolved. Recently, a new framework for understanding power was developed. Power is defined as arising from an asymmetry in a dyadic relationship and can be divided into two types: dominance and leverage. In the power framework, intersexual asymmetries based upon females having superior abilities to use force would be considered female *dominance*. For example, in some lemur species females are larger than males, and thus, female dominance may be an appropriate term. However, many species of lemurs are monomorphic. These species more likely exhibit female *leverage*, or resource-based power. By analyzing power in terms of the different characteristics outlined in the framework, it becomes apparent that the term "female dominance" is used to refer to different phenomena. "Female feeding priority" describes the *amount* of female power, while other definitions are based upon the *scope* of power. I show the utility of the power framework for studying the phenomenon known as "female dominance" with examples from the literature, as well as new data on wild Verreaux's sifaka. For instance, 92% of the aggression by male Verreaux's sifaka towards females is directed toward females who are poor-quality mates, i.e., females who have less leverage. By placing "female dominance" in the broader context of power, much of the confusion regarding the observed phenomena disappears.

#### New data on enamel thickness in *Homo sapiens*.

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The thickness of tooth enamel is widely held to be of phylogenetic and functional significance in hominoid evolution. Enamel thickness has, for example, played an important role in discussions of the phylogenetic placement of *Ardipithecus*, *Orrorin*, and *Sahelanthropus*. Such work has highlighted the need for a better understanding of enamel thickness variation in extant taxa --- intraspecific variation must be adequately characterized in order to interpret the biological significance of interspecific differences. To address this need, we present here new data on both absolute and relative enamel thickness in a large geographically diverse sample of modern *Homo sapiens*. All tooth positions, both primary and secondary, are represented in this sample. The raw data is in the form of CT scans (30 micron resolution). These scans were digitally segmented, so that the linear measures of enamel thickness can be considered relative to overall enamel and dentin volumes. The addition of a large set of both absolute and relative enamel thickness values to existing data should improve our ability to interpret enamel thickness

variation in fossil forms. This is particularly true for teeth other than molars, and especially deciduous elements, which have received comparatively little attention.

#### Analysis of a small mammal fauna from the !Ncumsta Hills, western Ngamiland, Botswana.

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Recent excavations in cave deposits of the !Ncumsta Hills, western Ngamiland, Botswana have produced a diverse mammalian fauna conservatively dated to 100,000 BP. The present climate in this region of the Kalahari is semi-arid, with annual rainfall of 400-450 mm per year that occurs during the austral summer. These deposits have yielded fossils of many mammals, including craniodental material of *Papio*. Along with the larger components of the mammalian fauna are fossils of many smaller mammals. Preservation of the small mammal fauna is consistent with an owl accumulation, most likely accumulated by *Tyto alba* (Barn Owl) given the depositional environment. The small mammals provide insight into the paleoenvironment associated with the primate fossils. Although the small mammal fossils are fragmentary, some diagnostic specimens are available. Specimens attributed to the rodents *Aethomys chrysophilus*, *Tetera brantsii*, *Steatomys krebsii*, and *Otomys maximus* have been identified. These species are all known from the region today. *Otomys*, the most common taxon in the small mammal fauna, is currently found in swampy areas from the upper Zambezi (Zimbabwe) into the Okavango and Chobe River regions. *Aethomys* and *Tetera* are ubiquitous today in dry grassland environments of southern Africa, while *Steatomys krebsii* is associated with sandy, grassy plains from northeastern Zimbabwe to northern Namibia. The presence of these taxa suggests a mosaic paleoenvironment with grasslands and a water source in the vicinity at the time of deposition. Such an environment is similar to that found in modern areas containing *Papio* and other more arboreal cercopithecoids.

#### Scaling patterns and the functional morphology of primate pelvis shape.

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The pelvis is an integral part of locomotor anatomy because it links the body and hindlimbs, and serves as anchorage for the primary propulsive musculature. Pelvic form is therefore expected to be influenced by the differing mechanical requirements of alternate locomotor behaviors, and previous work has confirmed this expectation. However, broad patterns of pelvic variation

and scaling remain poorly understood. This study tests a series of hypotheses relating pelvic form to locomotion in a diverse sample of primates using geometric morphometrics. Eighteen pelvic landmarks were digitized on articulated pelvis in 26 primate taxa using a Microscribe G2X three-dimensional (3D) digitizer. Principal Components Analysis of Procrustes-aligned 3D landmark coordinates indicate that while much of the variation in pelvic morphology is explained by phylogenetic relationships, a considerable amount reflects functional differences in locomotor pattern. As noted in previous studies, ilium and ischium length vary among locomotor modes. Additionally, iliac blade dimensions, pubic symphysis cranio-caudal length, and ilium cross-sectional area (a dimension expected to reflect stresses associated with habitual acetabulofemoral joint loading) are positively allometric relative to both pelvis size and body mass, perhaps as a response to the requirements for increased bone and muscle strength imposed by increasing body size. These results begin to reveal the structural correlates of locomotion and motivate further research into interspecific scaling patterns in the primate pelvis.

#### **Variation in facial features among European populations measured from 3D photographs.**

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The presence of craniofacial variation among continentally described groups has been documented. However, finer-scale phenotypic variation among populations has been more difficult to determine. The purpose of this study is to use three-dimensional images to evaluate if there are significant patterns of facial difference among European populations. Besides determining the extent of regional population differences in facial morphology, this work serves as a foundation for studies involving European genetic stratification and the detection of genes that determine facial features.

The study consists of 180 adult women, aged 18-35, from four geographically discrete European regions: Warsaw, Poland (N=45); Rome, Italy (N=45); Porto, Portugal (N=45); and Dublin, Ireland (N=45). Three-dimensional photographs were acquired from faces using the 3dMDFace imaging system. Three-dimensional landmark coordinate data were collected from using the 3dMD Patient software and were analyzed using Euclidean Distance Matrix Analysis. Pairwise comparisons between geographic regions were performed to determine patterns of significant differences in facial morphology among the four European populations.

Our results indicate that differences in female facial morphology are symmetrical

and that population differences are localized to specific facial regions. This shows that there are statistically significant differences in facial morphology among European populations which can be mapped using coordinate data generated from three-dimensional photographs. Furthermore, these results suggest that morphological differences in facial features may likely be the result of genetic differentiation among European populations.

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#### **The Epigenetic Funnel and the Cranial Base: how cranial base growth helps integrate interactions between the face and brain to constrain overall skull shape.**

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Understanding the developmental and genetic bases for evolutionarily important variations in complex phenotypes such as the skull is a challenge because of the complexity of the factors involved. We hypothesize that even in this complex system, the expression of phenotypic variation is structured by interactions among a limited set of developmental processes. One such process may be cranial base flexion. It has long been hypothesized that the growth of the brain and the face have opposite influences on the midline angle of the intervening cranial base so that constraints on cranial base flexion and elongation can modulate many aspects of overall skull shape. This hypothesis has been difficult to test using comparative or longitudinal studies in which other covarying factors also influence cranial shape. Here we experimentally tested several hypotheses about interactions of the cranial base using mouse mutants from the same genetic background but with specific, independent developmental perturbations that affect brain size, face size and cranial base size. Geometric morphometric comparisons of these mutants, their wildtypes, and their F2 crosses show that increased brain size and decreased face size both act to flex the cranial base, but with comparable overall effects on skull shape. The results indicate that vastly different mutations can have similar effects on overall cranial shape because key processes such as cranial base flexion funnel their effects in similar ways.

#### **Dental indicators of hunter-gatherer adaptation and cultural change in the mid-Holocene Cis-Baikal (Siberia).**

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This investigation of the Cis-Baikal dental record focuses on health and lifestyle

reconstruction of the region's mid-Holocene foragers with particular interest in possible gender and social inequality. The five cemetery populations considered represent two distinct cultural groups separated by an alleged 700-year biocultural hiatus: the late Mesolithic-early Neolithic Kitoi culture (6800-4900 BC) and the middle Neolithic-early Bronze Age Serovo-Glaskovo cultural complex (4200-1000 BC). In addition, three of these cemeteries likely reflect large multi-family usage while the other two appear to have been more specialized, relevant to smaller social units such as status groups. Research focuses on the prevalence of five dental health indicators: enamel hypoplasia, periodontitis, antemortem tooth loss, caries, and periapical abscess. Results reveal some discrepancies between the Kitoi and Serovo-Glaskovo, lending partial support to previous assertions of their distinct subsistence regimes (namely the narrower resource base and decreased mobility of the former). For example, enamel hypoplasia data suggest that Kitoi individuals may have suffered greater physiological stress than their successors, likely resulting from seasonal or annual fluctuations in resource availability. In addition, some differences are discerned between the alleged community and specialized cemeteries, suggesting that dental pathology in the Cis-Baikal may at least partly reflect social status. However, the overriding trend observed has been one of continuity and general good health among the region's mid-Holocene occupants, males and females alike. Thus, dental data indicate that both the Kitoi and the Serovo-Glaskovo employed comparatively effective adaptive strategies and experienced relative equality in their social and gender relations.

#### **Monkey abundance and population trends in and around Korup National Park, Cameroon.**

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Korup National Park (KNP), a protected area in southwest Cameroon beset by commercial hunting, is home to eight anthropoid primate species, four of which are listed by the IUCN as Endangered and one as Vulnerable. Updates on primate distribution, abundance, and population trends are vital in guiding conservation action and evaluating conservation strategies. Although primate surveys have been conducted in KNP, they have been in separate areas and in different years, which complicates assessments of population trends and comparisons of abundance patterns. From October 2004 through June 2005, I simultaneously surveyed 10 line-transects used in previous surveys in three different areas of KNP to estimate the relative abundance of monkey species, assess how patterns of cercopithecoid abundance have changed through time, and investigate how populations of different species have changed at different rates. I



also surveyed signs of human activity and enumerated trees along each transect to elucidate possible determinants of primate abundance. Results show that the three surveyed areas of KNP differed in their proportional representation of cercopithecoid species. Changes in species abundance over time also varied among the three survey sites. Evidence from all sites, however, suggests that the endangered drill (*Mandrillus leucophaeus*) is declining throughout the Korup area and may have already been extirpated from the most heavily hunted areas. Although market hunting is clearly affecting primate abundance patterns, its impact is not uniform across species. Habitat differences between KNP survey sites, especially between southern and northeast Korup, also influence primate distributions in and around the Park.

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#### **Age and sex-related changes in degenerative joint disease in the lumbar vertebrae of Japanese macaques**

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There have been few studies that have specifically examined age and sex-related patterns of vertebral joint disease in nonhuman primates. This study investigates the age and sex-related patterns of degenerative joint disease of the apophyseal (facet) joints (osteoarthritis OA) and osteophytosis (VO) of the vertebral bodies of the 7<sup>th</sup> lumbar vertebrae in the Japanese macaque. A total of 157 vertebrae (n = 99 m = 58) were selected for study from adult *Macaca fuscata* with known age, sex, and reproductive history housed at the Primate Research Institute, Kyoto University, Japan. Random individuals were selected and vertebrae with indicators of advanced degenerative diseases (i.e. DISH or ankylosing spondylitis) were excluded from the study.

Vertebral bodies were scored for osteophytosis (VO) on a 5-point scale of 0-4, and apophyseal facets were scored for developmental severity of the characteristics associated with true osteoarthritis (OA) on a 6-point scale of 0-5. Individuals were categorized into three broad age groups: young adult (8-13 yrs), middle adult (14-19 yrs), and old adult (20+ years). Both VO and OA of the vertebrae show an age-related trend with statistically significant differences between all age groups (ANOVA with pairwise comparison p < 0.05). Significant sex differences are also seen; males show greater severity of OA in the youngest and oldest age groups, whereas females show greater

severity of VO in the oldest age group (p < 0.05). The comparative etiology of VO and OA in the Japanese macaque, and possible reasons for the observed sex differences are discussed.

#### **Bioarchaeological analysis of diet in Coles Creek populations in the Lower Mississippi Valley.**

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In the Lower Mississippi Valley, complex societies are first recognized during the Late Woodland Coles Creek Culture (AD 700-1200). The number and widespread distribution of sites and the correlation between social complexity and agriculture traditionally led archaeologists to believe that Coles Creek diet was based on maize agriculture. However, little direct evidence for maize has been found in the Lower Mississippi Valley prior to AD 1000.

The present study assesses Coles Creek diet from a bioarchaeological perspective through the macroscopic evaluation of dental caries. The dentitions of 209 adults were examined from seven sites in the Lower Mississippi Valley. Data collection procedures followed recommendations in Buikstra and Ubelaker (1994). Three of the sites (n = 42) precede the Coles Creek Culture (dates range from 500 BC to AD 100) and represent hunter-gatherer populations. The remaining four sites (n = 157) date to the Troyville/Coles Creek Culture (AD 400-1200) and are further subdivided into "early," "middle," and "late" temporal categories. Data were assessed for population and temporal variation using SPSS. The level of significance for all analyses is p < 0.05.

ANOVA reveals that no significant differences exist in the average caries rate per individual between pre-Coles Creek and Coles Creek populations, as well as among the subdivided Coles Creek temporal categories. However, significant differences are present when data are analyzed by site (p = 0.037 for Coles Creek sites only; p = 0.039 for all seven sites). Therefore, though Coles Creek diet may have varied due to regional differences in resource availability, this study suggests Coles Creek populations did not consume maize.

#### **Causes of infant mortality in 2<sup>nd</sup> century B.C. . Greece: evidence from the Athens Agora "baby well."**

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A well discovered in the 1937- 1938 Athenian Agora excavations contained very large quantities of human infant and animal bones. Although the human bone was briefly examined by J. Lawrence Angel, no comprehensive study of the well was ever published, nor was an exact count of the remains attempted. In earlier publications, it was speculated that the large number of

infant deaths was associated either with an undocumented plague, or the sack of Athens by the Roman general Sulla in 86 B.C. Other suggestions for the unusual accumulation included an unrecognized practice of infant sacrifice, or a the disposal of infants from a brothel serving the Agora area. A recent collaborative study of the well's contents has shown that the bone accumulated over a period of approximately 15 years, before 250 B.C. The infant and fetal skeletons include a MNI of 449 individuals between 26 weeks *in utero*, and 4-6 weeks post term, as well as an older infant, a child, and an adult. A survey of the pathological indications on these commingled remains revealed evidence of extensive endocranial infections, perimortem trauma, and birth defects, including cleft palates, and a stunted limb, together with a large number of remains of non-viable fetuses. This suggests that the well was used for a period of time as the place of deposition for premature and stillborn infants, infants who died prior to formal inclusion within the family, and infants who may have been killed or exposed because of visible defects at birth. Project supported by the Malcolm H. Wiener Laboratory of the American School of Classical Studies in Athens.

#### **Anomalies and averages: the bioarchaeology of individuals in New Zealand.**

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Many skeletal collections from archaeological sites in both Australia and New Zealand have been repatriated, and restrictions are routinely placed upon the study of others. However osteology work continues at the request of government bodies as well as indigenous groups. Often the remains to be studied are those of single individuals raising the questions of how to convey meaningful information back to communities and also how to ensure that this type of project addresses larger research questions.

In this paper I present a case study from New Zealand. The burial dating from the mid-nineteenth century was of a young woman buried placed in a small box and with her parasol beside her. The nature and place of the burial are unusual as is the fact that there are apparently no stories or recollections associated with this grave among local residents. Analysis of the remains, while undertaken in the laboratory, involved only non-destructive methods. Comparison with other post-contact remains points to how she can be interpreted as both an "average" colonial Maori (significantly smaller than pre-contact Maori and with cultural changes such as pipe facets on the teeth) and also as an anomalous individual. Part of the challenge in this era of osteology is in the attempt to reconcile these two perspectives when analysing the remains of

single individuals or other quite small assemblages.

### **Childhood stress of Iron Age Taiwan: The Shih-san-hang site as an example.**

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Identifying patterns of childhood stress, reflected by morbidity and mortality, is relevant in assessing the overall well-being of a prehistoric population. Several large-scale bioarchaeological studies have been conducted towards this end across East and Southeast Asia, including Taiwan. This research utilizes 306 individuals excavated from the Iron Age coastal site of Shih-san-hang (SSH, 2,000-500 B.P.) in northern Taiwan. Two indicators, linear enamel hypoplasia (LEH) and porotic hyperostosis (PH), are assessed to infer trends in childhood stress and overall health. The SSH site is renowned for its locally innovative iron-smelting tradition. People subsisted on marine resources, terrestrial game, and some cultigens, although their dependency on rice remains unclear.

Prevalence of stress indicators and timing of LEH are analyzed by age and sex. LEH frequencies suggest a moderately stressful childhood, especially among females. Peak formation time falls between 2 to 5 years, with females exhibiting LEH events slightly later than males. These patterns are attributed to prolonged breast-feeding, a compromised weaning diet, and potential gender bias favoring males. Subadults and young adults showing greater incidence of LEH may be linked to higher morbidity due to an impaired immune system during early childhood. Prevalence of PH suggests greater anemic impact among teenagers and young adults, with both sexes similarly at risk. Heightened parasitic infection caused by a marine-based subsistence and/or poor site hygiene are possible etiologies. Results improve understanding of the biocultural milieu of the Iron Age people at SSH.

### **The timing of third molar formation in four groups.**

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In order to study population differences in tooth formation, it is necessary to document the timing and duration of entire teeth, from initial crypt formation up to apical closure. The third molar is the only tooth for which this is possible, using radiographs of living children of known age between 6-24 years who attend dental clinics. The aim of this study was to document the timing of the mandibular third molar formation from 1141 radiographs of white Caucasian and 942 Bangladeshi children from London, UK, 770 radiographs of black African children from Johannesburg and Pretoria, South Africa and

720 radiographs of Cape Coloured children from Cape Town, South Africa. Molar formation was assessed using 15 stages from crypt to apex closure defined by Gleiser and Hunt (1955). The age when 50% had reached or surpassed each stage for boys and girls for each group was calculated using logistic regression and compared using a t-test. The two London groups and Cape group were significantly later for 44 out of 45 comparisons compared to black Africans (sexes combined). White children from London were significantly later compared to Bangladeshi from crypt formation up to root cleft stage. These first results from a large worldwide study reveal an important shift in the timing of third molar formation between groups.

### **Evidence of Decapitation and 'trophy-taking' during the Late Archaic in Southern Indiana.**

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Christopher W. Schmidt, University of Indianapolis

Three recently excavated Middle/Late Archaic cemeteries from southern Indiana each have produced a single, young individual exhibiting decapitation and mutilation. The cemeteries are located along the Ohio River, are separated by approximately 100 miles, and the eastern-most site is over 1,000 years younger than the other two. The first cemetery contained over twenty individuals. A child around the age of 12 was found with its skull removed and placed in its right hand. No projectile points were recovered with the burial, but possible evidence of blunt-force trauma is on the occipital, a puncture is present on the right scapula, and cut marks are on at least five cervical vertebrae and on several ribs. The mandible has prominent cut marks that are consistent with the removal of the tongue. The second individual is a subadult around 15-18 years old that came from a large cemetery of over 60 individuals. It had its skull and left forearm removed in a manner consistent with 'trophy-taking', indicated by cervical and humeral cut marks. The third individual came from a small cemetery containing five people. He is a young adult male (late teens/early 20s) who also has cervical and humeral cut marks and is missing his head and right forearm. In addition, six projectile points were found with his skeleton. It is evident that Middle/Late Archaic populations in Indiana were engaged in (or at least subjects of) mutilation and 'trophy-taking', particularly of young people, for several centuries.

### **Functional morphology of the temporomandibular joint in catarrhines.**

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The functional morphology of the primate temporomandibular joint (TMJ) has been found to covary with gape and diet in several studies, but evaluating the effects of these factors across catarrhines is complicated by clade differences in diet and morphology. We use phylogenetic comparative analysis of 3D landmarks to determine the relationship of cranial TMJ morphology to diet and gape across old world anthropoids irrespective of taxonomic group.

Twenty landmarks were collected on the cranial TMJ surface of 16 catarrhine species, selected to represent a range of diets in hominoids, cercopithecines, and colobines. Landmarks were registered using generalized Procrustes analysis, and the resulting Procrustes coordinates were analyzed by PCA, all in Morphologika. Using independent contrasts, each principal component was compared to relative canine height as a surrogate measure for gape and to a dietary index scaled to account for the relative toughness of primary and secondary food sources.

The first principal component of TMJ variation across old world anthropoids separated taxonomic groups and was not correlated with diet or canine height. The second principal component was significantly correlated with both relative canine height and diet, with canine height having a stronger effect. Based on the morphology associated with PC2, predictions were fulfilled in several respects: e.g., the TMJ surface is extended more anteriorly in taxa with large canines, and a low entoglenoid process is associated with tougher diets and a broad articular eminence. Results are discussed with respect to hominin evolution, in which reduced canines are common, but diets vary widely.

### **A case of maxillo-mandibular and spheno-mandibular ankylosis from Alaska.**

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Maxillo-mandibular and spheno-mandibular ankylosis, rare forms of fusion between the mandible and the cranium, may be caused by hereditary progressive myositis ossificans or by localized myositis ossificans due to trauma, infection, or unknown etiology. The conditions often prevent movement of the mandible, even when the temporomandibular joints are not fused. A 30- to 45-year-old female from the Nushagak Region of the Dillingham Quadrangle in southwestern Alaska (NMNH 363511), housed in the National Museum of Natural History, Smithsonian Institution, is affected by both types of ankylosis. The right coronoid process appears to have been fused or attached by fibrous tissue to the maxilla, and the left coronoid process is completely fused to both the maxilla and the

lesser wing of the sphenoid. There is a healed fracture of the right mandible through the horizontal ramus, with resulting misalignment of the bone, atrophy, osteoporosis, and myositis ossificans. A large bone cyst is present in the right ascending ramus. The clinical effect on the life of the individual would have been significant. The face was asymmetrical and the mouth could not be opened. Radiographs of the long bones show marked growth arrest lines. Many of the mandibular teeth were lost antemortem, and the extant mandibular left second premolar and first molar have minimal occlusal wear.

A differential diagnosis is developed to determine the etiology of the ankylosis, the sequence of events (cyst, fracture, fusion, loss of teeth), and the age of onset.

**Parasite ecology and socioecology of ring-tailed lemurs (*Lemur catta*) and Verreaux's sifaka (*Propithecus verreauxi*) at the Beza Mahafaly Special Reserve, southwest Madagascar.**

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To date, field primatologists have investigated a broad spectrum of topics in order to understand nonhuman primate behavior, morphology, and adaptations. Surprisingly, investigations focusing on parasite-mediated selection in nonhuman primates are rare.

To truly appreciate primate host and parasite interactions, primatologists must first identify the parasite species harbored by a host and understand each parasite's life cycle and behavior. This paper highlights the interplay between two species of Malagasy strepsirrhines and the parasite species, which they harbor. Ring-tailed lemurs (*Lemur catta*) and Verreaux's sifaka (*Propithecus verreauxi*) live in sympatric associations yet dramatically diverge in terms of the parasite diversity, intensity, and prevalence, which they exhibit. During a 10-month study at the Beza Mahafaly Special Reserve, behavioral and parasitological data was collected on both strepsirrhine species. Preliminary results suggest that the differences in these parasite characteristics are largely due to each host species' behavioral profile. Ring-tailed lemurs display a wider diversity of parasites and higher degree of prevalence and intensity in comparison to Verreaux's sifaka. Such differences may be attributed to the dietary generalist pattern and the high degree of terrestriality that this species engages in. In contrast, Verreaux's sifaka rarely descend to the ground and consume a primarily folivorous diet. These conservative behavioral patterns may lower exposure to parasites and thus decrease the likelihood of obtaining an infection. Knowledge regarding the interplay between primate hosts and their parasites can be applied to better understand primate social behavior, societies, and life history patterns.

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**Social marginalization among the Chiribaya: the *curandero* of Yaral, Southern Peru**

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The Chiribaya of Southern Peru flourished between 750-1100 A.D. and represented a highly centralized administrative structure best illustrated by elite burials found at the political center of Chiribaya Alta. Notable departures from typical mortuary practices have been uncovered among the Chiribaya, however, that may have represented deviations from mainstream cultural practices. We report on an adult male from the mid-Valley site of El Yaral who was interred in a highly unusual manner and with burial accoutrements, that suggest he may have represented a Pre-Columbian equivalent of a shaman. We, therefore, hypothesize that this individual may have been of non-local biological origins, and tested this hypothesis by analyzing strontium isotope levels from tooth enamel of this individual and comparing it to isotopic signatures from modern fauna as well as other burials from El Yaral. Well established techniques were employed to measure the mean <sup>87</sup>S/<sup>86</sup>S ratios from all samples. Based on modern guinea pigs from the Upper Osmore Drainage, the local range in strontium isotope levels was determined to be 0.7059-0.7066. Most of the human samples from El Yaral fell within this range; however, the *curandero*, as well as three other individuals from El Yaral, was higher than the normal local range. These data suggest that the *curandero* of Yaral spent the first 3-4 years of his life outside of the Upper Osmore Drainage, and may not have been the only non-local individual interred at El Yaral.

**Female dominance relationships in Hanuman langurs - not as predicted by the socioecological model**

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The socioecological model predicts that strong within-group contest competition (WGC) should lead to female philopatry, stable and consistent agonistic relationships and linear, and nepotistic hierarchies. Subordinate females should furthermore use formalized signals to communicate rank and minimize aggression received. When strong between-group contest (BGC) is added to strong WGC, female agonistic relationships should be more tolerant. Earlier reports show that female Hanuman langurs experience

both WGC and BGC. However, while females are philopatric, agonistic relationships are unstable and individualistic. Reconciliation is rare, suggesting intolerance. Here, we examine in addition the predicted link between WGC and formalized submission, and between BGC and tolerance, as evidenced by frequent counter-aggression and low intensity of aggression. Data were collected via focal animal sampling from eight adult female Hanuman langurs at Jodhpur, India (419 hours in 1985). Although never shown for this species, female Hanuman langurs do indeed have formalized submission, as predicted by WGC. Particularly, female-female presenting (N = 132) was found to occur as a spontaneous signal in 40.9% of the events. Presenting was also unidirectional and highly predictive of approach-retreats and aggression initiated (dyad comparison and matrix correlation). However, *contra* the predictions for BGC, female agonistic relationships were non-tolerant (1.0% counter-aggression; N = 204), and intense aggression was common (39.1%). These results suggest that WGC may only predict some of the hypothesized agonistic characteristics and that the effect of BGC on tolerance may be weak. More data especially for non-macaque species are needed to elucidate the connection between competitive regime and agonism.

Data collection supported by DAAD (Bonn & New Delhi).

**Pedal skeleton of the Jinniushan hominin from the late Middle Pleistocene of China.**

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Much attention has been directed at the initial origins of hominin bipedalism. In spite of considerably varied interpretations, the distinctions of the modern human foot and striding gait are absent in the earliest bipeds. Foremost are the fixed longitudinal arch with stabilized transverse tarsal joint, and the elaboration of the ball surrounding a principal weight-bearing point at the hallux metatarsophalangeal joint. Relatively little deliberation has been afforded the eventual pattern and timing of emergence of the modern human striding gait, as the paleontological record has yielded meager representation of critical elements of the foot, especially for middle to late Pleistocene hominins. The fossil hominin recovered from the site of Jinniushan, Liaoning Province, China, dated to approximately 260 kya, affords a singular opportunity to consider the nearly complete pedal anatomy of an archaic hominin (c.f. *Homo heidelbergensis*). The Jinniushan foot skeleton presents similarities to that of neandertals. While the neandertal foot skeleton has been described as virtually "indistinguishable" from the modern human foot, the significance of its skeletal robusticity, segment proportions, and other

details of overall postcranial morphology are certainly correlated with distinctions in lifeways evident in the archeological record, that contrast with modern *Homo sapiens*. The trajectory of subtle distinctions in arch height, and relative heel and toe length, indicate the quite recent innovation of stabilization of the midfoot. Jinniushan offers the earliest indication of the complement of fixed arch and modified hallux metatarsophalangeal joint (ball), while retaining a number of primitive features apparently characteristic of robust archaic hominins.

#### **How a prey seed tries to avoid its predator: the orangutan-*Mezittia* interface**

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Seeds are heavily defended against predators, either by potent chemicals or a shell. Those with shells have a dilemma: they need to open for germination, but avoid being opened by predators. We re-studied *Mezittia parviflora* (Annonaceae) seeds (outer dimensions 35 x 25 x 15 mm), attacked by predators big (orangutans) and small (two species of scolytid beetles). The seed has a 3-4 mm thick woody shell of complex design. Fibers course in apparently randomly-oriented bundles, but a prominent band running around the seed contains roughly spherical, equally thick-walled, cells called brachysclereids. Within the band at one end is a diamond-shaped plug ringed by thinner-walled cells. Hydrostatic pressure inside the shell generates a germination crack, starting from both sides of the woody plug and propagating slowly within the band. Clearly, this seems sophisticated, with the stress produced by turgor acting on a pre-crack (half the width of the woody plug) being just large enough to extend in a quasi-equilibrium fashion. To confirm this, we used tensile, three-point bending and double cantilever beam tests for elastic moduli and fracture resistance, enhancing this now with indentation techniques to track the properties of each shell part. Hardness is probably the major deterrent to beetles (these bore holes randomly in the shell): despite its structural complexity, shell hardness is pretty similar everywhere. In contrast, orangutans crack the shell open. Video evidence suggests that they cannot use the germination mechanism because the seed is too large. Thus, high forces are necessary.

#### **Censuses of parapatric howler monkeys (*Alouatta palliata* and *Alouatta pigra*) in Pantanos de Centla Biosphere Reserve, Tabasco, Mexico.**

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Surveys of parapatric howler monkey species were undertaken in the Pantanos de Centla Biosphere Reserve in 2005 and 2006. The reserve covers more than 300,000 ha of wetland habitat in the Usumacinta River basin, which makes up a large portion of the state of Tabasco in southeastern Mexico. There are several rivers flowing northward here into the Gulf of Mexico; the largest and most important of these is the Usumacinta system. This river system marks the primary boundary and limiting factor on the east-west distribution of black howlers (*Alouatta pigra*) and Mexican mantled howlers (*Alouatta palliata mexicana*) (Smith, 1970; Hall, 1981; Horwich & Johnson, 1986; Luecke, 2004). This is the first report on the populations of both species in the reserve. A combination of ground, river, and triangulation surveys were conducted in fragmented mangrove forest, flooded forest, and private ranch land within and near the northern portion of the reserve. An estimated four groups of Mexican mantled howlers reside in the red mangrove surrounding a small lake and one group was found in remnant forest on a private ranch to the east of the river. Seven groups of black howlers were found in red and mixed association mangrove and flooded *pucteal* forest within the reserve to the east of the river system. A description of these populations and comparisons between them and with conspecific populations in other habitats is discussed, as well as intended future work on these howlers in their transition zone in Tabasco.

#### **Mitochondrial D-loop characterization of the Amazonian Ticuna population.**

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The Ticuna population exists between the Solimões and the Putumayo-Iça Rivers within Western Brazil as one of the largest group of descendants from a single population still living today. As a unique language group, the Ticuna are defined by their river borders and neighboring Arawak-speakers thereby providing an informative basis for genetic analysis. Previous haplogroup frequencies have been determined for 28 individuals through RFLP analysis by Merriwether et al. (1996) to show the characteristic New World haplogroups A, C, and D with the complete absence of B. To further determine the genetic relationships between members of the Ticuna population, over fifty additional individuals have been sequenced for the D-loop region (nt positions 15913 through 00429) of the Mitochondrial genome. This higher resolution data has allowed us to posit possible gene flow patterns among Ticuna villages as well as with the rest of the

Amazon and South America. This is part of a larger study of genetic variation in Amazonia and the roles of language, culture and geography in the spread of genes in the Amazon.

#### **Distinguishing Amerindian populations using calcaneal proportions.**

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Tarsal bones are very important in forensic anthropology and bioarchaeology because they are commonly preserved. It is, however, difficult to determine biological affinity ("race") from isolated skeletal elements. Watson and Pickering (1977) found that there are significant size and shape differences between the calcanei of American Negroids, Caucasoids, mainland Asian Mongoloids, Japanese, and Amerindians. Their study did not address the question of whether calcaneus size and shape can be used to distinguish between populations of Amerindians.

In this study, I calculated 15 indices of calcaneal proportion from two skeletal samples in the National Museum of Natural History (Smithsonian Institution): 1) 11 Amerindian individuals from the Arikara cemetery at Sully, South Dakota (1650-1750 AD), and 2) 10 Aleutian Islander individuals from Kagamil Island (Alaska). Based on six measurements and six indices I was able to determine that there is a significant difference between these two populations. The most significant difference was found when indexing the height of the cuboid facet against load arm width (breadth of the talus facet) [p-value 0.013]. Significant results were also obtained for the following five indices: 1) total length/height of the cuboid facet [p-value 0.019], 2) total height/height of cuboid facet [p-value 0.025], 3) load arm length/load arm width [p-value 0.037], 4) total length/load arm width [p-value 0.05], and 5) height of the cuboid facet/load arm width [p-value 0.065]. These results show that it is possible to distinguish Aleutian Islanders from Arikara individuals based on their calcanei.

#### **Sex differences in dental caries in living populations: a global meta-analysis.**

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Women's oral health is widely recognized by clinical researchers to be worse than men's. Anthropologists either disagree with the clinical perspective or are unaware of controversy over the 'gender gap' in oral health. A recent global meta-analysis of 144 prehistoric samples established a consistent bias toward higher caries rates in women than men. Until recently, clinical data on gender differences in dental caries was derived from westernized, industrial, Euro-American populations. In this analysis the hypothesis that women's oral health is

consistently poorer than men's was tested by gathering data on dental caries by gender in a global sample of living populations from different ecological, subsistence, and cultural settings.

To be included in this meta-analysis, epidemiological and clinical studies had to report caries prevalence by gender, explicitly state methodology, and statistically test for significant differences in caries prevalence. Data was gathered from a global sample of 67 published studies of dental caries experience. Reporting formats included: a) decayed, missing, and filled (DMF) index; b) percentage of individuals, teeth, or surfaces affected, and c) mean number of caries per individual. Data were entered into an Excel database and statistically analyzed. Despite regional variability, caries prevalence tended to be consistently higher in women and were more positively associated with age. This result was evident in studies by different investigators using different reporting methods. Anthropologists attribute the female bias toward higher caries to behavioral factors, yet new data indicate it is also influenced by women's developmental and reproductive biology.

#### Recent Southeast Asian domestication and Lapita dispersal of sacred male pseudohermaphroditic "tuskers" and hairless pigs of Vanuatu.

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Recent analyses of global pig populations revealed strict correlations between mitochondrial DNA (mtDNA) phylogenies and geographic locations. An exception was the monophyletic "Pacific clade" of pigs not previously linked to any specific location. We examined mtDNA sequences of two varieties of Vanuatu sacred pigs, the male pseudohermaphroditic *Narave* from the island of Malo (n=9) and the hairless *Kapia* from the island of Tanna (n=9) and control pigs (n=21) from the islands of Malo, Tanna, and Epi and compared them to sequences in GenBank to determine the 1) distribution of "Pacific clade" and introduced domestic lineages within Vanuatu, 2) relationship between the *Narave* and *Kapia*, and 3) origin of the "Pacific clade". All the *Narave* share two "Pacific clade" mtDNA sequences, one of which matches the sequence of a *Narave* collected in 1927, consistent with an unbroken maternal descent of these intersex pigs from the original pigs brought to Vanuatu 3,200 years ago. One third of the *Kapia* share a single "Pacific clade" lineage also found in the *Narave*. The remaining *Kapia* lineages are associated with recently introduced, globally distributed domestic breeds. The predominant *Narave* lineage is also shared with two wild boars from

Vietnam. These data suggest that "Pacific clade" pigs were recently domesticated within Southeast Asia and dispersed during the human colonization of Remote Oceania associated with the Lapita cultural complex. More extensive sampling of Southeast Asian wild boar diversity may refine the location of Pacific pig domestication and potentially the proximate homeland of the Lapita cultural complex.

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#### Patterns of mtDNA genetic diversity in capuchin monkeys at regional and local scales.

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For decades, a clear understanding of intrageneric relationships of capuchin monkeys (genus *Cebus*) has eluded researchers studying morphological characteristics. Here we elucidate patterns of genetic diversity within *Cebus* at regional and local scales by analyzing mtDNA characters. To assess genetic diversity within the genus, tissue was sampled from over 200 museum specimens of wild-caught capuchins of known provenance across their distribution in Latin America. To analyze the relationship of genetic variation to geography on a finer scale for *C. capucinus* in western Costa Rica, 64 blood samples were collected across seven localities in Alajuela, Puntarenas and Guanacaste provinces. For both data sets, we sequenced fragments of three mtDNA genes (12s, 328 bp; cytB, 346 bp; d-loop, 321 bp). We constructed phylograms of the sequences using likelihood and Bayesian methods.

Consistent with morphology-based studies, genetic data revealed *Cebus* as a monophyletic genus composed of two major clades, the tufted and non-tufted groups. In contrast to previous morphological studies, our data revealed *C. albifrons* as paraphyletic. Within the umbrella of *C. apella*, several distinct reciprocally monophyletic clades correlated well with geography. For *C. capucinus*, d-loop analysis revealed a deep genetic split between southern and northern populations, with a strong geographic signal for females and males, suggesting limited lifetime dispersal distance in this species. This study provides the first robust molecular phylogeny for the genus *Cebus*, including evidence for genetic diversification within *C. capucinus*.

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#### The iliac cancellous network of a juvenile *Australopithecus africanus* (MLD 7): structural properties and biomechanical implications.

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Structural properties of the cancellous bone relate to the nature, magnitude, frequency, and directionality of site-specific loads. During ontogeny, the iliac cancellous network optimizes for habitual loading conditions; accordingly, its structural assessment provides information about the habitually experienced postural/locomotor modes.

Previous qualitative investigation of the iliac trabecular architecture of eight South African australopithecines suggests that the strength and direction of the loads imposed upon their pelvis differed from those acting on extant humans and apes (Macchiarelli et al. 1999). Based on the cancellous pattern of MLD 7, we have detailed the major structural similarities and differences of a juvenile *Australopithecus* with respect to the human condition.

Seven square-shaped regions of interest (ROI) have been selected for textural characterization on a series of digitally-processed X-ray images. They document the marginal trabecular frame (ectochoric) and its arcuate iliac section (endochoric). Trabecular thickness, bone volume, and degree of anisotropy have been measured. The radiographic and the high-resolution (45.5 µm) microtomographic (2-3D) evidence deriving from homologous ROI investigated on five immature extant human ilia have been comparatively considered.

The MLD 7 ectochoric signal resembles the human condition. Also, the qualitative differences in density and degree of anisotropy previously observed at supra-acetabular level are not quantitatively warranted. Nonetheless, the australopithecine ilioischial bundle is much less structured, while the opposite is true for the sacropubic one.

We conclude that the topographic-related textural organization of this juvenile australopithecine ilium testifies a biomechanical environment only partially overlapping that habitually experienced by a human counterpart of similar age.

#### Obesity in an Adult East Indian Community of Limon, Costa Rica.

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Understanding the causes of obesity remains important, as rates of obesity in the world continue to increase and as obesity is a

risk factor in the development of various health problems such as hypertension, diabetes, and cardiovascular disease. Urban populations and particular ethnic groups (Amerindians, East Indians, etc.) have been shown to have higher rates of obesity compared to rural populations and other ethnic groups (Chadha, 1998). The purpose of this study was to examine the rate of obesity in an East Indian community from Limon, a rural area not yet affected by rapid tourism growth. The sample consisted of 39 adults (20 males, 19 females), with a mean age of 41 years old. The rate of obesity was investigated by analyzing body mass index (BMI), subscapular and triceps skinfold thickness. Thirty percent of the pooled sample was obese and 32.5% considered overweight by World Health Organization BMI standards. Mean BMI was 27.2. Forty four percent of the pooled sample had triceps skinfold thickness greater than 85 percentile (excessive fat), with 26% having subscapular skinfold thickness greater than 85 percentile. These results demonstrate a high prevalence rate of obesity in a rural setting, where some families are still practicing subsistence fishing and farming. We compare our population with others from the Indian diaspora and from India, matching the subsistence pattern. At this point, our results indicate that obesity might precede full immersion into the globalized world economy. Funded by a USF Globalization Research Center grant.

#### **Cutmarks and breakage of human bones in the Upper Paleolithic, La Salpêtrière cave, Department of Gard, France**

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Cannibalism was shown to have existed in Europe during the Lower Paleolithic at Gran Dolina cave in Spain, in the Middle Paleolithic Moufla-Guercy cave and the Neolithic Fontbrégoua cave in France. One of the characteristics of Upper Paleolithic populations is to have buried their deads. However, fragmented human bones with cutmarks were observed within several Upper Paleolithic French caves. We present a new case study, that of La Salpêtrière (Gard) in Southeastern France.

Two human remains were found, mixed with numerous fragmented reindeer bones, in an Early Solutrean deposit (radiocarbon date: 20200 +/-660 BP, Ly-940). The human remains are a right ascending ramus of a juvenile and a mental protuberance of an adult. The post-mortem lost of teeth does not make it possible to estimate more precisely the age at death. The external surface of the ramus displays numerous cutmarks, which were examined by means of optical and electronic microscopes. They are typical

traces made by lithic tools. No cutmarks are observed on the other fragment. The fracture patterns of the two remains are consistent with the breakage of fresh bone.

The presence of cutmarks and breakage on human bones in the Salpêtrière cave raises the question of alternative mortuary practices to burial and also of cannibalism in the Upper Paleolithic populations in France.

#### **Using the Calcaneus as an indicator of stature in Chinese populations.**

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Determining stature is one of the primary techniques used for identification in a forensic case, as well as gain demographic information of a population in an archaeological context. However, stature is not always easy to determine due to population variation. Additionally, the scarcity of complete elements due to skeletal deposition makes it difficult to determine stature with confidence. Recently, studies have shown that in the absence of complete long bones, the calcaneus may be used to estimate stature (Holland 1995; Bidmos and Asala 2005). These studies are limited, however, because they have only been conducted on American white, black and South African black populations. In order to determine if the calcaneus is an accurate indicator of stature among Chinese populations, I examined the relationship between calcaneus length and stature in 15 skeletons of Chinese ancestry from the collections of New Mexico State University. I measured the calcaneus following the Holland method (1995) and compared those measurements to stature estimates of the sample following the Fully method (1956). I found a strong positive correlation between stature and calcaneus length of 80% ( $r=.80$ ). Additionally, linear regression analysis of the two variables calculated an intercept (91.18cm) slope (.92cm) and standard error (3.65cm) which allowed me to develop a formula to predict stature using calcaneus length ( $y=.92(x)+ 91.18 \pm 3.65\text{cm}$ ). These results demonstrate that the calcaneus can be applied individually or in conjunction with other elements to estimate stature with confidence among Chinese populations and is recommended for obtaining stature estimates in other populations.

#### **Genetic contributions to normal variation in gene expression for a biomarker of cellular aging (CDKN2A) in baboons and humans.**

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The genetic contributions to human variation in aging are poorly understood. In mammals, aging is associated with reduced regenerative capacity in tissues containing stem cells. One contributor to senescence in stem cell progenitors and, by extension, to aging is *CDKN2A*. Coding for cyclin-dependent kinase inhibitor 2A, *CDKN2A* is a tumor suppressor and a robust *in vivo* biomarker of cellular aging in several classes of stem cells. We conducted a study to detect and quantify the effects of genes on normal variation in *CDKN2A* expression in two primate species. We obtained expression data in two, large-scale, transcriptional profile studies using the Illumina Human Sentrix-6 BeadChip micro-array to interrogate RNA from stored lymphocytes of 500 pedigreed baboons (*Papio hamadryas ssp.*) and 1240 humans from extended families in San Antonio. We used variance decomposition methods to estimate the proportion of the variance in age- and sex-adjusted *CDKN2A* expression due to the additive effects of genes (i.e., heritability or  $h^2$ ). In both species, genes account for a modest but significant ( $P<0.001$ ), proportion of normal variation in *CDKN2A* expression in lymphocytes:  $h^2=0.21$  in baboons and  $h^2=0.31$  in humans. Further, linkage analyses in both species provide suggestive evidence for *CDKN2A* expression QTL in locations orthologous to human chromosome 9, the location of the *CDKN2A* locus in humans. These preliminary results point to potential genetic similarities underlying cellular aging in two primate species and may implicate baboons as a non-human primate model for studies of the genetics of normal variation in human aging.

#### **Human molar crown formation in Bronze Age Britain.**

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A growing body of comparative dental developmental data is becoming available for extant hominoids. Here we add to this dataset by presenting new data for the ontogeny of M<sub>1</sub> crown formation in an archaeological sample of modern humans (n=15), dating to the British Early Bronze Age (4300-3200 bp). We examined the cuspal (protoconid, hypoconid, metaconid, entoconid) enamel secretion rates, formation times, extension rates, and sequence of calcification. Molars were embedded in a polyester resin, histological thin sections prepared, then short and long period lines were analyzed under polarized microscopy.

Cuspal secretion rates (mean = 3.94µm) together with long period lines yielded average formation times of 1062 days (2.91 yrs) for the protoconid, 1080 days (2.96 yrs) for the hypoconid, 916 days for the metaconid

(2.51 yrs), and 872 days (2.39 yrs) for the entoconid. The protoconid formation time is within the range of M<sub>1</sub> protoconid formation time for modern South Africans, but not modern Europeans. Extension rates began rapidly in the appositional enamel, slowed in the lateral regions, and increased in the cervical enamel. The increase in cervical enamel extension is rarely seen in extant humans. Cuspal growth began in the protoconid on average 25 days before birth, followed by the hypoconid, then the metaconid, and finally the entoconid, though there was some variation in the sequence of initiation between the hypoconid and metaconid. This sequence compares well to one individual dating to the French Medieval period, though the variation seen in this study has also been recorded in *Pan*. The results from this study show there may be some temporal variation in the ontogeny of M<sub>1</sub> crown development amongst recent modern humans.

**Using Nested Clade Analysis to explore temporal change in ancient population structure with aDNA sequence data.**

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Traditional methods for comparing ancient population relationships have relied on looking at degrees of overlap in a battery of morphological traits. With the advent of aDNA methods, haplotype sequence data can now be employed to explore population structure and levels of variation. However, methods for utilizing DNA sequence data for explaining ancestor-descendant relationships have proven elusive. Nested Clade Analysis (NCA) was developed to test for phenotypic and geographical associations in haplotype trees, utilizing the historical information inherent in a gene tree. Traditionally, NCA has been used to test for population structure across geographic dimensions. However, this framework has not yet been applied to cases where variation in groups is temporal rather than geographical, such as distinct populations from the same site with clear temporal separation. In such cases, an obvious need is to understand the degree to which the samples are derived from the same lineage, and the evolutionary parameters that led to the differences in population structure.

This paper explores the use of temporal association as a phenotype to test for relationships among temporally distinct populations from Point Hope, Alaska. Nested Clade Analysis was used to test for these associations using each temporally distinct sample as a categorical variable, rather than the traditional use of geographical spread. Tree topology was established using haplotype variation within the HV1 control region of mtDNA. Statistical testing was based on the nested hierarchical design of the haplotype tree using exact permutation contingency analysis of the temporal variation in nested haplotype sets.

**Collaboration with a Native American community reveals novel insight into mitochondrial DNA history of Native North Americans.**

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We describe the collaboration among the Canoe Creek Band in British Columbia and biological anthropologists in the analysis of skeletal remains near 5,000 years in age from China Lake. The ancient remains were removed from tribal lands during an excavation in the 1980s. Through a process of community visits and talks the researchers informed the Band of the location of the remains and requested permission to study them. The researchers were able to establish the concerns of the tribe regarding the analysis of the China Lake remains and developed a research plan that provided adequate safeguards to alleviate the concerns of the community.

Genetic, dating, stable isotope, and morphometric analyses were performed on the individuals. One highlight of this study was the finding of a novel mitochondrial DNA haplogroup, haplogroup M, never before seen in prehistoric or living Native Americans. The results of this finding are discussed in the context of additional data from the Northwest Coast and Plateau that pertain to the population history of Native North Americans.

**Bone Weathering in a Cold Climate: Forensic Applications of a Field Experiment Using Animal Models.**

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Building on well-established investigative methods in forensic anthropology, the examination of bone weathering patterns can help in estimating time-since-death and reconstructing postmortem events. Using animal carcasses as human analogues, an ongoing field experiment has been designed to add to the limited body of knowledge on bone weathering processes in a cold climate. While pigs are traditionally used as models in forensic experiments, deer bones are also being used since they are more similar in many ways to human bones. This study examines the various factors proposed to affect bone weathering, such as freeze-thaw cycles, micro-environmental conditions, scavenger activity, initial decomposition, and skeletal element, as well as animal species, age, and size.

The carcasses have been placed in different micro-environments and exposed to natural processes of decomposition as well as defleshing and disarticulation by scavengers. The bones are being carefully observed for signs of weathering such as cracking, flaking, and bleaching, and descriptions of weathering

stages for different skeletal elements are being developed based on these observations. In order to correlate the weathering rates of animal models to those of human skeletal remains, the degree of weathering observed in deer and pig bones was compared with that observed in human bones from past forensic cases in Alberta with known times of exposure. Thus, the results of this study can increase the precision with which weathering stages are used to assign time-since-death in forensic cases in this region.

**Ethoarchaeology of manual laterality: well-digging by wild chimpanzees.**

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Most studies of functional manual laterality ('handedness') are based on behavioral data, but these are not available for extinct or unobservable subjects. We report the first results from apes on laterality based on artefacts ('ethoarchaeology'), i.e. tangible products of behavior. Wild chimpanzees (*Pan troglodytes schweinfurthii*) at Toro-Semliki Wildlife Reserve in western Uganda dig holes ('wells') in sandy riverbeds, to get drinking water, often using compressed wads of vegetation ('sponges') to extract it. In doing so, the excavated wet sand is discarded beside the well on the surface, and when using two hands, two such piles are left behind, on left and right side.

We found 95 wells in a 950-m stretch of the Mugiri River, and 25 of these showed clear bi-lobed tailings (while the others were made unilaterally or were too disturbed to be distinguishable). If digging were lateralized, then the left- versus right-side piles of sand should be asymmetrical, with the favored hand producing a bigger pile. We measured the volumes (length x width x height) of the piles; individual diggers could not be distinguished, so data were pooled for analysis at population level.

Mean volumes of left versus right piles did not differ, nor did the *extent* of difference when the left-side pile was bigger than the right, or vice versa. Lack of lateralization at population level is congruent with other, behavioral data from manual activities by wild chimpanzees.

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**Lower limb bone remodeling in a Neolithic sample from Liguria (Italy)**

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The aim of this research is to improve our understanding of mobility and the role of the terrain in lower limb bone remodeling

studying the cross-sectional geometric properties of tibia from a Ligurian Neolithic sample (Italy, 4<sup>th</sup> millennium BC).

The sample includes eight males and seven females found in a restricted area (Finale Ligure, Savona) and dated to the fourth millennium BC. Results are compared to Late Upper Paleolithic and Mesolithic samples from the same site and from other sites around Europe.

Many paleoanthropological studies on skeletal robusticity have suggested decreased mobility with the advent of a food producing economy. Previous studies conducted on the femur of the same Ligurian Neolithic sample noted unexpected levels of mechanical stress for this population. Such robusticity could result from the combined effect of lifestyle and terrain conformation (Liguria is a mountainous region). As previously found for the femur, while all female indicators of tibial bending strength decrease steadily through time, Neolithic male values approach those of the Late Upper Paleolithic. Moreover, tibial sexual dimorphism characterizing the Neolithic sample is constantly greater than femoral sexual dimorphism, further pointing to quite different male-female mobility patterns, probably reflecting the importance of pastoral activity, well-documented in the Ligurian archeological record. The greater relative tibial strength compared to that of the femur, associated with the archeologically documented pastoral activity, further points out the stronger correlation between habitual activity patterns and relative strength of distal limb bones (tibia) than with proximal limb bones (femur), which shows a stronger correlation with climate.

**Pathology, development - or cranial deformation caused by taphonomic processes? Distinguishing among possible causes of asymmetry in Arikara subadult skulls.**

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The effects of moisture and overburden after burial in producing asymmetries in the skull are sometimes difficult to distinguish from ante-mortem processes. This study tests a method to do so.

Craniometry and digitized measurements on radiographs were obtained of 53 subadult Arikara skulls, using paired measurements that differed from each other by at least 10 mm. Principal components analysis, varimax and finally promax rotation of measurements in 3 dimensions produced dimensional combinations that were both logically and biologically interpretable.

The first and second factors estimated a deviation in the *pars basilaris*, suggesting a lateral shift of the foramen magnum, and a concomitant unilateral decrease in orbital width. These logically can be associated with postmortem deformation.

Within the second and third factors, a unilateral decrease in posterior palatine foramen-foramen lacerum dimension and a

concomitant decrease in gonion-gnathion length, respectively (each unique within its factor), were significantly associated ( $p < 0.001$ ): a condition likely to have existed in life. The fourth eigenvector measured several dimensions incorporating the foramen lacerum. Overburden pressure that would have altered the position of foramen lacerum also would have affected a variety of structures either anterior or posterior to it, including the location of the *pars basilaris*. Since none of these was asymmetric, deformation in these dimensions may represent an asymmetry that existed in life. Using logistic regression, right-left asymmetries also correctly predicted the presence of craniostynoses.

Though statistical methods can identify important factors, the location and combination of asymmetries must inform decisions about their cause by the trained investigator.

**Sex determination using the second cervical vertebra - a test of the method.**

E.J. Marlow, University of Bradford Student.

Sex is one of the critical questions addressed when unidentified skeletal remains are discovered in forensic contexts. Continuous testing and re-evaluation of existing techniques is essential to the improvement of accuracy and precision. The Wescott (2000) method of sex determination from dimensions of the second cervical vertebra was tested on 153 adult individuals, ranging in age from 21 to 92, from the Spitalfields documented collection of human skeletal remains. Significant sex differences were determined for all dimensions measured (independent two-sample t-test,  $p < 0.05$  to 0.001). The discriminant functions developed by Wescott were shown to have an accuracy of classification of c. 77%. Using stepwise discriminant analysis, a discriminant function was formulated based on the Spitalfields population data that correctly classified sex in 83.3% of individuals, and was equally accurate at classifying males as females. Further discriminant functions are presented for use in instances where preservation of the second cervical vertebra is poor.

Digital photographs were taken of all second cervical vertebrae that were preserved largely intact ( $n = 138$ ), and the area and perimeter of the vertebral foramen was investigated for the presence of sexual dimorphism. The independent two-sample t-test revealed no significant differences between the mean area or mean perimeter values of males and females ( $p = 0.118$  and  $p = 0.124$ , respectively). However, when misclassified individuals were removed from the area analysis and the independent two-sample t-test recalculated, the result verged on significance at the 5% level ( $p = 0.067$ ). Further investigation is clearly warranted.

**The Hadza Male's Dilemma: Good Father or Good Citizen?**

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In societies of human foragers, food distribution and consumption are usually public activities. Male food production can entail personal consumption, mate provisioning, paternal investment, kin provisioning, or non-kin group provisioning that could represent investment in reputation. One problem that Hadza males encounter is whether to act in ways that differentially benefit their offspring (Good Father) or in ways that benefit all fellow camp members (Good Citizen). We describe ways these two strategies conflict, creating a dilemma for the Hadza male. For example, a man who targets honey may be able to get it all to his children (Good Father), whereas if he targets large game he may need to share it with all in camp (Good Citizen). We present food-transfer data to illustrate this dilemma and its negotiation by Hadza males. While all foods are sometimes shared outside the immediate household, large game is the food that is shared outside the household most often with the most people, yet still provides the greatest benefit to the household per event because each share is so large by weight and calories. The number of occasions on which a man kills large game are fewer than those in which he kills smaller game or acquires honey, thus, over time the latter might add up to greater benefits to the household if males consistently target one or the other. We show, however, that Hadza men tend to take what they can get if it falls within the category of men's foods.

**Cranial vault thickness as a taxonomic indicator.**

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Unusual cranial vault thickness (CVT) is often cited as a derived trait specific to *Homo erectus*, relating especially to specimens from Java. A review of this trait highlights inconsistent reporting of CVT variation and how this dictates species membership. While exterior to interior measurements give descriptive information, their value is diminished due to inconsistent understanding of internal structure.

This study will evaluate previous techniques for measuring CVT, externally and internally, and how these may be applied to the fossil record. For descriptive purposes, caliper measurements of osteometric points on fossils, or point sampling, are constant comparative informers. To better quantify thickness variation, researchers utilize X-rays to measure living patients of varying life-stages, biological affinity, cranial capacity and the effects of osteopathy. These variables, excluding osteopathy, do not dictate systematic variation in bone thickness. In 2005, Lynnerup and colleagues



demonstrated that diploe contributes to the majority of CVT variation in modern humans. This correlation should be investigated within unusually thick *Homo erectus* crania to better exhibit the use of thickness as an ancestral trait.

With modern humans as a baseline, these patterns can be studied in hominin evolution to demonstrate a more complete picture of CVT. Thickness as a taxonomic indicator has been discussed since the first discovery of Asian *Homo erectus*. While their cranial bones have been repeatedly point sampled, there has been no study of the internal (diploe) composition. Such a study would offer new information for understanding the composition and relationships of vault thickness within and among species.

#### **Skeletal indicators of slavery and violence in the Greater Southwest (AD 800-1500).**

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In the Greater Southwest, emphasis on head wounds in female subgroups revealed that, in some cases, females were targets of violence. This study focuses on non-lethal (healed) cranial depression fractures and post-cranial trauma in females and males for seven major archaeological sites in the Greater Southwest (AD 800-1500). These injuries have been attributed to massacres, witch killings, and warfare. An alternative hypothesis is examined that focuses on the possibility that victims were abductees, mistreated captives, indentured servants, or slaves. Brooks (2002) documented widespread forms of slavery and the vast extent of slave systems in the Southwest borderlands region during historic times. This project involves the creation of a methodology sensitive to providing "signature" data on possible cases of slavery. Human remains present a robust source of data for exploring slaving practices. Biological (skeletal) indicators of slavery include patterned cranial and post-cranial trauma, recidivism, targeted subgroups, use of non-lethal force, and work-related bone lesions. Multiple lines of evidence suggest that at least 28 cases of healed trauma from six archaeological sites are the result of some form of slavery. This project addresses the extent to which women and children were the subjects of slaving practices and the effects of these practices on their morbidity, mortality, and societal position. These data contribute to understanding the skeletal indicators of slavery, and support the alternative hypothesis that women and children were the targets of violence and slavery in some regions of the pre-colonial Greater Southwest. This research was supported by Wenner-Gren Foundation Grant #6981.

#### **Faculty scholarly productivity in US Anthropology Ph.D. programs.**

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The *National Research Council* has commenced a new assessment of research-doctorate programs in the United States, renewing interest in the rankings of academic programs. We analyzed data on faculty scholarly productivity from a previous NRC study (published in 1995, covering 1987-92). Data on journal publications and citations, federal research grants and scholarly honors and awards from this study were used to develop rankings of Anthropology Ph.D. programs based on per capita faculty scholarly productivity. Results show that many Anthropology programs have levels of productivity different from expected based on the NRC's reputational assessment (that is, programs either "underperformed" or "overperformed" compared to reputation). This effect is especially strong for programs with a heavy emphasis in Physical Anthropology.

Continuing this line of study, *Academic Analytics, LLC* has developed an up-to-date faculty scholarly productivity database for faculty members affiliated with Ph.D. programs in the 2005-06 academic year. This database includes information on books published (from 2001-05) as well as journal articles and citations (indexed by *Scopus* for years 2003-05), NSF, NIH and NEH funding of research (2003-05) and major honors and awards (covering variable periods according to the prestige of the award). We present these data in a quantitative comparison of US Anthropology Ph.D. programs, and introduce a summary measurement of productivity: Faculty Scholarly Productivity Index™. The methods presented here illustrate a quantitative means to evaluate faculty productivity comparatively within a broad academic discipline such as Anthropology.

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#### **Evaluation of methods for estimating chronological age at linear enamel hypoplasia formation.**

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Linear enamel hypoplasia (LEH) is an enamel defect that records the effects of physiological stress on tooth formation. Estimating the age at which LEH defects form is integral to the reconstruction of population health in bioarchaeological studies.

Two principle methods for aging LEH defects have been introduced in the literature. The

conventional approach employs regression equations based on a linear model of tooth growth. The newer, Reid and Dean (2000) approach, is based upon a histologically derived curvilinear model of enamel development and therefore provides the most accurate age estimates. However, the extent to which the Reid and Dean (2000) method produces estimated ages at defect formation differing from those of the regression equations has not, until now, been determined. This study quantifies the differences between these two methods. Evaluating the degree to which these methods differ is essential for interpreting the accuracy of LEH age estimates given in previous bioarchaeological studies.

Age estimates of LEH defects on four hundred and thirty-three anterior teeth from the Hamann-Todd osteological sample were calculated using both methods. The resulting estimated ages were compared through a univariate, randomized block and single classification ANOVA. The ANOVA results reveal that the average variance between the estimated ages yielded by both methods is two months or less. The discussion focuses on the degree to which this difference affects answers to bioarchaeological questions.

#### **A preliminary analysis of parasite species and density patterns in white-collared lemurs, *Eulemur albocollaris* at Manombo Special Reserve and Mahabo Forest, and red-fronted brown lemurs, *Eulemur fulvus rufus* at Ranomafana National Park, Madagascar.**

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Primate species may be threatened by multiple, frequently synergistic factors, such as habitat loss, hunting, and disease. Parasite diversity and density are among the health variables likely affecting endangered populations. Small, fragmented populations are frequently in closer contact with human communities, thus potentially increasing their risk of infestation. In addition, degraded habitats and lower quality diets may lead to pervasive health effects, including greater susceptibility to parasites. Fecal samples from the critically endangered *Eulemur albocollaris* population at Manombo Special Reserve and Mahabo Forest were collected for parasite analysis. The Manombo study area included 13,450 ha of lowland rain forest, while Mahabo encompassed approximately 1,500 ha of littoral rain forest. Disturbance in these forests in both natural, due to periodic cyclone damage, and anthropogenic, including ongoing habitat loss and hunting. A total of 36 individuals were sampled from nine groups in two populations. These data were compared with samples collected from thirty individuals in one population of the closely related and less threatened *Eulemur fulvus rufus* at

Ranomafana National Park (which includes over 40,000 ha of protected mid-altitude rain forest). The density and richness of intestinal parasites found in these populations from these two species can be used to address whether critically endangered species are faced with more potential adverse health effects from parasites than their less threatened relatives. We also compare parasite infestation patterns among habitat types, including forest area and disturbance regime.

#### **Reproductive strategies in captive *Hylobates* populations.**

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It is long believed that wild *Hylobates* sp. primarily practice a monogamous breeding system. Institutions that house these captive animals often attempt to simulate wild environments and therefore usually pair two adult animals of each sex in a single enclosure. Interestingly, recent research has shown that wild gibbon and siamang populations are not exclusively monogamous, but exhibit serial monogamy and adulterous behaviors, which challenges long-held beliefs on how to properly house *Hylobates* in captivity. Given that gibbons and siamangs are currently listed on the International Union for Conservation of Nature and the World Wildlife Federation's list of threatened and endangered species, captive institutions have and will continue to be an important resource in the maintenance of these populations. Here we provide an extensive review of the research on wild and captive *Hylobates* sp. reproductive strategies, comparing this information with the current practices and procedures of captive institutions. Various models are illustrated that may be used by institutions in order to maximize reproductive success of captive *Hylobates*.

#### **Variability in osteon and Haversian canal sizes between medieval and recent human populations from Slovakia.**

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The sizes of cortical structures like osteons and Haversian canals are quite variable. Recent studies revealed that some past human populations had distinctly smaller osteons compared to recent humans. In general, osteon size seems to be more consistent across human samples than Haversian canal size. It appears that the more recent a sample's origin is, the larger Haversian canal area will be.

The purpose of this study was to quantify variability in osteon and Haversian canal area between medieval and recent human samples from Slovakia. Femora from ninth-century adult females excavated at Dubovany cemetery (n=14) and the recent ones obtained from Slovak cadavers in 2002 (n=10) were analysed. The bones were embedded, sectioned and examined according to procedures described by Martiniaková et al. (AJPA 2005; Suppl. 40:146). Those structures in which the maximum diameter was greater than twice the minimum diameter were excluded. The ANOVA analysis was used to distinguish differences between examined populations.

Our results indicate Haversian canal area within an individual sample is much more variable than osteon area. Bone samples in this study show significant patterns of relationship between Haversian canal area and age; the relationship between osteon size and age was nonsignificant. Both, osteon and Haversian canal area dispose higher values in recent individuals (P<0.01). Hypotheses for why differences in structures mentioned above exist for the same bone between human populations from Slovakia may be based on biomechanical rationale, endocrine factors, diseases and/or some lifetime behavioral choices.

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#### **A Biological Distance Study of Non-Metric Cranial Traits for Three Prehistoric New Mexico Sites: Nanishagi Ruins, Kuaua Pueblo, and the Angus Site.**

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A biological distancing approach to gene flow between three sites in New Mexico was utilized via non-metric trait analysis looking for cranial trait similarities and dissimilarities between these populations. Because shared traits may suggest the applicability of discrete traits toward a small-scale analysis (Rosing 1984), the focus was on determining if gene flow interaction existed in higher frequencies between the Angus Site and Nanishagi Ruins than between the Angus Site and Kuaua Pueblo (the latter being closest to the Angus Site).

This study examined 29 non-metric cranial traits obtained from crania located at the University of New Mexico. The collections consisted of Jemez (i.e. Nanishagi Ruins) having 155 burials, Kuaua (Kuaua Pueblo) having 79 burials, and the Angus Site having 18 burials. A cranial non-metric form was used to record all non-metric information that was visually obtained from the cranial remains for the three sites, with traits being noted as ranging from absent, to complete, to unobservable, depending on the numerical scales encoded meaning (Buikstra and Ubelaker, 1994).

The results indicated gene flow existence, due to cranial trait similarities, occurring at a

higher percentage between Nanishagi Ruins and the Angus Site than with Kuaua Pueblo and the Angus Site. While there are plausible explanations for this gene flow occurrence (i.e. tool innovations, etc.), more study is needed to conclusively answer the question of why the higher frequency of gene flow occurred between the Angus Site and Nanishagi Ruins than with the Angus Site and Kuaua Pueblo.

#### **Courtship behaviors of genus *Cebus*: a test case for inferences from phylogeny.**

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Between Sept. 2005 and Sept. 2006, Matthews habituated and studied a group of white-fronted capuchin monkeys (*Cebus albifrons*) at the Tiputini Biodiversity Station in Amazonian Ecuador. During this time he observed several copulations, and accompanying stereotyped courtship behaviors. The presence of several of these behaviors, such as "duck face" and "grin," in the courtship repertoire of *C. albifrons* is notable because these behaviors also have been reported in the courtship repertoires of some but not all other species of *Cebus*.

Using published molecular data, we inferred an intrageneric phylogeny for *Cebus* and then mapped the distribution of these courtship behaviors on that phylogeny. The courtship behaviors yielded highly parsimonious character reconstructions on this phylogeny. We then assessed the probability that the observed parsimonious reconstruction of courtship behaviors could be due to chance alone using several statistical methods. We conclude that the distribution of courtship behaviors across *Cebus* species evidences a phylogenetic effect; that is, it suggests that the behavioral states of ancestral species influenced the behaviors of descendant species. We hypothesize that such a phylogenetic effect could result from selection in each generation for the maintenance of a mate recognition system.

#### **An anthroposcopic approach to South Indian human population genetics: coalescence of data from the literature.**

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The endogamous castes of India create a rich ground for the study of human population genetics. Long term research by (Rami Reddy) provides a wealth of data for the study of population genetics in southern India. Anthroposcopic data for five traits from males and females of five castes and one tribal group of southern India were coalesced to examine the genetic distance between castes. Pairwise comparisons for significant

population differences were performed.  $F_{ST}$  and  $D^2$  were calculated. Also, gene flow patterns were elicited through principal components analysis of the linear distillation of  $D^2$ .

Pairwise comparisons found statistically significant differences between populations.  $F_{ST}$  was proportionate with other calculations based on anthroposcopic data. The first axis of the principal coordinate represents ninety-five percent of the variation between the castes. Population distances and arrangement on the first axis follow the caste hierarchy. Greater genetic distances were found between castes that have disparate rankings in the social hierarchy. Furthermore, systematic differences between the sexes were observed. Males were less distant from adjacent castes genetically than females. Following the observation of fluidity in the castes system by Bowles, reverse fluidity was observed with males being more genetic mobility than females. This contrasts to northern India where females exhibit more genetic mobility. It is posited that the differential genetic mobility relates to biased sex ratios. That is, where excess adult males are observed in India, females have more genetic mobility and where excess adult females are observed, males have more genetic mobility.

#### **Structural signature of bipedal training in the tibial plateau of a Japanese macaque.**

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Japanese macaques habitually trained in bipedal performance (Saru-mawashi) display functionally-related external skeletal changes (Nakatsukasa et al. 1995) and site-specific endostructural adaptations (Richmond et al. 2005; Volpato et al. 2006). Here we report the results scattered from the high-resolution non-invasive analysis of the topographic variation of the cortico-trabecular complex (CTC) underlying the tibial plateau of Sansuke, a macaque engaged in bipedal performance for eight years, and of three wild macaques.

The quantitative assessment of the proximal tibiae is based on a synchrotron radiation micro-CT record performed at the European Synchrotron Radiation Facility, Grenoble, at a resolution of 45.5x45.5x43.6  $\mu\text{m}/\text{pixels}$ . Projections were taken each 0.24° and were collected by a 2048x2048 CCD camera. A set of 30 virtual cross-sections spaced 1 mm medio-laterally have been realized and over 700 thickness measurements of the CTC have been taken electronically on each specimen. The structural topographic variation has been 3D mapped and rendered in pseudo-colour format.

With respect to the wild monkey variation, Sansuke's tibial plateau is in absolute thicker, with no structural difference between left and right side. Similar to the human condition, and differently from the baboon, the medial condyle is thicker than the lateral in both trained and non-trained macaques (av. Sansuke: 0.8 vs. 0.4 mm; av. wild: 0.5 vs. 0.4 mm), but the difference is much greater in Sansuke. Moreover, the 3D model of the bipedal macaque suggests an anteriorly displaced distribution of the joint loads on both condyles, likely related to the unique biomechanical environment experienced during bipedal training.

#### **Density mediated attrition at ESA faunal assemblages: using new density measurements and reference samples to examine bone element frequencies at early hominid sites**

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Since the 1980s, understanding the taphonomy of African Early Stone Age faunal assemblages has been a priority for zooarchaeologists. The frequencies of bones with characteristics referable to animal species, sex, age, and especially anatomical part have been among the main sources of information about early hominid carcass exploitation patterns. Aspects of taphonomy render this data source problematic, as many variables differentially affect the frequencies of bones in assemblages. Most taphonomic studies of early hominid sites have focused on the role of carnivores and geological transport in faunal assemblage formation. Another related aspect of taphonomy that affects bone frequencies is density mediated attrition. Bone density has been recognized as a key factor influencing the survival of bones in faunal assemblages for almost thirty years, but more seldom has this issues been examined for Early Stone Age faunal assemblages.

This paper uses recent advances in the measurement of bone density and expansions of density reference samples to examine several Early Stone Age faunal assemblages from Olduvai and Koobi Fora. We also examine methodological issues in the quantification of faunal assemblages and reporting of datasets. Despite important methodological limitations, we find evidence for significant density mediated attrition affecting the frequencies of certain elements. However, we also find variation in faunal assemblages that is not explained by density alone, and we suggest that this may point to aspects of hominid carcass exploitation strategies that affected element frequencies in assemblages.

#### **Taxonomy of Middle Pleistocene humans: What is *Homo heidelbergensis*, anyway?**

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Traditionally, researchers have lumped large-brained, non-erectine hominins from the Middle Pleistocene into archaic *Homo sapiens*, but increasingly researchers prefer to place these specimens into their own species, *H. heidelbergensis*. However, substantial morphological variation within this hypodigm suggests that these specimens could also be allocated to more than one species.

To test these taxonomic hypotheses, we assembled data from the neurocranium, basicranium and face for specimens commonly attributed to *H. heidelbergensis*, in addition to comparative data for a world-wide sample of modern humans (from Howells' craniometric dataset) and several fossil comparative samples (*H. erectus/ergaster*, Neanderthals and late Pleistocene *H. sapiens*). We used bootstrapping methods to resample coefficients of variation (CVs) for size and shape variables in both the test and comparative samples, and principal components (PCA) and canonical variates (CVA) analyses to explore patterns of variation within each character complex.

CVs calculated for size and shape variables suggest that the range of variation within the *H. heidelbergensis* hypodigm is too great to be accommodated within a single species. Bodo and Kabwe differ significantly from other archaic *Homo* specimens in vault height and width and both size and shape of the upper face, while Dali uniquely combines a long vault with a superoinferiorly short face. PCA and CVA analyses indicate systematic differences between African, European and Asian specimens. These results suggest that large-brained, non-erectine Middle Pleistocene hominins can be split into two, if not three, different species.

#### **Articular kinematics of the knee of *Kenyapithecus*.**

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The knee of *Kenyapithecus* is known from three specimens: a fragmentary left femur shaft (BMNH M. 16330), 2) a left femur distal end (KNM-MB 24727), and 3) a left patella (KNM-MB 24738). BMNH M. 16330 and KNM-MB 24727 probably derive from a single individual, as they appear to conjoin. KNM-MB 24727 preserves the lateral condyle and most of the patellar groove but lacks the medial condyle. We analyzed these specimens to reconstruct the articular kinematics of the knee of this large-bodied hominoid from the middle Miocene of Kenya

The overall distal femur proportions of *Kenyapithecus* were assessed by an index: lateral condyle anteroposterior diameter x 100/mediolateral diameter. The *Kenyapithecus* distal femur is moderately broad and shallow, being most similar to that of atelines, colobinans, and hylobatids.

Extant great ape distal femora tend to be even broader and shallower, while distal femora of pitheciines, presbytinans, cercopithecines, and papionins are narrower and deeper. The *Kenyapithecus* patellar groove is broad and shallow. The patella of *Kenyapithecus* resembles those of New World anthropoids and hominoids, with mediolaterally broad proportions and a short nonarticular extension distally. The *Kenyapithecus* patella is also quite thin anteroposteriorly, like those of platyrrhines and hominoids. Overall, the knee of *Kenyapithecus* is quite similar to those of platyrrhines, *Oreopithecus bambolii*, and extant apes. These findings support reconstruction of the knee of *Kenyapithecus* as permitting ranges of mediolateral mobility like those of extant hominoids. This pattern is fundamentally different from the emphasis on rapid extension of the knee joint seen in cercopithecoids.

**Ontogenetic and regional variability in intracortical remodeling at the midshaft femur and humerus of *Chlorocebus aethiops*, *Hylobates lar* and *Pan troglodytes*.**

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Analyses of secondary intracortical remodeling may provide insight into skeletal function, as its distribution is thought to reflect a history of loading-induced strains and/or microdamage. However, regional variability in intracortical remodeling in the limb skeletons of many nonhuman primates is poorly known, as is the manner in which adult patterns are acquired during growth. The current study examines regional variability in intracortical remodeling at the midshaft femur and humerus in ontogenetic series of wild-collected *Chlorocebus aethiops* (n=32), *Hylobates lar* (n=28), and *Pan troglodytes* (n=12; femur only). 100 micron-thick cross-sections were imaged in brightfield and polarized light microscopy. Percent area of secondary osteonal bone (%HAV) was quantified in whole cross-sections, and across three circumferential rings and eight radial sectors within cross-sections. Results demonstrate significant regional variability in %HAV within taxa, with remodeling most prevalent in the humerus. Within cross-sections, %HAV was usually higher in inner and mid-cortical rings compared to the outer ring, the latter representing bone of more recent deposition. Further, %HAV exhibited highly patterned distributions across radial sectors; this

distribution showed some correspondence with bone structural properties (e.g., Imax orientation) in *C. aethiops* and *P. troglodytes*. Qualitatively, secondary osteons were often concentrated at muscle attachment sites and in regions undergoing endosteal growth and cancellous compaction. Observations suggest that local growth circumstances may influence secondary osteon distributions in ways not related in an obvious manner to tissue age or strain history. These results have implications for understanding developmental versus mechanical factors influencing taxonomic and intra-skeletal variability in intracortical remodeling.

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**Biogeochemical effects of anthropogenic disturbance on *Propithecus edwardsi* (Primates: Indriidae) from Ranomafana National Park in southeastern Madagascar.**

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Selective logging has been suggested as a potential "win-win" conservation strategy that balances the demand for timber while presumably minimizing species loss and ecosystem changes. Biogeochemical methods such as stable isotope analysis are particularly important in documenting and tracing ecosystem effects of selective logging as stable isotopes yield information on energy and nutrient cycling through trophic levels within an ecosystem.

We analyzed the stable nitrogen ( $\delta^{15}\text{N}$ ) and carbon ( $\delta^{13}\text{C}$ ) isotope composition of hair from over 50 living individuals of *Propithecus edwardsi* from three sites in Ranomafana National Park (RNP) that are comparable except for the impact of logging: 1) Talatakely (heavily selectively logged 1986-1989); 2) Vatoharanana (minimally selectively logged 1988-1989); and 3) Valohoaka (not commercially logged). *P. edwardsi* from Talatakely is both nitrogen and carbon depleted relative to *P. edwardsi* from Vatoharanana and Valohoaka. Although Vatoharanana was minimally selectively logged for two years, there is no appreciable difference in the stable nitrogen or carbon isotope composition of *P. edwardsi* inhabiting this site and Valohoaka. However, when we analyzed the hair of several individuals of *P. edwardsi* collected in the late 1800s from the Faraony River Valley near the southern end of RNP, we found that *P. edwardsi* from all three current sites are depleted in nitrogen and carbon relative to the historic *P. edwardsi*. While Vatoharanana and Valohoaka are isotopically similar and appear to indicate ecosystem integrity, in the context of the historic specimens it becomes apparent that this ecosystem has been affected by even moderate anthropogenic disturbance.

**Mitochondrial DNA study of human variation in regards to behavior and the inheritance of landscapes.**

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The main objective of this research is to investigate and interpret human variation through time and space in order to provide anthropologists with a better understanding of past and present human behavior. The overall goal is to understand how humans inhabit and move within landscapes and how population variation can inform us about the roles of language, geography, and culture/lifeways when choosing a mate. We address how patterns of biological variation help explain the ways in which humans group themselves together. This study investigates variation through the study of gene flow, as reflected in mitochondrial DNA sequence data, in ancient and modern Aleut and Eskimo populations from Alaska. Measures of genetic diversity are used to explore the microevolutionary relationships between these populations. Preliminary results indicate that, in this case, geography is a more important factor in choosing a mate than language. There is genetic continuity in the region for thousands of years, as discovered through the comparison of ancient DNA to modern DNA for Aleuts and Eskimos, thus highlighting the tendency for these populations to remain genetically distinct from one another in spite of geographic proximity and language similarity. This study provides evidence that Aleuts migrated into Alaska and then populated the Aleutian Islands in an east to west movement. Our data support numerous other hypotheses that the Eskimos represent a separate, more recent arrival to North America.

**Prospects for bonobo insectivory: what's on the menu at Lui Kotal.**

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Published reports of insectivory by bonobos (*Pan paniscus*) are fragmentary, while chimpanzees (*P. troglodytes*) customarily eat insects at many sites across Africa. Chimpanzees, both habituated and unhabituated, use elementary technology in extractive foraging for social insects, in a wide range of ecotypes from savanna to rainforest, but bonobos apparently do not. This study aims to test the hypothesis that lack of customary bonobo insectivory may be due to absence of appropriate prey or raw

materials for tool-making, or to accessibility or scarcity of these necessary components.

We sampled the frequency, distribution and density of selected taxa of ants and termites, and of vegetation suitable for making probes or wands, at Lui Kotal, on the southern edge of Salonga National Park, Democratic Republic of Congo. Data were collected by three kinds of transects totalling 6 km, and opportunistically. Insect mounds and nests were sampled and monitored.

Five of the nine genera of termites eaten by chimpanzees were present at Lui Kotal, including their overwhelming favorite, *Macrotermes*; the same was true for five of the eight ant genera, including the most commonly eaten genus, *Dorylus*. Bonobos at Lui Kotal have ample amounts of these prey taxa available, and they are widespread; the same is true for both woody and non-woody vegetation for tools. Therefore, bonobos at Lui Kotal do not lack suitable prey or raw materials for extractive foraging on social insects.

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#### Getting Here: The Howells' style of mentorship and hominid postcranial morphometrics.

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In 1967 Patterson and Howells applied multivariate morphometrical methodology to a newly discovered 4 million year old distal humerus from Kanapoi, Kenya (KNM-KP 271). As Howells' graduate student, this author embarked on research applying multivariate morphometrics to assess the taxonomic and functional affinities of hominid postcranial fossils. Mentorship is multidimensional. On one axis there is the transmission of methodological skill. On another is the theoretical vision which in this case is provided by modern evolutionary biology. Yet another is the lifetime of developing personal and trusting relationships with colleagues. Bill Howells was a superb mentor in all of these dimensions and especially the latter which allowed a graduate student the opportunity to study original fossils.

New fossils flood the stage in recent years and each can be entered into the multivariate space defined by the variability among hominoid species. For example, "Little Foot" (STW 573) and OH 8 are more human-like in the discriminant axis separating humans and apes, but project in unique ways on higher functions. New distal humeri from Swartkrans, SKX 10924 and SK 24600, are remarkably human-like compared to most other fossil specimens. Australopithecine pelvic fossils (A.L. 288-1, Sts 14, and SK 3155) project close to humans on the axis that separates people from apes, but on higher axes the uniqueness of the Swartkrans specimen (SK 3155) is apparent. The rich

collection of new forelimb fossils reveals an unexpected complexity and uniqueness that defies any simple ape-human dichotomy.

#### Temporal characteristics of fossil cercopithecoid diversity and longevity in southern Africa.

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Fossil cercopithecoids are important for interpreting how changing environments shaped the evolution of African mammals. The southern African fossil record provides a good sample of cercopithecoids, comprising as many as 13 species from the Pliocene and Pleistocene. With caveats regarding taxonomy, taphonomy, and dating, cercopithecoids can be used to test paleoecological hypotheses.

Species diversity of recognized fossil cercopithecoids in southern Africa was at its peak in the late Pliocene. An apparent decline began after approximately 2.5 mya, with a further decline after about 1.6 mya. These trends do not appear to be artifacts of the fossil record or differing taxonomic schemes, and are consistent with trends among other fossil mammals. It is hypothesized that the initial decline was due to climatic change, and the latter decline is associated with the niche disturbance from the spread of early *Homo*.

Species longevity, based on first and last appearances, ranges up to 2.5 myr, with an average of 0.7 myr. This is well below the 1.3 myr average for large mammals, but close to the average longevity of recognized hominid species. The longest living species is *Thereopithecus oswaldi*, though fossils referred to this species may be in need of a taxonomic reassessment. *Cercopithecoides williamsi* is also a long-lived species, and likewise, the later representatives may be referable to a distinct chronospecies. If so, the cercopithecoids become even more unique in their longevity characteristics. Nevertheless, the patterns of diversity decline are clear, and the cercopithecoids demonstrate a unique pattern of rapid evolutionary turnover.

#### Premolar microwear of three New World monkeys: *Cebus apella*, *Pithecia pithecia*, and *Ateles belzebuth*.

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Nearly all studies of dental microwear have focused on the incisors and molars. However, canines and premolars might also be particularly informative for those animals that use the canine/premolar complex to open or manipulate objects. This study evaluated the dental microwear patterns found on the

anterior shearing facet of the mandibular P2 of three New World Monkeys with different diets. *Cebus apella* is often viewed as a hard-object specialist because its diet includes hard and brittle objects that resist puncture (Kinzey, 1992; Strait, 1997). *Pithecia pithecia* is a seed predator that frequently slices through hard and tough pericarps of unripe fruits to get at soft seeds and pulp inside (Kinzey, 1992). *Ateles belzebuth* consumes soft, ripe fruits (Nunes, 1998).

High resolution casts were examined under a scanning electron microscope and scored using Microware 4.02 (Ungar, 2002) to determine the average number of microwear features and their size and orientation for each individual. Single-factor analysis of variance, and post-hoc statistical tests reveal a very clear pattern separating the hard-object specialist, *C. apella*, from the frugivore, *A. belzebuth*, with *P. pithecia* intermediate. This is very similar to the results of molar microwear analysis on the same animals (Teaford & Runestad, 1992; Teaford, 1985). Thus, premolar microwear patterns may also be able to differentiate between broad dietary categories, and may indicate slight differences in premolar use during food processing or ingestion.

#### Spatial distribution of feeding and sleeping trees in territorial owl monkeys (*Aotus azarai*).

M.V. McLaughlin, E. Fernandez-Duque. Department of Anthropology, University of Pennsylvania.

Early studies of the ranging patterns of owl monkeys indicated that groups make relatively exclusive use of an area or territory. Still, given the strictly nocturnal habits of most owl monkey species, it has been difficult to characterize their territorial behaviors in detail. The present study was conducted to evaluate the influence that the spatial distribution of feeding and sleeping trees may have on the ranging patterns and territorial behavior of cathemeral owl monkeys in the Argentinean Chaco.

During a one-year study, we recorded all trees used by five owl monkey groups during 120 12-hr follows. We measured, identified to species level, and recorded the location of 467 trees used for feeding or sleeping. Our analyses indicate that there are no significant differences in the number of sleeping and foraging trees used by each group (chi squared test,  $p > .05$ ). Foraging and sleeping sites are strongly interspersed, though sleeping sites tend to be more clustered than foraging sites. Trees were rarely used by more than one group. In the few occasions that groups shared a tree, it tended to be a feeding tree, not a sleeping one. Although our data provide convincing evidence for the territorial nature of owl monkeys, the relative roles that ecological and social factors play in territory maintenance remain to be determined.

This project was in part funded by grants to EFD from the L.S.B. Leakey Foundation,

the Douroucouli Foundation and the Argentinean Council for Science and Technology.

#### **New primate fossils from Rusinga Island, Kenya.**

K.P. McNulty<sup>1,2</sup>, W.E.H. Harcourt-Smith<sup>2,3</sup>, H.M. Dunsworth<sup>4</sup>. <sup>1</sup>Dept. of Anthropology, Baylor University, <sup>2</sup> NYCEP Morphometrics Group, <sup>3</sup>Division of Paleontology, American Museum of Natural History, <sup>4</sup>Dept. of Anthropology, Pennsylvania State University.

Early Miocene localities on Rusinga and Mfangano Islands have historically been highly productive, preserving a diverse collection of floral and faunal specimens including several species of primate. Systematic fossil collection and excavation, however, have not been undertaken there since the mid 1980s. In 2006, we conducted a preliminary survey of the localities on both islands to assess the productivity and accessibility of fossil bearing exposures and to collect new fossil specimens from both Miocene and Pleistocene deposits. Findings from this season are encouraging. All localities remain highly productive and more than 550 specimens were collected during the short two week survey. Here, we present results from the 2006 field season, including eleven new primate specimens from three sites on Rusinga.

Based on our qualitative and metric analyses, all the primate specimens were found to fall within known taxonomic hypodigms. A new partial mandible preserving morphology from the left canine base to right m3 was discovered at locality R106 and is attributed to *Proconsul nyanzae*. Additional new dental specimens are attributed to *P. heseloni*, *P. nyanzae*, *Limnopithecus cf. legetet*, and *Nyanzapithecus vancouveringorum*. Several primate postcranial elements were also recovered including a femoral head, two metatarsals, and a manual phalanx. These are attributed to *P. heseloni*. The lesser known and more diffuse Pleistocene deposits were also surveyed, and two points of dense accumulation yielded extensive faunal remains and the stone tool presented here. This research was funded by grants and additional support from Baylor University.

#### **Morphometrics of the outline shape of hominid footprints.**

D.J. Meldrum<sup>1</sup>, R.E. Chapman<sup>2</sup>. <sup>1</sup>Dept. of Biological Sciences, Idaho State University, <sup>2</sup>Idaho Virtualization Lab, Idaho State University.

The discovery of fossilized hominid footprints provides a dynamic glimpse into the evolution of hominid bipedalism and the ultimate emergence of modern human walking. Many previous studies have been limited to linear and angular measurements, omitting the information of shape. Developing basic quantitative approaches to analyzing

variation in the shape of human footprints is an essential prerequisite to studying the fossil record of human footprints and relating the variability seen there to various factors such as individual variation, taphonomy, taxonomy, and the functional morphology of the soft tissue and underlying skeletal framework of the foot making the print. The approach used here combines the best aspects of both outline and landmark methods of geometric morphometrics. Outline shapes are extracted using equally-spaced pseudolandmarks extracted between a varying set of true landmarks along the outline of the footprint. In this way, the ability to analyze the full footprint outline is combined with the power of landmark shape analysis. Using a variety of different variants on this approach, applied to a large sample of university students, we are able to define what sections of the basic outline of the plantar sole pad are more variable than others as well as relate the shape of footprints made in compliant substrates – such as ashfalls and mud – to those taken on relatively hard ones. This was done by studying footprints made by the same individuals in both substrate types. Comparisons were made to the interpretation of fossil hominid footprints, including the Laetoli tracks.

#### **Mitochondrial DNA diversity in six Mennonite communities from Kansas and Nebraska**

Phillip E. Melton<sup>1</sup>, MJ Mosher<sup>1</sup>, MH Crawford<sup>1</sup>

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This study examined mitochondrial DNA (mtDNA) diversity in six Mennonite communities from Kansas (Goessel, Lone Tree, Garden View, Meridian, Old Order) and Nebraska (Henderson) in order to further elucidate the genetic structure and population history of these groups. mtDNA haplogroup and haplotype information were obtained for 119 individuals and biological relationships were analyzed using diversity measures, neutrality test statistics, analysis of molecular variance (AMOVA), and a multidimensional scaling plot. Results demonstrated a total of 12 mtDNA (H, I, J, K, T, U2, U4, U5, U6, X, pre-V, F) haplogroups were present in differing frequencies in these communities. Comparable to other populations of European descent, haplogroup H was the most frequent in all six communities and ranged from 35% in Lone Tree to 75% in Old Order Mennonites. A total of 60 different mtDNA haplotypes were found in these groups with only 8 shared between populations. Haplotype diversity (h) values varied from 0.81 (+/- 0.01) in Goessel to 0.96 (+/- 0.02) in Henderson. Population subdivision of these communities into congregations support previously published results regarding known patterns of fission-fusion and offer further clarification of the

relationship between genetic characteristics and historical events.

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#### **Walking and leg length: Are modern humans geometrically similar?**

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The dynamic similarity (DS) hypothesis provides a method to control for the effect of leg length on the energetics of modern humans, but, recently, questions about its usefulness have been raised. Inherent in DS is geometric similarity (GS), the requirement that all lengths scale isometrically. GS among humans might not be obtained, however, because extreme geographic dispersal and environmental conditions might select for distinct morphologies.

As a first step toward assessing GS among humans, we obtained external body length measurements from the physical anthropology literature, anthropometric databases, and a group of volunteers. Although biased towards Americans and Europeans, our sample includes men and women from central Australia, Latin America and Vietnam. We evaluated arm and leg segment lengths and hip breadth and created an average man and woman from a randomly-drawn sample of Americans. The measurements of all other individuals were predicted using a GS factor determined from the left upper arm. Predictions were then regressed against observed values and GS was defined as a regression slope ( $\beta_1$ ) of 1.0 (within the 95% CIs).

We found that modern human populations are essentially geometrically similar ( $\beta_1 = 0.95-1.06$ ) in their external measurements, although men and women differ in hip breadth ( $\beta_1 = 0.89$ ). Consequently, discrepancies between energetic predictions, based on the DS hypothesis, and observations in humans are not caused by geometric dissimilarity, thus mandating the search for alternative causes.

#### **What should we be looking for in brain and physiology to understand paternal care?**

Sally P. Mendoza, Ph.D. and William A. Mason, Ph.D. Department of Psychology and California National Primate Research Center, University of California, Davis, CA 95616.

Understanding the proximate mechanisms of social behavior is becoming increasingly important to several disciplines, including anthropology. Whereas in the past proximate mechanisms could only be explored using behavior as the endpoint, an increasing number and

availability of techniques allow the study of the proximate mechanisms to include sophisticated neural and endocrine evaluations. The question is how are social systems represented in brain and physiology? Research in titi monkeys has suggested that a number of behavioral tendencies, including neophobia, social facilitation, stress buffering, and parental tolerance all contribute to the expression of a monogamous social system featuring paternal care. The problem is that factors contributing to paternal care are not always correctly identified from behavior and, once identified, are not as reliably expressed as the outcome would suggest. Nonetheless, the appearance of the species-typical structure at the group level is completely predictable. We suggest that social systems, including monogamy, emerge from redundant, error-prone, and simple behavioral mechanisms. It is the sheer number of contributing, semi-independent mechanisms that ensures that virtually every titi monkey in the laboratory or field engages in a monogamous social system.

#### **Functional convergence of the haplorhine postorbital septum and strigiform postorbital process.**

R.A. Menegaz, E.C. Kirk. Department of Anthropology, University of Texas at Austin.

The evolution of highly convergent orbits, relatively large eyes, and high visual acuity in haplorhines is hypothesized to have necessitated the evolution of a postorbital septum in order to prevent mechanical disturbance of the eye by the temporalis muscle. However, the unique nature of the haplorhine postorbital septum among mammals limits the ability to test this hypothesis using comparative methods. Because birds are known to exhibit variation in the size and morphology of the postorbital process, we examined the orbital anatomy of 103 avian species to determine whether any clades converge on the haplorhine condition. Among the species we examined, we found that strigiform birds (owls) have the most extensive postorbital processes. In owls, this extension of the orbitosphenoid is plate-like and largely isolates the orbit from the temporal fossa. We also found that strigiforms have the highest range of orbital convergence and relatively large orbits compared to other birds in our sample. Furthermore, dissections of 4 owl species demonstrated that the postorbital process is positioned to deflect the path of the adductor mandibulae externus around the orbital contents. We conclude that the strigiform postorbital process acts to insulate the orbital contents from contractions of mandibular adductors, and that postorbital septa of primates and postorbital processes of owls have evolved in parallel as insulating mechanisms. The common occurrence of large eyes and highly convergent orbits in owls and haplorhines further supports the hypothesis

of a functional link between these characters and the need to prevent mechanical disturbance of the eyes.

#### **A three-dimensional shape comparison of AL129-1a and modern human distal femora.**

B.C. Merkl, A.D. Sylvester, M.R. Mahfouz. Department of Mechanical, Aerospace and Biomedical Engineering, The University of Tennessee.

While the general morphology of the australopithecine knee unequivocally indicates bipedal locomotion, the debate focusing on the exact nature of australopithecine bipedalism persists. Because functional differences are presumably preserved in morphological differences, a functional analysis of the australopithecine knee must be preceded by analyses to isolate morphological differences. Here we compare the specimen AL129-1a to a three-dimensional statistical shape atlas of modern human distal femora in order to determine shape differences.

Computed tomography data were used to generate three-dimensional triangulated mesh models of 89 male and 71 female modern human femora. These models were then used to create a statistical shape atlas of the distal femur (Merkl and Mahfouz, 2005). The shape atlas was scaled to match the size of AL129-1a, and average male and female distal femora were produced. AL129-1a was surface aligned with each femur and compared using the root-mean-square (RMS) of point-to-surface distances and visualized using surface distance maps. AL129-1a was projected onto a sex-combined shape atlas, resulting in the closest approximation of the fossil specimen based on nine principal components.

Initial results suggest that the average surface distance (point-to-surface RMS) of AL129-1a to the male distal femur is slightly smaller than the distance to the female distal femur. Distance maps indicate that largest shape differences are in the posterior and anterior aspects of the lateral condyle. The projection of AL129-1a onto the shape atlas resulted in a distal femur that captures much of the shape of the specimen, the major exception being the lateral patellar groove.

#### **Domestication of alpacas: Genetics of the North American herd.**

D.A. Merriwether. Department of Anthropology, Binghamton University, SUNY.

Alpacas were domesticated from vicunas in andean South America over 6000 years ago. Llamas were domesticated from guanacos around the same time. Since that time there has been introgression between llamas and alpacas, as evidenced by (currently 3) STR markers that are mutually exclusive in their allele size ranges between

guanacos and vicunas, but whose ranges partially overlap between alpacas and llamas. This admixture was accelerated with the conquest of the Inca empire and the subsequent decimation of the Incan alpaca and llama herds and breeding programs by the Spanish. North American farmers imported alpacas into the United States and Canada in the 1980s (primarily from Chile) and in the 1990s (in carefully judged imports primarily from Peru, but also including some from Bolivia and Chile). The US herd now exceeds 80,000 animals. We examined whether the phenotypic traits (chosen to avoid llama-like traits) the judges used to screen the imports actually reduced the number of guanaco (and thus llama interbreeding) alleles in the alpacas that were screened, versus the unscreened animals from the 1980s imports, and as compared to populations in Andean South America alive today and from the fossil record. Markers from a panel of 200 STRs we are using to map fiber characteristic genes in camelids may be a useful tool in trying to recreate the original alpaca and llama phenotypes from the time of the Inca and earlier.

Funded by a grant from the Alpaca Research Foundation and Binghamton University.

#### **Body size and shape in the Dmanisi hominids: implications for early genus *Homo* and *Homo floresiensis*.**

Marc R. Meyer<sup>1,2</sup>. <sup>1</sup>Dept. of Anthropology, University of Pennsylvania, <sup>2</sup>Dept. of Cell and Developmental Biology, University of Pennsylvania School of Medicine.

Body size is estimated here for two newly discovered partial skeletons associated with the D2700 and D3444 crania from Dmanisi. Body size in primates correlates with ecological and life history variables, including population density, home range size, and social organization. Body shape has been associated with water balance, thermoregulation, ecological habitat, dietary shifts and energetics. Because the hominids at Dmanisi are the oldest known outside of Africa, understanding body size and shape in this population may shed light on the nature of adaptation underlying hominid expansion out of Africa.

Body size and shape are estimated using postcranial variables shown to have high correlations in humans. Estimated stature of 1.39 meters for the Dmanisi hominids is similar to that of *Homo habilis*, while a ratio of estimated stature and bi-iliac breadth in D2700 of 0.14 is identical to that of *Homo erectus* (WT-15000). These results suggest that 1) increased body size did not precipitate the initial hominid expansion out of Africa, 2) early *Homo* was characterized by a distinct linear somatotype prior to the advent of increased stature, and 3) the Dmanisi somatotype reflects adaptation to warm climates and open habitats. The presence of the Dmanisi population in a relatively



temperate Eurasian climate suggests that early *Homo* had developed behavioral plasticity that allowed it to inhabit environments outside its physiological comfort zone. The new Dmanisi data also contribute to clarifying our understanding of the anatomical disconnect between *Homo erectus* and the diminutive Flores specimens.

#### Differential diagnosis of facial pathology in Dolní Věstonice 3: biobehavior in the Gravettian of Central Europe.

A.R. Michael<sup>1</sup>, R.G. Franciscus<sup>2</sup>. <sup>1</sup>Department of Criminal Justice, Michigan State University, <sup>2</sup>Department of Anthropology, University of Iowa.

The Dolní Věstonice site, located in the South Central region of the Czech Republic, is associated with several unusual burials and a number of pathological human remains whose bio-behavioral implications remain to be fully explored. A particularly compelling specimen, Dolní Věstonice 3, was studied to determine a differential diagnosis for the pathologies exhibited in her craniofacial remains within the larger context of early modern human behavior and interaction at this Upper Paleolithic site. Dolní Věstonice 3 exhibits significant alterations to her mandible and midface that stem from several possible causes. Though the cause of her skeletal modification could be congenital ("hemifacial microsomia"), it is also possible that she is a victim of interpersonal trauma, and thus one of the earliest examples of the antiquity of interpersonal violence in modern humans.

A qualitative study conducted on the large, documented Hamann-Todd Collection (Cleveland Museum of Natural History) resulted in the identification of a small number of individuals (n=13) who presented some, but not all, of the suite of altered morphology evident in Dolní Věstonice 3. While a definitive diagnosis of her pathologies was not possible, some possibilities (e.g., fauna induced trauma) could be ruled out. The comparative diagnostic baseline established in this study can be fruitfully extended to incorporate prehistoric comparative samples with more broadly relevant subsistence baselines. Additionally, clinical data for the skeletal manifestation of hemifacial microsomia in adults, combined with the results from the present study, will contribute to a more definitive diagnosis for this unusual and paleobiologically compelling case.

#### Behavioral responses to tooth loss in ring-tailed lemurs (*Lemur catta*) at Beza Mahafaly Special Reserve, Madagascar.

J. B. Millette<sup>1</sup>, M.L. Sauther<sup>1</sup>, F.P. Cuzzo<sup>2</sup>. <sup>1</sup>Department of Anthropology, University of Colorado, <sup>2</sup>Department of Anthropology, University of North Dakota.

Severe dental wear and tooth loss is often assumed to impede processing, breakdown

and energetic conversion of food items, thereby negatively impacting individual health, reproduction and survival. Ring-tailed lemurs at Beza Mahafaly Special Reserve demonstrate exceptionally high rates of severe dental wear and antemortem tooth loss, yet often survive a number of years with these impairments. Preliminary data suggest Beza ring-tailed lemurs may mitigate tooth loss through behavioral mechanisms. To test this hypothesis, we collected 189 hours of observational data in 2006 from 16 focal subjects, eight without loss and eight with 3% to 44% loss. We predicted individuals demonstrating loss would 1) increase maintenance behaviors while reducing resting, and 2) obtain and consume food items initially processed by group members. Individuals with loss maintained marginally higher overall rates of feeding, foraging and grooming. Daily activity budgets were similar except during early afternoon (12:00-14:30), when individuals with tooth loss maintained feeding, foraging and grooming while individuals without loss increased resting. Individuals both with and without loss consumed previously processed food items, although impaired individuals consumed pre-processed foods at relatively higher rates. One individual with severe loss (44%) was repeatedly observed to process *Tamarindus indica* fruit manually, although all others processed *T. indica* fruit dentally. Thus, lemurs with tooth loss may balance increased feeding challenges with the restrictions imposed by social living by remaining active while group members without loss rest. Observed consumption of pre-processed foods suggests that living within a social group allows dentally-impaired animals to access otherwise unavailable resources.

Funding for this study was provided by the University of Colorado (to J.B.M. and M.L.S.), and the St. Louis Zoo (FRC 06-1) and the University of North Dakota (to F.P.C.).

#### Hominoid milk composition: relationship to phylogeny and ontogeny

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Human milk composition has been argued to be species-specific due to unique ontogenetic priorities of human infants relative to nonhuman primates. However, the composition of human milk has never been evaluated through systematic comparison to multiple species of nonhuman primate. Various components of milk may have been modified to enhance infant survival but composition may also be constrained by phylogeny, with natural selection acting only on existing variation. Addressing evolutionary modifications on human milk necessitates understanding the range of variation in milk composition of extant hominoids. This study analyzes milk from five hominoid genera (*Pan*, *Gorilla*, *Pongo*,

*Hylobates*, and *Symphalangus*) for fat, protein, sugar, dry matter, calcium, and phosphorous (n = 19) with respect to milk composition of ceboids and cercopithecoids (unpublished data). Total gross energy (0.485 kcal/g ± 0.012) and mean (± SE) percent fat (1.35 ± 0.16), protein (1.24 ± 0.13), dry matter (11.00 ± 0.50), phosphorous (0.014 ± 0.001), and calcium (0.028 ± 0.002) are lower than, and significantly different from, both Old and New World Monkeys (p < 0.001). Hominoid milk is also less variable in fat, dry matter, gross energy and the proportion of energy from fat, sugar and protein than either monkey superfamily. The lack of variability and the relatively low energy values suggest hominoid milk composition may be buffered against environmental fluctuations. Larger body size and a relatively longer lactation period may have favored consistency in nutrient transfer rather than production of energy dense milk.

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#### Testing for a molecular clock boundary between fertile and infertile primate hybrids.

G.G. Millward. Department of Anthropology, Indiana University.

The inability of two species to produce fertile hybrid offspring is often a characteristic used to define a species using the biological species concept as defined by Ernst Mayer. However, the world is filled with fertile hybrids, including enough mammalian hybrids to fill a slim volume. Hybridization between species is commonly viewed as the production of a viable offspring, even if the offspring is infertile. But, fertile hybrids have the potential of introducing new genes to their parent population(s) or even creating a new species. These consequences make it important to construct a distinction between infertile and fertile offspring (Holliday, 2003). In this poster I will be testing the hypothesis that there is time since divergence that separates species that can produce fertile hybrid offspring from those that can only produce infertile hybrid offspring or no offspring at all in the order Primates. This hypothesis relies on the use of local molecular clocks to date divergences between primate species. 22 primate species were divided into pairs that can produce fertile primate hybrids, infertile primate hybrids, and pairs unable to produce hybrids, and time to most recent common ancestor estimated. Based on these analyses, primate taxa that diverged more than 5.2 ± 0.6 mya will produce infertile hybrids or be unable to produce offspring, thereby creating separate species under the biological species concept.

#### Does the morphology of the human atlas and axis reflect bipedality? A



### **multivariate approach to functional morphology.**

P. Mitteroecker<sup>1</sup>, E. Manfreda<sup>2</sup>, F.L. Bookstein<sup>1</sup>, K. Schaefer<sup>1</sup>. <sup>1</sup>Department of Anthropology, University of Vienna, <sup>2</sup>Department Child and Adolescent Psychiatry.

The cervical vertebral column bears the weight of the head supported by the nuchal muscles that partly originate from the cervical vertebrae. The position of the head relative to the vertebral column—and consequently locomotion and posture behavior—is thus evidently associated with the form of the cervical vertebrae. In spite of this assumption and empirical indications along these lines, classic studies describe primate vertebral morphologies as very similar and not clearly related to locomotion. We therefore address how the morphology of the first two cervical vertebrae relates to locomotion within primates and present a multivariate approach to relate morphometric data to functional variables.

Our sample comprises 116 specimens of adult *Homo sapiens*, *Gorilla gorilla*, *Pan troglodytes*, *Pongo pygmaeus*, *Hylobates lar*, *Macaca mulatta*, *Papio hamadryas*, *Ateles geoffroyi* and *Alouatta palliata*. On each atlas and axis we digitized 56 and 69 landmarks, respectively. Procrustes shape coordinates were analyzed by principal component analysis, multivariate regression, and partial least squares analysis.

The nine primate species differ clearly in their vertebral morphology. Although for the non-human primates we could identify morphological features that relate to the species' locomotion pattern as well as to body size, human morphology cannot be predicted by an extrapolation of the non-human primate model. This implies that either the primate cervical vertebrae are generalized enough to allow bipedal locomotion or else the human morphology is a unique adaptation different from that in the more orthograde non-human primates.

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### **Ontogeny and musculoskeletal stress markers in prehistoric New Mexico.**

M. Mondragón, A. Busby and O.M. Pearson. Department of Anthropology, University of New Mexico.

Studies of MSMs have become increasingly popular, especially those using Hawkey and Merbs' system. This study focuses on ontogeny of MSMs, which has received little attention. MSMs were recorded in individuals from the 1300-1500 AD site of Pottery Mound, located in central New Mexico. Hawkey & Merbs' system was used to score MSMs in a sample of 9 adults (2 females, 7 males; aged 20-50+) and 5 juveniles (birth-15 years). We used Spearman's rho and Wilcoxon or Kruskal-

Wallis tests to evaluate the data. In the humerus, scores for the development of the *extensor carpi radialis longus* increase with age (rho=0.53); adults of both sexes differ significantly from juveniles. Scores for the insertions of *latissimus dorsi* and *teres major* also increase with age (rho=0.87 and 0.59, respectively). *Latissimus dorsi* and *teres major* scores differ significantly between males and juveniles; those of females do not. In the lower limb, *gluteus minimus* scores increase with age (rho=0.57); adult males have significantly higher scores than juveniles. Scores for the origin of the medial head of *gastrocnemius* increase with age (rho=0.54) but without significant differences between sample groups. *Quadriceps femoris*, *soleus*, and *tibialis anterior* increase from juveniles to adults (rho=0.68, 0.65, and 0.61, respectively). In *quadriceps femoris* and *tibialis anterior*, adult males differ significantly from females, but females are not significantly different than juveniles. In scores for the *soleus*, males differ significantly from juveniles. These results show that some MSMs follow interesting ontogenetic trajectories potentially relevant to sexual dimorphism and division of labor.

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from juveniles. These results show that some MSMs follow interesting ontogenetic trajectories potentially relevant to sexual dimorphism and division of labor.

### **Patterns of affiliation in two captive chimpanzee groups.**

D.L. Moore. Dept. of Anthropology, University of Georgia, Yerkes National Primate Research Center, Emory University.

It is well known that primates associate differentially with individuals in their social groups, but the reasons for this preferential behavior is less clear. Undoubtedly, kinship plays a role in affiliative behavior, but studies have demonstrated that kin is not always the partner of first choice (Ehardt 1988, Ehardt et al 1987, Erhart et al 1997, Mitani et al 2004). This study measured degrees of affiliation in two captive chimpanzee groups at the field station of Yerkes National Primate Research Center. These groups contain individuals that represent a wide variety of relationships. Additionally, one group was formed from two unrelated subgroups, while the other has lived together for thirty years. The difference in the kinship structure of the two groups studied allowed for the relationship between affiliation and kinship to be examined, as well as the variables of age, gender, and degree of familiarity. The author collected data over a two-month period. Affiliation was measured using 10-minute interval scan sampling. Behaviors recorded were allogrooming, mutual grooming, close contact, and proximity. These four behaviors were recorded for every individual in the study group. This information was analyzed using adjusted residual and chi-square statistics. The results demonstrated that kinship was highly correlated to affiliation for most individuals. Age class was an important variable for adolescents. One group included three males with high affiliation rates among them, the other included two males, with low such rates. The latter may have been caused by greater rivalry between the two males.

### **Body mass estimation from human femoral midshaft cross-sectional area.**

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Body mass extremes of obesity and emaciation provide valuable insight into the health and economy of the culture they represent. The ability to estimate body mass from the 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. High-resolution CT scans were collected using a GE Lightspeed 16 Slice computed tomography scanner. The DICOM images were converted to JPEG files and manually segmented into three-dimensional bone surface models. This analysis focuses on the cross-sectional geometry of the femur at the minimum circumference of the mid-diaphysis for 58 individuals. This research indicates that the single best indicator of body mass, at least for females and the elderly, is the cross-sectional area of the femoral mid-diaphysis. A large cross-sectional area of the femoral midshaft corresponds to a high body mass index (BMI); a reduced cortical area, as seen in osteopenia, corresponds to an extremely small BMI. The Pearson correlation coefficient for the 24 white females is  $r = 0.82$ . The correlation is significantly smaller for the males,  $r = 0.31$ . By normalizing for cross-sectional shape and thus activity levels, the correlation coefficient will increase for both males and females. The ability to estimate body mass from the skeleton is relevant to the sub-disciplines of forensic anthropology, bioarchaeology and paleoanthropology.

#### **Body size and home range in nonhuman primates: Do they scale?**

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Several authors have found a positive and significant relationship between home range size and body size in mammals (McNab, 1963, Harestad and Bunnell, 1979), and specifically in primates (Milton and May, 1976, Harvey and Clutton-Brock, 1981, Leonard and Robertson, 2000). They argued that larger animals tend to have larger home ranges than smaller animals, as larger animals need more energy to function. Other researchers have suggested that home range size is influenced by other variables such as the distribution, quantity and the quality of food, competition and avoidance of predators. This paper explores the relationship of body size and home range size, using a larger sample than previous studies and also controlling for the possible phylogenetic effect. I collected body weight and home range information from the primary literature for 67 nonhuman primate species. I performed a linear regression analysis and an independent contrast analysis to control for the possible phylogenetic effect. The results indicate that there is no statistically significant relationship between the two variables ( $r^2 = 0.014$ ,  $p = 0.40$ , Correlation Coefficient = 0.12). I also examined the possible relationship between the two variables within three dietary categories (faunivores, herbivores and omnivores) and did not find a statistically significant relationship for any of the groups. I suggest that the taxonomic sample used in previous studies is responsible for the previously reported association between these variables. When more medium and small size primates are added to the sample, the relationship disappears suggesting that there

are other variables that could influence the home range of nonhuman primates.

#### **Are protected areas really protecting lemurs? A look at the genetic diversity in and around Ranomafana National Park, Madagascar.**

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A principal strategy in conserving endangered species has been to maintain isolated areas of habitat that are protected from human development. This approach has been highly successful in some areas; for example, in Madagascar, most of the remaining forests are contained in national parks and special reserves. However, little research has investigated how barriers such as reserve boundaries and roads impact the cohesion of primate populations. Since the newest management techniques focus on corridors and connectivity between protected areas, as well as the dynamics of metapopulations, research on the impact of natural and artificial barriers on gene flow is particularly important. We analyzed heterozygosity levels and tested for Hardy Weinberg equilibria within and between populations of 4 rainforest lemur species, *Propithecus edwardsi* (n=94), *Eulemur rubriventer* (n=30), *Eulemur fulvus rufus* (n=32), and *Haplemur griseus griseus* (n=33), using 17-20 species-specific polymorphic nuclear microsatellite loci. We examined populations found both within Ranomafana National Park and outside its protected boundaries in southeastern Madagascar, with at least 10 conspecifics examined in each population. Results indicate that barriers such as roads and rivers impact the movement of genes between adjacent populations, with variation in population differentiation potentially reflecting differences in species-specific behavior and locomotion. This study will provide baseline data for the genetic health of Malagasy prosimians as well as aid future management strategies to maximize heterozygosity in endangered lemurs.

#### **Comparative histology of the mandibular condylar cartilage in gouging and non-gouging platyrrhines.**

AL Mork, WE Horton, CJ Vinyard. Department of Anatomy, NEOUCOM.

Marmosets are unique among platyrrhines in habitually gouging trees with their anterior teeth to stimulate exudate flow. Furthermore, marmoset jaw muscles and skulls exhibit morphological features that facilitate biting at wide jaw gapes during gouging. We extend this investigation to the articular cartilage of the mandibular condyle in tree-gouging common marmosets (*Callithrix jacchus*) versus non-gouging

cotton-top tamarins (*Saguinus oedipus*) and squirrel monkeys (*Saimiri sciureus*) to compare their functional histomorphology. Specifically, we hypothesize that because gouging marmosets bite at wide gapes, they will have relatively thicker cartilage and greater proteoglycan percentages, as a measure of load-resisting ability, along the posterior half of their condyles as compared to non-gouging taxa.

The temporomandibular joints, of formalin-fixed adult monkeys, were removed en bloc and decalcified in EDTA. Decalcified joint were embedded in paraffin, sectioned at 10µm and stained with thionin to identify proteoglycans. Histomorphometric measurements were taken with BioquantOsteoII software.

Preliminary comparisons among samples (N=6) do not clearly demonstrate that marmosets have significantly thicker condylar cartilage or increased proteoglycan content along the posterior portion of their condyles. While marmosets tend to have relatively thick posterior cartilages, these values overlap with non-gouging species. Similarly, marmosets show relatively high proteoglycan percentages posteriorly, but with clear overlap with non-gouging species. Contrary to our hypothesis, marmosets show a higher percent of proteoglycans in the anterior region of the condyle relative to non-gougers.

These results fail to support a hypothesis that marmosets have articular cartilage morphology that facilitates resisting large bite forces along their posterior condyles at wide gapes.

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#### **The anatomical relationship between the infraorbital foramen and infraorbital nerve: Validating the use of infraorbital foramen size to infer ecology.**

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Osteological cranial features, such as foramina, are frequently used to interpret the ecology of extinct primates. My current research on the infraorbital-foramen (IOF) shows a significant relationship between IOF size and dietary preference. The IOF transmits the afferent sensory infraorbital-nerve (ION) to specialized maxillary mechanoreceptors. If IOF and ION size correlate, IOF size might be indicative of maxillary mechanoreceptivity, an important sensory cue used within a feeding context. However, there is currently debate regarding the validity of using foramen area as a measure of nerve area. Associated vessels may also exit the foramen, and in some instances they constitute the largest proportion of the foramen (e.g., hypoglossal). In other instances, foramina are better indicators of nerve size (e.g., optic). To date, it is unknown what vascular and neural structures pass through the IOF and to what degree each structure constitutes the

contents of the IOF. To address this query, all tissues from the infraorbital canal were removed from 50 primate and non-primate cadavers and measurements of the IOF were taken. Tissues were processed, embedded in paraffin, sectioned, mounted on slides, and stained with hematoxylin-and-eosin. Histological analysis revealed that only the ION and infraorbital-artery pass through the IOF and that the infraorbital-artery is small, representing a negligible portion of the IOF. Furthermore, the cross-sectional areas of the ION and IOF are positively correlated ( $p < 0.001$ ). Results provide strong evidence that the IOF is an excellent proxy for ION size, and that IOF size may be a useful predictor of relative maxillary mechanoreception.

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#### **What can small mammals tell us about giant lemurs?: Paleoenvironment of the late Holocene fauna at Ankiliteo Cave, SW Madagascar**

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To understand why subfossil lemurs went extinct in Madagascar, it is necessary to place them in the context of their natural habitats. Based on previous studies of functional anatomy and stable isotopes, subfossil lemurs have been reconstructed as forest-dwelling and, for most species, likely forest-limited. The fauna of Ankiliteo provides a rare opportunity to test this hypothesis because the assemblage includes subfossil lemur taxa in association with abundant well-preserved small mammal remains. In this study, we analyze the small mammal community in order to reconstruct the habitat of the subfossil lemurs.

We compare the small mammal fauna at Ankiliteo with 23 modern Malagasy communities spanning the range of Madagascar's habitat types. Taxonomic diversity is quantified using species richness measures. Similarities in species composition between modern communities and Ankiliteo are assessed using cluster analysis. Ecological similarities are examined by first assigning each species to dietary, locomotor, activity pattern, and body size categories. Discriminant function analysis is then used to classify Ankiliteo into one of the modern habitat types based on its ecological structure.

Results indicate that the habitat surrounding Ankiliteo during the late Holocene was similar to the spiny thicket of modern southwestern Madagascar. This suggests that approximately 500 yr BP, these arid habitats supported a subfossil lemur community that included the highly-suspensory *Palaeopropithecus*, and deliberate

slow-climber *Megaladapis*, as well as *Archaeolemur*, *Pachylemur*, and *Daubentonia robusta*. This finding has important implications for the vulnerability of these species, and the cause of their extinction in southwestern Madagascar.

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#### **Correlation of mammalian mitochondrial DNA diversity with population size.**

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A recent report by Bazin et al. (2006) found no relationship between mitochondrial DNA (mtDNA) diversity and population size when comparing large groups of animals, such as invertebrates versus vertebrates, although an association was found for nuclear DNA and allozyme markers. This result is surprising since population genetic theory predicts a positive relationship between genetic diversity and population size; thus, many researchers use mtDNA data to reconstruct demographic histories. We propose that species with smaller populations, such as mammals, are less likely to have experienced selective sweeps (as proposed by Bazin et al.) and, therefore, should retain demographic information in their mitochondrial genome.

In our study, we focus on the 47 species of eutherian mammals (a group with expected smaller populations) in Bazin et al.'s dataset for which allozyme heterozygosity data are also available. We find a positive correlation between mitochondrial diversity and allozyme heterozygosity, suggesting that mtDNA diversity correlates with population size as does allozyme diversity. Furthermore, the order with the greatest mtDNA and allozyme variability (Rodentia) is the one with the larger expected populations, whereas that with the least variation (Carnivora) is predicted to have smaller populations. Finally, humans seem to be a clear exception to Bazin et al.'s results in that mtDNA, X, Y and autosomal data converge on a similar population estimate of ~10,000 individuals. In sum, our results suggest that mtDNA is a valuable genetic marker for the study of population history and demography in animals with small populations, such as modern humans and other primates.

#### **Captive lemur response to two types of natural enrichment**

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Enrichment has been known to increase the well being and species typical behavior of captive animals. While much research has been done on the effectiveness of enrichment for captive monkeys and apes, research on enrichment of captive lemurs is not as common. This study focused on two types of enrichment that increased the natural behaviors of two types of lemurs.

Foraging postures on different feeding devices were noted during feeding and other activities for black and white ruffed lemurs (*Varecia variegata variegata*). A total of 48 hours of 30-second scan samples was collected, comparing responses to three devices (one being a "control" tub on the ground). Sniffing or scent-marking of olfactory enrichment and other materials in the enclosure was recorded for black lemurs (*Eulemur macaco macaco*). 64 hours of 30-second scans were collected, comparing response to three olfactory stimuli and a control of no stimulus (introduced sterile branch).

Both hanging bowls and mesh feeders resulted in an increase in hanging postures of ruffed lemurs. Hanging bowls resulted in suspensory postures 24.1% of the feeding time, and mesh feeders 22.8% of the time, while standard tub bowls elicited only 3.3% suspended feeding time.

More scent-marking behaviors on the introduced branch were seen in response to the three olfactory stimuli. Lemur scent elicited the most response with 46% directed to branch. The other two introduced scents, onion and perfume, resulted in only 15% of scent-marking behavior directed towards the enrichment. The control, no scent, had the least response with only 10%.

#### **Occupational stress and slavery: evidence from Bridgetown, Barbados.**

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In 1996 and 2000, construction workers uncovered unmarked burial grounds of enslaved Africans in the Pierhead and Fontabelle sections of Bridgetown, Barbados (Crain and Smith, 2004). In this study, five individuals from these sites were analyzed for potential labor induced skeletal lesions. Vertebral osteophytosis was observed in two individuals and scored following Buikstra and Ubelaker (1994). Vertebral anterior wedge compression fractures were observed in one individual, and scored according to Genant *et al.* (1993). Apophyseal facet remodeling was observed in three individuals and scored following Derevenski (2000). Musculoskeletal stress markers (MSM's) of the upper and lower limbs were scored based on Hawkey (1988) and Hawkey and Merbs (1994). Upper limb MSM's were observed in four individuals, while lower limb involvement was present in only one individual. Results from this analysis were similar to data from the African Burial Ground in New York as the individuals were exposed to

strain of the spine at an earlier age than documented for some traditional societies. However, the severity of skeletal lesions found among the Barbadians is mild in comparison with current literature on skeletal remains of enslaved Africans. Therefore, these results may support the suggestion that urban slavery in Barbados was less strenuous than plantation labor and some slave regimes in North America. Although the small sample size negates overarching conclusions about slave labor in Bridgetown, tentative conclusions about the physical strain experienced by these individuals can provide insight into their experiences as enslaved laborers and highlight the need for future research endeavors.

#### The use of rare genomic changes in mammalian phylogeny estimation and the phylogenetic position of Primates.

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Primates have traditionally been included in the superordinal group Archonta along with flying lemurs, tree shrews, and bats. Recent phylogenetic analyses of large DNA datasets reveal that placental mammal orders group into four major clades: Afrotheria, Xenarthra, Laurasiatheria, and Euarchontoglires. Within Euarchontoglires, Euarchonta includes Dermoptera, Primates, and Scandentia and is similar to the Archonta hypothesis but without bats, which are in Laurasiatheria. Whether or not the closest living relative of Primates is tree shrews or flying lemurs, or both, remains unresolved even with very large molecular datasets. Whole genome sequences are now becoming available for over two-dozen mammalian species, sampling most orders of placental mammals. Analysis of whole genome alignments provide the raw material to identify rare genomic changes (either indels in protein coding genes or retroposon insertions) that can be used to test hypotheses of mammalian relationships, particularly divergences that span short periods of time. The application of rare genomic changes to difficult nodes in placental mammal phylogeny is discussed, with reference to future applications to resolving the primate-tree shrew-flying lemur phylogeny problem.

#### Role of load carrying in the evolution of increased body size.

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The increase in body size between Australopithecines and *Homo erectus* is generally associated with a more modern human-like lifestyle, including a higher

proportion of meat in the diet and the longer daily movement distances associated with striding bipedality. However, large species are generally less economical than smaller species so the advantages to getting larger must have been significant. Here we test, as a function of body mass, the effect of small loads on the walking kinematics of women to assess whether the increased body mass apparent by the time of *H. erectus* might have provided a potential selective advantage in long distance transport of resources.

Ten female subjects (age 18-53 years) walked at 1.3 m/s on a treadmill wearing a lightweight belt containing 2%, 4%, or 8% of their body mass (BM). Videotape from behind was used to determine stance (ST), swing (SW), and double-support (DBL) durations (average of the left and right feet). Durations were normalized as a percentage of total stride period.

There is a small but highly significant difference (paired t-test) between the 8 and 2 % BM conditions for ST (longer), SW (shorter), and DBL (longer). However, the effect size has a significant inverse correlation ( $r = 0.7-0.8$ ) with BM, such that the effect diminishes almost to extinction at the highest BM. Thus, individuals with larger BM have less perturbation of their walking kinematics as the result of carrying extra mass suggesting that the larger size of *H. erectus* may have proved advantageous for carrying loads.

#### Directive 15 OMB, bureaucratic race and science

Nicole A. Naar and George J. Armelagos. Department of Anthropology, Emory University

Despite the century-long accumulation of evidence invalidating the scientific relevance of race, the concept persists as a means to describe human biological variation. In 1977, Directive 15 of the Office of Management and Budget (OMB) created standardized, bureaucratic notions of race in order to enforce civil rights laws. OMB Directive 15 represents the identification of socially constructed categories of race and ethnicity for the sole purpose of combating social racism and discrimination. Although the classifications of Directive 15 lack any scientific or anthropological basis, national health research organizations, such as the National Institutes of Health (NIH) and the Food and Drug Administration (FDA), require that all clinical research projects disaggregate data based on the racial and ethnic classifications set forth by OMB Directive 15. The contradictions inherent in the application of Directive 15 in health research stems from an underlying confusion over the meaning of race. Depending on the nature of the research, race can be used as a proxy for different behavior, different biology, or differing degrees of discrimination and marginalization. Some types of clinical research, including epidemiologic and behavioral studies, outcomes research, and

health services assessments, require consideration of the health impacts behavior and discrimination. However, the use of racial categories in the study of disease etiology, clinical, and drug development gives sociocultural constructions of race the illusion of biological relevance.

#### An osteological analysis of human cranial remains from the Atlantic Watershed Region of Costa Rica.

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This paper presents an analysis of human cranial remains from the Stone Cist Period in the Atlantic Watershed Region of Costa Rica. The collection was likely obtained by Carl V. Hartman, Curator of Ethnography and Archaeology at the Carnegie Museum of Natural History, in 1903 during his seven month field expedition to Costa Rica. Aside from the geotemporal context, little is known about the sample since it was not excavated through systematic archaeology. In addition, bioarchaeology in Costa Rica is restricted due to the poor preservation of biological material because of the highly acidic volcanic soil. Furthermore, large scale looting of archaeological sites has been an unfortunate part of Costa Rican history and sites have been completely decimated by the hands of looters. Therefore, this analysis provides information and contributes to the limited corpus of comparative Costa Rican skeletal data that can be utilized for future research.

Ten crania were analyzed for demographic, metric, nonmetric, and pathological conditions. Substantial dental disease was present in the sample. All individuals exhibited periodontitis and many demonstrated calculus, antemortem tooth loss, abscessing and carious lesions. Porotic hyperostosis was recorded with varying levels of severity in six of the adult individuals and the juvenile, in whom cribra orbitalia was also noted. As well, interesting nonmetric traits were unveiled demonstrating group variation.

#### Verreaux's sifaka (*Propithecus verreauxi verreauxi*) of Kirindy Mite National Park, a new field site in Madagascar.

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Verreaux's sifaka (*Propithecus verreauxi verreauxi*) are diurnal lemurs found in southwestern Madagascar. Most information on the behavioral ecology of this species comes from two field sites: Kirindy Forest (C.F.P.F.) in the west and Beza Mahafaly Special Reserve in the southwest. A new field site has been established in Kirindy Mite National Park, located between Kirindy (C.F.P.F.) and Beza Mahafaly. Kirindy Mite is a recently created 72,000 ha park that protects three types of habitats and the transitions between these ecosystems: dry,

deciduous forest of the west, spiny desert of the southwest, and mangroves of the coast. We present preliminary results from a study of Verreaux's sifaka socioecology at Kirindy Mite. Data were collected in June-August 2006. Thirteen individuals from 4 social groups were captured. Mean adult body mass was  $2.97 \pm 0.22$  kg. Females had significantly longer body length than males ( $p=0.003$ ), a trend for greater body mass ( $p=0.073$ ), but no difference in canine length. Adult males exhibited the bimorphic trait of chest staining. The location of three social groups was recorded twice daily for 30 days using a GPS. Home ranges averaged 7.88 ha. Home range size was similar to other sites. However, home ranges at Kirindy Mite overlapped less with neighboring groups than at other sites. These preliminary results suggest that the transitional habitat of Kirindy Mite influences Verreaux's sifaka morphology and behavior. Their adult body mass was less than sifaka in Kirindy and greater than Beza sifaka. As in Kirindy, reversed sexual dimorphism was present. Funding was provided by the Lazar Foundation/Student International Discussion Group at the Nicholas School of the Environment at Duke University.

#### Late Miocene fossil locality Nakali in Kenya and its paleoenvironment.

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Fossil ape from the Late Miocene of Africa was very poorly known until quite recently. Only exception was *Samburupithecus kiptalami* from the Namurungule Formation (9.6 Ma) in Samburu Hills, northern Kenya. Unfortunately, *Samburupithecus* is known from only a single maxilla, and its phylogenetic status is still controversial. There is debate on the implication of the paucity of African ape fossils during this time period, that is either a sampling bias or a decline of endemic fossil apes leading to their extinction. Our recent discovery of a diverse primate fauna from Nakali, 60 km south of Samburu Hills, supports the former possibility. From the Late Miocene Nakali Formation, four catarrhine taxa were collected including a large-bodied hominoid that is clearly distinguishable from *Samburupithecus*. The fossil bearing horizon was dated as 9.8-9.9 Ma by <sup>40</sup>Ar/<sup>39</sup>Ar method and magnetostratigraphy. The associated fauna exhibits a general resemblance to that of the Namurungule fauna. However, the Nakali fauna includes strict forest dwellers such as a small-bodied colobine and a non-

cercopithecoid small catarrhine, which are absent from the Namurungule fauna. Regardless of the geographical and temporal proximity, a significant difference of regional environment is presumed between these fossil sites.

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#### The Magician: Collaborative Studies of an Ancestral Hopi Leader.

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The Magician's burial was excavated in 1939 from the site of Ridge Ruin, an ancestral Hopi site located east of Flagstaff, Arizona. Dating to A.D. 1150-1200, the burial contained the skeleton of an adult male and one of the richest mortuary assemblages ever recovered in the U.S. Southwest. The skeleton has been analyzed on several occasions by physical anthropologists; and archaeologists and Hopi cultural advisors have worked together in interpreting the Magician's grave goods. In addition to describing the Magician as a high-ranking individual who had considerable magical power, these advisors have identified the clans and religious societies to which he may have belonged. Archaeologists continue to have a great interest in the Magician's burial because of what it can reveal about the organization of ancestral Puebloan societies. The burial is also of great interest to the Hopi both for what it can reveal about their past, especially with reference to issues of cultural affiliation, as well as for their religious concerns about respectful treatment of their ancestors' skeletal remains and grave goods. This poster summarizes previous research done on the Magician's burial, highlights issues raised by its eventual repatriation and reburial, and describes current efforts to further document and study its contents prior to repatriation in ways that will be meaningful for physical anthropologists, archaeologists, and the Hopi.

#### Skeletal biology of new Gallina burials from Rio Arriba County, New Mexico.

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The Gallina occupied a relatively small area of northwestern New Mexico appearing abruptly around 1000 AD and disappearing as abruptly between 1250 and 1300 AD, possibly as a result of genocide. Here we report on the skeletal biology and paleopathology of a new series of Gallina burials from the site of Cañada Simon I. Discovered in Fall 2005 during the attempted reburial of a partial human skeleton collected as it eroded out of a road cut bank in 1992, the site was excavated in October 2005 and May 2006. During the excavations six additional sets of remains were recovered.

The sample comprises five adults of greater than 20 years and two sub-adults of less than five. The disposition of the burials mirrors that typically associated with the Gallina as skeletal elements, particularly heads, are not in anatomical position, burials are randomly distributed, and the manner of death appears traumatic. Specifically, evidence of trauma indicates extreme interpersonal violence including broken necks, fractured long bones and ribs, and a crushed pelvis. Outside of trauma, the individuals appear to have been in good health with the pathology profile being what would be expected from maize horticulturists of this time period and location. Levels of DJD are moderate and increase with the age of the individual. Dental wear is moderate to extreme with frequent antemortem tooth loss and alveolar abscessing. This and future work at Cañada Simon I will hopefully lead to a better understanding of Gallina lifeways and the nature of their demise.

#### Using the length of the 2<sup>nd</sup> to 4<sup>th</sup> digit ratio (2D:4D) to investigate the influence of prenatal sex hormones on non-human primate mating systems and human social evolution.

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There is a genetic link, via the *HoxA* and *HoxD* group of genes, between the development of the digits and the reproductive system. In humans, the length ratio of the 2<sup>nd</sup> and 4<sup>th</sup> digits (2D:4D) correlates negatively with prenatal testosterone (PT) and low male 2D:4D has been associated with higher fertility and more successful male-male competitive abilities. Variation in human mating behaviors, using marriage systems as a proxy, has been shown to correlate with mean 2D:4D such that monogamous groups show low PT (high 2D:4D) and polygynous societies show high PT (low 2D:4D). This study investigates whether similar patterns of mean 2D:4D are expressed across non-human primate mating systems. Using 2D:4D as a bio-marker, our evidence indicates that PT varies between taxa, with the lowest PT (higher 2D:4D) found in monogamous New World Monkeys and Apes. Across monkeys as a whole, species with high intensity/high intra-sexual competition had the highest PT (low 2D:4D) whilst those with low intensity/low frequency competition had the lowest PT (highest 2D:4D). We conclude that prenatal sex hormones are implicated in the organisation and expression of mating systems in the Primate order and consider the effects of lowered PT on human social evolution.

#### *Homo floresiensis* and *Homo sapiens* size-adjusted cranial shape variation.

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On the basis of a unique combination of morphological features, the LB1 specimen was assigned a novel taxon *Homo floresiensis* (Brown *et al.*, 2004); however, critiques propose LB1 does not differ significantly from modern humans, LB1 belongs to a local short-stature population, and LB1 suffered from microcephaly (Jacob *et al.*, 2006). Comparisons of LB1 with a small sample of microcephalic patients failed to support diagnosis of any specific form of the disease (Argue *et al.*, 2006; Falk *et al.*, 2005). We demonstrate that LB1 cranial shape falls outside the range of normal modern human skull shape by analysis of multiple cranial dimensions relative to their overall size as measured by their geometric mean (GM). Small size alone can not account for LB1 cranial shape.

The GM four of six cranial variables is significantly smaller for LB1 than a comparative sample of 2486 modern human (mean human GM = 122.3, human SD = 4.88; LB1 GM = 99.9,  $p < 0.001$ ) (Howells, 1996). Shape variation is characterized by analysis of relative size variables: raw size divided by individual geometric mean. Principle components analysis confirms that LB1 is an extreme outlier for a global modern human sample, with LB1 Euclidean distance from the centroid 13 standard deviations away from the modern human mean. These results suggest that LB1 can not be accommodated within a non-pathological global sample of *Homo sapiens*. These results are consistent with the taxonomic validity of *Homo floresiensis*, although they do not rule out the possibility that LB1 is pathological. Supported by NSF IGERT Grant No. 9987590.

### The relationship between height and dental caries – A life course perspective

B Nicolau<sup>1,2</sup>

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For years, researchers have been on the lookout for ways and means the interaction between nature and nurture. An individual's biological resources are influenced by their genetic endowment, their pre-natal and post-natal development and their social and physical environment in early life. Adversity in childhood becomes 'embodied' at an early age, its full impact manifesting later in life. For example, socio-economic circumstances influence foetal development and growth during childhood. Poor foetal development and delayed linear growth are associated with increased mortality. A variable commonly used in social sciences and social epidemiology to capture biological fitness is height. In this presentation we will review

how height has been used in social epidemiology and illustrate that use with an example. We interviewed and examined 652 13-years old Brazilian adolescents to investigate whether or not dental caries experience is associated with height in Brazilian adolescents. Our hypothesis was that taller children had better biological resources and would have better oral health signified by lower levels of dental caries. Dental caries was measured by decayed, missing and filled teeth (DMFT) index. Data on socioeconomic and family environment, health behaviour and anthropometric measures was also collected. After dichotomizing the outcome measure into high and low caries levels, logistic models were used in a series of simple and multiple regressions. Adjusted results showed that taller adolescents were less likely to experience high levels of caries. Thus, we could conclude that there is a relationship between height and dental caries experience in this sample of Brazilian adolescents.

### The utility of molecular techniques to address the impact of paleoclimatic events on demographic history of populations in Africa and Arabia.

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Increased availability of genetic data and advances in computational modeling techniques over the past decade have permitted greater resolution of hypotheses regarding human paleodemography. However, few attempts have been made to correlate past demographic changes with paleoclimatic data. Although studies have shown an expansion of European populations at the end of the last glacial maximum (LGM, 18-23,000 years ago), little comparable research has been conducted on Northeast African or Arabian populations. Evidence from speleothems, tufa deposits, and lake and groundwater records all support a history of fluctuating aridity over the past 25,000 years, with maximum arid conditions at the LGM, followed by a sudden humid transition at the onset of the Holocene. This project examines the utility of genetic approaches for detecting general demographic shifts that may be correlated with these types of paleoclimatic events. Established methods for detecting population bottlenecks and expansions were applied, including Tajima's D, haplotype frequencies, and mismatch distributions, as well as newer coalescent-based inference techniques, such as Bayesian skyline plots and computer modeling using Simcoal. Mitochondrial DNA from both humans and non-human primates living in similar environments in NE Africa and Arabia were utilized. Comparison across species provides insight into whether fluctuations in population size were caused by global external factors such as climate change, or by human-specific factors such as cultural adaptations. These data also contribute to our

greater goal of elucidating the evolutionary and demographic history of humans in Northeast Africa and Arabia.

### Morphological variation within primate species: papionines versus koalas.

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Diagnosis of species in the fossil material is a perennial problem in palaeontology. The only objective method available is the assessment of morphological differences and similarities among specimens. In order to tell whether two individuals differ morphologically in a way normal for conspecifics, or some of their differences exceed intraspecific levels, it is necessary to have reliable standards of within- and between- species variation. We have used cranial variation in an undoubted single species of the Koala (*Phascolarctus cinereus*) as a guideline. Koalas are arboreal mammals of the lifestyle similar to some primates, with vertical clinging and vertical sitting as habitual postures. Using multivariate coefficients of variation (MCV) proposed by Van Valen (1974) we have assessed variation in koalas (N=43, both sexes). MCVs ranged from 9.8% in the neurocranium through 11.1% in the splanchnocranium to 15.7% in the mandible. In a test sample of 48 male and female crania belonging to 6 species of the genus *Papio* MCV values ranged from 13.2% for neurocranium through 26.5% for splanchnocranium to 27.14% in the mandible. It follows that variation assessed by MCV in variously constituted samples of fossil hominids can indicate whether these samples consist of individuals belonging to one or to several species.

### Early *Homo erectus* occupations appear in Northeast and Southeast Asia. What about Central-East Asia (JAS, China)?

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Sometime after 2 Ma *Homo ergaster/erectus* moved out of Africa in two initial directions: 1) north toward Dmanisi, Georgia, and 2) east toward Sangiran, Indonesia. Chronometric reconstructions from Yuanmou in southern China, and Sangiran in Indonesia indicates hominins may have reached East Asia between 1.8 – 1.7 Ma. In addition, sites in the Nihewan Basin (e.g., Majuangou) in northern China have been tentatively dated to 1.66 Ma. Currently however, the hominin migration route to Northeast Asia is unclear, as *H. erectus* could have traveled north through Dmanisi and then east, or from the south passing by Yuanmou and/or Sangiran. In central Asia, the Himalayan Mountain Range

and the Tibetan Plateau, both forming during the Paleogene, created a barrier that surely would have made hominin movement between northern and southern Asia difficult, if not impossible. Nevertheless, it may have been feasible that the region east of Himalayan/Qinling Mountain Ranges could have served as a biogeographic corridor, facilitating hominin bilateral movement between Northeast and Southeast Asia during the Plio-Pleistocene. We present results of a field survey, conducted in Jiangsu and Shandong Provinces (central-east China), that investigates presence / absence of evidence for Plio-Pleistocene hominin occupation in the region. This research builds on a survey we conducted in May 2006 in Anhui Province, China. JAS (Jiangsu, Anhui, Shandong) is a region with flat plains and low lying hills, which easily would have allowed migrations of flora and fauna (including early hominins) in both directions during periods of environmental fluctuation.

#### **Sequence variation in the pigmentation candidate gene *SLC24A5* and evidence for independent evolution of light skin in European and East Asian populations**

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Human skin pigmentation shows a strong correlation with ultraviolet radiation, suggesting that phenotypic variation in pigmentation has been shaped by natural selection. To test this hypothesis at the molecular level we sequenced ~4.8kb of the pigmentation gene *SLC24A5* in a panel of 82 chromosomes representing Africa, Asia, Europe, and the Americas. We compared levels of nucleotide diversity at *SLC24A5* to ten X-linked loci sequenced in the same individuals. While overall levels of diversity at *SLC24A5* ( $\theta=0.050\%$ ,  $\pi=0.062\%$ ) are slightly lower than in the X-linked loci, European diversity levels are markedly lower ( $\theta$ ,  $\pi = 0.000\%$ ). HKA tests comparing levels of polymorphism and divergence between *SLC24A5* and these loci indicate that the low European diversity is unusual and unlikely to be explained by demographic processes alone. Computational phasing of the chromosomes revealed that all Europeans share a single haplotype defined by the nonsynonymous Ala111Thr polymorphism.

This polymorphism is rare outside of Europe and central Asia. Using HapMap data we identified a region of extended high linkage disequilibrium (LD;  $D' > 0.5$ ) ~450kb upstream and downstream from this polymorphism. Utilizing the decay of LD in this region we estimated the age of the Ala111Thr polymorphism to be between ~3,000 and 12,000 years. The reduced diversity among Europeans, extended LD, and relatively young age of the Ala111Thr allele suggest that variation at *SLC24A5* in Europeans was shaped by recent positive directional selection and support a hypothesis of independent origins of a light skin phenotype in Europeans and East Asians.

#### **Analysis of intrinsic joint function in the primate foot by evaluating apparent density in the calcaneus.**

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Most primates adopt digitigrade, semiplantigrade, or plantigrade foot postures during locomotion. Morphometric studies demonstrate a connection between external form of bony elements and habitual locomotor behaviors, including different foot postures. Few studies, however, explore internal characteristics of these elements, despite the fact that bone plasticity may generate locomotor signals. We evaluate apparent density (AD) in human, ape, and monkey calcanei to address differences in compressive joint loading regimes associated with habitual foot postures. Computed tomography osteoabsorptiometry was used to visualize AD in the subchondral cortical plate at the calcaneo-cuboid articular surface. Maximum intensity projection (MIP) maps condensed this 3D volume into a 2D surface by extracting AD maxima. The MIPs were projected onto 3D virtual reconstructions of calcanei to isolate regions of interest (ROIs). False-color maps of ROIs were constructed through binning AD values into eight categories, from which quantity and distribution of relative high AD areas were compared. Humans exhibit reduced areas of relative high AD compared to other primates. Area differences between non-human primates are less striking, despite their various habitual foot postures during locomotion. Non-human primates regularly display dorsal concentrations of relative high AD in the calcaneo-cuboid articular surface. Focused high AD in the dorsal articular surface is consistent with the notion that greater compressive loads are transferred between the calcaneus and cuboid in this joint region during "mid-tarsal break" of support phase. Analysis of internal characteristics of the tarsus, such as AD, offers new insights into primate foot function. Supported by the L.S.B. Leakey Foundation.

#### **The influence of climate on the obstetrical dimensions of the human bony pelvis.**

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This study examines the influence of climate on the obstetrical dimensions of the human bony pelvis. There may be a relationship between obstetrics and climate due to selection on adult body shape following

Bergmann's (1847) and Allen's (1877) Rules, as well as selection on infant size at birth for larger neonates in colder climates and smaller neonates in warmer climates (Brace, 1988; Wells and Cole, 2002).

In order to approach this question, osteometric pelvic and long bone measurements were collected from adult human postcranial skeletal samples (n=543) representing populations from a wide range of climatic regimes. Climate was quantified using latitude and mean temperatures of the warmest and coldest months from each locality.

Both univariate and multivariate statistical approaches were used to analyze the data. Results indicate that there is a strong correlation between climate and mediolateral (ML) obstetrical measurements of the female pelvis, even after accounting for body size differences between samples. There is not a strong correlation between climate and anteroposterior (AP) measurements of the female obstetrical pelvis, again after accounting for body size. These results are consistent with the cylindrical model and the findings of Ruff (1994). Results also indicate some sex-based differences, with males showing a weaker relationship between climate and the same ML pelvic measurements, and a stronger relationship for some AP pelvic measurements compared to females.

This research was funded by the Wenner-Gren Foundation (Gr. 7236).

#### **Inca Imperialism and its Influence on Sex-Specific Phenotypic Variation**

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Inca imperialism impacted several different levels within a conquered society, altering local economic infrastructure, sociopolitical organization, and overarching ideology to suit imperial needs. One major structural change wrought by the Inca was the restructuring of gender relationships, including gender-specific economic production and control over female reproduction. While this imperial restructuring may have material manifestations, (e.g., establishment of production enclaves) it would also affect populations at the genetic level. This research examines how imperial control influences sex-specific phenotypic variation within the Chachapoya region of Perú. Skeletal samples from three pre-Inca Chachapoya (total sample size=264) sites form the baseline for comparison. While only one Inca period Chachapoya skeletal sample (n=13) was examined for this research, it does allow preliminary evaluation of the impact of Inca imperialism. Utilizing craniometric variables, univariate and multivariate methods evaluate two aspects of sex-specific phenotypic variation; 1) between-sex, within-time period comparison in order to establish the baseline and 2) within-sex, between-time period comparison in order to assess changes following Inca domination. Both analyses

indicate that shifts in sex-specific variation occurred after the Inca conquest. The results are discussed in relation to social institutions (e.g., forced relocation of taxpayers, economic and reproductive isolation of female aella, compulsory urbanism) commonly used by the Inca during their consolidation of conquered groups.

#### **Culture clash: individuals and identity in medieval Dublin.**

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Material culture appears to have played a central role in the maintenance of social and political distance between the population of the Viking colonial enclave of Dublin and the local population of the hinterland between the 10<sup>th</sup> and 12<sup>th</sup> centuries. While the cemeteries associated with the settlement during these centuries have not been investigated archaeologically, human remains were a relatively common occurrence within the Viking Age town, with two main phases of deposition. Evidence of trauma and the location of the remains suggest that bodies and body parts were also used as a device to maintain social and political boundaries. This was particularly so in the 10<sup>th</sup> century when it is postulated that the ambiguous treatment of some individuals was used to make statements about corporate identity and power.

#### **Chimpanzee charging displays: a case of social rhetoric?**

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Conspicuous charging displays, in addition to their use in one-to-one competitive bouts, may be used by males to negotiate social relationships. Non-competitive witnesses gather information about the actor and displays reinforce and mould perceptions of social status. In chimpanzees (*Pan troglodytes*), a highly fluid fission-fusion social system presents the cognitive challenge of tracking multiple relationships over open-ended timescales; social relationships need to be continually examined and reinforced. Male charging displays may be one way of advertising social status to all or specific bystanders. Strong circumstantial evidence suggests displays function in male-male competition. It is unclear, however, which groups or particular individuals are being targeted as witnesses to displays: all other males, specific male competitors or prospective mates. Displays are often noisy and carried out in group contexts. Therefore, dissemination may be non-specific and simply targeted toward the widest possible audience. The present study tests the hypothesis that male charging displays are performed strategically with specific competitors targeted and that such charging displays function primarily in intra-male, and not

inter-male, competition. Data were collected over six months in Budongo Forest, Uganda. All occurrences of male charging display ( $n = 137$ ) were recorded during timed focal sampling with simultaneous scan sampling of party composition. Results suggest that males target other males and not females for display audiences. Moreover, close rivals appear to be targeted strategically. These results infer male chimpanzees are cognizant of audience-type and that charging displays may act as a form of social manipulation.

#### **Hand preferences during foraging in white-faced capuchins (*Cebus capucinus*)**

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To address the paucity of manual laterality data on wild capuchins, we present data collected during a foraging study in 2001. We compare hand preferences during bouts of "pick and eat" foraging as well as in object-use (pounding and rubbing *Luehea candida* and *Sloanea terniflora* fruits). Of twenty-five subjects, a minority exhibited hand preferences for "pick and eat" foraging (pooled across foods), with five to the left and two to the right. For *Sloanea* processing, one of eleven subjects exhibited an exclusive right hand preference, while two others exhibited a significant right-hand preference. One subject showed an exclusive left-hand preference. For *Luehea* processing, two of nine subjects exhibited an exclusive right hand preference, while a third exhibited a significant right-hand preference. Three other subjects exhibited an exclusive left-hand preference.

Neither sex nor group appeared to affect the strength or direction of hand preferences for any task, though adults were generally more likely to exhibit hand preferences than non-adults. We did not see consistency within individuals in the direction of hand preferences across tasks. Using McGrew and Marchant's (1996) framework, "pick and eat" foraging and *Sloanea* processing ranked at Level 1, with a minority of subjects lateralized and no population-level bias to either side. *Luehea* processing ranked at Level 3, with a majority of subjects showing an exclusive hand preference but again with no population-level bias. The degree and direction of lateralization exhibited by individual capuchins appears to vary among tasks, and more complex manipulations appear to elicit stronger hand preferences. This research was supported by a discovery grant from the Natural Sciences and Engineering Research Council of Canada (NSERCC) and by a 2000 Grant-in-Aid of Research from the Sigma Xi National Honor Society.

#### **A comparative analysis of the ontogeny of body mass dimorphism in lorisooids.**

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Generally, prosimians show little to no body mass dimorphism, though some species of lorisooids do, with the most marked examples occurring in *Nycticebus* and *Otolemur*. Previous work demonstrates that no sex differences in either rate or timing of growth are present in monomorphic, diurnal lemurids while bimaturism characterizes most anthropoids with body mass dimorphism. To what extent either rate differences or bimaturism produces body mass dimorphism in nocturnal lorisooids is unknown. We present a statistical analysis of mixed-longitudinal growth data (from the Duke Primate Center records, 1979-1996) for males and females of 5 species of lorisooids that exhibit varying levels of dimorphism (*Galago moholi*, *Nycticebus garnettii*, *Loris tardigradus*, *Nycticebus coucang*, and *Nycticebus pygmaeus*).

Rates of growth are determined from reduced major axis regressions of growth data, while ages at maximum and minimum velocity and acceleration of growth are determined from the first and second derivatives of growth data. With the exception of *O. garnettii*, dimorphism in lorisooid adult body mass results from a combination of rate and duration differences. *Otolemur garnettii* is the only species to exhibit body mass dimorphism via bimaturism, a pattern characteristic of anthropoids. Interestingly, female slender lorises (*L. tardigradus*) grow at a faster rate than males, a unique pattern in primates (female slope=0.55, male slope=0.50;  $p < 0.05$ ). No one process generates body mass dimorphism within the lorisooid clade suggesting complex links among life history, socioecology, behavior, and reproductive physiology within this radiation of primates.

#### **Metabolic cost of locomotion and muscular force generation in strepsirrhine quadrupedalism.**

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The factors underlying the metabolic cost of locomotion in primates are not well understood. Studies of quadrupedal mammals ranging in size from mice to horses support the hypothesis that metabolic costs are dictated by the generation of muscular force for body weight support. However, nonhuman primates differ significantly in both limb morphology and locomotor mechanics from the quadrupedal mammals upon which this hypothesis is based. This study investigates whether the link between the metabolic cost of locomotion and muscular force generation



can be applied to a nonhuman primate as well.

Metabolic cost was measured in 3 adult ring-tailed lemurs (*Lemur catta*, body mass  $2.5 \pm 0.2$  kg) at the Duke University Lemur Center. Animals were trained to exercise on a level treadmill in an enclosed chamber at a wide range of speeds. Net metabolic rate was determined from steady-state rates of oxygen consumption minus the resting rate of oxygen consumption. The rate of muscle force generation was determined from the inverse period of foot-ground contact ( $1/t$ ).

Ring-tailed lemurs increase their net locomotor costs by more than a factor of two across speeds (0.5 to 2.0 m/s). Initial results suggest that much of the increase in metabolic rate with speed can be explained by changes in the rate of force generation. These results support the idea that the cost of muscular force production is a significant determinate of the energetic cost of terrestrial locomotion. These data are evaluated in the context of energetics measured in other strepsirrhines.

#### Strontium isotope ratios as a valid tool in the geographic fingerprinting of hard tissue samples in the United States.

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Strontium (Sr) isotope signatures are currently being evaluated by scientific researchers as a tool in the geographic fingerprinting of hard tissue (ie: bone, teeth, fish otoliths and antlers). These signatures are indicative of an organism's region of birth and/or the region it inhabited a short time prior to death, depending on the type of hard tissue sample. Strontium isotope research in the United States has been applied to the identification of osteological remains in forensic contexts and tracing the migration patterns of prehistoric peoples. It has also been used to map salmon migration and spawning patterns (Kennedy 2000). White tailed deer antlers have been georeferenced for prosecution purposes in illegal harvesting cases (Beard 2000). The focus of this research project is to document the success with which Sr isotope signatures have been found to be representative of the predicted Sr isotope variations in the United States. In order to document the correlation between isotope variations derived from hard tissue samples and predicted variations, the authors rectified an existing geologic map of predicted Sr values using ArcMap software. Hard tissue data, from which Sr values had been derived, was then plotted by respective geographic location. While the results of this effort reveal varying degrees of success, a more complete record of actual Sr isotope variation is needed to make a definitive judgment as to their reliability. The data recorded as a component of this research is a preliminary attempt at creating a database of Sr isotope variations for the United States.

#### Variability in the ESR and CALCR genes in Slovak postmenopausal women and its associations with bone mineral density, bone-related biochemical markers and fracture incidence.

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Osteoporosis is a disease of low bone mineral density (BMD) and microarchitectural deterioration of bone with increased fracture risk. The estrogen receptor (ESR) and the calcitonin receptor (CALCR) are proteins which mediate hormonal action in target tissues. In bone the effect can result in bone resorption or formation. Therefore, possible variability in the ESR and CALCR genes could play a role in variability of BMD followed by variability in fracture risk.

In present study we analyzed effects of PvuII and XbaI polymorphisms in the ESR gene and AluI polymorphism in the CALCR gene on variability in femoral and spinal BMD, as well as circulating alkaline phosphatase (ALP; formation marker), beta-CrossLaps (CTX; resorption marker) and fracture incidence in 121 Slovak postmenopausal women ( $63.4 \pm 7.5$  years). Women were selected according to strict inclusion criteria. Genetic polymorphisms were detected by PCR-RFLP method. The differences between the genotypes were analyzed by covariance analysis after correction of the measurements for age and BMI. Frequencies of fractures were tested using the chi-square test.

We found a significant effect of ESR/pp genotype on ALP ( $p=0.034$ ), CTX ( $p=0.024$ ), and femoral ( $p=0.034$ ) and spine ( $p=0.041$ ) BMD. ESR/XbaI polymorphism did not affect any of the analyzed traits significantly. However, significant association of ESR/ppXx haplotype and ALP ( $p=0.020$ ), CTX ( $p=0.001$ ), femoral ( $p=0.046$ ) and spine ( $p=0.038$ ) BMD was observed. With the CALCR gene we did not find significant associations with the traits. Comparison of fracture incidence between the genotype groups showed significant differences ( $p<0.001$ ) for both ESR polymorphisms and ESR haplotypes.

This study was supported by the grant ASO SK-05/06-BA-016 (SAIA). All procedures were approved by the Ethical Committee of the Specialized Hospital of St. Svorad in Nitra.

#### Evolutionary convergence of tail structure in prehensile- and nonprehensile-tailed primates and procyonids.

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Atelines and *Cebus* are unique among primates, as they have prehensile tails

capable of suspending their entire body weight. These specialized organs have similar skeletal and muscular arrangements, distinguishing them from nonprehensile tails. However, the abundance of prehensile-tailed mammalian taxa (40 genera in 14 families) suggests that tail structure in platyrrhines be evaluated against a broader comparative backdrop.

This study evaluates tail structure in platyrrhines and procyonids, a group of carnivoran mammals living in similar Neotropical habitats. Linear caudal vertebral measurements were taken for a procyonid sample comprising prehensile-tailed *Potos*, semiprehensile-tailed *Nasua*, and nonprehensile-tailed *Bassaricyon* and *Procyon*. Data were compared to similar measurements for prehensile-tailed *Alouatta*, *Ateles*, and *Lagothrix*; semiprehensile-tailed *Cebus*; and nonprehensile-tailed *Aotus*, *Pithecia*, *Saguinus*, and *Saimiri*.

Among platyrrhines, the prehensile-tailed taxa have longer proximal tail regions, confirming previous results (Ankel, 1972). In the distal region, prehensile tail vertebrae possess expanded transverse processes, providing extensive attachment sites for ventral and lateral musculature (also noted by German, 1982; Lemelin, 1995). Hemal process expansion, a proxy for the moment arm of dorsoventral bending, is also greater in prehensile-tailed platyrrhines in all three tail regions.

Results are less clear for procyonids. *Potos* generally has the same pattern of features as prehensile-tailed primates, and *Nasua* is intermediate, as expected. However, *Procyon* has a longer proximal tail region (contra Yulatos, 2003) and well-developed hemal processes in the proximal region. These results suggest that some structural differences between prehensile and nonprehensile tails are common to both platyrrhines and procyonids, while other specific details are not.

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#### Bioarchaeological investigations at the church of San Felipe de Neri, Albuquerque, NM.

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Constructed in 1793, the church of San Felipe de Neri represents the oldest church in the city of Albuquerque, New Mexico. During the 2005 remodeling of this historic property, it was discovered that the original architects of San Felipe de Neri built their church over a community cemetery. This paper will present the results of bioarchaeological investigations conducted upon the discovery of at least eighty-five disarticulated and commingled individuals, ranging in age from fetal to older adults, excavated from ossuary pits. Only two individuals survived partially articulated in their original burial contexts. Analysis of the individuals and their mortuary accompaniments found within the courtyard of this church shed light on the composition

and health of the colonial laeity. The health status of this community is discussed in reference to dental analyses, skeletal signatures of occupational stress, and pathologies.

**Exploring Human Craniometric Variation: Statistical, Mensural, Biological, and Historical Considerations.**

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Williams et al. (2005) compared a sample of ancient Nubians to the W.W. Howells database groups using Fordisc 2.0 (Ousley and Jantz 1996) and were surprised to find tremendous within-group variability and that few of them classified into their nearest geographic neighbor, Howells' Egyptian sample. There are several problems with their approach, including the use of a small number of measurements with a large number of groups, probable measurement errors, and an unrealistic and typological null hypothesis of perfect classifications.

Williams et al. concluded with "The possibility that skeletal material could be accurately sorted [classified] by geographic origin, at any other level than geographic extremes, is quite small". However, they ignored the classification results of Howells groups in their analyses. The cross-validated accuracy using the same variables on Howells' 27 male groups is 49% overall, and 69% were classified into groups from the same region. The random expected accuracy is only 3.7%. These results are decidedly non-random, though not perfect, which no one has claimed for craniometric data. Contrary to Williams et al.'s assertions, Fordisc reveals significant differentiation among groups as well as group and regional overlap. Using more variables improves classifications further.

Finally, their "test" was replicated. Using 144 male and 93 female Nubians from the fortress at Mirgissa and 17 measurements, 60% of them were classified into Howells' Egyptian sample and 78% into an African group, which is what Williams et al. expected but did not find in their Nubian sample.

**Palaeohealth in Sub-arctic Hokkaido, Japan: the Evidence from Trauma and Infection**

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The remains of 99 individuals recovered from sites in far northern Japan were examined for signs of trauma and infectious disease. Samples derived from two periods: 60

individuals from the middle (4000-1000 BCE) to epi-Jomon (300 BCE-700 CE) and 39 individuals from the Okhotsk (500-900 CE) culture period. The aim of this study was the development of profiles of trauma and infectious disease to be compared to a range of prehistoric Asian samples and, in particular, to data in the literature derived from comparable ecological and behavioural conditions: pre and proto historic Eskimos and Aleuts. Hokkaido is unique in East Asia in forming one of few extreme environments to which prehistoric peoples adapted and thrived. Discussion will focus on an appreciation of how aspects of health in communities that lived in particularly challenging conditions can enhance our appreciation of how they coped and the biological costs and/or benefits they suffered or enjoyed. Further, it is concluded that comparisons between samples from similar environmental zones, albeit vastly different cultures, is sometimes more meaningful than comparisons within single generalized archaeological cultures spread over a number of environmental zones: the Japanese Jomon for instance.

**Early childhood caries in prehistoric Southeast Asia: oral health in an often ambiguous status and gender category**

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Newly excavated neolithic/bronze transition cemetery site in northern Vietnam has so far uncovered more than 50 extremely well preserved burials. The focus of this paper is on early childhood caries (ECC), specifically looking at the ECC experience in very young children from Man Bac and other Southeast Asian sites with well preserved infant remains. This paper will review the modern clinical lit on ECC, explore the potential risk factors relevant to prehistoric communities, and draw behavioural and biological implications regarding this disease (particularly in terms of stautus and gender) in a somewhat disregarded, contested, ambiguous group of people we often call young kids.

**The prevalence of vertebral and peripheral characteristics of diffuse idiopathic skeletal hyperostosis (DISH) in a late nineteenth and early twentieth century Almshouse cemetery**

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The Milwaukee County Almshouse Cemetery was the place of burial for the

indigent of the city as well as residents of institutions for long term care. The cemetery was in active use from 1884 to 1925 and included an estimated 6,400 inhumations. Mitigation excavations of a construction impact area recovered 1,649 burials of which 588 were non-adults and 1,061 were adults at the time of death. The identity of the burials are unknown but records document a significant representation of northern Europeans, particularly Irish and Irish derived.

All of the remains were surveyed for indicators of pathologies and anomalies during which data were compiled on the occurrence of entheses on vertebral centra as well as enthesophytes at peripheral sites. A total of 102 individuals exhibit entheses in the spine, but only 45 meet the formal definition of DISH.

The location of expression of entheses and enthesophytes is highly variable. This variation is documented with differential occurrence of entheses in regions of the spine with co-occurrence of enthesophytes at peripheral sites. These data are presented by age group where it is noted that all adult age groups are affected but significant onset usually only occurs in individuals aged at forty or more years. Data are also presented on co-occurrence of DISH and DISH-like features with rheumatoid arthritis and osteoarthritis.

Co-occurrence of DISH and osteoarthritis suggest an association with heavy manual labor while a co-occurrence of DISH and rheumatoid arthritis may reflect a differential susceptibility by ethnicity.

**Examining the diversity of colobine monkey folivory.**

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Although members of the Colobinae are all specialized folivores, there is variability in the degree of folivory across taxa. In addition, the limited anatomical data on colobine feeding adaptations suggest that some genera may be more morphologically adapted to folivory than others. For example, previous research has shown that *Colobus spp.* have relatively larger digestive tracts than *Trachypithecus spp.* who have relatively larger stomachs than *Presbytis spp.* It is unknown whether these phylogenetically related morphological differences correspond to differences in feeding behavior. In addition, several other factors may affect the degree of folivory, such as body size, climatic seasonality, and human-induced habitat disturbances. Therefore, in this study, variation in the degree of folivory in colobines was examined in the context of these factors.

Data for over twenty colobine species from four genera (*Colobus*, *Procolobus*, *Presbytis*, and *Trachypithecus*) were gathered from the literature. Generalized linear multiple regressions were conducted to predict three types of folivory: percent of total leaves,

percent of mature leaves, and percent of young leaves. In the analyses, genus was used as a categorical predictor while female body mass, maximum latitude of the geographic range of the species, and human population density were used as continuous independent variables. The results indicated that genus was the best predictor of total leaf intake. In addition, when leaf consumption was divided into young and mature leaf eating, body mass was the best overall predictor. Smaller species consumed more young leaves and fewer mature leaves than larger species, independent of other factors.

#### **The fused frontal as an anthropoid synapomorphy- perhaps not.**

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Since the era of the prosimian-anthropoid dichotomy, with its essentially universal taxonomic distribution among higher primates, closure of the metopic suture has been considered an anthropoid synapomorphy. However, while capacity to fuse the frontal bones undoubtedly evolved in parallel among disparate primate lineages, frontal fusion is more widespread among haplorhines than commonly acknowledged, raising the possibility that anthropoids share this trait homologously with others due to a monophyletic relationship. We reexamine the issue to corroborate and extend Ashley Montagu's classic study of primate metopism. We find that strepsirhines rarely fuse the frontal; adapids, lorises and indriids show the highest frequencies. Among non-anthropoid haplorhines, frontal fusion occurs invariably in all species of tarsiers, it occurs definitively in *Rooneyia*, and is consistently found in crania of Eocene microchoerines, such as *Necrolemur* and *Microchoerus*. We argue that morphological continuity here, and an independent line of cranioskeletal evidence, suggests that the pattern *Tarsius* shares with microchoerines is homologous as a haplorhine synapomorphy, while the *Rooneyia* condition appears to be convergent. This underscores the growing view that the conventional taxon Omomyidae is becoming an outmoded, polyphyletic assemblage, and that tarsiers are monophyletically linked with a collection of Laurasian Eocene tarsiiforms. Frontal fusion in *Rooneyia* may be a synapomorphy uniting Protoanthropoidea (*Rooneyia* + Anthropoidea) as a monophyletic group, along with other craniofacial and orbital features, though the high incidence of parallelism and the difficulty of testing this hypothesis means that this similarity should not yet be weighted too heavily, or in isolation, as a phylogenetic marker.

#### **The impact of malnutrition on bone micro-anatomy.**

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An opinion shared by many bone biologists has been that dietary deficiencies affect bone formation or loss and those micro-anatomical features specific to these conditions could be defined. Identifying these quantitative differences in micro-anatomical features can lead to a health and quality of life assessment for prehistoric peoples. Such an assessment is critical in the evaluation of the impact of micro-nutrient deficiencies on bone. The foundation to our conclusions for this presentation comes from a case study drawn from a 20th century Black South African skeletal population housed at the University of Witwatersrand's Medical School, Johannesburg, South Africa. Some of these individuals died of pellagra, niacin deficiency disease which is often associated with high-maize/low protein diets. Others in our sample died from non-specific malnutrition. Histological results from these individuals help to illustrate how little we know about the affect of diet on bone remodeling and how much can be gained from understanding this metabolic relationship. Given their age at death we have found that these South African individuals experienced considerably slow bone turn-over rates. This, along with considerable cortical bone loss (measured as cortical area) and low osteon population densities (OPD) provide us with a model of expectation for bone changes in individuals with pellagra and non-specific dietary problems. Future directions now require an assessment of how other common dietary deficiencies such as iron anemia and scurvy affect remodeling rates and the process of bone maintenance, which will also be address in this presentation.

#### **Reading Lives: Contextual Issues in Osteobiography.**

A.M. Palkovich Krasnow Institute for Advanced Study at George Mason University.

Life histories are composite stories individuals in their larger social and populational contexts. The presentations in this symposium illustrate the ways in which bioarchaeological reconstructions allow us to understand the individual as part of a larger societal whole. These reconstructions necessarily address two contextual issues – the societies and populations of which these individuals were a part and the archaeological contexts from which these individuals are recovered. I explore the strengths and limitations of osteobiographies and the ways in which such studies enhance populational approaches.

#### **Applicability of confocal laser scanning microscopy for anthropological research.**

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Conventional light microscopy of soft-tissue and bone usually lacks 3-dimensional (3D) morphological information. Since the availability of confocal laser scanning microscopy (CLSM) it is possible to specifically fluorescently label target areas and to study them at high resolution in 3D. Surprisingly, this advanced microscopic method has been used very rarely in anthropological research (e.g. Maggiano et al. 2006, Scott et al. 2005, Šeřčáková et al. 2001). However, numerous clinical and basic science studies showed its value to study e.g. 3D bone morphometry, bone growth and bone microarchitecture. In combination with stereological methods, accurate quantitative histomorphometric information can be gained. We show the feasibility of CLSM to evaluate bone microdamage in a historic human bone sample (n=12; Tomils cemetery, Switzerland; 11<sup>th</sup>-16<sup>th</sup> century AD). Specifically, we test whether the presence of musculoskeletal stress markers correlates with the extent of bone microdamage. CLSM allows us to precisely localize and characterise microdamage and, in particular, to differentiate intra vitam versus artifactual microcracks (due to sectioning and grinding of the specimen). This is achieved by staining up to 100µm thick slices with auto-fluorescent Fuchsin. Digital processing of the data is done by IMARIS®-software and stereological methods. Based on our pilot study, we strongly recommend the use of CLSM in similar studies, especially to assess historic 3D bone histomorphometry, pathological bone microarchitecture or soft tissue ontogeny. Examples of such further applications of CLSM in physical anthropological research are being also addressed.

#### **Male dispersal as a mating strategy in the ringtailed lemur (*Lemur catta*).**

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Dispersal out of a natal group and subsequent inter-group transfer can have marked effects on an individual's mating success. In the present study, patterns of male dispersal in a provisioned, free-ranging population of ringtailed lemurs (*Lemur catta*) on St. Catherines Island across a multiple-year period were analyzed to assess the effects of dispersal on the mating success of males. Like many primates, ringtailed lemurs exhibit male-biased dispersal. Data on male dispersal in this non-endemic population were collected between 1997-2005. To measure male mating success, 'all-

occurrences' sampling for agonism and reproduction was performed during the breeding season months between 2000-2004. Data on mating behavior and male dispersal were collected on all four resident ringtailed lemur social groups in the population.

A total of 30 male transfer events were recorded in this study. Males were significantly more likely to transfer into a group having fewer non-natal males than in their previous group ( $p < 0.05$ ), suggesting that males may avoid groups in which male-male competition would be more intense during the mating season. Males never migrated back into their natal groups, which is notable given the few options available to males in this closed island population. In addition, novel males were shown receptivity and proceptivity by a larger proportion of estrous group females than were resident males having longer troop tenures ( $p < 0.05$ ). In conclusion, inter-troop movement appears to be a successful male mating strategy based upon non-random patterns of male dispersal at this site and female sexual preference for novel males.

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#### High throughput morphometrics and the developmental basis for facial length in mice

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The analysis of shape is useful for the comparison of skeletal morphology and is increasingly being used to investigate evolutionary and developmental questions. Morphometric research has had difficulty making an impact in the scientific community due to the intensive user-interaction for landmarking in the currently available methods, rendering it unable to efficiently analyze shape. Here we present a new high-throughput technique for the quantification and comparison of 3D shape that semi-automates the data collection process. This method is not intended to replace existing morphometric techniques; it will extend the existing toolkit by allowing the high degree of standardization and rate of throughput that large scale phenomic analyses require. This new technique is demonstrated by an analysis of facial shape between A/WySnJ and C57BL/6J mouse embryo and adult micro-CT reconstructions. The A/WySnJ mice are of interest because the developmental basis for the short-faced adults was previously unknown. Determining this developmental basis may

have important implications concerning changes in facial prognathism in primate evolution. The visualizations from this method show that the facial processes of the A/WySnJ embryos appear to be developmentally delayed compared to C57BL/6J and the greatest amounts of shape difference are at the maxillary prominences, the forebrain and frontal nasal prominences. The new analysis is able to show the locations of the greatest amounts of shape variation in each strain and the differences in variation between the strains. These results are compared to those of traditional geometric morphometric techniques which also provide statistical shape analyses between the two strains.

#### Forensic age-at-death assessment: Multiple methodologies based on four techniques

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The goal of this presentation is to propose new methods to combine multiple classic age estimates from different anatomical areas, in order to produce a single, more precise age-at-death estimate.

Age-at-death indicators in adults suffer from the degenerative nature of most of the processes in which they are based. Degenerative processes are largely influenced by epigenetic factors, resulting in variability ranges that often fail to meet forensic requirements of accuracy and precision. In forensic contexts the estimate must be accurate enough to prevent incorrect exclusion of the victim from the list of potential matches, but at the same time it must be precise enough to narrow the search list to a significant extent.

While there are numerous age estimation techniques for different skeletal areas, only a handful fit the criteria of forensic usage, and even fewer are widely employed. Further, there are no standard criteria to combine the estimates from different methods, so that the final age estimate heavily depends on the researcher's experience and personal preference.

These methods were developed from a sample of European American males ( $n=109$ ) from the Bass Collection (University of Knoxville, TN), and then tested on an equivalent sample ( $n=49$ ) from the Hamann-Todd Collection (Cleveland Museum of Natural History, OH). Four age-at-death techniques were combined: Suchey and Katz (1998), Iscan and Loth (1993), Lovejoy et al (1985), and Passalacqua (2006). Results indicate that combined methods show accuracy and precision similar to individual methods, although they may serve to reduce inter-observer error by simplifying the scoring systems.

#### Relationship between speed and forelimb kinematics in terrestrial quadrupedal locomotion: Why do

#### primates adopt digitigrade hand postures?

B.A. Patel, Interdepartmental Doctoral Program in Anthropological Sciences, Stony Brook University

Digitigrade postures are proposed to: 1) increase effective limb length (ELL) to achieve preferred or higher locomotor speeds more efficiently by increasing step length and duration; and 2) help lower torques around distal joints and lower stresses in distal limb elements by assuming an extended limb posture. Unlike most terrestrial mammals, primates rarely use digitigrade hand postures. This study explores why some terrestrial monkeys adopt digitigrade hand postures during quadrupedal locomotion. Four subjects (two *Macaca mulatta*, two *Erythrocebus patas*) were videotaped moving unrestrained along a horizontal runway instrumented with a force plate. Forelimb kinematics and ground reaction forces (GRF) were recorded during support phase. Hand postures were measured as the angle between the metacarpal shaft and the ground (MGA). A total of 460 symmetrical gait steps (speed=0.4-3.4m/s) were analyzed; 270 steps included force data.

As predicted, a larger MGA yielded a longer step length, step duration, and ELL (when controlling for speed). However, contrary to expectations, subjects used more palmigrade postures (smaller MGA) at higher speeds (with higher GRF). At slow to preferred (median) speeds, subjects used more digitigrade postures (larger MGA). Digitigrade postures at slower speeds may increase efficiency by increasing step durations and mechanical advantage of antigravity muscles, thus lowering torques around the wrist joint (possibly also lowering metacarpal stresses). At higher speeds, palmigrade postures may be better suited to utilize elastic strain energy of tendons that cross distal joints and to distribute GRFs across the entire hand. Digitigrady in primates, therefore, appears to differ from that of other mammals.

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#### Reconstructing Lucayan Mortuary Practices through skeletal analysis

Michael Pateman and Erin Kimmerle Ph.D., University of South Florida

Archaeological studies in The Bahamas have focused mainly on the cultural adaptations of the prehistoric peoples, the Lucayans (600 – 1500 AD) to their environment. Few studies have taken place concerning the biological development and adaptations to The Bahamian environment. The Lucayans appear to have buried their dead in the limestone cave systems of the archipelago. These caves exist in two forms, wet (including blue holes and caves with a direct connection to the water table) and dry caves. This study compares the demography,

health and diet of individuals buried within wet caves (n=25 individuals from 3 sites) to dry caves (n=28 individuals from 23 sites). In total, the demography of 58 individuals is analyzed; males (n=20), females (n=24), subadults (n=7), and unknown adults (n=7). Pathology is present in the following categories; trauma, nutritional defects, dental disease and occupational markers. These conditions are described in detail and interpreted in the archaeological context of the prehistoric Bahamas. Temporal patterning is used to access shifts in burial practices over time. This study along with previous studies into Lucayan funerary practices contribute to the understanding of Lucayan mortuary practices. This study was supported by a grant from the Antiquities, Monuments, and Museums Corporation; The National Museum of The Bahamas.

#### Canine tooth crown and root proportions in African hominoids.

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Canine crown reduction is a defining hominin feature. Unfortunately, teeth often are too worn or broken, leaving only root or alveolar size as a proxy for crown size. For example, a single large alveolus has been used to infer larger canines in *A. anamensis* than in *A. afarensis*. Covariation in canine root and crown dimensions is not well understood, so it is unclear to what extent canine alveoli or roots can be used to accurately infer crown size. Maxillary canine root and crown data were gathered for 30 *Pan*, 50 *Gorilla*, and 50 *Homo*. Crown height and basal dimensions were measured from actual specimens, and root length from calibrated radiographs. Canine size and proportions were evaluated using standard intraspecific allometric analysis.

Within sexes, correlations between crown height and either root length or basal dimensions are insignificant for all species. Male African apes do have larger crowns relative to root sizes than do females, leading to significant correlations in combined-sex samples. Humans and chimpanzees have equivalent crown-root proportions. Standard errors of estimates for least-squares relationships between crown size and root length within species range from 9-22%.

Our analyses reveal that root dimensions have limited utility for predicting crown height and dimorphism in fossil hominins. Statements about canine dimorphism or canine reduction in hominoids based on root or alveolar data should be approached with caution.

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#### The expression of femoral trochanteric spicules with relation to age.

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A preliminary investigation found that size and number of enthesophytes present in the human femoral trochanteric fossa were significantly related to age and most prevalent in individuals over the age of 45 years. However, subjectivity in interpreting spicule size necessitates a re-evaluation of this study.

Femora from 149 individuals were examined from the Terry Collection. Number of spicules in the trochanteric fossa were counted and length of the longest spicule was measured with a dental probe. Individuals with obvious pathological conditions, clear healed fractures or excessive osseous hypertrophy were excluded from the sample. Data were divided into the four subgroups of sex and ancestry. Results show no correlation between sex and spicule length, and a weak correlation between ancestry and spicule length. Differences in ancestral groups can be attributed to variation in robusticity and activity. Combined data were tested for age and spicule length relationships. Results confirm the findings of the 1991 study: femoral trochanteric spicules are well correlated to age (left:  $p = .0002$ , right:  $p = .0001$ ) and the observance of spicules are more extensive and longer in individuals over 45 years. Present results indicate that in general, spicule length will be 1 mm or less in individuals under 35 years, between 1 mm and 2 mm for 35 to 45 years, and greater than 2 mm in individuals over 45 years. The use of trochanteric spicule size and frequency follow the same expectations for age estimations by osteoarthritis - trauma, pathological conditions and occupational stress will greatly influence this feature.

#### Prediction of long bone cross-sectional geometrical properties from external dimensions.

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Cross-sectional geometric properties of long bones should be partially predicible from external dimensions. If these predictions are accurate, they will be useful because external dimensions can be recorded quickly and inexpensively, and because they are widely reported in the literature. We tested the accuracy of predictions derived from external dimensions for J,  $I_{max/min}$ , and CA of the femur, tibia, and humerus using a large data set (n = 124), of Khoe-San (14

female, 16 male, 1 indeterminate), Zulu (23 female, 25 male), and African American (6 female, 39 male) individuals. Data for external dimensions (AP & ML or maximum & minimum diameters) and cross-sectional geometry of each bone's midshaft were collected. The data were logged (except for the ratio of  $I_{max/min}$ ) and multiple regression was employed to predict the cross-sectional properties. The resultant equations were transformed back into raw space.

The results showed that J could be predicted with reasonable assurity ( $R^2$  values of 0.88, 0.87 and 0.91 for femoral, tibial and humeral midshafts, respectively). As expected, cortical area (CA) was less accurately predicted, generating  $R^2$  values of 0.66, 0.65, and 0.59 for the femoral, tibial, and humeral midshafts, respectively. Quite unexpectedly, external dimensions predicted  $I_{max/min}$  fairly well in the midshaft tibia ( $R^2 = 0.72$ ) and humerus ( $R^2 = 0.66$ ), although not for the femur ( $R^2 = 0.48$ ). Thus, the most accurate predictions are for J while predictions of  $I_{max/min}$  in the femoral midshaft produce a large amount of error. Data collection was supported by NSF DBS-9120117.

#### The ins and outs of mangabeys: An examination of internal versus external basicranial and facial architecture.

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The extant mangabeys (*Cercocebus* and *Lophocebus*) are characterized as the smaller-bodied and shorter-faced members of different papioninan molecular clades. Given their separate lineages and phenetically similar morphologies, the mangabey genera are an important group for understanding homoplasy and the character polarity of papioninan integrated form. Therefore, this study attempts to establish the external and internal structural relationships among cranial regions to provide a firmer foundation for functional and phylogenetic interpretations of mangabey evolution.

The variation in internal (midsagittal) and external cranial morphology of adult mangabeys was analyzed using 3D landmarks obtained from spiral computer tomography (CT) scans (slice thickness, 1mm; reconstructed increment, .5mm). The landmarks were collected from three cranial regions: the internal and external basicranium, and the face. Landmarks were subjected to a Generalized Procrustes Analysis, followed by PCA.

Analyses reveal a clear separation between the two genera. PC1 (56% of the total variation) separates the sexes and is highly correlated with size; females demonstrate a relatively short face and internally expanded occipital. PC2 (19% of the total variation) separates the two genera. Relative to *Lophocebus*, the lateral external morphology (specifically, the postglenoid processes and zygomatics) of *Cercocebus* is

more posteriorly oriented while such structures as the petrous pyramids and lateral pterygoids are more medially placed. Internally, and anterior to the foramen magnum, the basicranium of *Lophocebus* is relatively more compacted and angled. Posterior to the foramen magnum, the nuchal plane of *Lophocebus* is shifted inferiorly. Preliminary analyses are currently being conducted to interpret these patterns within their broader papionin context.

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### Work or Violence: sources of traumatic injury during the Chinese Neolithic.

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Patterns of traumatic injury are examined in two recently excavated human skeletal collections from Guanxia and Xipo, Middle Yangshao (ca. 4000-3500 BC) archaeological sites in Henan province, northern China. These sites differ in size and presumed function. Xipo, considerably larger and with some monumental construction, is hypothesized to have been a regional center. Considerable differences in funerary wealth at Xipo, unseen at Guanxia, suggest the initial stages of social stratification.

Skeletons from both sites were delivered to the laboratory in their entirety, yielding an unbiased representation of all skeletal elements. With the exception of a single fractured nose, no cranial injuries were found in either collection. However, forearm injuries were unusually common among Xipo males (42% of all postcrania). These predominantly affected the ulnae and are interpreted as resulting from the parrying of blows. Rib fractures were also common in this collection; some ante-mortem loss of anterior teeth can likewise be attributed to fighting. This pattern of injuries seems to be most consistent with sparring, "friendly combat", or ritualized competition, rather than more overtly violent confrontations. At Guanxia, fractures were infrequent and randomly distributed across the skeleton, suggesting occupational causes. Middle Yangshao patterns of trauma stand in contrast with the high frequency of both healing and perimortem cranial fractures found in Early Yangshao (5000 – 4000 BC) skeletal collections from Jiangzhai and Beiliu, suggestive of more widespread interpersonal violence during that period.

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### The impact of Roman imperialism: skeletal evidence of dental health and diet in Britain.

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Roman imperialism engendered a number of changes in the social, economic, political, and cultural spheres of Britain. Two direct consequences of these changes are the more intensive use of existing land and the introduction of exotic foods. This study considers the biological impact of these changes by examining the state of human dental health at Roman York (*Eboracum*). Specifically, this study tests the hypothesis that the agricultural intensification associated with the integration of Britain into the Roman Empire affected dental health in a discernible way.

Dental caries, abscesses, and antemortem tooth loss data were collected from individuals at the Romano-British site of Trencholme Drive, York (N=228). Data on dental health from the Iron Age site of Dane's Graves (N=52) were also included, allowing for a preliminary comparison of pre- and postcontact populations in the region. Results indicate that dental health parallels that reported for other Romano-British cemeteries, while representing a clear departure from that reported for the previous Iron Age. When directly compared to data collected from the site of Dane's Graves, a significant increase is observed in both caries and abscess frequency (chi-square;  $p \leq 0.05$ ), while the rate of antemortem tooth loss remains the same (chi-square;  $p = 0.95$ ). The overall evidence from dental health is interpreted to be the result of increased consumption of carbohydrates coupled with improved oral hygiene. These findings support the hypothesis that changes in agricultural production associated with Roman contact directly affected the dental health of Romano-British populations.

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### Observation of a birth in wild black and gold howler monkeys (*Alouatta caraya*)

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We report the first case of a birth seen in a group of wild *Alouatta caraya*. Births are expected to occur at night and at a considerable height above ground to avoid diurnal predators. The observed birth occurred in daylight in a troop of 4 individuals (1 male, 2 adult females and 1 juvenile male) in a population on Brasileria Island (27° 20' S-58° 40' W), Argentina. The focal female has had 2 infants (including the newborn) in the last 3 years and both have survived. Prepartum behaviors included squatting and anogenital self-examination. During the birth, the female was situated approximately 17 m from the rest of her group on a *Cecropia pachystachya* branch 4 m above ground. The mother took a squatting

posture during parturition and assisted the delivery with her hands. The infant was born at 17:45 hs, 5.4 min after first appearing at the vulva. The female started foraging 23 min after parturition, and the infant nursed for the first time 67 min after being born. The mother started eating the placenta 5.2 min after the birth and it was completely ingested 47 min after parturition. She moved to the sleeping tree 38 min after parturition, joining the rest of the group. Inspection of the infant by other members of the group took place the day after parturition with a permissive mother's behavior. Distance from the ground of the female at birth, and the time of day at which the birth occurred suggests that predator avoidance was not involved. Funded by the American Association of Primatologists and Consejo Nacional de Investigaciones Científicas y Técnicas

### Evolutionary population genetics of the human RhD negative blood type.

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Because of its clinical significance, the Rh blood group system is one of the most widely studied human phenotypes. Homozygous deletion of the entire RHD gene (chr1) results in RhD negative (-) blood type. RhD- mothers produce anti-RhD antibodies in response to an RhD+ fetus, such that any subsequent RhD+ offspring may be affected by hemolytic disease of the newborn, seemingly having an adverse affect on the mother's reproductive fitness. Therefore, one might expect strong purifying selection to act against the RhD- phenotype; however, the RHD deletion allele is at high frequency in many European populations. We hypothesized that the RHD deletion allele may confer an as of yet unknown fitness benefit, such that positive or balancing selection may explain its otherwise puzzlingly high frequency. To begin to evaluate this hypothesis, we set out to characterize patterns of linkage disequilibrium around RHD. We used a quantitative PCR assay to genotype the RHD deletion in 90 European-American individuals from the International HapMap Project, for whom >3 million genome-wide single nucleotide polymorphisms (SNPs) were previously genotyped. We observed an RHD deletion allele frequency of 0.43. By comparing the distributions of deletion and SNP genotypes, we found that the deletion allele was in high linkage disequilibrium ( $R^2 > 0.9$ ) with SNPs extending >200 kb from the RHD gene, which could reflect a recent and

rapid frequency increase, a signature of positive selection, though additional population genetic analyses and denser SNP genotyping (currently being conducted) are necessary to determine statistical significance.

#### Do lemurs bite off more than they can chew?

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The masticatory system is likely adapted to the size of ingested food particles, not just to the material properties of food. Preferred bite size (PBS) is the maximum food size that an animal consistently ingests whole. PBS is an estimate of gape that has behavioral relevance because it is controlled by the animal during normal behavior.

We measured PBS in four foods (melon, sweet potato, carrot, and cabbage) in 17 strepsirrhine species at the Duke Lemur Center. RMA regression demonstrated that PBS scaled isometrically or with slight negative allometry relative to body mass for all food types. A study on lemur chewing muscle anatomy (Perry and Wall, 2005) demonstrated that muscle fiber length scales in a similar manner. We found a strong positive relationship between relative PBS and relative fiber length. This relationship is stronger for carrot and sweet potato than for melon. We also explored intraspecific scaling of PBS in *Varecia rubra* and *Propithecus coquereli* (Hartstone-Rose and Perry, this volume).

Dietary preference affects PBS. The frugivores ingested much larger cubes of melon than did folivores of similar body mass. PBS in frugivores was much smaller for tough foods (carrot and sweet potato) than for melon. PBS in folivores was constant across food types. The short chewing muscle fibers and short faces of folivores may constrain their gape in general. Frugivores may limit PBS for tough foods to avoid stretching their muscle fibers beyond a mechanically-efficient length to produce bite force, thereby avoiding biting off more than they can chew.

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#### Investigating the transport of Byzantine mining camp prisoners into southwestern Jordan using strontium and oxygen isotopes.

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Byzantine officials reportedly sentenced criminals to hard labor in mines such as at Faynan (*Phaeno*) in southwestern Jordan. Historical sources document the grim conditions at *Phaeno* in addition to the transport of prisoners from distant locales, particularly the Mediterranean coast. Texts emphasizing the prisoners' miserable journeys and their prison sentences' bleak realities however ignore the possible presence of locally-derived mining camp residents at *Phaeno* for economic, rather than punitive, reasons. Did Byzantine administrators regularly transport criminals long distances to the mines?

In order to elucidate the implementation of this policy, the origin of 28 individuals recovered from the Byzantine cemetery at *Phaeno* was investigated using strontium (<sup>87</sup>Sr/<sup>86</sup>Sr) and oxygen ( $\delta^{18}\text{O}$ ) isotope analyses. Strontium isotope signatures from human dental enamel, indicating the geological zone spent during childhood, identify over half of the individuals at *Phaeno* as non-local when compared with local faunal <sup>87</sup>Sr/<sup>86</sup>Sr values. These "non-local" individuals could have originated from multiple geological regions in the Levant, including Wadi Araba immediately adjacent to the site. Results from the oxygen isotopic ratios revealed five individuals with higher than expected  $\delta^{18}\text{O}$  values, including three individuals previously identified as "local" by strontium isotope signatures, who may have originated from locales closer to the Mediterranean coast than *Phaeno*. The oxygen isotope data thus support documentary evidence for movement of prisoners from the Mediterranean coastal region not identified by strontium isotopes. Isotopic analyses additionally identify locally-derived individuals at *Phaeno* invisible in ancient texts, likely mine overseers and local laborers.

This research was supported by an American Center of Oriental Research CAORC Senior Fellowship and an East Carolina University Creative and Research Activity Award.

#### Can the Frontal bone be used as a distinguishing tool between Hominins? The Zuttiyeh frontal: is a still an enigma?

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Over 80 years have passed since the discovery of hominin cranial remains in Zuttiyeh, Israel. During this period efforts were made by several scholars in order to determine which species this fragmentary skull represents.Untill now the answer to this question is not conclusive.

The attempts made to place these remains in the phylogenetic tree of the genus Homo raised a basic question: Are there really significant differences between frontal bones,

especially frontal squamae that can serve as distinguishing characteristics?

Frontal bones from several hominine species were examined in this study. The specimens were grouped apriory as accepted in the scientific community into five groups: modern *Homo sapiens*, early *Homo sapiens*, *Homo neanderthalensis*, *Homo heidelbergensis* and *Homo erectus*. A craniograph was used to obtain 3 contours from each frontal bone: a midsagittal contour, a parasagittal contour and an oblique one. The contours were transformed into numerical values that were analysed statistically.

Using all variables from the 3 contours yielded a good discrimination between the groups, a discrimination that fits with what is accepted in the scientific community. Using only the parasagittal contour values gave the best discrimination between early *Homo sapiens*, *Homo neanderthalensis*, *Homo Heidelbergensis* and *Homo erectus*. Preliminary results based on this method show that the frontal bone from Zuttiyeh's is different from the frontal bones of *Homo sapiens* and *Homo erectus*.

#### Preliminary investigation of infant burials from 3<sup>rd</sup> millennium BC Kish, Iraq.

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Large-scale excavations at the site of Kish in the 1920s and 1930s by the Field Museum of Natural History and Oxford University produced sizeable collections that have not been systematically studied. Kish, located on the Euphrates floodplain in modern Iraq, was one of the world's earliest true cities and a dominant regional polity claiming sovereignty over the whole of Mesopotamia nearly 5000 years ago. Osteological analyses of over 600 largely incomplete and poorly preserved individuals have revealed the unexpected presence of 21 well-preserved fetal and neonate skeletons. It is notable that a large number of these (n=16) were between 38 and 42 weeks post-conception, suggesting a distinct class of funerary treatment for near full-term infants. Integration of the osteological data with long-separated burial records and fieldnotes reveals further aspects of the mortuary ritual afforded infants at Kish. First, excavation records indicate that the excellent preservation of these fragile remains likely results from the practice of burying this particular category of infants in vessels. In addition, at least five of these infants were buried together in a cache while two others were recovered from opulent graves. Taken together, these data suggest a special canon of burial practice reserved for infants of this age group.

Specialized infant burial practices and precincts are not unique to Kish, having been documented at other Near Eastern sites including Hassuna, Tepe Gawra, and Tell-es



Sawaan, where there is evidence of infant burials clustered under a shrine. In the case of the Kish burials, we explore a number of issues including the prospect of infanticide and of the social significance of peri-natal death for early Mesopotamian civilizations.

This project was supported by NEH Grant PI-500014-04, The Field Museum of Natural History, Colorado College, and the Associated Colleges of the Midwest.

#### **Mahalanobis distance, missing values, and the end of the Mesolithic.**

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Missing values pose a general problem in many statistical analyses of prehistoric skeletal material. Especially multivariate methods and measures are difficult to use in the presence of missing values. One such measure is the Mahalanobis distance, where proper inferential procedures in the presence of missing values are wanting. Based on the principles of multiple imputations, a method for obtaining test statistics and approximate degrees of freedom, and thus test probabilities and confidence intervals for Mahalanobis distances, is developed, and a real-data example is presented.

The first part of the study consists of simulations aiming at investigating and evaluating the proposed procedures. Different two-group datasets, with varying sample sizes ( $n = 10, 20, \text{ and } 50$ ), number of variables (2, 3, and 5), and percentages of missing values (5, 10, and 20 percent), were drawn from a multivariate normal distribution. For each combination of sample size, number of variables, and percentage of missing values, 10,000 datasets were generated, and level and coverage of test procedure and confidence intervals proposed were evaluated.

A continuing discussion is going on as to the process of Neolithisation in, i.a., Scandinavia. The second part of the study will contribute to this discussion by presenting results from applying the statistical methods developed, to human crania from adults of both sexes, representing four chronological subgroups in the Danish Stone Age, from the Late Mesolithic to the Late Neolithic (~ 4000 BC to 1500 BC, C14 uncalibrated). All procedures and analyses have been performed in the statistical freeware "R".

This study was in part supported by the Danish Natural Science Research Council, grant no. 21-03-0567.

#### **Morphological affinities of Stw 329, a juvenile temporal from Sterkfontein, South Africa.**

T.R. Petersen, University of New Mexico.

Stw 329 is a juvenile right temporal bone from Sterkfontein Member 4. Despite good preservation, its taxonomic status is uncertain. This is because its morphology bears some similarities with *A. afarensis* as

well as with *A. africanus* and early *Homo*, but also important differences from adults of those species. In light of its juvenile age combined with these differences, Lockwood and Tobias (2002) declined to assign it to a specific taxon.

In an effort to further elucidate the morphological affinity of this specimen with other South African specimens, a series of morphometric analyses using Procrustes superimposition were employed. Stw 53, MLD 37/38, and SK 47 were used as exemplars for early *Homo*, *A. africanus*, and *P. robustus*, respectively. The Procrustes distances between each pair were calculated, and clustering was performed with NTSYS. The various clustering algorithms within NTSYS consistently indicated that Stw 329's closest affinity is with Stw 53. While these results are not strictly dispositive with respect to taxonomy, they do serve to support the contention that Stw 329 is a gracile hominin. If it can be shown that the minuscule eustachian process on Stw 329 is unusual for *A. africanus* specimens of comparable developmental age, results such as these that link Stw 329 with Stw 53 may indicate that a second species with affinities to *Homo* is present in Sterkfontein Member 4. Supported by NSF Doctoral Dissertation Improvement Grant BCS-0451969.

#### **Nucleotide sequence variation of the oxytocin receptor (OXTR) locus in ethnically diverse human populations.**

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The peptide hormone oxytocin (OT) is best known for its essential role in lactation and parturition, but OT also has major effects on stress reactivity and a number of sexual and social behaviors including affiliation, pair bonding, parenting, and attachment. Human and animal data suggest OT may be a factor in psychiatric disorders such as autism, social phobia, and depression. OT has multiple sites of action but only a single known receptor - OXTR. It is thought that OT action may be modulated by variations in receptor function and temporal and spatial expression, which are the result of polymorphisms at the OXTR locus at 3p25-3p26.2. Here we present the first study of OXTR nucleotide variation in a random sample of over 150 humans from globally diverse populations with an emphasis on African groups. We are resequencing ~ 5 kB of OXTR (Exons 1-4, introns 1-3 and 5' and 3' flanking regions) and estimating levels of variation within and among human populations, as well as levels of sequence divergence between humans and several non-human primate species. Preliminary analysis of ~ 2 kB of sequence from the promoter region and Exon 1 has revealed > 20 single nucleotide polymorphisms, with several occurring in putative regulatory regions. Since the OT system plays crucial roles in physiology and behavior, we also tested for evidence of selection at OXTR. These results have

implications for understanding the genetic basis of adaptation in humans as well as the identification of potentially functionally significant variants at OXTR.

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#### **Variability of the femoral head in catarrhines – a new 3D method for describing anatomical structures.**

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Classically, postcranial skeletal form was quantified by linear measurements and angles. The Microscribe made it easier to measure extended structures, but still physical possession of the object was necessary. New advances that permit the relaxation of that requirement are particularly suitable for postcranial applications, where landmarks are scarce and information from surfaces is relevant to function.

We present a method for measuring the proximal femoral surface in a virtual three-dimensional space that visualizes a very detailed surface scan. 3D images of 68 proximal femurs were produced using a triTOS surface scanner (Breuckmann GmbH). The scans clearly show many anatomical features such as landmark locations, surface form, and muscle scars. The study of localized surface form is particularly important because it controls and differentiates locomotor patterns.

Our sample consists of femurs of *Homo sapiens*, hominoids, and cercopithecoids. Some landmarks can be directly located on the virtual surface, while others are constructed by algorithm. For example, once a sphere has been fitted to the femoral head, its centre can be treated as a Type 2 landmark. The full measurement scheme will be displayed on our poster.

Preliminary results indicate that it is better to locate landmarks and to measure directly from scans compared to traditional methods. Also, there is no problem in returning to a previously measured specimen to extract more information. This method of measuring virtual specimens can be used for any skeletal part. Future work will examine how the hip joint articular surface changes shape with locomotor pattern and taxon.

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Science and Technology to the Department of Anthropology, University of Vienna, Austria.

**Locating elusive animals: Using a passive acoustic system to study savanna chimpanzees at Ugalla, Western Tanzania.**

A.K. Piel, J.M. Moore. Department of Anthropology, University of California, San Diego

Compared with chimpanzees that live in forested habitats, little is known about populations in dry, open areas. At Ugalla, Tanzania, direct observation of parties is rare and researchers rely on indirect means (e.g. feces and nests) to learn about behavior. Birds and marine mammals can be similarly difficult to observe, and thus acoustic behavior has become a valuable source of information regarding ranging, feeding ecology, and communication. While methods have been developed for short-range triangulation in air (birds) and long-range monitoring in water (whales), few have been employed for long-range, loud calls of terrestrial taxa. This study reports a pilot-test using passive acoustic monitoring to study unhabituated wild chimpanzees.

Observations from Ugalla (Moore & Piel, unpublished) suggest inter-party calling between individuals separated by large distances. Uhlenbroek (1996) found some support for location-specific responses to pant hoots, but was unable to monitor all individuals at all times to further investigate counter-calling. To address this problem, passive acoustic monitoring using an array enabling three-dimensional localization with acoustic tomography was pilot-tested at Ugalla. Three Autonomous Recording Units - designed by Cornell University - were arrayed in locations that differed in topography, wind exposure, and forest type. A series of playback tests from multiple locations using a portable amplifier was conducted to investigate the acoustic dynamics of a variable sound environment. ARUs recorded for more than 93 hours over 8 days. Results reveal differences in the recording quality within different habitat-types, as well as the efficacy of this method at accurately localizing sound sources.

**Contribution of mitochondrial diseases to molecular anthropology: haplogroup distribution of A3243G French patients.**

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The mitochondrial haplogroups (monophyletic groups of mitochondrial DNA)

are currently used in phylogeography studies. However, recent studies have propose that "the natural selection may have influenced the regional differences between mtDNA lineages. But this hypothesis is only supported by the observation ratio of nonsynonymous/synonymous nucleotide changes in mtDNA genes between different population and this no give proof of physiological expression of the haplogroups. In order to elucidate the existence of link between the mtDNA lineage and physiological expression of the mtDNA, we propose to test the haplogroup influence on mtDNA pathogenic mutations expression. Up to now, only few studies are published on the relationships between haplogroups and mitochondrial diseases and concern few of these pathologies. In addition, these studies have been realised on a relatively small number of patients, which do not allow a clear statistical analysis.

In collaboration with the French network of the mitochondrial diseases, we have started characterisation of the haplogroups of near 500 French patients suffering of mitochondrial diseases to highlight the importance of the mitochondrial genetic background in the mtDNA mutations expression. Preliminary results, based on the comparison of haplogroups distributions in a cohort of 130 French patients with A3243G mutation (associated with diabetes, encephalopathy, miopathy and surdity), provide evidence of clustering differences with the distribution of French population. These results could imply :

- The non-neutrality of haplogroup on the phenotypical expression of the mtDNA
- The numerous independents mutation events of A3243G that highlight the presence of hotspots in coding mitochondrial sequence.

**Biological connections across the Sea of Japan: a multivariate craniometric study of ancient and more modern crania from Japan, China, and Korea.**

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This study examines biological relationships and population history among several earlier and near modern inhabitants of Northeast Asia and Southeast Asia through the application of multivariate statistical procedures. The hypothesis that the sharp biocultural discontinuity found to occur in Japan ca. 300 B.C. is the result of extensive immigration and gene flow during the late Jomon period is tested. Also tested are hypotheses that maintain that the Ainu and Ryukyu Islanders of Japan are the descendants of prehistoric Jomon and that the predecessors of the Jomon can be traced to Southeast Asia.

Stepwise discriminant function analysis and Mahalanobis' generalized distance are applied to 24 landmark measurements recorded in 39 prehistoric and near modern cranial series from Japan (e.g., Jomon, Yayoi,

Kofun etc.), other regions of Northeast Asia, and mainland and island Southeast Asia.

The results of this new multivariate craniometric study support a major influx of new people across the Sea of Japan beginning in the late Jomon period. While the Ainu and Jomon are biologically related, there is no similar close relationship between these two groups and the inhabitants of the Ryukyu Islands. With the exception of the Jomon and Ainu, cranial series from the Japanese Archipelago (including the Ryukyu Islands) ultimately form a cohesive grouping, one that is closest to one that includes all the series from China and northern Asia. None of the Southeast Asian series, including prehistoric Ban Chiang from northeastern Thailand, are particularly close to any of cranial series from East Asia.

**Biological distance analysis of households at Neolithic Çatalhöyük, Turkey.**

M.A. Pilloud, C.S. Larsen. The Ohio State University.

The Neolithic site Çatalhöyük (9000-7400 BP) lies across 26 acres in the Konya plain of southern Anatolia. This large settled community is widely recognized for its important role in understanding the development of early urban centers. Previous archaeological studies uncovered multiple individuals interred below the plastered floors of buildings. It has been hypothesized that the human remains buried in individual buildings represent family units.

The present study reports on dental metric and morphological variation of a sample (n=45) of this population to identify potential kin groups in relation to burial location. Data were analyzed at a micro-level comparing all individuals, and at a macro-level comparing groups. The interindividual and group Mahalanobis D<sup>2</sup> measures of distance as well as Smith's mean measure of divergence were calculated.

Results using buccolingual metrics indicate closer biological affinities between buildings located in the north than those in the south. This discrepancy in findings is likely the result of the southern sample containing fewer individuals as well as a temporal discontinuity between buildings. Calculations of biological distance using data on dental morphology reveal no significant difference between individuals buried at different locations throughout the site.

These data on dental morphology suggest that Çatalhöyük was genetically homogeneous. Data using dental metrics identified potential kingroups on the site; the patterning of which implies a biological basis to burial location. This study offers insight into genetic patterning which can be used to clarify social practices at this critical point in the development of early urban societies.

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### **Craniodontal versus postcranial variables as estimators of size dimorphism in extinct taxa.**

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Estimates of size dimorphism in hominins and other extinct taxa necessarily vary depending on those remains available to estimate size. Debates occasionally arise over which elements provide a more accurate signal. For example, *Australopithecus afarensis* has been argued by some to be highly dimorphic, and others much less so partly on the basis of how dimorphism is estimated using disparate remains. Postcranial remains are often thought to provide more accurate indicators of size dimorphism than cranial and dental remains. Few studies have systematically compared the relationship between size dimorphism and dimorphism in teeth, skulls and postrania. We therefore evaluate the relationships between size dimorphism and dimorphism in craniodontal (96 taxa) and postcranial (21 taxa) variables, using both phylogenetic and non-phylogenetic methods.

Postcranial metrics are more strongly correlated with size than are craniodontal variables. Cranial variables show strong phylogenetic differences in scaling. Within species, variation in dimorphism across individual metrics increases with increasing size dimorphism, but cranial variables tend to show the greatest variance in dimorphism as a group. Counter-intuitively, though, estimates of dimorphism in several cranial variables are more strongly associated with size dimorphism than most postcranial variables. Methods that sum dimorphism across variables stabilize estimates, providing more accurate indicators of size dimorphism than estimates based on single elements. Summed dimorphism estimates perform equally well for cranial and postcranial dimensions. Our data suggest that craniodontal dimorphism estimates cannot be ignored as inferior to postcranial estimates, and that size dimorphism in *A. afarensis* was likely strong.

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### **Taphonomy of primate skeletal remains from chimpanzee hunts at Ngogo, Kibale National Park, Uganda.**

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This study provides a taphonomic analysis of the largest known sample of primate bones to date collected from chimpanzee hunts. The sample consists of

over 400 bone fragments from chimpanzee hunting and consumption episodes of 67 individuals at Ngogo, Kibale National Park, Uganda. It has low taxonomic diversity, consisting overwhelmingly of primates (especially red colobus monkeys). The age distribution of prey remains is skewed towards pre-adults. Cranial bones are the dominant element, followed by long bones. Axial postcranial elements have low survivorship, with a complete absence of vertebrae, except for caudals. Bones are damaged in distinct ways, such as: destruction of long bone ends, typically with intact shafts bearing crenulated edges; fragmentation and compression cracking of crania; and innominates preserving only iliac blades. Tooth marks are present, but uncommon (4.4% of total NISP).

This analysis enables us to: 1) describe and characterize consistent patterns of bone damage inflicted by chimpanzees across a much larger prey sample than has been previously studied; 2) compare the generalized chimpanzee taphonomic signature with that of leopard and eagle consumption of primates, as well as modern human consumption of small mammals; and 3) assess the utility of such samples for recognition of early hominin small mammal carnivory. We recommend some guidelines for taphonomic investigation of fossil assemblages to this end, but caution that a hominoid-modified fossil "assemblage" may not be archaeologically visible.

### **Coregulation during grooming in baboons and bonobos: implications for the evolution of attention.**

H.B. Poje, S.C. Strum. Department of Anthropology, University of California, San Diego.

The extent to which nonhuman primates share and manipulate the attention of conspecifics during social interaction has been a topic of considerable debate. However, few studies have focused on the process by which individuals mutually regulate each others' behavior ("coregulation") during natural social interaction. This study utilizes microethology to understand the dynamics of normal grooming interactions in two species, bonobos and baboons, and thereby offers a unique perspective on the function and evolution of attention in nonhuman primates. Frame-by-frame analysis of videotaped grooming interactions among adults was performed on 10 grooming sessions for each species. The information coded included the activities and focus of attention of each participant, parts of body groomed, use of communicative signals, relative positions of partners, and the activities of other group members in proximity during grooming.

Contrary to expectations, this study shows that both bonobos and baboons demonstrate instances of mutual eye contact during shifts in body part groomed. However, both eye contact and grooming of the face are more frequent in bonobos than in baboons,

indicating potential differences in the extent to which individuals in these species monitor their partners' attention during interactions. Use of communicative signals during grooming (including presentation and/ or manipulation of the body part to be groomed) occur in both species, particularly in sessions with more potential disruptions from the group. Results suggest that coregulation plays an important role in maintaining stable grooming bouts, while differences between monkeys and apes have implications for the role of attention during primate evolution.

### **The seasonality of sex differences in the feeding ecology of the chimpanzees (*Pan troglodytes*) of Kibale National Park, Uganda.**

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Since female reproductive success is more dependent upon acquiring high quality food resources than is male reproductive success, one would predict sex differences in foraging strategy. However, as most primates live in cohesive groups, foraging decisions are constrained by the presence of other group members. Chimpanzees (*Pan troglodytes*), however, exhibit a fission-fusion system in which individuals can forage independently. This study examines the foraging behavior of 5 male and 5 female chimpanzees in the Kibale National Park, Uganda, to test whether they differ in diet and foraging strategy. Over 1,300 hours of data were collected during all-day focal follows over 13 months. Results indicate that although male and female diets were similar during periods of preferred fruit abundance, their foraging strategies diverged during periods of preferred fruit scarcity. Females, but not males, significantly increased fruit consumption (particularly figs) by increasing both travel and time spent feeding. The sexes also differed in the degree to which they included non-fig fallback foods in their diet during periods of scarcity, with males increasing the amount of new leaves in their diet whereas females increased the proportion of pith. This suggests that females, more than males, relied on maximizing energy intake during periods of fruit scarcity. These results will be discussed in reference to the nutritional quality of the diet.

This study was supported by the Leakey Foundation, the Wildlife Conservation Society, the American Society of Primatologists, and Stony Brook University.

### **Comparative analyses of body support and joint posture in primates.**

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Kinematic and kinetic studies of phylogenetically broad groups of mammals and a small study of closely related

cercopithecine primates have both demonstrated that, with increasing body mass, larger and longer-limbed animals use more extended joint postures than smaller and shorter-limbed animals. The general applicability of these results to broader samples of primates, as well as assessing intraspecific variation, both require further testing. However, both are hampered by the logistical difficulties involved in obtaining experimental data for different primates and larger samples of any taxon. In this study, I use an experimentally validated method for reconstructing knee posture in primate specimens from museum collections. This method involved analyses of patterns of subchondral bone density obtained by computed tomography. Validation of this method involved accurate reconstruction of kinematically measured differences in joint posture between two groups of sheep that were trained to walk on flat and inclined treadmills, respectively. This validation demonstrated that subchondral bone exhibits a plastic response to *in vivo* joint loads. In this study, patterns of subchondral bone density in primate knees are compared between 5 quadrupedal cercopithecine species that differ in body mass by a factor of 22, and a broader sample of 11 quadrupedal primates that differ in mass by a factor of ~250. In both samples, larger taxa used more extended knee postures than the smaller taxa, thereby supporting the results of previous experimental work on more limited samples. Implications for fossil primates are also discussed.

#### **Impaired reproductive function in women in obese populations: an evolutionary perspective.**

T.M. Pollard. Medical Anthropology Research Group, Department of Anthropology, Durham University, UK.

It is well established that ovarian function responds to chronic energy availability. Thus affluent western women, who live in environments in which calorically-dense foods are readily available and where little energetic expenditure is required, secrete high levels of ovarian hormones and are generally considered to lie at the high extreme of global variation in ovarian function. This picture is, however, only a partial one, mainly because it is based on hormone levels in regularly menstruating women, but also because of the effects of recent increases in obesity levels. Here I draw attention to the large proportion of women in populations with high levels of obesity that experience problems with reproductive function. Insulin resistance and hyperinsulinemia are strongly associated with obesity, and there are important consequences of hyperinsulinemia for reproductive function. In particular, hyperinsulinemia is associated with hyperandrogenism, irregular menstrual cycles, reduced fecundity and polycystic ovary syndrome (PCOS). Thus it is appropriate to

consider hyperandrogenism, irregular menstrual cycles, PCOS and associated low levels of fecundity in women as problems created by the evolutionarily novel obesogenic environment. These are conditions that can profoundly affect quality of life for women. Moreover, the existence of high levels of insulin and androgenicity in many populations has important methodological implications for studies of ovarian function in these populations. These issues are illustrated using results from a study of insulin resistance and androgen levels in 85 British women, comparing European-origin women with British Pakistani women, who have particularly high levels of insulin resistance.

#### **Contributions of muscular and skeletal morphology to locomotor performance: How much can bones tell us about locomotion?**

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Out of necessity, investigations of locomotor performance in fossil species typically focus on skeletal anatomy, but variation in muscle anatomy may also affect performance. To better understand the relative contributions of skeletal and muscular anatomy to locomotor performance, we investigated their independent effects on locomotor energy cost in humans and chimpanzees. Using an inverse dynamics approach, we measured both the ground forces generated and the volume of muscle activated per step for both humans and chimpanzees. As expected, differences in force generation and muscle activation explain the difference in locomotor cost between humans and chimpanzees. However, bone and muscle morphology contributed to cost in different ways. Species differences in the magnitude of ground forces and joint moments were largely a function of skeletal anatomy (namely limb length) and gait, whereas differences in active muscle volume were largely due to differences in muscle morphology, namely fiber length. Using a modeling approach, we assessed the effect of species differences in muscle fiber length on cost. The long muscle fibers of chimpanzees appear to increase chimpanzee locomotor cost substantially. Since most primates share relatively long muscle fibers, we discuss potential evolutionary compromises in primate locomotion in general, and apply the results of this study to current debate regarding locomotor performance in apes and early hominins.

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#### **Niche expansion of a cryptic primate, *Callimico goeldii*, during polyspecific associations.**

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We examined the effects of polyspecific associations on the behavior of one group of *Callimico goeldii* in northwestern Bolivia. Data were collected for one year using focal animal sampling at 5 min intervals, for a total of 1,375 observation hours. In total, *C. goeldii* associated with (defined as individuals of 2 species <25m from one another) five groups of *S. fuscicollis* and six groups of *S. labiatus*, and these associations occurred during 81% of observations. *C. goeldii* rested more (n=48, Z=-3.646, p<0.001) and traveled less (n=48, Z=-4.379, p<0.001) while alone than while associated, but there was no difference in vigilance behavior (n=27, Z= -4.379, p<0.001). The composition of the group's diet was different while alone than while associated (fungi 59% vs. 26%; fruits 44% vs. 18%; insects 13% vs. 6%). The mean height used was greater while associated than while alone during travel (2.88m vs. 2.58m, t = -.390, df = 80, p = .75), resting (2.94m vs. 2.84m, t = -.806, df = 86, p = .44), and eating (5.7m vs. 3.11m, t = -1.03, df = 51, p=.20); although these differences are not significant this trend is consistent across activities. We propose therefore, that *C. goeldii* is able to use a greater range of vertical space while associated than while alone, allowing it to increase its consumption of fruit and insects.

This research was funded by the Chicago Zoological Society, the Margot Marsh Biodiversity Fund, and the Research Board of the University of Illinois.

#### **Implications of spatial and temporal heterogeneity of food resources for variation in chimpanzee community size in Kibale National Park, Uganda.**

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Considerable study has been devoted to understanding the factors affecting chimpanzee party size and composition. The ecological bases of variation in community size and composition have received less attention, despite the important influence of these factors on chimpanzee behavioral ecology. We present the results of ecological sampling at two sites in Kibale National Park, Uganda (Ngogo and Kanyawara) separated by 10 km and differing notably in chimpanzee community size (Ngogo= ~150 individuals, Kanyawara= ~50). Our objective was to quantify the floristic and phenological characteristics that most directly differentiate the home ranges of the two chimpanzee communities. We enumerated and measured stems in 104 50x50 nested botanical plots to quantify spatial aspects of resource availability and recorded the

phenological state of trees and figs on phenology trails each month for 96 months to assess temporal resource fluctuation. We show that the sites are superficially similar in gross floristic measures, including species richness, species diversity, and stem density. However, fine scale differences in species composition and in the density and distribution of particular species and resource classes clearly distinguish the two sites. Fluctuations in non-fig fruit availability are less intense at Ngogo, and certain species found at both sites more frequently produce large fruit crops there than at Kanyawara. Thus, ripe fruit at Ngogo is more abundant overall and less temporally variable than at Kanyawara. This study highlights the importance of the synergistic effects of spatial and temporal resource heterogeneity on small spatial scales in influencing the size of chimpanzee communities.

#### **Environmental dynamics and the evolution of adaptability.**

R. Potts. Human Origins Program, NMNH, Smithsonian Institution.

Paleoenvironmental and ecological data demonstrate that (1) organisms have faced unstable survival conditions over time and space, and (2) humans and the modern biota evolved during the Cenozoic's most dramatic period of environmental variability. These findings lead to the question of adaptability: How do organisms become adaptable – not merely tuned to one specific ancestral habitat? Can adaptability evolve such that genetic lineages may thrive in novel habitats? Behavioral plasticity, species diversification plus heightened extinction, and the later Pleistocene evolution of ecologically-adaptable species have typified several mammalian clades, especially the hominins. That a highly adaptable, worldwide species, *Homo sapiens*, eventually emerged from a geographically limited, apelike lineage further suggests the importance of adaptability in human evolution.

New paleoclimate information shows that the African context of hominin evolution entailed alternating eras of high and low climate variability. The oldest stone technology, key dietary shifts, brain enlargement, geographic expansions, and the expression of modern behaviors, all coincided with the most prolonged eras of high climate variability, each lasting 192 to 326 kyr. New experimental and mathematical treatments further suggest that inconsistent conditions of natural selection are responsible for the evolution of adaptable phenotypes. These lines of evidence support the concept of variability selection, in which adaptations evolve in response to environmental dynamics expressed over a wide spectrum of temporal scales and levels of biological organization, and enable organisms to accommodate to highly variable and novel settings.

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#### **Syngnathia (II): craniofacial malformations in historic skulls**

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Craniofacial defects in form of *syngnathiae* are infrequently found pathologies. Such alterations are either caused by connective soft tissues (synechia) or bony junctions (syostoses). There are congenital and acquired malformations, all affecting form, size, and function of the orofacial skeleton and hence influencing the facial physiognomy.

We present two recently discovered historical cases with complete unilateral bony adhesion. Specimen 1, a fragmentary left temporal bone with an associated portion of the mandible originates from the Early Mediaeval (Schönkirchen, Lower Austria). The skeleton belongs to an adult male; it represents the most ancient sample being affected by this malformation yet. The skull of specimen 2 belongs to an adult male dated to the 19<sup>th</sup> century. His anamnestic data are reported in the protocols of the Federal Pathologic-Anatomical Museum Vienna. Additionally, a further male specimen stored at this museum was taken for comparative purpose. It shows massive bony outgrowth on the left maxillary corps.

We applied conventional radiography and high-resolution computed tomography; based on the latter, 3D-reconstructions were created. Subsequently, samples of the tissue connecting the jaws were prepared for light-(LM) and scanning electron microscopy (SEM) investigation in backscattered electron (BSE) mode according to standardized procedures.

Our results indicate that in two individuals the deformations were most probably caused by trauma and/or chronic inflammation, while the third individual severely suffered from a neoplasm with massive bone formation, but without any jaw coalition. This review shows different forms of bony malformations on the skull causing complete or incomplete blocking of the jaws.

#### **The incredible shrinking molar: a study of the metrics and morphology of upper third molars.**

Suzanne T. Price, New York University

Upper third molar agenesis has long been of interest to dentists and anthropologists. Less research has focused on third molar crown size reduction (e.g., peg or reduced upper third molar), how it is manifested morphologically, and its relationship to the morphology of other teeth in the same dentition. This study explores the metrics of upper third molars and the frequency of the peg-shaped molar in European populations from museum collections at the American Museum of Natural History and the Natural History Museum (London). Buccolingual and mesiodistal dimensions were taken for all upper third molars. Crown morphology was recorded using the Arizona State University Dental Anthropology System in order to assess the morphological components of size reduction. Results indicate that Europeans exhibit a high frequency of reduced third molars (< 8 mm buccolingual). These populations also display a higher frequency of the peg-shaped molar than most other geographic populations. Furthermore, within the European sample, differences in trait frequency do exist. This study demonstrates that a population continuum exists in third molar size, as suggested previously in the literature. Within Europeans, some individuals in a population may show only subtle changes in third molar size, others may show a moderately reduced molar with some morphological change, and some may exhibit a peg-shaped molar that is both small in size and morphologically simple. This study was funded by a summer research grant from NYCEP.

#### **Precision grips and tactile hand movements: comparison of gibbons with great apes.**

J.M. Prime, Department of Anthropology, Southern Illinois University, Carbondale.

This study presents a comparison of the manipulatory hand functions in gibbons with published data on the other ape species to illustrate the unique variations of hand movements used by each species to perform precision grips and tactile sensory movements. Detailed data on hand manipulation skills in four captive gibbons was collected to determine how gibbons use their hands to manipulate various kinds of objects within their environments. This research has revealed that gibbons are quite capable of moving their hands in complex ways, incorporating a variety of different positions and combination hand maneuvers. Hand positions in gibbons involve precise and powerful movements that employ independent thumb or finger manipulation, or incorporate both the fingers and thumb in conjunction. However, hand use in gibbons appears to be significantly different from

their great ape counterparts. While the great apes frequently use their index and middle fingers to manipulate objects (to pick up objects or in an exploratory fashion), gibbons most frequently utilize their thumbs for such tactile sensitivity actions. Differences in the behavioral expression of hand use for each taxon show a direct relationship with their underlying morphology, which reflect selection for specialized locomotor mechanisms without compromising the ability for different ape species to manipulate objects proficiently.

**Electronic segmentation methods reveal the preservation status and otherwise unobservable features of the Mladeč I cranium.**

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The almost complete cranium of a young adult female, Mladeč I, is the most prominent specimen found in 1882 in the Upper Paleolithic site Mladeč/Lautsch in southern Moravia (today Czech Republic). Recently dated to 31 thousand years BP, the cranium has large parts of the right parietal missing, partly due to damage incurred during recovery by the archeologists. The restorers, while reconstructing these missing parts with gypsum, did not remove many encrustations present on the outside and the inside of this cranium. We show how we electronically remove the gypsum reconstructions, the stigmatic deposits and the sinter encrustations. In many places, we cannot electronically remove the curing agent (most probably shellac) with which the specimen had been painted, as the curing agent layer is usually too thin to be unequivocally identified in the CT-scan. We show the appearance of the cranium without the gypsum and encrustations and supply some estimates of the volume of encrustations and total endocranial volume. The distribution pattern of the encrustations is unusual. It seems that the deposition orientation of the cranium changed at least three times while lying in the cave. We can demonstrate these re-orientations through careful analysis of the distribution of stigmatic deposits in the endocranium. The endocranial volume of the cranium and its appearance without gypsum and encrustations bear implications for future researches.

**The steamroller blues.**

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Skeletons dating to the contact period (mid-1700's) are rare, due to taphonomic factors that inhibit good bone preservation.

Colonial skeletons, when preserved, are often encountered incidentally as unmarked burials in the name of modern progress (i.e. road or civic improvements).

This poster presents such a find. Human remains discovered in July 2005 were initially thought to be a forensic case by the county sheriff's department as a road was being dismantled for utility upgrades. The sandy substrate, geologically deposited by a glacial delta of the Genesee River, allowed for excellent preservation of the skeleton. The remains were interred in a pinned shroud within a wooden coffin, which had since degraded. Anthropological analysis revealed a craniodental anomaly, intense physical labor, and nutritional deficiency as a child. Cranial measurements and gross morphological observations reveal an "atypical" skull for a European male. Femora also lacked anterior bowing. Portable XRF was performed to determine trace element concentrations.

This individual represents one of multiple burials that were discovered in this general area. An incomplete adult calvarium and pelvic bone of a juvenile were also recovered in the days after the initial excavation. Historical documents revealed that two other burials were discovered in 1920 and 1820, however no anthropological report was found. It is likely that these burials represent the earliest settlers of the region dating to the contact period in New York State.

**Nutritional status and dental health: the complicating influence of gender and status**

Walter Psoter DDS, PhD, New York University College of Dentistry

There are few reports of the effect of early childhood protein-energy malnutrition (EC-PEM) on oral health in adolescents with a complete permanent dentition. The purpose of this retrospective cohort study is to provide the first scientific evidence of a relationship between EC-PEM and permanent teeth eruption, dental caries, enamel hypoplasia, and salivary hypofunction, while assessing the contributing factors of gender and socioeconomic status (SES).

Serial weights recorded between 1988-96 were used to establish a cohort of five categories of malnutrition exposure defined children. Between May and August, 2005 oral examinations and questionnaire administration was completed on 1,058, 11-19 year old rural Haitian children using.

EC-PEM is found to be correlated with delayed tooth eruption, decreased stimulated salivary flow and pH, increased enamel hypoplasias, and inversely with dental caries, although malnourished children appear to have a higher incidence of caries in adolescence. Gender and SES were predictors of the oral outcomes examined or modified of the effect of malnutrition on those oral outcomes.

EC-PEM levels adversely affect oral health in adolescents and their permanent teeth. Gender and SES are confounding

factors in evaluating oral pathologies. Importantly, even subtle differences of social capital in an otherwise homogenous population experiencing extreme poverty is a contributing factor in oral health outcomes. This is the first report of a longitudinal cohort study that describes a relationship between EC-PEM and oral disease and conditions in adolescents and should suggest avenues of further anthropological research to elucidate the deterministic mechanisms for these relationships.

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**Iris color and texture in admixed populations.**

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As part of a broader sampling of individuals from Europe, Africa, and the Americas, high-resolution eye photos were taken of volunteers in Porto, Portugal (n=201), Brasilia, Brazil (n=868), and Cidade da Praia, Cape Verde (n=128). Iris color was quantified by relative intensity of the RGB components of the digital photograph. Multiple measurements were taken from different sections of the iris to estimate variability in pigmentation and patterning. The iris color data was tested for correlation to hair and skin melanin data gathered using reflectometry. Additionally, frequencies of four textural characteristics of the iris (Fuchs' crypts, pigment dots, Wolfflin nodules, and contraction furrows) were ascertained by comparing the sample photographs to five reference photos selected as examples of the variation of each of these traits. Both eyes were scored for each individual to determine concordance.

These population samples are of particular interest because they include a European population as well as two admixed populations. The Cape Verde population is a mix of Western African and European ancestries while the Brazilian samples represent a population having European, West African, and Indigenous American origins. The biogeographic ancestry of each individual was determined using ancestry informative markers (AIMs) - autosomal SNPs selected to differentiate European, East Asian, West African, and Indigenous American populations. A first-level analysis showing correlation between biogeographic ancestry, eye color and the textural features will be presented. Future analysis will focus on the determination of genes functionally responsible for pigment levels, variability and the presence of these textural phenotypes.

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**The species problem: revisiting the idea of a temporary cessation in the naming of new species in hominin evolution.**

C.B. Quintyn. Department of Anthropology, Bloomsburg University.

The species problem is one of the most complex and enduring problems plaguing evolutionary biology in general and human paleontology in particular. In the past fifty years, species concepts have diverged and speciated analogous to the present, largely accepted view of hominin phylogeny. In fact, conventional wisdom supports a more "bushy" hominin phylogeny. But chaos rains because there is no agreed upon methodology to delimit species taxa in paleontology. No doubt, this dispute is complicated by the ever present intraspecific and interspecific variation and exacerbated by other types of variation, i.e., morphological, genetic, sexual, behavioral, ecological, geographical, and temporal within these two broad categories of variation. And when two or more of these forms of variation are used in the delimitation of "new" extant or fossil species, any decision arrived at could be construed as arbitrary. Based on several critical problems, such as the explosion of species concepts, arising from disagreements on species definitions; the differing interpretations of population variation leading to an overestimation or underestimation of the number of species, i.e., 'characters' (phylogenetic pattern posits high speciation rates) versus 'traits' (reticulate pattern posits low speciation rates); the problem of *modes* of speciation being confounded with criteria used to distinguish among species, e.g., punctuated equilibrium posits high speciation rates; and the difficulty of interpreting hybridization in nature—some believing that it is prime facie evidence of polytypic species or races while others view it as sympleisomorphic, a temporary cessation in the naming of hominin species should be considered.

**Migrations in and out of Africa; historical inference aided by simulation.**

R.L. Raaum, A.L. Non, C.J. Mulligan. Department of Anthropology, University of Florida.

Correct inference of human population history is dependent not only on the ability to estimate the time of origin of an allele but also its time of arrival in a population. Some populations have very simple histories and it is easy to distinguish between reliable and confounding data, but most population histories of interest, such as migrations in and out of Africa, are complex and include admixture from multiple sources at multiple times. Furthermore, data collected from any one genetic system (mtDNA, Y, X, or

autosomes) cannot uniquely identify a population's history; there is always a range of possible scenarios that pass unmentioned and go untested.

To improve our ability to infer population history, we performed simulations of the effects of admixture at different times (recent, Neolithic, Upper Paleolithic, and Middle Paleolithic), intensities (few migrants, many migrants), sex bias (male, female), and combinations thereof on the genetic structure of contemporary human populations. Our results show that the data from either mtDNA or Y chromosome data alone may be compatible with a broad range of possible population history scenarios. Analyzed together, mtDNA and Y chromosome data do diminish the range of possible population histories, but full elucidation of complex histories requires additional loci. Based on these simulation results, we interpret the results of our analysis of previously published and newly collected mitochondrial, Y chromosome, X chromosome, and autosomal data from the Horn of Africa and apply our findings to questions of both recent and ancient migrations in the region.

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**A test of articular modeling in response to load in human upper limb.**

K.Rabey. Département d'anthropologie, Université de Montréal.

It is recognized that mechanical loading plays an important role in skeletal development. Articulations were often considered to be less responsive to the mechanical environment and be much more constraint genetically. However, recent animal studies have shown that mechanical loads do influence joint architecture. Still, the contribution of the mechanical environment during bone growth to the variability of joint surface size and shape is incompletely understood. This project tests the hypothesis that joint surfaces are, in part, shaped by the mechanical environment. It tests whether individuals with larger muscle markings are characterized by differently shaped joints or proportionally larger joints. Most humans use preferably one arm over the other and as a result, have stronger muscles on the preferred side. Specifically, this project tests the hypothesis that the side that has larger muscle markings will have joints that are modeled to accommodate larger loads. Least-square regression was used to evaluate the influence of muscle size on the upper limb articulation shape and size on a sample of 108 individuals from the Canadian Museum of Civilization. The results show that there is little evidence that upper-limb articulations are asymmetrical. The hypothesis stating that the side with larger muscle markings will have joints that are larger and/or have a different shape is only supported by a few significant comparisons. This suggests that differences in the articulations may be very small and the sample too little to observe any

significant differences in the upper limb joints.

**Joint kinetics in chimpanzees and other mammals: are large bodied primates unique?**

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The kinetics of primate quadrupedalism differs from that of more cursorial mammals. Primate quadrupeds support a larger amount of body weight on their hindlimbs compared to their forelimbs, whereas most other mammals display the opposite pattern. While researchers generally agree that this pattern of force distribution allows primates to relieve their more mobile forelimbs from potentially dangerous weight-bearing, as yet, we do not fully understand why this pattern occurs and how it impacts the hindlimbs. Using an inverse dynamics approach, we calculated joint moments and joint power in a sample of three adult chimpanzees, and compared them with human and non-primate data from the literature. We suggest that chimpanzees support more body weight on their hindlimbs largely due to relatively flexed hindlimb joints. While it is true that these postures reduce peak joint moments in the forelimb, they also increase peak joint moments in the hindlimb and generate particularly high peak moments at the hip. Peak moments in chimpanzees differ from the patterns found in most other mammals, where moments are generally higher at more distal joints. Notably, primate quadrupeds exhibit joint moment patterns that might be expected for a large-bodied quadruped maintaining the joint postures of smaller, non-cursorial mammals. Results will be discussed in terms of both locomotor energetics and the evolution of joint mobility in primates.

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**Body mass estimation and personal identification.**

C.W. Rainwater, L.L. Cabo, S.A. Symes. Departments of Anthropology and Applied Forensic Sciences, Mercyhurst College.

Body mass estimates aid in the reconstruction and interpretation of sexual dimorphism and the construction of ecological models in paleoanthropology. While reliable estimation techniques with these goals in mind are well established in human paleontology, paleontological body mass estimates are rarely used in forensic settings and it is questionable whether they are appropriate for the forensic goal of personal identification.

This presentation explores the ability of standard paleontological body mass estimation methods to assess gross weight

differences in forensic settings using typical osteometric measurements. A range of standard paleontological models and a set of equivalent linear models developed for this study from modern samples (Forensic Databank and Hamann-Todd Collection) are tested in a case study to narrow a list of potential victims with large reported weight differences.

Results strongly suggest that confidence intervals associated with paleontological body mass estimates do not effectively narrow a list of missing individuals in a forensic setting, even between potential victims with large reported weight differences.

Alternatively, the probability ranges estimated from linear models are shown to be efficient in aiding in victim identification when the standard estimation method is substituted by a classification method. This method uses reported weights as independent variables to predict confidence intervals of osteometric measurements, which can then be compared to those recorded in the unidentified human remains. The likelihood of the unknown remains belonging to the known missing individuals can then be quantified in terms of posterior probabilities and typicalities.

**The effects of demographic and ecological factors on territory size and ranging patterns of Argentinean owl monkeys (*Aotus azarai*).**

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For a wide number of primate species, ranging behavior and territory size are thought to be influenced heavily by resource abundance and distribution, and by demographic factors, such as group size. Yet, abiotic factors (e.g., temperature, precipitation, wind, photoperiod, ambient light) are also likely to play a role in ranging patterns. Regardless of the factors considered, most field-based studies of the ranging patterns of nonhuman primates have focused on diurnal and tropical species. Data on primates with more diverse geographic distributions and activity patterns are needed to further evaluate the predictions of alternative models of primate ranging. We investigated how various ecological and demographic factors influence ranging patterns in Azara's owl monkey (*Aotus azarai*) – a cathemeral, temperate species. Ranging data were collected every twenty minutes during 120 12-hr follows of five owl monkey groups in the Chaco region of Argentina in 1998-1999. Average territory size across seasons was 7.1 ha, and the variation in territory size among groups (4.0 to 9.9 ha) did not correlate with group size (Spearman's test,  $r=0.16$ ,  $p=0.79$ ). We found

owl monkey ranging patterns to be influenced by moonphase and temperature. In particular, nocturnal ranging could best be predicted by moonlight, with groups ranging farther during nights of full moon, while diurnal ranging was related to daily ambient temperature. Future work should evaluate the influence on additional abiotic factors on day range length and territory size in nonhuman primates.

This research project was funded in part by grants to EFD from the L.S.B. Leakey Foundation, the Dourocouli Foundation, and the Argentinean Council for Science and Technology.

**Ancient Disease and Trauma: A Case from Tell Mozan, Syria dating to 1600 BC**

L. Ramos Department of Anthropology, Binghamton University (SUNY)

This poster seeks to provide osteo-archaeological analysis of A15.52 from the site of Tell Mozan to increase our understanding of ancient health, disease, and trauma during the late Khabur period (Old Babylonian 1600 BC) in northern Mesopotamia. Archaeological evidence from this site suggests that during the late Khabur, the dead were interred inside small houses with A15.52 found in a shallow subterranean tomb that formed part of a large multi-room funerary structure. This structure also contained the remains of three infants and one sub-adult buried under the floor levels in an adjacent room. The body was found resting on the right side, gently flexed, facing east, oriented north to south, with two ceramic vessels next to the lower legs. Skeletal analysis estimates A15.52 as an adult, possible female, exhibiting chronic hematogenous osteomyelitis characterized by cortical bone remodeling, medullary bone necrosis, and cloaca presence on the distal right femur with inflammation also noted on the right tibia, fibula, and patella. The skull contains two defects, the largest located on the back of the skull exhibiting a large circular hole with three radiating fractures and the second along the sagittal suture, elongated in shape that does not pierce the skull. The characteristics of these two defects are highly suggestive of perimortem trauma and trephination. Given the range of pathological conditions, A15.52 provides a rare opportunity to explore ancient disease in this region where currently very little skeletal data exists.

**Play and grooming as conflict management strategies in a captive group of Sulawesi crested macaques (*Macaca nigra*).**

J.K. Ramsey, C.M. Berman. Department of Anthropology, State University of New York at Buffalo.

Play and grooming in nonhuman primates are hypothesized to function to

avoid conflict and promote tolerance by alleviating tension before predictably tense periods, e.g., when feeding on provisioned food. Seven Sulawesi crested macaques (*Macaca nigra*) were observed at the Buffalo Zoo for four months. Affiliation, play, aggression, tension, and tolerant behaviors were recorded during 46 sessions, each consisting of four conditions focused around enrichment feeding: baseline, anticipation (food preparation), feeding, and post-feeding. We predicted that, if play and grooming serve to prevent conflict and promote tolerance, rates of play and/or grooming would increase over baseline levels during anticipation. In addition, we expected a negative correlation between rates of play and grooming in the pre-feeding period and rates of aggression during the feeding period. Rates of adult grooming decreased, juvenile play increased, and group pacing increased from the baseline to anticipation periods. Relatively high juvenile play rates during anticipation periods were significantly correlated with relatively low aggression rates by the adult male during feeding ( $N=30$ ,  $r = -0.347$ , Pearson:  $p < 0.05$ ). Similarly, relatively high grooming rates during specific anticipation periods were correlated with relatively high co-feeding rates during the subsequent feeding period ( $N=30$ ,  $r=0.266$ , Kendall:  $p < 0.05$ ). These results suggest that grooming and play immediately before feeding may decrease chances of aggression and facilitate tolerance during feeding. However, the correlation between grooming rates and co-feeding may also reflect general excitement surrounding feeding. It is also possible that juveniles played more frequently on days when the group was more relaxed.

**Curved beam model of mandibular symphyseal bending including heterogeneous elasticity.**

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Comparative biomechanical study of the anthropoid mandibular symphysis proceeds from the premise that it behaves as a curved beam with respect to bending due to laterally directed components of masticatory muscle forces. Such a model has been used to explore functional linkages between mandibular form and masticatory loads. This "strength of materials" approach to characterize symphyseal stress assumes the midsagittal section of the symphysis to be an idealized geometric shape under symmetrical bending with a single elastic modulus throughout (i.e., homogeneous elasticity). We improve upon this model by including material heterogeneity inherent in bone via an elastic modulus distribution that reflects experimentally determined variation in bone density and by more accurately portraying the internal loading as unsymmetrical bending.

Our model can apply to idealized cross sectional shapes (e.g., a solid or hollow ellipse) or to generalized cross sectional shapes via numerical approximation. Modulus variations from bone densities were determined from calibrated quantitative micro-computed tomography scans. We validated predicted strains with full-field strains measured with speckle image photogrammetry on an intact colobine mandible subjected to lateral transverse bending. Our model and experimental results indicate that the characteristic inclination of the symphysis functions to alleviate the potential increase in strain in the inferior transverse torus caused by the combined effects of a curved mandibular arch and lingually compliant bone. Both experimental and model data suggest that symphyseal bone is not optimized for strain similarity but rather for maximization of an index relating stress to strength in regions most susceptible to failure.

#### **Ontogeny and phyletic size change in living and fossil Malagasy primates.**

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Malagasy primates are notable for encompassing the range of body-size variation for all other primates past and present - about five orders of magnitude. Benefiting from the close phylogenetic proximity of many larger-bodied subfossil species to smaller living forms, this research uses allometric data from the skull and postcranium to probe the ontogenetic bases of size differentiation and morphological diversity across this clade.

The goal of this study is to perform the first comparative examination of growth allometries in 359 non-adult and adult crania from 10 lemuroids, 176 non-adult and adult crania from 8 indrioids, and 102 non-adult and adult postcrania from 5 indriids. In extant species, ontogenies are employed as a criterion of subtraction with which to evaluate morphological variation, and putative adaptations, among sister taxa.

In lemuroids, a pervasive pattern of ontogenetic scaling is observed for facial dimensions in all 5 genera, with 3 genera also sharing relative growth trajectories for jaw proportions (*Lemur*, *Eulemur*, *Varecia*). Differences in masticatory growth and form characterizing *Hapalemur* and fossil *Pachylemur* may reflect similar dietary properties. Pervasive ontogenetic scaling characterizes the limbs, trunk and facial skull in *Indri*, *Avahi* and *Propithecus*. Facial growth allometries for these 3 extant indriid genera and 2 larger, extinct sister taxa (*Mesopropithecus*, *Babakotia*) also are ontogenetically scaled. Significant interspecific differences are observed, however in the scaling of indrioid masticatory proportions. Differences in the mechanical advantage of the jaw adductors and stress-

resisting masticatory elements appear trophic in nature. Such dissociations highlight selection to uncouple shared ancestral growth patterns.

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#### **New long bone stature estimation equations for ancient Egyptians.**

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Trotter and Gleser's (1952, 1958) formulae for blacks or derivations thereof (Robins and Shute, 1986) have been previously used to estimate the stature of ancient Egyptians. However, human proportions differ between populations; consequently the most accurate mathematical stature estimates will be attained when the population being examined is as similar as possible in proportions as the population used to create the equations. The purpose of this study was to create new stature regression formulae based on direct reconstructions of stature in ancient Egyptians and assess their accuracy in comparison to other stature estimation methods. We also compared Egyptian body proportions to those of American blacks and whites from the Terry Collection.

The Egyptian sample included 100 adults (63 males, 37 females), primarily from Old Kingdom sites. Living stature estimates were derived using a revised Fully anatomical method, applied to virtually complete skeletons (Raxter et al., 2006). Long bone stature regression equations were then derived for each sex.

Our results show that although modern US blacks are closer in body proportions to Egyptians than are US whites, proportions in blacks and Egyptians are not identical. The newly generated Egyptian-based stature regression formulae have standard errors of estimate of 1.9-4.2 cm. All mean directional differences are less than .4% compared to anatomically estimated stature, while results using Robins and Shute's and Trotter and Gleser's formulae are more variable, with mean directional biases varying between .2% and 1.0%, tibial estimates being the most biased.

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#### **Polarized light microscopy of the dural tracks underlying prematurely synostosed coronal sutures in New Zealand white rabbits**

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The dura signals the tissues of the cranial vault both mechanically and chemically to affect the timing of the closure of cranial sutures. Premature suture closure may be a result of excessive dural thickness or abnormal dural track orientation. The present study using a perinatal rabbit model of craniosynostosis was used to test this hypothesis. Polarized light microscopy (Leica stereo microscope with polarizing lenses) in conjunction with imaging software (ImageJ) were used to measure collagen birefringence and thus the amount of dura present in the interdigitating region of the left and right coronal sutures from 100 preserved calvaria of New Zealand white rabbits (n=200) ranging in age from 21 to 41 days postconception. The sample groups are: wild-type (WTC) normal controls (n=24); normal in-colony (ICC) controls (n=57); delayed onset synostosis (DOS) (n=50); early onset synostosis (EOS) (n=69).

Gross microscopic examination showed thickened and less parallel dural tracks in DOS and EOS rabbits compared to controls. Digital images of each coronal suture at the interdigitating region were converted to 8-bit grey scale ranging from 1 to 255 and quantified (WTC, mean=53.0, std=11.4; ICC, mean=48.4, std=12.5; DOS, mean=64.5, std=16.8; EOS, mean=81.6, std=18.5). Oneway ANOVA revealed significant mean grey scale differences (F=47.5, p<.001) demonstrating that there is more collagen present at the interdigitating zones in rabbits with prematurely fusing sutures compared to controls. These results suggest that an overdevelopment of the dural track and subsequent tethering may be a causal factor for premature suture fusion in this model.

#### **Long-distance solo calls of white-handed gibbon males (*Hylobates lar*).**

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In many territorial primate species, males produce vocalizations that carry further than the caller's home range boundaries. The evolution of such long-distance male calls is most commonly explained by one of the following hypotheses: males call to (1) defend a female, (2) attract a female, or (3) defend resources important for a female.

We studied long-distance solo calling in seventeen habituated white-handed gibbon males (*Hylobates lar*) over a one year period (~7200 group contact hours) at Khao Yai National Park, Thailand. Three males did not sing during observations and were excluded from analyses, although they solo called at other times. For the remaining males, 101 solos were spread over 750 observation days.



Two recently matured adult males called about ten times as often and seven times longer than other males, and three out of six polyandrously paired males called 3.4-times more often and 3.6-times longer than monogamously paired males. These and additional results agreed more with predictions of the mate-attraction-hypothesis than alternative explanations. Nevertheless, since the three main hypotheses are not mutually exclusive and our data did not allow us a direct test of all proposed functions additional explanations are not rejected. We conclude that mate attraction plays a key role in long-distance calls of white-handed gibbons, which remains important beyond pair formation, and argue that solo songs potentially function as honest signals of male quality in the context of male-male competition as well as in assisting females in their sociosexual and extra-pair copulation partner choices.

#### **The ecology of puberty: C-peptide and anthropometry in an Eastern Toba population.**

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Puberty represents a major human life history transition during which the body changes its pattern and purpose of resource allocation. The timing of puberty is sensitive to ecological and developmental conditions, yet its precise proximate determinants remain obscure. Understanding what cues the body to switch from growth and juvenile development to reproductive investment and the physiological pathways along which such information flows will help us understand the evolutionary forces that have shaped this transition. Furthermore, characterizing the variety and flexibility within normal development will help elucidate the causes of puberty-related pathologies such as PCOS and Type II Diabetes.

Past research has focused on neuronal, pituitary, and gonadal contributions to the initiation of puberty. We propose that the timing of puberty may be responsive to changes in metabolic energy availability coordinated by major hormonal regulators of metabolism. A period of transient, adolescent insulin resistance, present in Western populations independent of BMI and pathology, may mark this transition. To begin investigating this possibility, research was performed with a recent hunter-gatherer population of Eastern Toba in the Gran Chaco region of Argentina. Height, weight, percent body fat, and C-peptide data were collected from 110 participants between the ages of six and eighteen. The growth patterns and C-peptide profiles of this population are characterized independently and in relation to each other.

This research was supported by a Summer Research Fellowship from The Endocrine Society.

#### **Quantifying the angle of orientation of the metatarsophalangeal joint surface of proximal phalanges in extant primates.**

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The metatarsophalangeal joint surface of proximal pedal phalanges of humans has a high angle of orientation (i.e., dorsal canting) when compared with those of other extant large hominoids. This difference has been functionally related to extreme dorsiflexion of the foot during bipedal locomotion. Previous comparative studies have focused on the significance of this feature for inferring bipedality in the locomotor repertoire of early fossil hominins. It is important to extend the analysis beyond hominoids and compare the angle of orientation in a diverse range of extant primates with varying positional behaviors in order to examine the broader functional significance of the trait.

Measurements were made from digital images of the angle of orientation of the metatarsophalangeal joint surface of the four lateral digits of the pes. Pooled mean values of the angle of orientation were compared. As reported in earlier studies, *Homo* has the highest angle of orientation of all extant primates while *Pongo* demonstrates the lowest value. Aside from modern humans, semi-terrestrial cercopithecines have the highest angles of orientation. These angles are significantly higher than those of primarily arboreal cercopithecoids and platyrrhines. This difference is related to the contrasting kinematics of the foot in these taxa. Semi-terrestrial cercopithecines experience more dorsiflexion of the lateral rays than strictly arboreal taxa that are characterized by plantarflexed digits during locomotion. The results indicate that the function of dorsal canting is related to increased stability in dorsiflexed positions of the foot during terrestrial locomotion.

#### **Lessons from collaborative bio-cultural anthropological research for improving conservation of African apes and protected area management.**

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This collaborative, cross-subfield bio-cultural anthropological research documents changing relationships between humans and animals in the Dzanga-Sangha Dense Forest Reserve (RDS), Central African Republic (CAR). Recent decades at RDS have seen striking tensions between rapidly growing human populations, logging and conservation-related economies under an

Integrated Conservation and Development Project (or ICDP). Documenting the rise of rival economies within the four distinct use sectors of RDS, we elaborate the significance of micro-ecologies and changing human/animal interactions for variation in the spatial distribution and density of African apes and other wildlife and human hunting. Combining ethnographic interviews, archival research, line-transects and longitudinal ecological studies captures nuances and variations in resource use patterns by both humans and animals over time, facilitating our understanding of the cultural and the ecological significance of such patterns. Unfortunately, anthropology's potential to enable more intelligent formulation of conservation policy and strategies for complex multi-use sites is rarely realized. Long-term anthropological studies enhance our understanding of micro-regional shifts in density, ecology and behavior and how to put these insights into practice for conservation. Our approach offers an alternative to increasingly institutionalized divisions of method and theory between biological and social monitoring of change within protected areas. It suggests possibilities for improvements to current conservation strategies, by offering alternatives to the divisions between core and buffer zones, for the integration of social and ecological research in adaptive management, fine-tuning capacity building efforts, and expanding the idea of cultural keystone models for considering cross cultural and competing values of African apes within protected areas.

#### **The genetics of post-cranial skeletal development: implications for interpreting primate morphological evolution.**

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Our understanding of the genetics of skeletal development has burgeoned in recent years. Skeletal morphology is now understood to be specified during pattern formation. Selector genes determine developmental fields, and downstream target gene expression then coordinates the assignment of presumptive cellular identity. As an example, the complex overlapping domains defined by Hox genes play a fundamental role in patterning both the axial and appendicular skeletons. Such selectors sculpt the skeleton by interacting with often elaborate and complex *cis*-regulatory regions of realizator genes that modulate particular cellular growth processes. The implications of these discoveries for the interpretation of both contemporary and ancient primate skeletal morphology are profound. The modular nature of Hox gene expression can serve as a mechanism underlying the co-evolution of various skeletal traits. Of equal importance, however, is the emerging understanding of

the specificity by which individual promoters in the regulatory regions of realizator genes, such as members of the TGF $\beta$  family of signaling molecules, impact their expression. Directional change in the interaction of selector genes with such promoters serves as an ideal mechanism for evolutionary modification of the skeleton. Moreover, intraspecific variation in the relationships of these promoters likely underlies fluctuating interpopulational differences in phenotypic characters. One of the most salient insights of these discoveries is that strain transduction now appears to play a only a minor role in shaping the mammalian skeleton, and indeed, "Wolff's Law" must now be reassessed in light of new knowledge about pattern formation.

**A preliminary demographic study on a historical cemetery from rural Canada: children mortality at St. Ignace-du-Lac village (Matawinie, Quebec, early 1900s).**

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Through the historic archives of a village cemetery from rural Quebec (St. Ignace-du-Lac, Matawinie), this preliminary study prior to cemetery excavation aims to reveal some demographic aspects (mortality rates), dealing with a critical period of the early 20<sup>th</sup> century AD. The mortality of children in a population is often a good socioeconomic indicator of problems related to state of health such as epidemics and nutritional deficiencies (weaning problems). The life duration of the village of St. Ignace-du-Lac (1906-1929) corresponds exactly to the pre-thirties period before the great depression. Its cemetery (N=168), which is composed mainly of individuals under 18 years of age (60%), shows in particular a very high mortality of 1 year old individuals (49%). During the first year of age (N=83), a mortality peak has been identified at 3 months of age, after which it declines progressively. In 1918, the Spanish flu epidemic apparently did not increase infant mortality, as it affected mainly the adults (26%). Several interpretations about high infant mortality could be proposed in relation to stress caused by weaning and/or various infections such as diarrhoea. Weaning age has been observed at a later age (6 months) in other populations dated to 19<sup>th</sup> and 20<sup>th</sup> centuries AD and originating from Canada and Europe. The influence of weaning practices has been here not excluded as a possible explanation. However, further research is needed to explore the variation of cultural and epidemiological aspects in eastern Canadian societies, especially from Quebec in early 1900s.

**The Taylor Burying Ground Skeletal Assemblage: Demographics, Antemortem Characteristics, and Health.**

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In the early 1970s, Dr. Marshall J. Becker and an untrained student field crew from West Chester University, Pennsylvania excavated the archaeological site, the Taylor Burying Ground. Located on the old Taylor family 200 acre tract of land in Westtown, Pennsylvania, the group of individuals interred experienced a transition from an agricultural-based to an industrial-based way of life between 1750 and 1850. The experience of this transition implies that this group of individuals worked and lived, died and was buried within this one hundred year time frame. However, specific dates of birth, life, death, and burial could not be ascertained. Nonetheless, I theorize this transition could have had direct consequences on the overall health of this group of individuals.

To understand overall health, an osteological analysis was conducted based on the context and condition of the skeletal assemblage, demographic characteristics: age, ancestry, and sex, and antemortem characteristics: pathological conditions, skeletal anomalies, and markers of occupational stress. As a whole, the skeletal assemblage, which was comprised of 16 skeletons, was well preserved, but the individual condition of the skeletons varied and played a major role in analysis. Ultimately, discussion centered on one key three-part question: What indicators of overall health did the demographic characteristics, pathological and skeletal anomalies, and markers of occupational stress reveal, if any? Therefore, this analysis could help to reveal aspects of overall health in Chester County, Pennsylvania during late colonial and early federal times.

**Developmental genetic basis of primate craniofacial variation and human origins.**

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We describe an integrative, collaborative, and multidisciplinary project aimed at understanding the developmental genetic basis of the evolution of craniofacial variation in the genus *Homo*. We have launched a project that identifies the dimensions of natural craniofacial development, variation and evolution using baboon skulls from the Southwest Foundation for Biomedical Research (SFBR), select fossil primate skulls, and a large sample of F10 Advanced

intercross mice (N=1200). Using these complementary skeletal collections and modern genetic technological discoveries, we quantitatively describe craniofacial phenotypic integration and variation, conduct linkage analyses to identify genes in baboons and mice that are associated with phenotypes, and experimentally confirm that these genes are appropriately expressed during craniofacial development in networks that are responsible for evolution of craniofacial shape within and between species. 3D CT scans are being analyzed to identify single and multivariate axes of craniofacial variation. The baboons are from a known pedigree at SFBR, and have been genotyped for about 350 microsatellite markers. Mice and primates share basic processes of skeletal development, so the mouse is used as a phenotypic and genetic model for identifying these processes.

We are continually adding to several databases that will be made available to future collaborators including 3D CT images of mouse and baboon skulls, 3D coordinate data collected from these scans, genetic information, and quantitative methods. Our project website is designed to inform the public of our work in these areas. We welcome inquiries about data sets that are available for collaborative work.

This work is funded through NSF BCS-0523637.

**The reemergence of the Joseph Jones collection**

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The pursuit of ancient American skeletal materials led one medical doctor, Joseph Jones, to initiate his own archaeological excavations of mounds, earthworks, and stone box graves in Tennessee during 1868 and 1869. Through his analysis of these remains, Jones formulated and endorsed an informed theory regarding New World origins for venereal and non-venereal syphilis.

While re-analysis of these remains is desirable in order to test Jones' theory using modern anthropological methods, the collection appeared to be lost following Jones' death in 1896. The Jones family sold the collection to the Heye Foundation/Museum of the American Indian (MAI) in 1906 and the history of their subsequent dispersal remains unclear.

During recent repatriation proceedings, twenty-two skulls in the NYUCD collection were found to be associated with the Jones collection. The majority of these were from Jones' Tennessee excavations and were re-examined for pathological conditions. Of the skulls housed at NYUCD, none showed specific lesions indicative of syphilis and no other major pathological conditions were found.

While it is true that no lesions were found to support Jones' theory of syphilis in the Pre-Columbian New World, their absence does not necessarily provide definitive proof that Jones' diagnoses were incorrect. It is possible that NYUCD was simply not in possession of any of the syphilitic skulls present in Jones' original collection. In addition, with the relatively rare occurrence of diagnostic cranial lesions in N. American skeletal materials which show post-cranial treponemal changes, a sample of skulls alone may not be representative of the paleopathology in the collection overall.

#### **Spatial proximity and association patterns in four groups of wild black howler monkeys (*Alouatta pigra*) in Southern Mexico.**

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The study of association patterns in non-human primates is useful for a critical understanding of group sociality. We analyzed spatial proximity and association patterns in four groups of Mexican black howler monkeys (*Alouatta pigra*) in the states of Campeche and Tabasco, Mexico, from October 2002 to May 2003. Spatial proximity was defined as the distance between focal animals (adult males and females) and their nearest neighbors (adult males, adult females and juveniles) considering two distance categories: in contact and less than 5 m away. It was analyzed through three dimensional contingency tables. Association was defined as the frequency with which two individuals were found close to each other (0-5m) within a social group. To determine association patterns, we considered the frequency of association between two recognized individuals (dyad), and then analyzed it using a proximity index. Our results indicate that during feeding, resting and traveling, same-sex individuals were infrequently in close proximity (male-male 3.9% of the time; female-female 29.5%), while males and females were each other's nearest neighbor 44.8% of the time (more frequently than expected by chance). In addition, we were able to detect long-term associations between males and females in each group. Male-female dyads were stable during the whole study period (including reproductive and non reproductive periods). We suggest that black howlers are selective in their associations, and that proximity among particular males and females can offer benefits including protection (for females) or mating advantages (for both males and females).

#### **The role of Dmanisi in early hominin dispersals.**

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The site of Dmanisi continues to yield traces of the earliest hominins from western Asia. The morphology of the Caucasus skulls is clearly consistent with that of genus *Homo*. Geological context suggests that the Dmanisi assemblage represents either a single population, or penecontemporary groups, living ca. 1.77 million years ago. Endocranial volumes range from 600 cm<sup>3</sup> to 775 cm<sup>3</sup>, while tori and other vault superstructures are only moderately developed. The hominins thus resemble African *H. habilis*, although many of the similarities are likely to be symplesiomorphies. Other characters suggest that the Dmanisi skulls are best placed with *H. erectus*. This evidence can be read to support an early dispersal of *H. erectus* from Africa to Eurasia. However, the relatively primitive morphology of the Dmanisi fossils suggests that an alternative hypothesis should be considered. It can be argued that the first hominins to leave Africa were similar to *H. habilis* (*sensu stricto*), and that such a founding population only later gave rise to *H. erectus*, as documented at Dmanisi. This "Asian origins" view holds that *H. erectus* evolved in western Eurasia and then dispersed to Africa. At about the same time, other populations of *H. erectus* must have pushed eastward toward Java and China. Such an interpretation is consistent with the distribution of anatomical characters in the ancient fossil assemblages, and it can be accommodated within the current geochronological framework established for the Early Pleistocene.

#### **Distribution of *Macaca ochreata* and identification of mixed *ochreata-tonkeana* groups in South Sulawesi, Indonesia**

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The goal of the research was to collect distributional data on booted macaques (*Macaca ochreata*) in the Faruhumpenai Nature Reserve in South Sulawesi, Indonesia in order to assess its appropriate conservation status. Methodology included censuses conducted along piecewise linear transects established at two sites at the nature reserve from April – July 2006. Total distance walked was 45km for the Matano site and 20km for the Kasintuwu site. Group density of booted macaques at the Matano site was 2.2 – 2.4 groups/km<sup>2</sup>. At the Kasintuwu site, groups of booted macaques, tonkean macaques (*Macaca tonkeana*), as well as mixed *tonkeana-ochreata* groups were encountered. Group density of booted macaques was 2.5 – 2.8 groups/ km<sup>2</sup>. Overall macaque group density (i.e., *Macaca* spp.) at

this site was 4.5 – 6.8 groups/ km<sup>2</sup>. This research demonstrates that two species of Sulawesi macaques, *M. tonkeana* and *M. ochreata*, as well as mixed *tonkeana-ochreata* groups occur in the forests in and surrounding Faruhumpenai Nature Reserve. These results indicate that the range of *M. ochreata* extends further north and northwest than previously believed. The conservation status of booted macaques may therefore not be precarious since their habitat is protected in not only two large conservation areas in Southeast Sulawesi (i.e., Rawa Aopa National Park and Tanjung Peropa Game Reserve), but also in South Sulawesi. Nonetheless, because cacao is frequently planted on the edge of protected forest, human-macaque conflict resulting from crop raiding may eventually pose a threat to the macaques.

This research was sponsored by the Indonesian Institute of Sciences (LIPI) and financially supported by the Margot Marsh Biodiversity Foundation.

#### **A comparative diffusion tensor imaging (DTI) study of the arcuate fasciculus language pathway in humans, chimpanzees and rhesus macaques.**

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The cognitive attribute that most clearly distinguishes humans from other primates is our capacity for language. Human language is supported by typically left sided regions in temporal, parietal and frontal cortex that are connected by a white matter tract known as the arcuate fasciculus. The objective of this study was to identify possible language-related specializations of the human brain by comparing human, chimpanzee and rhesus macaque brains in the region of the arcuate fasciculus with diffusion tensor imaging (DTI).

Post-mortem and in vivo DTI scans were acquired from human, chimpanzee, and macaque subjects. Color maps illustrating the principle diffusion direction were produced with the FSL DTI software package. Probabilistic (FSL) tractography software was used to reconstruct the arcuate pathway or its homologue in all three species.

Tractography results suggest that connections linking the posterior superior temporal gyrus (Wernicke's area) and left inferior frontal cortex (Broca's area) exist in all three species. However, connections linking semantic processing areas of the middle temporal gyrus (BA 21, 37, 39) with Broca's area are only present in humans and chimpanzees, and are considerably more prominent in humans.

These differences in the arcuate fasciculus language pathway between humans and chimpanzees may be relevant to the evolution of the neural substrates for human language. Supported by a grant from the University Research Committee of Emory University and by the Center for Behavioral Neuroscience under the STC Program of the National Science Foundation under Agreement No. IBN-9876754

#### Sacral fusion as adult age indicator.

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An understanding of the basic growth rates and patterns of development for each element of the human skeleton is important for a thorough understanding and interpretation of data in all areas of skeletal research. Yet, surprisingly little is known about the detailed ontogenetic development of many bones, particularly the sacrum. New methods in transition analysis for modeling age estimation based on the age indicator stage of skeletal elements enable a greater precision for determining age structure in samples. Since McKern and Stewart's study on the fusion of the sacrum as related to age little has been published on the stage of fusion in the sacral segments. The present study provides a non-truncated sample of known age Portuguese individuals scored for sacral fusion at four sacral segments from 242 individuals (100 females, 142 males). Preliminary results indicate that after 35 years of age males and females have S2-3, S3-4 and S4-5 completely fused. However S1-2 does not fuse completely until 55 years old in both sexes. A comparison of the McKern and Stewart data with the Portuguese sample using transition analysis demonstrates the utility of this age indicator across a broader age range and allows for the examination of interpopulational differences. An application of these methods is demonstrated on an unknown sample of skeletons recovered from a mass grave from the Spanish Civil War.

#### A fine line: a preliminary study comparing methods of estimating ages of linear enamel hypoplasia formation.

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Linear enamel hypoplasias (LEHs) result from periodic disruptions of enamel matrix secretion, providing markers of non-specific stress. The position of LEHs allows reconstruction of a chronology of stressful events. Previous methods for estimating LEH formation, however, do not conform to current models of non-linear crown growth. This study compares conventional models for

estimating the age of LEH formation (one that graphically transforms measurements from the cemento-enamel junction [CEJ] to the LEH into ages of formation in 6-month intervals, and another that uses regression equations that relate LEH position to age of formation) to a new and more appropriate method based on histological analyses that constructs chronologies of crown growth, in deciles, using both a northern European and South African reference population.

LEH timing is determined on a pooled sample of teeth (n=125) of 62 individuals from Semna South, Sudan, dating from 350 B.C.–A.D.1400. LEH position is recorded as linear distance from the CEJ, then transformed into its position from a reconstructed cusp tip using data from preserved unworn teeth. The conventional methods consistently yield significantly lower age estimates. Specifically, regression equations provide significantly different ( $p < 0.001$ ) age estimates that are 1.06 years less than those using the new method. When calculated using the graphical method the modal interval of age at LEH formation is 1.5 years less than that using the new method ( $p < 0.0001$ ). This magnitude of underestimation produces divergent interpretation of bioarchaeological datasets and justifies reevaluation of the methods for estimating ages of LEH formation.

#### High inter-individual microbial diversity among baboon vaginal ecosystems

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Recent molecular ecological analyses of human vaginal microbiota have demonstrated strikingly high levels of inter-individual vaginal ecosystem diversity. Such high diversity implies that variables such as reproductive status, hormonal state, immunologic factors, and environmental factors affect the composition of vaginal ecosystems. We examined microbial community profiles of baboon (*P. hamadryas*) vaginal samples to test the hypothesis that baboon vaginal microbial diversity is comparable to that of humans.

A single observer collected vaginal samples (first swab, then gentle scraping, followed by lavage) from 35 captive baboons (Southwest Foundation for Biomedical Research) under IACUC-approved protocols. 16S rDNA from each sample was amplified by PCR using primers specific for sequences flanking the V3 variable region and analyzed using denaturing gradient gel electrophoresis (DGGE). Our results showed that baboons exhibit high levels of vaginal ecosystem diversity among individuals, paralleling previous findings for humans. While partial overlap in DGGE bands suggests that different individuals may share certain microbes, overall banding patterns differed

substantially, with some individuals lacking bands present in others. Within individual baboons DGGE banding patterns were generally consistent among the three sampling methods (i.e., swab, scraping, lavage), with lavage showing the greatest variability compared to swab or scraping.

In contrast to humans, where different environments and dietary practices are confounding factors, the relatively uniform management practices in the baboon colony exclude some environmental factors as causes of the observed variation and imply that other factors contribute to vaginal ecosystem diversity. Current research efforts seek to define those factors that affect vaginal ecosystem diversity.

#### Evidence for modularity in the cranium: quantitative genetic analysis of a pedigreed mouse population.

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The genetic architectures of morphological traits employed in primate phylogenetic analyses are relatively unknown. Advances in developmental genetics suggest that many of the cranial traits employed may result from similar developmental modules. Increasing our understanding of the genetic interrelationships between individual traits and the identification of developmental/genetic modules may clarify which characters would be most informative in phylogenetic analyses. Here we report on research investigating the cranium, exploring the genetic relationship between the face, the dentition, and the braincase.

This study utilizes quantitative genetic analyses to identify and quantify genetic correlations between cranial traits in a pedigreed outbred mouse population. Mice present a useful model from which genetic and developmental patterns of integration can be identified and subsequently applied to primates.

Linear measurements of the maxillary first molar are analyzed in conjunction with measurements of facial and cranial height. Using a maximum-likelihood-based variance decomposition approach (SOLAR), we estimated heritability for thirteen phenotypes and genetic correlations between them. All phenotypes yielded significant heritability estimates (average dental  $h^2r = 0.81$ ; average cranial  $h^2r = 0.59$ ). Tests of genetic correlations show incomplete pleiotropy between the length of the first molar and both cranial and posterior facial height ( $RhoG = 0.51 \pm 0.11$  and  $0.28 \pm 0.11$ , respectively). However, molar length and anterior facial height are genetically independent, suggesting that the anterior and posterior face may reflect different developmental modules. We compare these results to other studies of cranial modularity and outline the possible implications for primate evolutionary studies.

### **Saving the Babies from the Bathwater: a new Method for estimating Fertility.**

G. Robbins. Department of Anthropology, Appalachian State University.

This poster provides a new method of estimating Gross Reproductive Rate (GRR), crude birth rate, and life expectancy at birth for samples that are heavily biased toward representation of sub-adults under 5 years of age. Methods for estimating demographic parameters in fertility-centered demography include the Index of Juvenility (Bocquet-Appel and Massett, 1977, 1982; Bocquet-Appel, 2002), the Mean Childhood Mortality Quotient (Jackes, 1986), and other proportional hazards (Buikstra et al., 1986). These methods exclude perinates, infants, and children because they are often poorly represented in skeletal assemblages. There are skeletal assemblages, such as those from the Deccan Chalcolithic in India (3800-2700 B.P.), that are primarily comprised of individuals less than five years of age. These infants and children have a lot to offer paleodemography because of the relatively greater accuracy and precision of age estimates for these individuals.

Using Weiss (1973) model tables and demographic data from published sources (McCaa 1998, 2002), this poster provides a quadratic equation for estimating GRR solely from proportions of individuals less than five years of age. This method provides a statistically significant way of predicting GRR from early childhood remains ( $F = 21.38$ ;  $p = 0.000$ ) that is not significantly different (adjusted R squared = 0.689;  $p = 0.000$ ) from estimates provided by other methods, such as Bocquet-Appel and Massett (1977). An estimate for GRR and archaeological estimates of settlement growth rate makes these samples more comparable with other populations through estimates of fertility and life expectancy at birth using McCaa (2002).

This research was supported by grants from Fulbright, American Institute of Indian Studies, and the George Franklin Dales Foundation.

### **Encephalization and life history: Lessons from primate brain growth trajectories.**

S.L. Robson. Department of Anthropology, University of Utah

Life history studies often associate encephalization with a slow life history, suggesting that large adult brain size requires a long duration of post-natal brain growth, thereby extending the juvenile period and delaying sexual maturity. Because primate species are characterized by long subadult periods and are notably encephalized compared to other mammals they provide an excellent opportunity for examining the association of brain growth and life history trajectories. Utilizing published cross-sectional brain growth data

for three primate species (rhesus macaques, chimpanzees, and humans), I examined the following expected associations. First, greater duration of post-natal brain growth will be correlated with a longer juvenile period. Second, species with a longer duration of post-natal brain growth will have a smaller percent of adult brain size at birth. Third, species with a longer subadult period will have slower rates of brain growth. Results show that while primate brain size is strongly correlated with a longer juvenile period, these species achieve adult brain size long before maturity. In addition, larger brains do not necessarily require longer growth periods. Rather, encephalization is achieved through an increase in growth velocity. These data challenge ideas about altriciality, growth and development, and the association between brain growth and life history.

### **Ethnogenesis in the slave trade: the case study of São Tomé (Gulf of Guinea).**

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Populations derived from the Atlantic slaving process provide unique opportunities for studying key evolutionary determinants of current patterns of human cultural and biological variation. São Tomé is a small (832 km<sup>2</sup>) plantation island that played a crucial role as a slave entrepôt and has a surprising level of linguistic variability, including two autochthonous creole languages (São-Tomense and Angolar) alongside with the official Portuguese language. We present an analysis of the genetic structure of São Tomé based on a study design that avoids the use of preconceived ethno-linguistic labels to define genetic sampling units. To this end, we used a transect sampling strategy encompassing 14 major localities within the island, followed by the sorting of 394 sampled individuals into genetic clusters based on 15 microsatellite loci genotypes, and the comparison of additional phylogeographic informative markers across the inferred genetic clusters (mt-DNA sequences, Y-chromosome and Beta-globin haplotypes, and Duffy blood group variation). We found that, despite the maximum distance between any two sampled sites being less than 50 km, São Tomé has an unusual level of genetic structure that is mainly caused by the grouping of Angolar creole speakers in a separate genetic cluster, which carries a distinct imprint of genetic drift, while retaining the signature of genetic contributions from disparate areas of the African mainland. Together with the available historical and linguistic evidence our results indicate that Angolar speakers

descend from an original community of slave escapees, providing one of the earliest examples of ethnogenesis associated with the Atlantic slave trade.

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### **Fathers and Stepfathers: Familial relations of old and new males within groups of *Callicebus brunneus* in southeastern Perú**

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F. J. Bossuyt studied seven groups of titi monkeys (Callicebinae: *Callicebus brunneus*) at the *Estación Biológica Cocha Cashu* on the Manu River in Peru from 1996 through April 2000. The population consists of monogamous pairs living with offspring in small territories. Observations were taken of diverse social and spatial relations of all individuals, which were well identified, within groups. Typically, a pair produced one offspring per year in September or October, and offspring remained with the pair for up to four years. Multiple adults died or disappeared from groups with one or more offspring present. The adults were replaced by strangers or by dispersers from within the local population, and the current offspring then lived with a non biological "parent." Preliminary examination of the data suggested that social relations between a new adult and the rest of the group quickly stabilized and closely resembled social relations of the previous adult. The data are examined more closely to compare intra group relations of post replacement stepfathers with intra group relations of biological fathers.

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### **Scratching the surface: observations of tool use in wild spider monkeys.**

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Tool use has been observed among several anthropoid primate species but reports of this behavior in spider monkeys are absent from the literature. Here, we present evidence of tool use in wild spider monkeys (*Ateles geoffroyi ornatus*) at El Zota Biological Field Station, Costa Rica. Three bouts of tool use were recorded *ad libitum* over the course of two field seasons involving two adult females and one juvenile female among two different communities. The three individuals were observed using unattached sticks for

scratching and grooming. Tool modification, consisting of chewing on the sticks' ends, was also observed for two individuals. The type of object modification and manipulation described here agree with Beck's (1980) standard definition of tool use. These behaviors are especially noteworthy given that *Ateles* hand morphology presumably constrains their ability to manipulate objects in relation to more prodigious tool users such as *Cebus* and *Pan*. In addition, our observations broaden the range of species in which tool use is known to spontaneously occur. Most discussions of tool use focus on the procurement of food resources. However, the use of sticks as tools for purposes other than food extraction in *Ateles* and other species suggest that additional contexts should be considered in theories addressing the development of tool use.

### Why are our toes so tiny? Walking, running and the evolution of a short forefoot in the genus *Homo*

Campbell Rolian, Daniel E. Lieberman, John W. Scott  
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Humans have an extremely short forefoot relative to total foot length. The derived pedal proportions of humans are thought to have evolved in the context of committed bipedalism, but the benefits of shorter toes for walking and/or running have not previously been tested. Short toes are typically associated with cursorial digitigrade mammals, where they improve the ability of the digital flexor apparatus - the muscles, tendons and ligaments that collectively flex and resist extension of the metatarsophalangeal (MTP) joints - to support the body and generate propulsion at the end of stance. We tested the hypothesis that in humans a shorter forefoot similarly improves locomotor performance by decreasing the force, power and work outputs of the digital flexor apparatus (DFA) during late stance, especially in running, when only one foot provides support and propulsion against high ground reaction forces. Kinematic, force and plantar pressure data were collected from a sample representing normal variation in toe length (n=12). Hindlimb kinematics, DFA force, power and work outputs were compared during barefoot walking and running in subjects with short, average and long forefeet in relation to body mass. Results suggest that individuals with relatively longer forefeet experience higher MTP joint moments, and their DFA generates more force, power and work than subjects with shorter forefeet, at both walking and running speeds. Contrary to our prediction, however, the difference between groups in DFA performance is not greater at running speeds. Implications for the evolution of endurance running in the genus *Homo* are discussed.

### Blood atonement in Nephi, Utah: an event from the Walker War of 1853.

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A mass grave containing at least seven individuals was unearthed in Nephi, Utah during home construction. The location and artifacts associated with the grave suggest it may be that of a group of Native Americans that were killed during the Walker War. The Walker War was a series of skirmishes and raids between the Mormon settlers and Ute Indians in central Utah. Historical accounts indicate that in early October 1853 a group of eight or nine Ute men, one woman, and two boys came to the fort seeking protection. The men were killed by the settlers in what accounts claim to be either a slaughter or as a result of a skirmish between the groups; the woman and boys became prisoners. This grave represents a significant find as there has been little to no archaeological or bioarchaeological evidence recovered from this tumultuous time in Utah.

The artifacts recovered provide a mid-nineteenth century date for the grave. Craniofacial morphology indicates the individuals are Native American; this is supported by associated artifacts. The individuals are all male and range in age from 12-35 years, with the majority being between 20-25 years. All seven individuals exhibit perimortem trauma. Four individuals have gunshot wounds (two cranial, two post cranial), three individuals have cranial blunt force trauma, and there are three radii with perimortem fracturing. The sex and age profile and the trauma exhibited by the remains support that this is the mass grave from the Nephi incident. This paper will present the bioarchaeological analysis of the grave.

### Paleobiological aspects of El Sidrón (Asturias, Spain) Neandertals.

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~1400 human remains have been recovered at El Sidrón site (Asturias, Spain). At least eight individuals have been identified: one infant, one juvenile, two adolescents, and four young adults. All the individuals present dental hypoplasia (50 out of 104 observed dental specimens). Five individuals present 2 events of arrest, whereas Adult 4 shows up to four. The highest frequency of hypoplasia is found to occur at the fourth year of life. Weaning and adolescence are the life-history events more prone to nutritional stress in the sample. Dental calculus is detected in the adults and the adolescents. There are no "toothpick"

grooves so far in the sample, and no serious traumatic lesions are present.

Tooth-to-tooth contact occasionally shows a number of subvertical grooves, frequently found in Neandertal teeth, and occasionally in other humans. El Sidrón adults and adolescents all show interproximal grooves in 11 incisors, 4 canines, 16 premolars and 19 molars, ranging from 1 to 8 grooves per tooth.

Un-equivocal evidence of human-induced modification is observed in the Neandertals from El Sidrón (cut marks, flakes, percussion pitting, conchoidal scars and adhering flakes). Individuals seem to have been treated differentially. Scarcity of faunal remains in the El Sidrón sample prevents a direct comparison with human bones and avoids inference of cannibalism. Yet, the clear evidence of bone breaking (conchoidal percussion scars) is presumably related to processing for marrow and brains, which strongly suggest a nutritional exploitation.

On the whole, Paleobiology of El Sidrón sample shares the common standard for Neandertal populations.

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### The genetic basis of phenotypic integration in baboon and mouse craniomandibular morphology with implications for human cranial evolution.

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Results from studies of experimental organisms can provide information on which regions of the genome contribute to individual differences in phenotypes that can be investigated in humans and their close relatives to see if they show departures from a neutral model of evolution. Investigating the quantitative genetic contributions to phenotypic integration in those model organisms is necessary to achieve this goal. Here we present results of a quantitative genetic study of cranial morphology in a pedigreed population of baboons and mandibular morphology in the F10 generation of an advanced intercross breeding design in mice. In the case of the baboon crania, we tested hypotheses about the genetic basis and integration in phenotypes thought to have undergone important changes in the interface between the cranial base and face that took place during hominid evolution. Aspects of the basicranium and its interface with the face thought to be relevant to aspects of human evolution are significantly heritable in the baboon population. This indicates that they have the potential to respond to various

forces of evolution. Elements of mouse mandible morphology are similarly significantly heritable. The added power afforded by the greater numbers of mice demonstrates that there is a fairly straightforward relationship between additive genetic and phenotypic covariance, which is typical of morphological phenotypes. These results are a first step toward identifying genes that merit investigation for their role in human cranial evolution and a contribution to the understanding of phenotypic integration in the cranium and mandible in general.

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#### **Modulation of mastication to variation in food material properties in *Cebus capucinus*.**

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Food material properties influence EMG activity and kinematics of mastication, but their precise effects are not well documented, in part because of the difficulty of precisely measuring jaw kinematics in three dimensions. To address these issues, three-dimensional kinematic, EMG, and mandibular bone strain data were collected from two *Cebus* using a Vicon motion-analysis system. A novel bone-screw mechanism eliminated error resulting from skin movement and enabled collection of three-dimensional kinematic data with a high degree of precision ( $\pm 0.048$  mm). The positions of the first molars were digitized relative to the position of each kinematic marker. The digitized coordinate system was then rotated into the kinematic coordinate system using Euler Angles and molar displacement was quantified throughout the chew cycle. The relative timing of a range of EMG, bone strain and jaw kinematic events were then calculated, including onset and offset of fast-strain (FST) loading, fast-close/slow-close (FCSC) transition, and minimum gape. Analyses reveal a significant relationship between the closing angle of the jaw and the square root of the ratio toughness/Young's modulus  $[(R/E)^{0.5}]$  for 17 food types. Significant relationships were also found between  $(R/E)^{0.5}$  and both the displacement of the first molar from FCSC transition to minimum gape and the time from minimum gape to the FST offset. These relationships suggest that foods with a high  $(R/E)^{0.5}$  elicit a more vertical jaw angle prior to occlusion, experience a greater displacement of the molar from FCSC transition to minimum gape, and induce a more rapid unloading time relative to minimum gape.

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#### **Haplorhini, haplorhinism, and nasolacrimal ducts.**

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Study of the nasal region has revealed a host of characters that distinguish haplorhines from strepsirrhines. Some researchers have mentioned potential differences between these taxa in the morphology of the nasolacrimal duct, but no study has addressed this in any detail. Here we present the results of a comparative study of the ontogeny of the nasolacrimal duct and associated structures in a large sample of primates from both suborders. A sample of thirty-seven serially sectioned cadaver specimens were examined by light microscopy. These fetal, neonatal, infant, and adult specimens were previously decalcified, paraffin embedded, serially sectioned, and stained. In addition, 52 juvenile, subadult, and adult osteological specimens were investigated using high-resolution computed tomography.

The results of the study confirm that the morphology of the NLD provides consistent differentiae of the two suborders. Moreover, the developmental pattern of the distinctive morphology of haplorhines strongly suggests that the condition is homologous in tarsiers and anthropoids. Consideration of the functional role of the NLD suggests that its morphology in haplorhines may be directly associated with the evolution of anatomical haplorhinism (i.e. loss of the wet rhinarium).

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#### **The effects of musculoskeletal stress markers on cortical thickness decline in the humerus of Black adults.**

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Previous studies of populations from varied historical contexts and genetic backgrounds have shown that cortical thickness changes in predictable patterns with age and that musculoskeletal stress markers (MSMs) on bones may serve as indicators of relative habitual activity levels during the lifespan. This study builds upon these observations by investigating the relationships between age, cortical thickness, and musculoskeletal stress markers in the right humeri of black adults ( $n=99$ ) from the Terry Collection at the Smithsonian Institution National Museum of Natural History. According to the results of this study, cortical thickness declines throughout adulthood for both sexes; however the rate of cortical thickness decline is greater in females than in males. Multivariate regression evaluations of changes in MSMs with cortical thickness, when controlling for age, display no statistically significant relationships for either sex. Therefore, both cortical thickness and MSMs vary with age

for males and females; however, MSMs have no effect on cortical thickness when controlling for age in either males or females. In conclusion, musculoskeletal stress has no direct effect on patterns of cortical thickness decline due to senescence. The findings of this study have implications for future investigations of the effects of activity on bone health and bone degeneration in both bioarchaeological and contemporary populations.

#### **The new partial pelvis of Omo 1: implications for sexing early modern humans.**

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The Omo 1 partial skeleton from Ethiopia, which has been dated to approximately 195 kya, may represent the oldest currently known early *Homo sapiens*. A recently discovered partial left os coxae that is almost certainly attributable to this individual provides an opportunity to assess the sex of Omo 1. This study employs a combination of non-metrical features and measurements of the skull and os coxae in an assessment of the sex of the Omo 1 fossil. Cranial features that differentiate recent males and females, such as nuchal crest and mastoid process prominence, and the morphology of the supraorbital margin were recorded and features of the pelvis, such as the presence of a preauricular sulcus and the configuration of the greater sciatic notch were scored. In addition, discriminant function analyses were conducted using size and shape variables from 12 measurements of the os coxae that have been demonstrated to be reliable indicators of sex among different recent human population samples.

The results of this study highlight the presence of contradictory indicators of sex in the Omo 1 skeleton. In particular, the multivariate analyses of pelvic variables failed to unambiguously classify Omo 1 as a modern male or female. This study supports the conclusions of previous workers who have suggested that a number of skeletal features that are commonly used to distinguish living males and females may have evolved only in the recent past.

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#### **Maternal Genetic Ancestry and Risk Factors for Cervical Cancer Prevalence in the Guarani Indians from the Province of Misiones, Argentina**

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In the Misiones Province of Argentina, home to indigenous Guaraní populations, cervical cancer caused by the human papillomavirus (HPV) is considered an endemic disease, with an infection rate of 35 out of every 100,000 indigenous women. This rate far exceeds the national average of 5 out of every 100,000 women. To better understand the epidemiology of this disease, and to assess possible associations between viral infection and genetic background, we examined mtDNA diversity in 178 women from Misiones. Of the 91 Guaraní individuals examined, 99% had Native American mtDNA lineages (haplogroups A, B, C, D) and 63% tested positive for HPV, with 49% of these HPV-positive persons having viral type HPV 16, the most prevalent of the invasive carcinomas (Tonon et al. 2000). By contrast, among the 74 individuals identified as "white," 70% had Native American mtDNA lineages and 54% tested positive for HPV, with 45% of them having HPV 16. While none of the 13 Criollas tested positive for HPV, 69% had Native American mtDNA lineages. West Eurasian lineages comprised the remainder of the mtDNAs, with hg H and U being mostly commonly seen. These data will be used to statistically measure the correlation between HPV prevalence/viral type and maternally inherited genetic ancestry among Guaraní women to determine both epidemiologic and genetic risk factors associated with cervical cancer incidence and progression in this population.

#### **Prediction of body size from juvenile skeletal remains, with application to KNM-WT 15000.**

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There are currently no available methods for predicting body mass, and only a very few for predicting stature from juvenile skeletal remains. Thus, most analyses of body size in juvenile archaeological samples have relied on comparisons of long bone lengths, which greatly limits inferences that can be drawn regarding patterns of growth and development and the various factors that affect them.

In this study, body mass and stature prediction equations are generated from data

available for a sample of 20 individuals from the Denver Growth Study, measured from infancy through adolescence. Because body proportions change constantly throughout growth, equations are developed for each year from 1 to 17 years. Body mass is estimated from distal femoral metaphyseal breadth in younger individuals (1-12 years), femoral head breadth in older individuals (7-17 years), and stature and long bone lengths in older adolescents (14-17 years). Stature is estimated from diaphyseal (1-12 years) and total (10-17 years) lengths of the femur, tibia, humerus, and radius.

Body mass and stature estimation errors (%SEE's) are equal to or better than those for similar adult equations. A sample application to the juvenile early *Homo* KNM-WT 15000 is given. Estimated body mass for this specimen (based on femoral head breadth) is about 50-53 kg, similar to that estimated in an earlier study using a different technique. Stature estimation is more problematic due to differences in body proportions between KNM-WT 15000 and the Denver sample, but was probably somewhat under 157 cm, again similar to previous estimates.

#### **Magnetic resonance imaging of ancient human mummies.**

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Historic mummies are a unique source for soft-tissue research; therefore, it is not surprising that modern diagnostic imaging such as computed tomography has been widely applied on. Contrary, magnetic resonance imaging (MRI) of ancient dry mummies hitherto - in a non-invasive way without tissue rehydration - has never been successful. The aim of our study is to show the feasibility of non-clinical MRI on historic human mummified tissue. Mummified body parts of human adults (Egypt; New Kingdom or later, Rätisches Museum, Chur, Switzerland) and the natural human glacier mummy Iceman (3300 BC; South Tyrol Museum of Archaeology Bolzano Italy) have been analysed by non-clinical 7 Tesla MRI and / or portable NMR-MOUSE®. We were able to acquire various high-resolution depth profiles / T2 relaxation curves of the frontal head region of the Iceman mummy in situ in the cold storage room at the Museum. The spatial differentiation of ice layer, cutis and skull bone up to a depth of ca 5 mm was possible. In addition, in ancient Egyptian mummified specimen, e.g. the thickness of a fingernail and a differentiation of a single bandage layer versus the skin underneath were possible. Also, we could visualize <sup>1</sup>H and <sup>23</sup>Na spatial distribution (main component of

ancient Egyptian mummification substance) in dry ancient mummy tissue. Our results demonstrate for the first time ever the feasibility of non-clinical MRI to visualize historic human tissues completely non-invasively. This can be applied on both, natural glacier mummies as well as on ancient dry mummified tissue.

#### **Dental size evolution in west Mediterranean populations.**

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Odontometric classical studies postulate a reduction in dental size in the Near East populations, during the transition from Upper Paleolithic to Neolithic. This statement is admitted for the entire Mediterranean region. Nevertheless, it has not been contrasted among west Mediterranean populations. Besides this, archaeological data suggest that the way of life during this period wouldn't differ so much, above all during the transition from Mesolithic to Neolithic. The aim of this study is contributing to increase odontometric data in the west Mediterranean region and verify the supposed dental size reduction in this area.

The study examines mesio-distal (MD) and bucco-lingual (BL) crown diameters. Odontometric data were collected from six populations from the NE of the Iberian Peninsula (dating from 11.460 ± 230BP to 4.225 ± 90BP) which were compared with other European sites dating from Upper Paleolithic (35.000BP) to Modern Age. Different behavior is observed from both sets of data (MD and BL diameters). While there is no difference among MD diameters, BL ones show a reduction of teeth size along the time as happens in Near East.

#### **Using ultrasound to determine gestational age and litter size in marmoset monkeys**

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Ultrasound offers a window into fetal and placental development throughout gestation. In captive common marmoset monkeys, litter size is variable and both fetal and placental growth are correlated with litter size. Previous longitudinal studies employing ultrasound to monitor intrauterine growth in marmosets have not focused specifically on placental features in the context of litter size variation. Because the triplet marmoset term placenta exhibits structural differences and overall size characteristics that appear to differ in pattern and distribution compared to the twin placenta, ultrasound was applied to investigate litter size differences in placental



dimensions during gestation. The current study sought to answer the following questions: 1) Do placentas differ according to litter size and total litter weight in terms of measurable dimensions such as thickness or cross-sectional circumference? 2) Do measurable placental dimensions provide a means of establishing gestational age? A total of 120 ultrasound exams representing multiple pregnancies were included in the analyses; fetal and placental growth measures were taken from live and archived exams. Uterine diameter is a better predictor of litter size than are placental dimensions. Placental thickness correlates with fetal crown rump length ( $r^2=0.790$ ,  $p<0.01$ ), but not with biparietal diameter ( $r^2=0.330$ ,  $p=0.250$ ). Because of its correlation with both crown-rump length and gestational age estimates based on CRL, placental thickness can be considered another tool to estimate gestational age, especially when full visualization of fetal structures is not possible during ultrasound examination. Uterine, but not placental, dimensions can be used to predict litter size.

#### **Mechanical adaptation of trabecular bone in the growing human femur and humerus.**

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The strong relationship between the amount and distribution of trabecular bone and its elastic properties is well-established in adults. However, there are few quantitative data on the development of trabecular bone structure and mechanics in humans. This study uses high-resolution computed tomography (HRCT) and micro-finite element (microFE) analysis to determine the relationship between trabecular bone structure and its elastic properties in developing bone. HRCT scan data were collected from the proximal humerus and femur of 20 juvenile individuals ranging in age from six months to 11 years from the Norris Farm #36 archaeological sample. Voxel resolutions ranged from 0.030 to 0.045 mm. Five mm cubic volumes of interest (VOI) were extracted from each femoral and humeral dataset and various three-dimensional morphometric parameters were calculated including the bone volume fraction, trabecular thickness, trabecular number, and anisotropy. A voxel conversion method was used to convert each voxel of the scan dataset into an eight-node brick element in the microFE model. For each VOI, six microFE analyses representing uniaxial strain in different directions were run and the apparent elastic moduli for each specimen were calculated. The results suggest that after one year of age there is significant reorganization of trabecular structure in the humerus and femur with increasing differentiation in both structural and

mechanical properties with age. The maximum elastic modulus is generally similar between the femur and humerus at young ages. After one year of age the maximum elastic modulus increases in the femur and decreases in the humerus.

#### **2005 Turkey nationwide anthropometry survey.**

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It is widely accepted that population specific anthropometric data bases are essential for biological sciences. Limited information is available on body dimensions of Turkish population. A nationwide anthropometry survey was conducted in 1937 on 64,000 adults and was followed by a survey in 1960 at 2501 adult females. From this starting point a nationwide survey was conducted to determine up-to-date anthropometric measurements for The Turkish adult population.

A cross-sectional survey was conducted on 2100 healthy adults (1050 males, 1050 females) aged 20 to 65 years from 7 geographical regions of Turkey. Subjects were selected by The State Statistical Institute using multi-stage, multi-cluster and multi-weighted sampling methods. Thirty six measurements were collected according to the International Biological Programme, and socio-economic status (SES) was determined. Smoothed centile curves were developed using the LMS method and standard deviation scores (SDS) were calculated.

Results showed that mean height and weight were 168.88cm and 74.74kg for males and 155.03cm and 67.12kg for females, respectively. Mean iliospinal height was 96.42cm in males and 86.91cm in females. Mean BMI was 26.23 for males and 28.02 for females and multivariate analyses showed significant relation with BMI SDS and SES. We are of the opinion that current anthropometric data for Turkish population might answer basic questions about the nutritional status of the population, variation due to geographic distribution and secular changes in body morphology.

#### **'Put your shoulder into it': Upper limb pathology at a Byzantine Jerusalem monastery.**

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As part of a large study reconstructing activity patterns in a Byzantine (5<sup>th</sup> – 7<sup>th</sup> c. AD) monastery, the upper limb bones from St. Stephen's monastery in Jerusalem were examined for paleopathological indicators.

Detailed analysis of the lower limb bones, combining biomechanical and pathological evidence with the historical/liturgical record, permitted the reconstruction of a biocultural model of repetitive genuflexion (200+ times per day) by the members of this community. Upper limb involvement was indicated as well, relating to the use of the arm to push up from a squatting position and/or balance while genuflexing.

For this project, the shoulder and elbow joints [including the glenoid fossa (n=71), humeral head (n=51), trochlea (n=37), capitulum (n=34), radial head (n=55), and olecranon (73)] were examined for arthritic lipping, eburnation, and the presence of osteophytes. The capitulum was the most affected landmark, with 93.3% of the right and 89.5% of the left side displaying characteristics of osteoarthritis. Additionally, there was no significant difference in the presence of osteoarthritis between the left and right sides of each landmark, except for the humeral head ( $p=0.042$ ), in which the right side showed a much greater incidence of lipping. Periosteal reactions of the St. Stephen's humeri, radii, and ulnae provided a survey of health status, and demonstrated little trauma to the upper arm bones from the Byzantine monastery.

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#### **A test of three regression formulae to age fetal skeletal remains.**

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The analysis of skeletonized fetal remains consists primarily of age estimation. Fetal age is very important when studying historical skeletal samples or fetal remains from the modern forensic context. This study tested the efficacy of a traditional method (Fazekas and Kosa, 1978) of aging dry skeletal remains against more recent ultrasound (Chevernak et al., 1998) and radiographic (Sherwood et al., 2000) methods to determine which was most accurate. The fetal skeletons used for this study are from the Lamb collection which consists of individuals born between 1903 and 1917. Only individuals with known ages were included in the study for a sample total of 82.

Each regression formula employs diaphyseal femur length to predict age of the skeleton. Age was estimated for each individual using the three methods and converted to lunar weeks based on a 40 week gestational period. By comparing the estimated ages to the known ages, error and bias were calculated.

The methods produced similar error rates, but had different patterns of bias. The method produced by Fazekas and Kosa (1978) overaged the remains an average of 2.15 weeks. The ultrasound based regression formula of Chevernak et al. (1998) underaged the remains by an average of 2.20 weeks and

the radiographic based regression formula of Sherwood et al. (2000) overaged the remains by 2.75 weeks.

#### Genetic profile of Macaronesia islands: evidences from mitochondrial DNA.

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Macaronesia encompasses four inhabited Atlantic archipelagos: Azores, Madeira, Canary and Cape Verde. Canary archipelago was inhabited when conquered by Spaniards in the 15<sup>th</sup> century. By contrast, the other archipelagos were uninhabited when discovered by Portuguese in the 15<sup>th</sup> century. Historical reports point out the impact of Iberians in the settlement of Macaronesia; however, important differences in the peopling process of the archipelagos are documented. To date, there are no integrative works that aim to infer the genetic relationship and the impact of evolutionary forces in Macaronesia islands. In this work, we compile published data mtDNA for 919 individuals from Macaronesia (172 Azores, 300 Canary, 155 Madeira and 292 Cape Verde). To obtain a representative sample for the nine Azorean islands, we analyzed the HVRI and coding region polymorphisms of mtDNA in 84 additional Azoreans. Results obtained allowed to conclude that Cape Verde is the most distinctive archipelago of Macaronesia, with six islands presenting exclusively mtDNA lineages of African origin, and only 3 islands presenting West-Eurasian lineages in frequencies lower than 4%. On the contrary, the remaining archipelagos present a mtDNA profile dominated by the presence of West-Eurasian mtDNA haplogroups with typically African lineages being absent in some of the islands of the Canary and Azores archipelagos. The MDS representation of genetic distances evidenced the homogeneity of the Canary islands since they set in a separate cluster. In contrast, the islands of the Azores archipelago appear in different quadrants evidencing the important genetic substructure of this archipelago.

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#### The lunate bone of Peking man and its bearing on the classification of *Homo erectus*.

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The lunate bone is the most complete postcranial element of the Zhoukoudian *H. erectus* remains, and the only one to preserve joint surfaces. In spite of this, it has not figured in *H. erectus* systematic and behavioral studies. Comparisons of lunate volume and cross-sectional areas, curvatures and relative set of the lunate joints of *H. erectus* to those of 20 or more individuals of each of the three great ape genera and of humans show the *H. erectus* lunate is distinct. Overall it is smaller than average for humans and each great ape genera. In relative joint size and orientation it is closest to the *P. troglodytes* lunate. Its medio-laterally broader capitate and radial surfaces distinguish it from the human lunate. Relative to humans the *H. erectus* radiocarpal joint sacrificed mobility for stability and was better suited for forelimb weight support and propulsion in quadrupedal behaviors.

The lunate's distinctiveness accords with that of the Zhoukoudian femora which are specifically distinct compared to the virtually identical femora of modern humans and Javanese (i.e., Trinil and Sangiran) *H. erectus*. Because all fossil hominids from Java are currently referred to *H. erectus*, the distinct differences between the Javanese and Zhoukoudian *H. erectus* indicate that either the Zhoukoudian fossils do not belong to *H. erectus* or that Javanese *H. erectus* encompasses more than one species.

#### Genetic estimation of patterns of social organization in western gorillas (*G. g. gorilla*) in the northern periphery of the Dja Reserve, Cameroon.

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Because specific information on western gorillas has accumulated slowly, much of our understanding of gorilla ecology and behavior is based on studies of mountain gorillas (*G. b. berengi*). However, an ecological model of folivory, as exhibited in mountain gorillas, or frugivory, as exhibited in chimpanzees, cannot be used to predict the social behavior of western gorillas, which consume both terrestrial vegetation and fruit. The goal of this study is to examine social organization (and thus population size, sex composition, and social cohesion) among social groups in a population of western gorillas (*G. g. gorilla*) living in the northern periphery of the Dja Reserve, Cameroon, relative to other

currently studied western gorilla populations. To achieve this, we first collected fecal samples through systematic surveys of gorilla night nests and extracted the DNA. The DNA from each sample was then subjected to a panel of microsatellite markers in order to build individual genetic profiles for each animal surveyed. Population genetic analysis, based on these profiles, reveals between-group patterns of social organization. For several variables, such as median group size, population sex ratio, and effective population size, the study population fell within the range of variation described for mountain gorilla and other western gorilla populations, suggesting that these aspects of behavior may not be influenced by differences in diet. However, some behaviors, including the rate at which animals transfer between groups and within-group sex composition, are quite different than those observed at other mountain and western gorilla sites. There are several factors that could potentially influence these unique variables, including diet, but also high gorilla population densities and hunting by humans.

#### "Maleness" reconsidered: hominoid craniofacial sexual dimorphism.

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The typical male facial morphology is conventionally characterized as having protruding cheekbones, mandible and chin, a prominent orbital ridge, and a long lower face. A large body of literature suggests that women have evolved preferences for such features under conditions of mate choice. But as these characteristics perceived as "masculine" combine at least three separate processes affecting the male facial shape—extended growth, prenatal testosterone, and pubertal testosterone—our aim is to determine which of those features are attributable to pure allometry (and to what extent), and which are actually not.

We decompose craniofacial morphology in five taxa: *Homo sapiens*, *Pan paniscus*, *Pan troglodytes*, *Gorilla gorilla* and *Pongo pygmaeus*. 3D coordinates of 35 traditional landmarks and ~300 semilandmarks are measured for each of 372 adult and sub-adult specimens and analysed using geometric morphometric methods.

A multivariate analysis in form space shows that ontogenetic scaling contributes to the development of sexual dimorphism in all five taxa. This scaling includes a protruding maxilla, relatively smaller and more rectangular orbits, and a relatively shorter cranial base. Eigendecomposition of the five vectors of mean sexual dimorphism reveals two dimensions independent of allometry. One, which differentiates between *Homo* and

the great apes, is characterized by a relative widening of the maxillary region, orbits and orbital ridges, while the other, which separates Pongo from the African apes and Homo, represents mainly a relative narrowing of the zygomatic arch in Pongo. There are implications for the role of intrasexual competition and intersexual selection (female choice) in humans.

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### **Syngnathia (I): craniofacial malformations in infants - a systematic methodological approach**

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Fusion of the jaws (syngnathia) is an uncommon abnormality, ranging from consolidation of soft tissues (synechiae) to complete ossification (synostoses). Etiologically this condition may result from embryonic malformation, but can also be acquired, e.g. by trauma, chronic inflammation or neoplasm.

Only 26 cases of congenital adhesions have been published since 1936. We report 5 new cases of newborns which present complete or incomplete, uni- as well as bilateral bony jaw coalitions. The specimens included in this study are part of the osteological collection of the Federal Pathologic-Anatomical Museum Vienna, Austria. The sample dates from the 19<sup>th</sup> century and comprises 3 males and 2 individuals with unknown sex.

We used several techniques for differential diagnostic purpose: After performing conventional radiography, a high-resolution computed tomography has been carried out and 3D -reconstructions of the malformations were created. Subsequently, we gathered a bone sample in rectangular plane to the occlusion for light-microscopic investigation. These probes were resin-embedded and 100µm thick undecalcified ground sections for conventional histological examination were prepared. Then these sections were used for scanning electron microscopy (SEM) investigation in backscattered electron (BSE) mode.

Additionally observed morphological alterations yet not described indicate that congenital syngnathia can be associated with three other developmental anomalies. Thus, the individuals exhibit either a cleft lip and palate and/or signs of microcephaly. Furthermore, one individual suffered from a premature sutural ossification. Hence, we hypothesize that syngnathia seems to be an additional sign of severe disturbances in the orofacial development and ossification of the human skull.

### **Brain size/body size ratios of insular and mainland foxes: possible implications for *Homo floresiensis*.**

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The discovery of *Homo floresiensis* has drawn attention to the 'island rule', which hypothesizes that species living on islands may become reduced in body size, or insularly dwarfed, because of limited food resources and lack of predators. Two of the most remarkable features of the type specimen for *Homo floresiensis*, LB1, are its tiny absolute brain size (or cranial capacity) and the australopithecine-like ratio of its brain size to body size (relative brain size). The latter is difficult to interpret, however, because few data exist that pertain to scaling of relative brain size in insular dwarfs compared to their normal-sized relatives that live on nearby mainlands.

This paper compares brain size/body size ratios of gray foxes, *Urocyon cinereoargenteus*, from mainland California to island gray foxes, *Urocyon littoralis*, from the California Channel Islands. *Urocyon littoralis* is the smallest fox species in North America and is a dwarf version of the gray fox. Fox belong to the taxonomic order Carnivora, family Canidae. The study sample consists of ninety-two fox crania and femora from skeletal collections housed at the Museum of Vertebrate Zoology (MVZ), the Natural History Museum of Los Angeles County (LACM), and the National Museum of Natural History (USNM). Cranial capacity, i.e., brain size, was measured using mustard seeds and femur length and circumference were measured to derive femoral area, a proxy for body size. Statistical analyses were performed using Stata 9 software. Preliminary results indicate that mainland and island foxes differ in brain size/body size ratios and relative brain sizes.

### **A comparative analysis of cytoarchitecture and vertical organization of Broca's area in humans, great apes and macaques.**

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We identified cytoarchitectural regions homologous to human Broca's area in the ventrolateral frontal cortex of three chimpanzee, two bonobo, two gorilla, two orangutan, and four long-tailed macaque brains. Relatively thick cortex and the presence of large pyramidal cells in layers IIIc and Va characterize this area in all species. Broca's area consists of Brodmann's areas (BA) 44 and 45, which can be distinguished from each other across species by the thickness of layer IV (with layer IV being smaller in BA44). Key characteristics for determining boundaries with neighboring frontal regions include differences in pyramidal cell size in layers III and V and in the thickness of layer IV.

We analyzed minicolumns in layer III of BA44 and 45 in both hemispheres of nine ape and eleven human specimens using a quantitative approach. A semi-automated method based on ImageJ software is used to digitize images of Nissl-stained material. Minicolumns were compared for spacing distance, neuropil space, and gray level index (GLI) across species.

We found a positive relationship between average minicolumn size and brain size across species. Human minicolumns are larger than those of great apes and macaques ( $p < 0.002$ ), but they are the size expected based on the regression through nonhuman primates. Contrary to our preliminary findings, no parameter in this larger sample exhibits hemispheric asymmetry.

Larger minicolumns reflect increased spacing between cells, suggesting the presence of greater neuropil space for connections in layer III. Increased connectivity means that Broca's area in humans may be better able to integrate information from a variety of cortical regions. Supported by NSF 0406605

### **Locomotion-related trabecular architectures in long bones of primates.**

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The fact that bone is a functional structure and that alterations of the loading conditions affect the internal and external bony structures has been common knowledge since the 19th century. As a consequence different kinds of habitual locomotion are able to leave clear signatures in the cancellous bone of long bones by their specific load cases. The architecture of the trabecular

network reflects in this way different habitual locomotor styles.

To investigate the complex spatial structure of cancellous bone and its specific features in detail high-resolution computed tomography (CT) was used. This non-destructive method offers an alternative to time consuming, error-prone and destructive sectioning techniques. Several extant and two fossil (*Paidopithecus rhenanus* and *Pliopithecus vindobonensis*) primate specimens were imaged with high-resolution CT. Based on these 3D-data, the trabecular architectures were structurally described and histomorphometrically analyzed to quantify their characteristics. Draw on the results of the extant primate species first architectural models, related to different loading conditions and linked to distinct locomotor behaviors were developed. Results obtained from the fossil species were compared with these models, enabling an estimation of the locomotor preferences of the fossils.

By focusing on internal bony morphology, this study offers a new method which can be used in concert with the classical analysis of locomotor behavior. The applied method will improve the biomechanical analysis of fragmentary fossil material.

This study was supported by a scholarship for women in natural science and engineering of the Hessian Ministry of Science and Art given by Darmstadt University of Technology.

#### **Kinematics and proportions of the three-segmented limb: How are small primates different from other small mammals?**

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Quadrupedal walking in mouse lemurs, brown lemurs, cotton-top tamarins, and squirrel monkeys was analyzed using cineradiography to investigate the relationship between body size and limb kinematics. In discussing the kinematic similarities and differences among the primate species and between them and other small mammals, both the scaling of limb length to body size and intralimb proportions of the limbs were considered. Morphometric data were obtained from 60 mammals including 35 primates.

Hindlimb kinematics of the four primates are size-independent and resemble those of other small mammals. Step length and pivot height increase proportionally with limb length, whereas intralimb proportions remain fairly constant. However, hindlimb lengthening causes a cranial shift of the contact point of the foot at touchdown. By contrast, forelimb kinematics change with increasing body size. Although the total angular excursion is size-independent, the forelimb is more protracted and less retracted in the brown lemur than in the mouse lemur. The retraction angle seems to be related to the excursion range of the hindlimb. The significantly altered forelimb proportions in primates towards shortening

the scapula and lengthening the humerus and the forearm are proposed to be related to these kinematic changes. The comparison to other small mammals shows that the initial transformation from a relatively retracted forelimb at touchdown into the more protracted position of primates might therefore represent an evolutionary solution to the constraint of having long hindlimbs in combination with a specific diagonal footfall pattern where interferences between the ipsilateral fore- and hindlimbs have to be avoided.

#### **Two northern Nevada Chinese cemeteries: A bioanthropological assessment.**

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The investigation of historical cemeteries enables direct assessment of biological variability, health and disease, and additional insights into populations that have gone relatively undocumented in North America and elsewhere. This study will examine two historic human skeletal populations from small cemetery locations in northern Nevada. In 1996, personnel from the Department of Forestry and the Bureau of Land Management excavated a small cemetery in the town of Carlin, Nevada. This produced a total of 13 well-preserved skeletal individuals, all buried within coffins and whose Chinese origin has been confirmed through historical documentation and associated artifacts (Chung *et al.* 2005). Carson City cemetery was uncovered in 2001 as a result of a public works project, and excavated expeditiously by members of the Nevada State Museum. This yielded a total of 6 individuals, however there were no discrete burials. Although the sample size for these two cemeteries is small, they provide a number of important insights into the health and behavior of early Chinese-American communities, including dental pathologies, generalized bone disease, age/occupational-related pathologies, and trauma, from which 3 individuals (16%) died traumatic deaths. This study is unique in that there are few comparative populations that have examined skeletal biology of early Chinese Americans. The synthesis of historical archaeology and osteological analysis can have substantial implications for uncovering information relative to a population that has been, for the better part of academic inquiry, invisible.

#### **A new method to assess adult age at death from the auricular surface of the ilium.**

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Many studies show that the method proposed by Lovejoy *et al.* (1985) to assess adult age at death from the sacro-pelvic surface of the ilium is not reliable. Two

fundamental sources of error are described in assessing age at death of adult skeletons: the complex variability in the process of skeletal aging and methodological bias. Taking into account these limits, we elaborated a new method from the auricular surface.

A new scoring system was proposed. Four features are observed and processed separately with its own scale of variation. The data are processed using Bayesian prediction in order to classify specimens in age range categories. When elaborating a new method, it is necessary to observe samples of various osteological collections of known age-at-death in order to obtain the widest variability of aging patterns. Therefore, we examined reference samples from Europe, North America, Africa and Asia.

The results show that morphological changes with aging are variable between Asian, African and European populations. However, European samples follow the same trend of variation. As a consequence a European model was created. We tested the model reliability on two independent target samples. True age at death was included in the predicted chronological interval for 89% to 94% of the individuals. Bayesian prediction on European population produces reliable classification in large but reliable chronological age categories and performs also for subjects over 60 years old, a real methodological improvement compared to others methods.

#### **Comparative ranging behavior of eight species of primates in a western Amazonian rainforest.**

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Despite the large number of field studies of ranging behavior in nonhuman primates, few have taken a comparative perspective and examined multiple members of a primate community at a single site. The Tiputini Biodiversity Station in Yasuní National Park, Ecuador – situated in undisturbed primary rainforest in the western Amazon basin – hosts a diverse primate community comprising 10 genera: howler monkeys (*Alouatta*), owl monkeys (*Aotus*), spider monkeys (*Ateles*), titis (*Callicebus*), pygmy marmosets (*Cebuella*), capuchins (*Cebus*), woolly monkeys (*Lagothrix*), sakis (*Pithecia*), squirrel monkeys (*Saimiri*), and tamarins (*Saguinus*). During the course of several

long-term field studies, we gathered ranging and demographic data from all eight noncallitrichine primates present at the site. For each species, we collected location records regularly during full-day follows, by mapping the group's position relative to previously mapped and georeferenced trails and reference trees. From these records, we characterized daily travel paths and calculated day range lengths and home range sizes for each species, as well as inter- and intraspecific range overlap, using ArcGIS, and we compared these to measures of body size, group size and biomass, and diet. Home range size varied considerably across species (from ~4 ha for titis to well over 200 ha for capuchins). Home range overlap between species was extensive, and neither range size nor day range length was clearly associated with diet or group biomass. Though some of our results echo those in other ranging studies, there are some intriguing differences that might be explained by interspecific competition in this large primate community.

#### Center of mass movements in primates.

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Recently physical anthropologists have focused on limb stiffness during walking in primates compared to other mammals. It has been suggested that primates use a relatively compliant gait (with high joint yield) and that this is associated with requirements of locomotion on thin, flexible branches. However, joint yields represent a surrogate measure for movements of the center of mass (COM) and few studies have made such measurements directly. Animals who walk with relatively stiff limbs oscillate their COM vertically in such a way that allows an efficient exchange of potential energy (PE) and kinetic energy (KE), reducing the external work done on the COM. High degrees of exchange are indicated by a high percentage recovery. The purpose of this project is to examine if primate gait compliance leads to reduced exchange of PE and KE. Center of mass movements derived from force plate recordings for *Lemur catta* (N=3), *Eulemur fulvus* (N=3), and *Macaca fascicularis* (N=2) walking on a runway and simulated arboreal supports will be presented. Current data on lemurs shows substantial variation. The majority of steps have extremely low values for exchange (< 20% recovery). However, some steps within the same individuals have high exchange values (> 50% recovery). If supported by data on a wider range of primates, the use of a compliant walking gait with low energy exchange represents a distinct difference between primates and most other legged animals and allows a better understanding of specific mechanical adaptations associated with the origin of primates.

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#### Sex differences in cranial form assessed via non-rigid deformation analysis of high-resolution CT images.

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The use of computed tomographic (CT) imaging in fossil and skeletal studies has increased substantially in recent years. Because these images are essentially density measurements in three-dimensional (3D) space, they can be used to assess complex shapes in mathematically interesting ways. Image analysis methods developed for functional brain imaging studies allow the morphing of objects (e.g., crania) into common coordinate systems, resulting in transformation maps that describe, in detail, where and by how much a given object differs from another object. The methods used to create these maps are anatomically reasonable, in that they focus on local distortions, rather than simply globally scaling the entire object. In principle, these methods can be applied to 3D images of any type (MRI, CT, laser scan, etc.). They can also be applied to sets of images, resulting in population maps of localized morphological variation, as well as allowing comparisons of localized differences between populations. We illustrate the usefulness of these techniques by showing how sex differences in cranial form can be assessed in a population of male and female crania from the Morton collection at the Museum of Archaeology and Anthropology at the University of Pennsylvania (CT's were obtained from the Open Research Scan Archive at Penn, <http://grape.anthro.upenn.edu/~lab/pennct/>). Maps of significant t-values for sex differences at each point in 3D space will be shown. Comparison with previous studies of sex differences in cranial form will be discussed. The usefulness of these methods for a wide range of anthropological analyses will be discussed.

#### The quiet life? Indications from a rural late Anglo-Saxon village.

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The human skeletal remains from Bishopstone, Sussex, England represent a late Anglo-Saxon rural coastal community. Preliminary skeletal analysis has indicated that the frequencies of trauma and disease within this collection differ from other Anglo-Saxon communities dating to a similar time period. Of the 40 individuals identified in the Bishopstone collection, 47.5% (19 of 40) show

evidence of trauma and 35% (14 of 40) show evidence of disease. The trauma observed varies widely among individuals, ranging from cases of blunt force trauma, likely associated with cause of death, to more mundane cases of healed broken fingers. When compared to the frequencies of trauma and disease observed from two other Anglo-Saxon collections, St. Nicholas Shambles, London (White, 1998) and Raunds, Northamptonshire (Boddington, 1996), the frequencies observed at Bishopstone are markedly higher. At St. Nicholas Shambles observed frequencies of trauma and disease were 5.5% (13 of 235) and 7.7% (18 of 235) respectively (White, 1998). Similarly, in the remains from Raunds trauma is observed in 6.9% (25 of 363) and disease in 8.8% (32 of 363) of the individuals analyzed (Boddington, 1996). Although the overall size of the Bishopstone collection is considerably smaller than those from both Raunds and St. Nicholas Shambles, the collection could be extremely important to discussions of Anglo-Saxon life in a rural area.

#### Assessment of the time of origin of New World primates and rodents.

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The abrupt appearance of primates and rodents in early Oligocene deposits of South America has puzzled mastozoologists for decades. Geoclimatic changes that occurred during the Eocene/Oligocene transition period may have enabled mammalian invasions in the continent. This unsolved issue is a fertile field for divergence time methods using molecular data. Although traditional molecular clock approaches are unpractical when dealing with rodent and primate sequences altogether, techniques that relax the assumption of rate uniformity allow the tackling of such problems. In this study, we have used mitochondrial genomes of selected mammals and three different methodologies of rate relaxation - Bayesian inference, maximum likelihood estimation with local clocks and automatic rate assignment - in order to validate a consistent timescale for the emergence of New World primates and rodents. We found that the dates of origins of these mammalian groups are stable and all clock-relaxing methods performed similarly.

#### Evidence for clans in a population of wild hamadryas baboons.

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Hamadryas baboons are known for their complex, multi-level social structure consisting of troops, bands, and one-male units (OMUs). Abegglen (1984) observed a 4<sup>th</sup> level of social structure consisting of several

OMUs that rested near one another on sleeping cliffs, traveled together during daily foraging, and sometimes traveled as subgroups independently from the rest of the band. Abegglen called these associations "clans" and suggested that they consisted of groups of related males.

Here we report behavioral evidence for the existence of clans in a group of about 200 hamadryas baboons in central Ethiopia. Data derive from three observation periods: November 1996 through May 1997, December 1997 through September 1998, and March 2005 through February 2006. Data consist of over 4300 OMU scan samples conducted at 10-minute (1996-1998) and 2-minute (2005-2006) intervals during all-day follows. Analysis of proximity patterns revealed that OMUs were most likely to be in proximity to certain other OMUs, both while resting and while foraging during daily travel, and that a "clan" structure can be identified. Additionally, the band divided in half for 1 month, as well as for over 3 hours on at least 10 days. OMU membership remained the same during these fissions. Further, the OMUs that were most frequently in proximity (i.e., the "clans") during the 11 months when they behaved as a cohesive band were in the same half when the group split. These results indicate that subgroups of OMUs consistent with Abegglen's clans exist in this population of hamadryas baboons.

#### **Paleontological models of intraspecific variation and molar-size dimorphism in Miocene apes.**

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*Lufengpithecus lufengensis* represents the most convincing case of a single fossil hominoid species with higher molar sexual dimorphism than living primates. Two size morphs are present in the *Lufengpithecus* molar samples. Based on canine shape, the large specimens are males, whereas the smaller ones are females. Because sex assignments are secure and sample sizes for the teeth are relatively large, this taxon can be used as a model of intraspecific variation and sexual dimorphism for other fossil taxa. Thus, we used the *Lufengpithecus* sample to evaluate metrical dimorphism in the mandibular molars of another Miocene sample thought to represent a highly dimorphic species, *Ouranopithecus macedoniensis*.

Most of the material for *O. macedoniensis* comes from a single locality, and the depositional context suggests that it derived from a single population. Moreover, canine morphology suggests the presence of two sexes rather than two species in the sample. Using resampling methods, we compared molar-size dimorphism of *Ouranopithecus* to that of *Lufengpithecus*, as well as *Gorilla*, *Pongo*, and *Mandrillus*. The *Ouranopithecus*

sample included recently described specimens, augmenting the sample used in previous analyses. Our results show that *Ouranopithecus* mandibular molars are generally more dimorphic than those of extant primates, but not more dimorphic than those of *Lufengpithecus*. Therefore, we conclude that the *Ouranopithecus* and *Lufengpithecus* species share a similar degree of molar dimorphism, which exceeds that of extant primates. Our results support previous suggestions that patterns of variation among late Miocene great apes do not conform to those observed in extant hominoids.

#### **Testing the association between limb anatomy, positional behavior and habitat structure of *Macaca fuscata* from Yakushima and Kinkazan Islands.**

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The range of Japanese macaques (*Macaca fuscata*) is one of the most ecologically varied of all primate species. The monkey's distribution throughout the Japanese archipelago includes broad-leafed evergreen forest in the south (e.g., Yakushima Island) and deciduous forest in the north (e.g., Kinkazan Island). These habitats differ markedly in temperature, tree species diversity and density, seasonality and food availability, thus providing an ideal opportunity to test relationships between ecology, behavior and anatomy. In this study, we provide preliminary results on the extent to which differences in foraging and positional behavior are reflected in the limb anatomy of monkeys from Kinkazan and Yakushima Islands. We studied a large sample of *M. fuscata* skeletons from each island (Kinkazan n=25; Yakushima n=63) housed at several Japanese institutions. We collected 38 measurements from adult specimens and generated 34 indices that reflect trends in limb usage. Our preliminary results indicate that the populations differ significantly in a number of these osteological measures. For example, males from Yakushima have a higher intermembral index, larger supraspinous fossa and more robust femora and tibia while males from Kinkazan exhibit a wider deltoid plane and intertubercular gap. The differences in osteological features between the two populations may reflect differing patterns of forest utilization, locomotion and/or foraging strategies. Our results have implications for understanding the relationship between limb anatomy and ecology in extant primates and provide new information on primitive limb morphology within Papionini.

#### **Diet and subsistence during the Middle Bronze at Sidon, Lebanon - The isotope evidence.**

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We report here on the results of carbon and nitrogen isotope analysis from collagen in human skeletal remains (n=55) and associated terrestrial and marine fauna (n=37), dating to the Middle Bronze Age (c. 2000-1500 B.C.) at the College site at Sidon, Lebanon. The data ( $\delta^{13}\text{C}$  and  $\delta^{15}\text{N}$ ) indicate that for most of the humans the protein component of the diet was largely derived from C<sub>3</sub> sources, i.e. plants and herbivores feeding on C<sub>3</sub> vegetation. A number of individuals had  $\delta^{13}\text{C}$  values consistent with the input of a small proportion of marine or C<sub>4</sub>-derived protein. These individuals also had higher  $\delta^{15}\text{N}$  values than the others, suggesting that the less negative  $\delta^{13}\text{C}$  values were derived from marine, rather than C<sub>4</sub>, dietary protein sources. However, a comparison with the isotope values of a range of contemporary faunal species, including fish, indicates that the  $\delta^{15}\text{N}$  values are more elevated than would be predicted based on the amount of marine protein indicated by the  $\delta^{13}\text{C}$  values. Also of note is the unusually large spread in  $\delta^{15}\text{N}$  values for the humans, ranging from 6 to 12.5. There is no indication of dietary change over the time period under study. Within the population, the diet of males appears to be much more varied, whereas female diets are distinctly more homogenous. The findings will be discussed in relation to the coastal setting of the site and social differentiation as inferred from the archaeology of the burial ground.

#### **Associations between the neuropeptides oxytocin and vasopressin and the behavior of free-ranging female rhesus macaques (*Macaca mulatta*).**

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The neuropeptides oxytocin and vasopressin have been shown to influence social behavior in a number of mammalian species. This study investigated relationships between oxytocin, vasopressin, and solitary and social behavior among free-ranging female rhesus macaques. Cerebrospinal fluid (CSF) and blood samples were collected from 46 cycling, but non-lactating, adult females over a period of two years, and both were assayed for concentrations of oxytocin and vasopressin. Blood plasma samples were also assayed for adrenocorticotrophic hormone (ACTH), cortisol, and growth hormone. Focal animal sampling was used to collect behavioral data within three months following physiological sampling. Behavioral

data were summarized by lumping social and solitary behaviors into 7 behavioral categories. There were no correlations between CSF and plasma concentrations of either oxytocin or vasopressin. However, plasma levels of oxytocin and growth hormone were positively correlated ( $r = 0.56$ ,  $p < 0.001$ ). With subjects characterized as having low, medium, or high plasma oxytocin and vasopressin levels, we found that females with low levels of oxytocin were more fearful than females with high levels of oxytocin ( $F = 3.18$ ,  $p = 0.05$ ), and females with high levels of vasopressin exhibited more leaping behavior than females with low levels of vasopressin ( $F = 3.74$ ,  $p = 0.03$ ). While oxytocin was not directly related to levels of social behavior, our results suggest that oxytocin may play a role in a “tend and befriend”, as opposed to a “fight-or-flight”, response to fearful situations.

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#### **How short is too short? Evaluating the explanatory power of statistical modeling methods when using recent ancient DNA data.**

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Recently, a variety of simulation programs to model demographic population histories using ancient DNA data have been developed. Several publications show that statistical modeling of regional temporal genetic data sets is a valuable tool for testing hypotheses about ancestral descendent relationships. These simulation programs rely on mutation rate estimates for determining either serial coalescence or forward-time predictions of genetic differentiation, and it is as yet unclear how appropriate are they when the time period in question is fairly recent. For population histories that span relatively recent time periods, will hypothesis testing based on different models of demographic history have any real explanatory power? Researchers are often interested in typing aDNA data sets from recent prehistory, but are generally limited to measuring mtDNA diversity. Will mitochondrial sequence data provide sufficient information for statistical modeling when the ancient population is less than 1000 years old? To address these questions we compare confidence intervals of expected mean pairwise difference and population pairwise  $F_{st}$ 's generated from forward-time and serial coalescent simulations for published ancient and modern genetic population data (Shinoda et al. 2006; Lewis et al. 2005) that share a potential ancestral descendent relationship in highland Peru. Our simulated population histories include several models of single population and multiple population origins with varying degrees of demographic events, including population expansion, bottlenecks, and migration. Results suggest that single

population models provide a better fit to the observed data and that these methods have only moderate statistical power to differentiate between strong demographic events in the recent past.

#### **Sexual dimorphism in the superior mandibular ramus.**

I.A. Scott, H. Schutkowski. Archaeological Sciences, University of Bradford, United Kingdom.

The mandible is known to display useful criteria for an assessment of sex in human skeletal remains. Previous studies have suggested that the mandibular notch may hold discriminative traits as well, but this region of the mandible has not been fully explored. Three documented skeletal populations from two different time periods and geographical areas were metrically assessed and subjected to discriminant function analysis to explore the suitability of the mandibular notch and ramus in delineating sex and differentiating geographical variability of sexually dimorphic traits. The assemblages comprise the collections from Christ Church, Spitalfields (104 individuals) and Chelsea Old Church (8 individuals), London, dating to the 18<sup>th</sup>/19<sup>th</sup> century, and the Luís Lopes collection, Lisbon, (204 individuals) of 20<sup>th</sup> century date, representing a total of 170 males and 146 females. Metric dimensions from the mandibular notch and ramus were found to separate the sexes with 84.9% accuracy for historic remains from Britain and with 80.4% accuracy for modern remains from Southern Europe. There were significant differences between the populations that could be attributed to morphological changes due to age and increased gracilisation of the modern skeletal population. We present a set of discriminant functions, which accommodate different states of morphological preservation of the superior mandibular ramus and which are able to provide an effective tool in skeletal sex assessment of unknown skeletal remains that is easy to apply.

#### **The adaptive value of android body shape in women.**

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Studies of male preferences for female body shape report these center on a low waist-to-hip ratio (WHR) of 0.70. It is argued men prefer low WHR since it signals higher fecundity and adaptive mate value. This is supported by research showing associations between low WHR (“gynoid” body shape) and measures of fecundity (e.g., higher

reproductive hormones), health and social status. High WHR is also indicative of health problems in contemporary societies including metabolic disorders commonly associated with android body-shape in women.

We suggest, however, that if an evolved universal, pan-cultural preference does exist, men should prefer android-shaped women since this body type signals thrifty genotypes, thrifty phenotypes, or both, better adapted for the uncertain nutritional environments in which our human ancestors presumably lived for thousands of years. However, since males do not (at least in modern western societies) prefer android women, perhaps preferences are plastic and adapt to what signals a healthy [optimal] phenotype in particular environments. Recent studies in more resource-challenged, traditional societies indicate men do, in fact, prefer women with higher WHR and body mass index (BMI).

To investigate further this apparent plasticity in male preferences, we present data from a study undertaken among migrant Bangladeshi men in London, UK, and Bangladeshi men resident in Sylhet, NE Bangladesh. These data show male preferences for higher female WHR and BMI in Bangladesh, but changing preferences for WHR among London Bangladeshi migrants that mirror well-documented, western preferences. We conclude male preferences are indeed plastic and subject to local ecological conditions.

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#### **Molar-size dimorphism in highly dimorphic extant anthropoids and *Lufengpithecus lufengensis*.**

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Dental remains attributed to *Lufengpithecus lufengensis* indicate that the molars of this late Miocene hominoid were more size dimorphic than those of *Pongo*. *Pongo* is commonly cited as possessing the greatest level of molar dimorphism among extant primates; if true, then the molars of *Lufengpithecus* would be the most dimorphic of any known primate. However, dimorphism in papionins is comparable to or in some cases greater than that observed in the most dimorphic apes. Thus, we tested the hypothesis that *Lufengpithecus* exceeded extant primates in molar-size dimorphism by comparing it to the highly dimorphic drill, *Mandrillus leucophaeus*, as well as *Pongo pygmaeus* and *Gorilla gorilla*.

For each mandibular molar, size was calculated as the geometric mean of the mesiodistal and buccolingual diameters. The bootstrap was used to evaluate differences in each pairwise species comparison. Results indicate that *Pongo* and *Gorilla* are generally similar in molar dimorphism. Dimorphism in *Mandrillus* exceeds that in *Gorilla* at  $M_1$  and

M<sub>2</sub>, whereas the drill is only more dimorphic than *Pongo* at M<sub>3</sub>. Dimorphism in *Lufengpithecus* exceeds that in the extant hominoids at all molar positions and is greater than that in the drill at M<sub>1</sub> and M<sub>2</sub>. Failure to find a significant difference between *Mandrillus* and *Lufengpithecus* at M<sub>3</sub> could be due to small sample size for the latter species. These results support the hypothesis that molar dimorphism in *Lufengpithecus* was greater than in extant primates. However, when compared to *Mandrillus*, the degree of dimorphism in *Lufengpithecus* is not as extreme as previously thought.

#### ***In vitro* study of shock absorption in simulated intervertebral disks and the implications for bipedal distance running.**

J.E. Scott, J.D. Polk. Dept. of Anthropology, University of Illinois at Urbana-Champaign.

The purpose of this project is to provide a preliminary experimental test of a biomechanical model that relates the shock-absorbing characteristics of intervertebral disks to their cross-sectional area. This has implications for studying the evolution of bipedal distance running in hominins since vertebral body size, and hence, intervertebral disk size increases with the origin of *Homo erectus*, the taxon believed to be the first endurance runner; and because impact force magnitudes differ dramatically between walking and running. An *in vitro* study was conducted using six simulated intervertebral disks of varying area, but otherwise identical material properties. Each disk was subjected to impact loads and transmitted force characteristics were measured using a force platform (AMTI Inc. Watertown, MA). Specific measurements include the peak force transmitted through each disk, the duration of time that the load remained in contact with each disk, and the amount of energy absorbed by each disk. The results show that, for a constant impact load, the energy absorbed by each disk did not increase significantly with increasing disk area. Impact forces transmitted through the disk increased with disk area, while the duration of the impact load decreased with increasing disk area. These results suggest that increasing disk area alone will not confer an advantage for impact force absorption. Our model suggests that concomitant changes in disk material properties and thickness may be more effective at moderating the transmission of impact forces, and these changes should be expected in the vertebral columns of bipeds adapted to distance running.

#### **Dental microwear texture analysis of megaladapids and archaeolemurids.**

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The inference of diet in subfossil lemurs is key to understanding the adaptive diversity of the Malagasy strepsirhine radiation. While dental microwear analyses have been conducted on several of these species, different studies have yielded inconsistent results. Here we reconstruct the diets of some of these taxa by dental microwear texture analysis, a new approach that offers observer error-free surface characterizations.

All available M<sub>2</sub>s of *Archaeolemur edwardsi* (n=23), *A. majori* (n=15), *Hadropithecus stenognathus* (n = 9), *Megaladapis edwardsi* (n=7), *M. grandidieri* (n=12), and *M. madagascariensis* (n=5) that preserved unobscured antemortem microwear were included in this study. First, point clouds were generated for facets 9, 10n, or x using white-light confocal microscopy with a lateral sampling interval of 0.18 μm over an area of 276 x 204 μm. Scale-sensitive fractal analysis variables known to separate extant primates with differing diets (complexity, anisotropy and textural fill volume) were then calculated for each surface.

Results indicate that the first axis of a discriminant analysis accounts for more than 82% of the total variance, contrasting individuals with higher textural fill volumes versus those with higher values of anisotropy. This axis tended to separate megaladapids from archaeolemurids, which fell with previously examined extant primates that eat more leaves and hard-objects respectively. Still, there was extensive overlap among species and many classification errors. This suggests possible differences in dietary preferences between taxa, but also considerable overlap in the types or at least material properties of foods eaten.

#### **Exhibiting Human Evolution in the Museum: Does it Matter?**

M. R. Scott, Natural History Museum Consultant.

As the topic of evolution becomes increasingly manipulated in popular media, what role do museums play in communicating evolutionary information to the public? My research examined the ways American, British and Kenyan museum visitors understand human evolution exhibitions as well as understand what it means to have evolved "Out of Africa." Through quantitative and qualitative visitor studies at the Natural History Museum (London), the Horniman Museum (London), the National Museums of Kenya (Nairobi) and the American Museum of Natural History (New York City), my work reveals that museum audiences largely

interpret exhibitions through preexisting cultural frameworks and through popular science picked up outside the museum. Because of this, museum visitors still often regard evolution as a neat, linear ladder of progress and generally misunderstand the scale of evolutionary time and the complexity of evolutionary processes. My work also identifies strategies museums can use to challenge these pervasive misconceptions; for example, we can ask visitors questions in exhibitions to facilitate critical thinking; we can demystify the museum by discussing how exhibitions are built and artistic reconstructions are made; and we can demystify the science of human evolution by illustrating how evolution by natural selection actually works. These are tools museum visitors can use to better understand the science presented to them in natural history museums as well as in the world around them.

#### **Ontogeny of fore limb and hind limb muscular mass distribution in habitually upright versus quadrupedal primates.**

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A non-human primate model is used to investigate muscular ontogeny underlying the transition from quadrupedalism to habitual upright posture. Muscular mass distribution was compared between neonates and adults of the specialized leaper *Galago moholi* and the arboreal quadruped *Cheirogaleus medius*. Fore- and hind limbs of cadavers of *G. moholi* (4 adults, 3 neonates) and *C. medius* (4 adults, 5 neonates) were studied. Following dissection, muscles were removed, excluding intrinsic hand/foot muscles. Muscles of limb segments (arm, forearm, thigh, leg) were weighed in groups (e.g., adductors, flexors), or individually (e.g., sartorius). Muscle mass data were used to calculate the percentage of muscle groups in each limb segment as well as fore limb (arm/forearm) and hind limb (leg/thigh) mass ratios. Muscle mass percentages for the arm and thigh are nearly identical between ages in both species, but subtle differences exist distally. In both species, the relative mass of forearm flexors increases by approximately 10% between age groups. In the leg, adult *G. moholi* gains whereas *C. medius* decreases in relative mass of the superficial plantar flexors. In both species, forelimb and hind limb ratios follow a trend of neonate > adults ratios by 5 to 10%, indicating a proximal shift in muscle mass. These results support previous findings that the thigh of primates is precociously organized and indicate that the arm is similar. The forearm undergoes mass redistribution reflecting a common specialization for grasping that typifies all primate hands. However, the leg may



undergo a redistribution of relative muscle mass related to locomotor specialization.

This study was funded by a grant from Slippery Rock University.

### The PCFA-MCA Method: A New Approach for Studying Reconciliation in Nonhuman Primates

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Most primates tend to engage in affiliation following aggressive conflict. The standard method of examining reconciliation compares latency until the first affiliative post-conflict (PC) contact following an aggressive encounter, with a "matched" control (MC) period of same length (the "PC-MC Method," de Waal and Yoshihara, 1983). Studies using this and related methods such as the "time-rule" (Aureli et al., 1989) and "rate method" (Veenema et al., 1994) have depended on operational definitions of reconciliation that concentrate primarily on latency until the first observed affiliative event after conflict, thus missing the potential importance of its temporal lag and communicative connection with subsequent behaviors. Here, I propose a new operational definition of reconciliation comparing patterns of behavior obtained in the period immediately following the first affiliative post-conflict (PCFA) event with an "affiliative matched control" (MCA): non-conflict periods immediately following baseline affiliation obtained using a new technique that uses spontaneous baseline behaviors as flags for extracting relevant matched control periods. This "PCFA-MCA Method" results in differences measured in duration of the first affiliative behavior (e.g. the length of an initial bout of grooming, contact sitting, or maintaining close proximity) or by the nature and timing of the behaviors which follow. In my presentation, I will show how the addition of this more complex measure gives rise to empirical tests of how individual differences in stress and qualitative differences in primate relationships may contribute to post-conflict strategies. Ultimately, this new method can offer insight into how primates cognitively represent conflict and their social relationships.

This work was partially funded by MSTP grant T32 GM007170, and by institutional funds from the University of Pennsylvania School of Veterinary Medicine.

### Size factor as a hard nut in the sex estimation of skulls: Upper Paleolithic sample from Predmosti (Czech Republic) as an example.

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In this study we estimate sex and population affinity of Predmosti (P) skulls using linear and geometrical discriminant analysis (DA), and compare them with results of 2D geometric morphometrics (GM).

We used measurements of P3, P9 males, P4, P10 females, and two databases – the recent by Howells and the fossil by Henke.

DA classify the P skulls as robust and belonging to the „male“ region, losing the sensitivity of inter-population differences. That is why this approach could not be applied. Geographic differences do not define P skull shapes as extreme. The geographic variability influence could be stronger than inter-sexual differences. These differences are a component of regional inter-population variability, despite the chronological differences between databases and Gravettian skulls.

Because of required precision, recently it is suggested to use for sex estimation DAs, and it is necessary to have reference skulls database from similar population. Their sex should be estimated on the basis of the same specimen pelvis. In earlier fossil findings, this is almost impossible, because they mostly have larger cranial dimensions than the used younger database.

Our previous sex estimation of P skulls with help of GM is completely in accordance with the classical morphoscopic estimation. In this case, GM is more successful methodical approach than DA. However, a database is necessary, which satisfy the same requirements used in DA.

In this view, the estimation of sex and population affinity of skulls could be sometimes effectively realized by the morphoscopic variables, too.

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### Population movement into the Japanese Archipelago during antiquity: a craniofacial and odontometric perspective.

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Ancient population movement into the Japanese Archipelago is examined using odontometric and craniometric data among the Japanese of various eras and major populations of the Old World. Affiliations are analyzed by the Principal Coordinate Plot generated by Relethford and Blangero's R matrix and the Neighbor-Joining methods based on minimum genetic distance from R matrix.

Using craniometric data, the Jōmon and Ainu are separated from Neolithic Chinese, China Bronze Age, modern Chinese, Northeast Asians, the rice agriculturist Yayoi of Japan, historic and modern Japanese and Southeast Asians. The Yayoi tie more closely to Neolithic Chinese, Koreans, and Japanese. Once we include the New World samples including Archaic Americans, the Jōmon and Ainu rather tie to Archaic Americans than the Old World samples. Using odontometric data we obtained results that support our craniometric analysis. The Jōmon and Ainu are separated from all other groups. Neolithic/Mesolithic Laos, Thai Bronze Age, and modern Southeast Asians form one cluster. Moreover, these Southeast Asian groups show similarities to Neolithic Chinese, Yayoi, and Modern Japanese.

Considering both odontometric and craniometric data, our preliminary results partially support Kazuo Hanihara's "Dual Structure model for the population history of the Japanese." However, our results do not support Hanihara's proposal that the prehistoric Jōmon of Japan were derived from Southeast Asia. We further suggest the Jōmon as being the Late Pleistocene descendents of Northeast Asia and some of them moved into the Japanese Archipelago, and others moved to the New World.

### Effects of the periodontal ligament in occlusal load distribution and the implications for finite element modeling of the primate skull.

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The periodontal ligament (PDL) is the medium of occlusal force transfer in the jaws and its mechanical properties likely have an effect on masticatory strain dissipation in the skull. The importance of incorporating the PDL in theoretical modeling is unexplored and the PDL is often ignored in finite element analyses of the primate mandible and cranium. Experimental data were collected to evaluate the effect of PDL behavior in two contexts: 1) comparing strains arising from loads applied through an intact PDL to those arising from loads applied through simulated direct tooth-bone contact, and 2) considering PDL effects on strain magnitudes local to and remote from the point of load application.

In vitro strain analysis was performed on a previously frozen, fresh *Sus domesticus* cranium. A vertical occlusal load at the Ldm<sup>1</sup> was applied at varied rates and surface bone strain data were collected from rectangular

rosette strain gages bonded to the cranium with the PDL intact and subsequently with a tooth-bone interface established using an adhesive with properties comparable to cancellous bone (cyanoacrylate). The viscoelastic properties and rate dependency of the PDL affected strain dissipation in the adjacent alveolar bone which resulted in more efficient load transmission to bone at higher rates. The cyanoacrylate interface produced markedly different strain magnitudes; however, we infer that effects of the PDL are primarily local to the load application site as remote gages did not register significant differences in strain between the two iterations.

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#### **Evidence for a Galatian occupation of Gordion, Turkey from human skeletal remains.**

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This research examines regional population movements using mortuary practices, paleodemography, and skeletal analyses (including metric and non-metric studies). Although documented in classical literature, support for the presence of Galatians, a Celtic people, at Gordion is mixed. In combination with archaeological and linguistic evidence, osteological analysis of forty-six individuals excavated from the Lower Town area of the site, 20 Later Hellenistic (late 3<sup>rd</sup> to 2<sup>nd</sup> centuries BCE) and 26 Roman (1<sup>st</sup> to 2<sup>nd</sup> centuries CE), provides a means of investigating a Galatian incursion. This study represents the most comprehensive osteological study to date and offers the first intrasite comparative data from Gordion.

Corroboration for a Galatian presence includes different paleodemographic profiles in the Lower Town sub-samples. Composition of the Later Hellenistic or Celtic group is unusual, with few infants (5%) and primarily young or middle aged adults (55%), whereas the Roman sample has many infants (27%) and less than half young or middle aged adults (35%). Burial contexts for the two groups are also distinct, with only one formal interment associated with the Later Hellenistic, the remaining individuals being in mixed groupings of human and animal bones or disarticulated and commingled human skeletal deposits. By comparison, the Roman sample is made up of two cremations and 24 inhumations, all primary burials. Evidence of interpersonal violence is absent in the Roman group but present in some of the Later Hellenistic specimens. Many of the features observed in the Later Hellenistic skeletal assemblage have similarities to European Celtic remains suggestive of ritual sacrifice.

#### **Release of social hormones in response to visual cues in a pair-bonded primate.**

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The current paradigm holds that the hormones oxytocin (OT) and vasopressin (AVP) play a role in the cementation of social bonds through tactile contact with familiar conspecifics, a conclusion based largely on work with subterranean rodents. Due to evolution in an arboreal habitat, however, social primates rely more on visual cues than many other mammals. It was therefore hypothesized that peripheral release of these hormones, and hence socially relevant behaviors, might take place upon commencement of visual contact with the mate in pair-bonded male common marmosets (*Callithrix jacchus*) even in the absence of any tactile contact. To test this, six males from the Wisconsin National Primate Research Center were isolated from visual contact with any conspecifics for a period of 48 hours. Each was housed in a metabolism cage permitting continuous urinary collection in a separate room, with auditory and olfactory contact remaining intact due to the proximity of the main housing colony. Males were then reintroduced to the colony while still in metabolism cages, and positioned to face the cage of their mates. Levels of urinary OT and AVP were measured via solid-phase extraction and subsequent radioimmunoassay. Relative to the last 24 hours of isolation on average, there was a significant increase in both urinary OT (p-value = 0.049) and AVP (p-value = 0.044) after only one hour of visual contact with the mate in all subjects. It is concluded that visual contact alone is sufficient for the release of social hormones in this species.

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#### **Dimorphism of the Radial Head Diameter and its Potential for Sex Determination.**

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The present study assesses the degree of sexual dimorphism in the human radial head diameter, as an indicator of overall body size, and the accuracy of sex estimates based on this measurement. Group differences between modern European- and African-Americans were also tested.

The study utilized a modern forensic sample of European-Americans consisting of 272 males and 138 females from the Bass Collection (University of Tennessee, Knoxville, TN). This sample was compared to a modern African-American sample of 36 males and 31 females from the Hamann-Todd

Collection (Cleveland Museum of Natural History, Cleveland, OH).

Normal analysis of variance (ANOVA) techniques were applied to test the presence of between-group differences and assess effect size. Analysis of covariance (ANCOVA) allowed testing for group differences after correction for body size.

Cross-validation of sex classification through discriminant function analysis shows that radial head diameter, before or after correction for body size, is a sex indicator showing accuracies comparable to those of the femoral and humeral head diameters. Furthermore, it is argued that, due to the simplicity of the measurement and its reliability as a sex indicator, it should be included in the standard measurements set.

#### **A preliminary study of mate-guarding in wild titi monkeys (*Callicebus discolor*).**

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Sexual selection theory predicts that monogamy should be rare as a reproductive strategy among mammals as one sex, often the male, is more likely to benefit from polygamous associations. The mate-guarding hypothesis for explaining the maintenance of monogamy proposes that males may benefit from protecting their partners from extra-pair copulations, whereas females may benefit from defending the territory jointly and/or sharing parental duties. Under this hypothesis, males should be more likely to guard females when they are receptive.

As part of a long-term study of red titi monkeys (*Callicebus discolor*) at the Tiputini Biodiversity Station in Ecuador, we conducted a preliminary evaluation of the mate guarding hypothesis through an examination of the role that the male and female in one focal study group played in proximity maintenance during estrous and non-estrous periods. We estimated the period of receptivity based on changes in the rates of copulations and genital inspections by the adult male and adult female. To examine differences between the sexes in proximity maintenance behaviors during estrous and non-estrous periods we calculated Hinde's Index.

We found a significant difference in the amount of time the male and female spent in proximity during the estrous versus the non-estrous period (within 3m: p<0.005; within 1m: p<0.005). We found the male was primarily responsible for proximity maintenance during the estrous period, whereas the male and female were equally responsible for maintaining proximity to one another during the non-estrous part of the year. Although preliminary, our results

provide support for the mate-guarding hypothesis.

**Effects of rearing temperature on long bone growth in mice: an experimental model for examining Allen's rule.**

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Ambient temperature impacts limb and body growth in mammals. Animals chronically exposed to cold have stouter bodies and shorter limbs/extremities than littermates housed at warmer temperatures. These changes resemble the ecological-thermoregulatory predictions of Allen's Rule, but the mechanisms underlying this response are unknown. This study tests the hypothesis that cold temperature restricts long bone growth by reducing growth plate kinetics and/or vascular supply, and that warmer temperatures enhance these factors. Methods: Male CF-1 mice (N=65) were housed at 7, 21, and 27C from weaning (3.5 weeks) through maturity (12 weeks) and diet/activity levels were recorded. Prior to euthanasia at 4.5, 6.5 and 12 weeks, mice received an intracardiac injection of fluorescent microspheres to measure regional blood flow. Growth plates were examined histologically. Results: Ears, limbs, and tails of warm-reared mice were significantly longer than those raised in the cold with no change in body mass. Cold-reared mice had the shortest extremities, consumed the most food, were most active, and had enlarged hearts and kidneys. Hindlimb bone blood flow was significantly decreased in young-cold mice suggesting that vascular factors underlie these differences. Furthermore, growth plate size was decreased in mice raised at 27C suggesting accelerated growth and/or epiphyseal maturation at warmer temperatures. Whole-bone culture experiments are currently underway to help elucidate the precise role of temperature and vasculature on these *in vivo* growth differences. Conclusion: Growth plate physiology and vascular supply are significantly altered by ambient temperature during growth. These results have implications for interpreting primate species living at climatic extremes. [Funded by NSF-0524899]

**Geographic variation in orbital shape in modern human populations.**

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Among the nonmetric characters used to assess ancestry in modern humans, differences in orbital shape are suggested to be good indicators of geographic ancestry. This study tests the linkage between orbital

shape and geographic region by examining the variation in orbital shape and related areas of the face and anterior cranium in 150 modern human crania from Africa, Asia and Europe using 3D geometric morphometrics. I recorded 57 landmarks and resampled 20 semilandmarks per orbit. I calculated group means and degrees of overlap, Procrustes distances in group means, and performed Principal Components analysis using Morphologika.

Previous work suggested individuals of African ancestry exhibit "rectangular" orbits, those of Asian ancestry "round" orbits, and those of European ancestry "angular orbits". My results suggest these descriptions are insufficient. Only the Asian sample affirmed previous descriptions having an evenly rounded inferior orbital rim with a medially located orbitale. African and European samples had depressed inferolateral orbital corners, and differed between one another in the position of the superior relative to the inferior orbital rim. The analysis of the face and anterior cranium suggests geographically patterned differences in both the width and length of the frontal bone and facial length. Because of the continuous nature of human variation, in all analyses there was overlap between all samples. However, the data also suggest that clinal variation in aspects of the face may be useful in identifying ancestry, and that 3D geometric morphometrics is effective for assessing nonmetric shape variation in forensic anthropology.

**The paleobiology of the robust australopithecines (*Paranthropus*): a test of the durophage model with trace element analysis.**

A.B. Shabel. Museum of Paleontology, Museum of Vertebrate Zoology, and Dept. of Integrative Biology; University of California, Berkeley.

Most early hominin fossil localities in Africa are associated with ancient wetlands, however the extent to which early hominins used wetland habitats and resources is not known. I have argued previously that the craniodental anatomy of robust australopithecines (*Paranthropus*) can be explained as an adaptation to a diet that included hard-shelled invertebrates such as freshwater crabs and molluscs. Here I test this durophage model through an analysis of the trace element biogeochemistry of more than 35 species of extant African vertebrates — including aquatic, semi-aquatic, and terrestrial forms — with a focus on small- and medium-sized carnivorans. I also include an exhaustive analysis of freshwater crab tissues (Potamonautidae), the primary food source of three extant African taxa (*Aonyx*, *Atilax*, *Varanus niloticus*). The ratio of strontium to barium (Sr:Ba) is found to statistically distinguish taxa that forage in freshwater (*Hydriectis*) from those that forage amphibiously on land and in freshwater (*Aonyx*, *Atilax*, *Varanus niloticus*) from those that forage terrestrially (including both

carnivores and herbivores). Sr:Ba increases from freshwater aquatic to semi-aquatic to terrestrial ecologies, in part as a result of the high levels of barium in crab tissue, a major wetland food resource. Coastal populations of *Aonyx* and *Atilax* that consume marine prey have the highest Sr:Ba ratios because of the very low levels of barium in seawater. These overall biogeochemical patterns are evident across sub-Saharan Africa. I compare these results with the published literature on fossil hominins, including *Australopithecus* and *Paranthropus*, and I conclude that the durophage hypothesis has not been falsified.

**Center of mass position, quadrupedalism, and stability: Where do primates fall?**

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The preference shown by primates for diagonal sequence (DS) walking is unusual among mammals, but a satisfying biomechanical explanation for this gait choice remains elusive. This study approaches the question from the point of view of stability, a basic requirement of terrestrial locomotion regardless of gait choice. With at least three limbs on the ground, an animal achieves static stability if its body's center of mass (COM) lies within the triangular base of support. An untested, though frequently cited hypothesis regarding primate walking states that DS gait is statically stable because primates share a relatively caudal location of the body's COM. This study evaluates the extent to which static stability is achieved when primates walk, and tests for the effects of COM position and gait sequence on stability. Infant primates were used for hypothesis testing because their gait preferences and COM positions change with age. Using 3D kinematic data in conjunction with body segment measurements, gait preferences and the position of the COM were tracked in four baboons as they aged from two to nine months. Relative to the trunk's midline, the COM moved caudally in this developmental time span. Contrary to predictions, DS gaits did not become more statically stable as the COM shifted caudally with age. In fact, across all ages, DS gaits were less stable than LS gaits, as evidenced by smaller triangles of support, and more frequent movement of the COM outside the support triangle. Primates most likely rely on dynamic stability even during three-limbed support. Supported by the Leakey Foundation and NSF BCS-0313821.

**Color vision and food detection in squirrel monkeys (*Saimiri boliviensis*).**

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Within most New World primates, color vision abilities are influenced by a single-locus opsin gene on the X-chromosome. In *Saimiri*, females heterozygous for the opsin gene have proteins sensitive to three different wavelengths (trichromatic), whereas all males and females homozygous for the opsin gene are dichromatic. Because of differences in visual abilities within populations, these species provide a unique opportunity to study the evolution of color vision and the cause of preservation of polymorphisms in a population. It has been suggested that polymorphism is maintained through heterozygote advantage, as trichromats presumably are better able to locate ripe fruits against a green background. However, dichromats may be better able to detect camouflaged objects such as cryptic insects or predators. This study examines the link between color vision genotypes, foraging strategies, and foraging success in a group of captive female squirrel monkeys (*Saimiri boliviensis*) at the Center for Neotropical Primate Research and Resources. Individual females were given food in three different conditions: red food against a white background (control), red food against a green background (trichromatic advantage), and green food against a green background (dichromatic advantage). The time taken to find the food was recorded and genetic analysis was conducted using both fecal and blood samples. The relationship between color vision genotypes and foraging efficiency is discussed. This study will help to address questions such as how and why color vision evolved in primates, what visual cues are used to locate food, and how differences in visual abilities may affect relative fitness.

**Lithic technology and hominid behaviour of the earliest occupations at the Nihewan Basin, northern China.**

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The Nihewan Basin of Hebei province is a large extinct lacustrine basin with extensive Pliocene and Pleistocene deposit containing hominid activity sites with associated fossil faunal and stone tools. Over the past three decades, more than a dozen sites of the Early Pleistocene have been recovered, indicative of the earliest hominid occupations in East Asia researching 40° north latitude landscape. This paper will report recent archaeological fieldwork at the basin, including excavations at Xiaochangliang, Dongguotuo, Goudi, and Maliang. With an establishment of palaeomagnetic lithostratigraphy at the basin, cultural materials from these Early Pleistocene archaeological sites are able to be analyzed with comparative and technological data. Archaeological evidence from the Nihewan Basin clearly points to continuous development of Asian hominids in northern China starting 1.7 million years ago. These hominids utilized local resources of lake water sources and raw materials for tool making. Use-wear of tools suggests that the

occupants engaged in various activities for survival. The study reveals a fact that lithic technology and hominid behaviors of the earliest occupation in northern China could be much more complicated than we thought previously.

This research has been supported by grants from the Wenner-Gren Foundation for Anthropological Research, the Chinese Academy of Sciences, and the Royal Ontario Museum Heritage Governor.

**Return of *Alouatta pigra* to the forests around Nahá, Chiapas, Mexico.**

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By the early 1980s, *Alouatta pigra* became locally extinct due to forest degradation and hunting in the region of Nahá, Chiapas, which is located on the eastern edge of the Selva Lacandona and is owned by the Comunidad Lacandona. Recently, this species was reported by the Lacandon Mayans in Nahá to have returned, even though forests in adjacent areas are being cleared for large-scale agriculture by ejidos. In this study, I determined that *Alouatta pigra* are present in the forest immediately surrounding Nahá, however, the population density is low. I examined the potential for the continued survival and growth of populations through an assessment of possible food sources, through interviews with local Lacandones, and through an examination of satellite images of the region. I found that there are food sources present, including the preferred tree species *Brosimum alicastrum*. In addition, I discovered that the Lacandones in Nahá have locally prohibited the hunting of *Alouatta pigra* and, furthermore, that they have made a community decision to restore their forest. While there is still evidence in the forest of past degradation, it has been shown that *Alouatta pigra* have a better survival rate in fragmented forests than do other species. The satellite images demonstrate the continued encroachment by ejidos into the forest around Nahá, a principal constraint to the conservation of *Alouatta pigra* in this region of Mexico.

**Radiography of the pubic symphysis: an alternative method for the age at death estimation of human skeletal remains.**

P. Sherin. Department of Anthropology, Queens College of the City University of New York.

A number of articulating skeletal surfaces, including the pubic symphysis and auricular surface of *os coxae*, and sternal ends of ribs, have been shown to experience a predictable sequence of morphological changes with biomechanical stress and progressing age. Metamorphosis of these surfaces evaluated macroscopically is the basis for a plethora of age estimating techniques. Unfortunately postmortem

taphonomical processes can render conventional methods of estimating age at death unusable. In this study we examine the possibility to use radiographs of the pubic symphysis to estimate age at death from fragmentary human skeletal remains. The pubic area of 120 skeletons with known age at death was radiographed to evaluate changes that occurred in trabecular structure with age. In young adults (ages 15 – 25) we find a uniform high density of trabeculae. Evenly spaced tensile and compressive groups of trabeculae are best defined in younger individuals. After age of 25 the structure of trabeculae becomes somewhat irregular with areas of high density intermittent with areas of low density. In older individuals we find a markedly reduced trabecular density, thinning of tensile trabeculae, hollow pockets and increased radiolucency. We also report significant correlation between changes observed on radiographs and the commonly accepted Suchey-Brooks method for age estimation based on the pubic symphysis.

**The development of hunting behavior in young male chimpanzees at Ngogo, Kibale National Park, Uganda.**

H.M. Sherrow. Department of Sociology & Anthropology, Ohio University & Department of Anthropology, Yale University.

Chimpanzees in all known populations hunt and eat meat. Previous studies support the “male bonding” hypothesis, which proposes that males hunt and share meat largely to establish and reinforce alliances with other males. Despite the political and social importance of hunting to male chimpanzees, little attention has been paid to the development of this behavior. I present data on the hunting behavior of young (juvenile or adolescent) male chimpanzees at Ngogo, Kibale National Park, Uganda that address this deficiency. The Ngogo chimpanzees mostly hunt red colobus monkeys and are extremely successful hunters relative to other known communities. Data from over 225 hunts, collected over a five year period, show that young males are often present at hunts and actively pursue prey. Pursuit frequency, prey-capture success, and meat acquisition all vary positively with age category. Older males pursue prey more often, have greater success in prey capture, and acquire more meat from other group members than younger males, although exceptions exist. Scrounging behavior varies negatively with age category among young males. Younger males scrounge for meat more often than older males, and acquire the majority of their meat through this activity. These results confirm earlier reports that males develop hunting abilities slowly and that body size and experience influence male willingness to pursue prey and their hunting success. These results also indicate that scrounging is an important reinforcement behavior for young males,

allowing them to acquire some meat during hunts.

**Histological asymmetries of primary motor cortex predict handedness in chimpanzees (*Pan troglodytes*)**

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Like humans, captive chimpanzees display robust and consistent hand preferences during the performance of certain tasks. Although correlations have been previously demonstrated between gross anatomic measures of primary motor cortex asymmetry and handedness in chimpanzees, the relationship between histological asymmetry of this cortical area and behavioral lateralization has not yet been investigated. In the present study, we have identified aspects of cortical microstructural organization which correspond to individual variation in handedness. We examined interhemispheric asymmetry of several different histological characteristics of the primary motor cortex in the region of hand representation from 14 chimpanzees in which handedness was behaviorally tested before death. We found that asymmetries in overall neuron density and the density of parvalbumin-immunoreactive interneurons were the best predictors of hand preference on a coordinated bimanual task. Associations were weaker between histology and hand dominance that was expressed during feeding. Notably, our current data showed no evidence of population-level asymmetry of neuropil space within the hand representation of primary motor cortex, as has been observed in human postmortem brain studies. Although alternative explanation cannot yet be ruled out, this dissimilarity between species suggests that this feature of histological asymmetry in humans might have arisen after the split from the last common ancestor with chimpanzees.

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**Heritability of the human jaw and dentition.**

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The dentition and jaws are a common subject of study throughout the subdisciplines of biological anthropology. The fundamental genetic architecture underlying variation in dentognathic traits, however, is still poorly understood. Here we provide the first report of a quantitative genetic study of the genetic architecture of the human dentognathic complex.

Dental impressions were taken of 195 members (16 to 69 years old) of the Jirel population of eastern Nepal who belonged to a single extended pedigree. Palatal metrics as well as rotation and mesiodistal dimensions were measured from digital images of the dental casts using the software program Nemocast (CDIImaging). 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 and sex were also simultaneously estimated. In this preliminary dataset, most dentognathic measures were significantly heritable ( $p < 0.05$ ). Mesiodistal dimensions were generally moderately heritable (mean residual  $h^2 = 0.52$ ). Dental arcade length measures were also frequently significantly heritable (residual  $h^2 = 0.45$ ); significant tooth rotation measures showed a mean residual  $h^2 = 0.52$ .

The Jirel population's single pedigree has been documented and genotyped through over twenty years of genetic research. This pedigree provides an unparalleled opportunity for investigating the fundamental aspects of the genetic architecture of the human dentognathic complex. The high heritabilities found for dentognathic traits in this preliminary study provides strong justification for a more extensive study aimed at identifying the specific gene complexes involved in dentognathic morphology and disorders in this population.

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**The maintenance of social bonds in adult pairs of captive cotton-top tamarins (*Saguinus oedipus*).**

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Cooperative breeding systems, in which individuals other than the parents take care of the infant, occur in a number of mammalian groups. They are particularly characteristic of the tamarins and marmosets of South America. There is extensive literature on the interactions between adult male tamarins and the offspring; such behaviors include food sharing, grooming, and infant transport. However, little is known regarding the interactions between

adult males and the breeding female, including how their bonds are maintained. This study examines interactions between captive male and female cotton-top tamarins (*Saguinus oedipus*), focusing on the occurrence of possible behaviors that may serve to reinforce bonds.

Data were collected on two captive cotton-top tamarin adult pairs at Central Park Zoo (NY) and Brookfield Zoo (IL) from June through August 2006. Results on allogrooming, scent marking, and food sharing behaviors are based on approximately 180 hours of behavioral observations through focal and ad libitum sampling. Both food sharing and scent marking behaviors were rare. Allogrooming behaviors were prevalent in both groups, although the pairs differed in the patterns of giver/receiver. Behavior differed between an adult male and the dominant female as opposed to the male and his adult daughter retained in the group. Results are compared to those from other callitrichid primates.

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**A test of the Buckberry and Chamberlain revised method for age estimation from the auricular surface using a modern sample.**

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This research tests Buckberry and Chamberlain's (2002) revised method of age estimation from the auricular surface using a modern sample. This composite scoring method is based on the Lovejoy et al. (1985) method for auricular surface aging. The composite score is derived from 5 features of the auricular surface (surface texture, transverse organization, microporosity, macroporosity, and apical changes). Buckberry tested the method on the Christ Church, Spitalfields, London skeletal population and reported low levels of inter- and intraobserver error, as well as a higher correlation with age than the Suchey-Brooks pubic symphysis method. However, a recent test by Falys, Schutkowski, and Weston (2006) on the St. Bride's, London historic skeletal assemblage found considerable variation in the composite scores; these authors report that the method is unsuitable for forensic purposes.

The sample for this test is the University of Tennessee's William M. Bass Skeletal Collection. Eighty-six percent of the individuals tested fell within the estimated age ranges. However, 5 of the 7 age stages have ranges between 39 and 59 years. The Pearson correlation between age-at-death and median age was only 0.35. Furthermore, a trait-by-trait transition analysis using Konigsberg's Nphases2 program gave inconsistent results concerning the age at which an individual is most likely to transition from one phase to the next for any of the 5 traits. These preliminary results support the conclusions of Falys et al.

concerning Buckberry and Chamberlain's revised method. The auricular surface is best used in conjunction with other accepted aging methods.

**Primate dental morphology: something different but nothing new.**

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The diversity of tooth morphology among extant and fossil primates provides an extensive basis for deciphering taxonomy and making inferences concerning diet. These morphological differences have been intensively studied and every minute nook and cranny documented. However, without understanding the genetic and developmental processes that pattern the dentition it is impossible to properly weigh the evolutionary or taxonomical relevance of tooth morphology. There are complex genetic dependencies among traits within and among individual teeth and jaws in the same individual. Discerning within from between population variation in the fossil record where isolated teeth are common is particularly problematic. Understanding tooth development requires the experimental manipulation of embryos which requires an available but relevant model organism. Many of the genes, pathways, and processes involved in dental patterning have been identified in the mouse. Mutations that cause human dental anomalies often have similar effects in mice showing conservation of these basic processes. The most important genes are signaling and transcription factors whose protein structure is highly conserved among taxa, implying that pattern changes are largely brought about by mutations affecting timing or intensity of expression of these genes in the embryo. Substantial adaptive differences can be quickly (or easily) achieved by fairly simple signaling genetic change. It is for this reason that the mouse is useful as a model or analogy for the kind of genetic and developmental processes involved in producing primate dental morphology: although the details can differ greatly, in the basic processes there is nothing new.

**Understanding vertebrate brain size evolution**

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The Social Brain Hypothesis argues that large brains have arisen over evolutionary time as a response to the social and ecological conflicts inherent in group living. However, in primates relationships between brain size and non-social factors such as life history and ecology have long-been recongised. We put brain size evolution into a framework and suggest that body size, BMR and lifehistory act as constraints on brain evolution, and through this influence the coevolution of neocortex size and therefore maximum group size. We secondarily present results for

comparative analyses that compare factors associated with brain size in primates with four other vertebrate orders (Carnivora, Artiodactyla, Chiroptera and Aves). Across all five taxonomic groups, relative brain size is strongly related to pairbonding and enduring stable relationships. However, primates alone consistently show a strong correlation between brain size and group size, and we argue that this reflects the different nature of primate relationships as compared to most other group living vertebrates. We argue that monogamy represents a qualitative shift from loose aggregations of individuals to complex negotiated relationships, and that these bonded relationships have been generalised to all social partners in a few taxa such as primates.

**The biogeographic origins of Primates and Euprimates: east, west, north, or south of Eden?**

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Beard (1998) proposed an unequivocal Asian origin for Primates *sensu stricto* (=Euprimates) as part of his East of Eden model of mammalian biogeography. The analysis upon which this proposal was based included only a very limited sample of taxa and was not backed up by an explicit data matrix. Results of an analysis using a similar optimization-based approach with a more comprehensive sample of taxa assessed for cranial, dental, and postcranial characters fail to uphold Beard's conclusions. An unequivocal origin for Primates *sensu lato* (including plesiadapiforms) from North America was reconstructed, while the place of origin of Euprimates was found to be equivocal, with origins from Asia, Africa, North America, and Europe all being equally parsimonious. However, optimization analyses of this sort are problematic when continents differ markedly in the quality of their fossil records, and should be supplemented by a detailed examination of which fossils are driving the results.

In assessing the fossil evidence for the biogeographic origins of Primates and Euprimates directly, it was found that there are some good reasons to consider an Asian origin likely for both clades. The description of *Asioplesiadapis*, in particular, adds a very primitive primate to the known Asian fossil record. However, considerations such as the absence in Asia of any primate as primitive as *Purgatorius*, and the presence in Africa of the oldest published euprimate, make it clear that the place of origin for neither clade is unequivocally Asian.

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**The evidence for social bonds in primate groups**

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A growing body of evidence from a wide range of mammalian species indicates that sociality has positive fitness consequences for individuals. Some of the most detailed information about the structure and function of social bonds comes from long-term studies of females in female-bonded species. These studies suggest that females' social lives revolve around a tight core of close associates, who are mainly close maternal kin. However, some primates also recognize paternal kin and selectively associate with them. Although nepotistic biases in affiliation imply that females form long-lasting relationships, there is considerable controversy about the nature and stability of social bonds in primate groups. Some researchers have emphasized the ephemeral and opportunistic nature of social bonds, and argues that social interactions are based on short-term market-based principles. Here, I review evidence which shows that female baboons form close, equitable, and stable social bonds. Moreover, analyses of the same population indicates that social integration confers fitness advantages on females.

**Analysis of commingled skeletal remains from Bee Cave rockshelter, Val Verde County, Texas.**

T.L. Simmons. Department of Anthropology, Texas State University.

Initial reports of the commingled Bee Cave remains suggested the presence of approximately twelve adults accompanying the bundle burial of a child. Rockshelter bundle burials from the Lower Pecos region of Texas are thought to date to the Late Archaic (2300-1300B.P.). Although bundle burials are common for this region, this bundle is very well preserved with a fur-covered rabbit skin blanket. My analysis of the commingled remains has revealed the presence of four other young children that were not bundled.

The other remains consist of a minimum of eight adults, ranging from young to old, and including males and females. Taphonomic evidence and metric data have allowed sorting of some of the bones into separate individuals. Perhaps the most unusual find is the presence of bright green stains on several bones of one adult, indicating the presence of copper within the burial context. The pattern of staining on the skeleton suggests the presence of personal adornments made of copper, something that has never been reported for the Lower Pecos region.

**Testing a 'Caries Correction Factor' in Two Populations with Differing Dental Caries Rates.**

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Dental carious lesions are one of the most commonly collected indicators of a population's oral response to local diet and

environmental conditions. Current studies of human skeletal populations commonly use total number of carious teeth divided by the total number of observed teeth as a measure of prevalence. The results are percentages, which can be compared among populations. Various authors (Erdal and Duyar, 1999; Hillson, 1986, 2001; Lukacs, 1995; Kelley et al., 1991) have noted that this simple calculation does not reflect the actual prevalence of dental carious lesions, especially in relation to antemortem tooth loss (AMTL). Lukacs (1995) introduced a dental caries correction factor to calculate a more accurate rate for carious lesions that includes AMTL in its formulation. Since its introduction, this method has only rarely been used (i.e. Lingström and Borrman, 1999; Lukacs, 1996; Nelson et al., 1999; Saunders et al., 1997) and warrants further testing. Two populations were chosen to assess the Lukacs (1995) formula. The first population, from the Dan River Phase, VA (AD 1000-1400) has a dental carious lesion rate of 28%, and a corrected rate of 47%. The second group, from the Tatham Mound, FL (AD 1000-1500), has a dental carious lesion rate of 3%, corrected to 15%. These differences in caries correction factors suggest further analysis is needed of the Lukacs (1995) formula, as well as those proposed by other authors (Erdal and Duyar, 1999; Lingström and Borrman, 1999).

#### Late Miocene Hominid Teeth from Gona Project Area, Ethiopia.

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Here we report Late Miocene hominid fossil remains recently recovered from the Gona Paleoanthropology Project area in the Afar Regional State of Ethiopia. These fossils were discovered from a previously undescribed region of the project area located among the fault blocks at the edge of the western escarpment. A great diversity of terrestrial fauna were recovered from these sites with tuffs radiometrically dated to >5.4Ma. Depositional context and faunal composition indicate a well-watered riverine environment dominated by woodlands. Isotopic analyses of the large mammal enamel indicate a dietary dependence on C4 grasses for most herbivores except for the suids that were mixed browse/graze feeders.

The seven teeth recovered include a mandibular I2, P3, P4 (2) and a maxillary C, M1 and molar fragment. All teeth were isolated finds. The lower I2 and maxillary C were found at the same site but individual identity is uncertain. The low-crowned molars are small with intermediate thin enamel. The lower P4s have a large talonid

basin. The asymmetric lower P3 is unicuspid with cervical waisting. The I2 is tall and narrow. The markedly worn canine is large and robust with a cervically placed mesial shoulder. There is no evidence of sectorial wear on these teeth. They are morphologically similar, except for canine size and P3 details, to Early Pliocene *Ardipithecus ramidus* from Gona and Middle Awash. These differences result in assignment of these teeth to *Ar. kadabba*.

#### A 3D geometric morphometric study of morphological integration in the primate mandible.

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Shape variation in human mandibular form has been a recent subject of investigation, but little work has been done on the integrative aspects of its morphology. Following a study by Nicholson & Harvati (2006) on the human mandibular shape, this study examines the pattern and level of integration in the mandible of modern humans, Pleistocene hominids and chimpanzees. Developmental studies on mouse mandibles show that the mandible consists of two modules – alveolar and ascending ramus. These modules are determined by cellular differentiation, the alveolar being odonto- and osteogenic and ascending ramus chondro- and osteogenic (Atchley & Hall, 1991).

Here we used two mandibular landmark sets corresponding to these two regions. We hypothesized that shape differences in mandibular morphology among the groups can be explained by different patterns and levels of integration between the anterior (alveolar) and posterior (ascending ramus) regions. Twenty-eight 3D landmarks were collected on 155 modern human, 25 fossil (Nicholson & Harvati, 2006) and 13 chimpanzee mandibles. Specimen landmark configurations were superimposed using generalized Procrustes analysis. Fitted coordinates were analyzed using partial least-squares analysis so as to estimate the covariation between the modules. First two singular warps account for 80% of the total variance, with chimpanzees having the highest scores along singular warp one. Intra and inter group correlations between the two modules was high; humans  $r=0.95$ , chimpanzees  $r=0.87$ , combined  $r=0.95$ , indicating a high level of morphological integration between the anterior and posterior parts. Overall, preliminary results suggest a similar pattern of integration among the included groups.

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#### Geometric morphometric analysis of mangabey suborbital morphology.

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The distinctive suborbital fossae of *Cercocebus* and *Lophocebus* mangabeys have variously been regarded as: 1) a shared derived trait uniting mangabeys as congeners or sister taxa; 2) a shared primitive trait for the African papionin clade (Papionina); or 3) nonhomologous and independently derived. Most recently, McGraw and Fleagle (2006) have proposed that the pronounced suborbital fossa of *Lophocebus*—most closely approximated among *Cercocebus* species by *C. agilis*—represents the primitive papioninan condition and that the shallow fossa of *C. torquatus* is a *torquatus*-*Mandrillus* synapomorphy.

These possibilities were evaluated through geometric morphometric analysis of mangabey suborbital morphology. The sample comprised adult crania of *Cercocebus*, *Lophocebus*, and key papionin and cercopithecine taxa. 3D facial landmarks and contours describing suborbital morphology were subjected to a standard GPA-PCA analysis sequence. The resulting principal shape components distinguish cercopithecine tribes and summarize variation in papionin fossa conformation, position, and depth. Relative fossa depth scales with negative allometry within and across African papionin taxa. Fossa shape variation within *Cercocebus* is minimal and apparently attributable to allometric effects. When these are controlled, *C. agilis* and *C. torquatus* are not distinguishable. *Lophocebus* differs from other papionins in zygomaxillary suture position and the prominence and vertical depth of the suborbital bar. These features are most pronounced in *L. albigena*; *L. aterrimus* is more similar to *C. agilis* but is nevertheless distinctive. Based on results, an *agilis*-like papioninan ancestor cannot be rejected; however, the classic *Lophocebus* morphology appears derived in *L. albigena* and, perhaps, *aterrimus*.

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#### Patterns of gastrointestinal infection in nineteenth century Rochester, New York.

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Historic records provide a valuable resource for studying and comparing demographic profiles and health assessments for peoples living in urban areas during the nineteenth century. In 2002 Sirianni reported disease specific mortality for the City of Rochester for a ten year period (1847-1856) based on death records from the Mt. Hope Cemetery. Since deaths attributed to consumption overshadowed all other reported diseases during this time period, a detailed

demographic analysis of consumption was reported in the study. The purpose of this investigation is to examine the demographic patterns of deaths attributed to gastrointestinal infection for the same ten year period.

A total of 5,866 death records from Mt. Hope Cemetery for the period of 1847-1856 were examined to determine the demographic patterns of mortality attributed to gastrointestinal infections. Twenty-eight percent of the records listed G.I. infections as the cause of death, making these diseases second to respiratory infection as a leading cause of death among Rochester residents. The cemetery records show yearly as well as seasonal fluctuations in gastrointestinal diseases with cholera making appearances in the summers of 1849, 1852, and 1854. While cholera accounted for more deaths among adults, approximately 75% of those effected, diarrhea and bowel inflammations were more common among children, 87% and 55% respectively. Diarrhea particularly seasonal diarrhea, summer complaint, claimed a high percentage of infant lives. These infections may be attributed to contaminated milk.

#### Dentine crown expression of discrete dental traits on extant hominoid and fossil hominin lower molars

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Discrete dental traits (e.g., C6, protostylid, etc.) feature widely in taxonomic and phylogenetic analyses of living and extinct hominoids. Underlying analyses of these traits is an assumption of developmental homology that remains largely untested. We present the results of a project undertaken with the following aims: 1) to assess the relative contribution of the dentine crown and enamel cap to the expression of dental traits on lower molars; 2) to evaluate the validity of coding dental traits along a morphological continuum; and 3) to assess the developmental homology of dental traits among taxonomic groups.

The study sample includes lower molars from several living hominoid (*Pongo*, *Gorilla*, *Pan*, and *Homo*) and fossil hominin (*Australopithecus*, *Paranthropus*, and *Homo*) taxa (n = 74). Lower molar dental traits examined include C6 and C7 accessory cusps, protostylid, and the mid-trigonid crest. Results suggest that interpretation of dental trait variation and partitioning trait expression into grades along a morphological continuum are facilitated by (and in some cases may necessitate) examination of their manifestation at the dentine crown surface.

Furthermore, the assumption of developmental homology between groups for some traits (particularly C6) is not always supported. The results of this project enhance our understanding of dental morphological development and the interpretation of trait variation including its taxonomic significance. The results are particularly pertinent to the analysis fossil teeth in which the original state of trait expression has been modified by wear.

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#### Warfare in the Bell Beaker period revisited: An analysis of size and shape of humeral cross-sections.

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It has been argued that male grave goods in European Bell Beaker (Late Eneolithic, 2900-2000 B.C.) burials are expressions of warfare. However, these objects may indicate other identities of the dead than the warrior identity. Since archaeological evidence is not convincing, independent evidence has to be used. It has been shown that size and shape of humeral cross-sections reflect manipulative behavior in prehistoric populations. Therefore, we hypothesize that if grave goods provide evidence of warfare, the humeral cross-sections would show differences in size and shape between Bell Beaker males and males from other closely related prehistoric groups. A sample of 40 humeri was selected from the Late Eneolithic and Early Bronze Age skeletal material. Five biomechanical properties (CA, I<sub>max</sub>, I<sub>min</sub>, J<sub>p</sub>, I<sub>max</sub>/I<sub>min</sub>) of 35% humeral diaphysis were obtained through computed tomography on right and left side. Body size was calculated as the product of body mass and biomechanical length, with body mass determined from femoral head breadth.

None of the comparisons were statistically significant to demonstrate differences between Bell Beaker males and the comparative sample. All the individuals are equally distributed among pooled RMA axis. Therefore, the Bell Beaker males cannot be distinguished from the rest of the agricultural groups of the period based on humeral cross-sectional properties. We assume that the Bell Beaker grave goods are expressions of social differences rather than warfare. The results support our previous analysis when the similarity in mobility and asymmetry of upper limb cross-sections has been found among the studied groups.

#### Fill in the blanks: trabecular bone and the biomechanical consequences of having paranasal sinuses.

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The evolution of paranasal sinuses has been a topic of debate in evolutionary primatology. Maxillary and sphenoid sinuses are present in all hominoids, while ethmoidal and frontal sinuses are found only in African apes and humans. These sinuses are typically absent in cercopithecoids, although a maxillary sinus is present in *Macaca*. These voids in the bony structure of the face have been hypothesized to serve either thermoregulatory or immune functions, and may relate to masticatory biomechanics insofar as the cortical bone surrounding the sinuses may form thin-walled shells that can efficiently resist high loads. This study uses finite element (FE) analysis to examine the biomechanical consequences of replacing craniofacial trabecular bone with sinuses. An FE model of a *Macaca fascicularis* cranium was constructed using imaging, surface, and solid modeling software. This particular specimen has a small maxillary sinus and an extensive network of trabecular bone in the maxilla. The model was subdivided into parts representing cortical bone and trabecular bone. Elastic properties were assigned to each of these parts using data from our previous studies and the literature. The model was loaded with forces representing the muscles of mastication and was constrained at the articular eminences and a bite point on the left molar row. Resulting strain patterns were recorded. The experiment was then repeated after removing trabecular bone to create maxillary and frontal sinuses. Differences in strain patterns between the analyses reflect the role of trabecular bone during chewing, and the consequences of having these sinuses.

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#### Isotopic ecology of wild chimpanzees from Liberia and observed gender differences in adolescent isotopic profiles.

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We report on the first extensive suite of isotopic data ( $\delta^{13}\text{C}$ ,  $\delta^{15}\text{N}$ , and  $\delta^{18}\text{O}$ ) gathered from adult male and female wild chimpanzees (n=40) that derive from a restricted region in northern Liberia. Here we present  $\delta^{13}\text{C}$  data



for tooth enamel apatite (both M1 and M3) and occipital bone collagen to establish baseline data for this taxon and to investigate age and sex differences in diet at three life stages — pre-weaning (M1), young juvenile (M3), and adulthood (bone). These data offer an independent and objective line of evidence to primatologists interested in the dietary strategies of the great apes and to paleoanthropologists seeking comparative models for reconstructing early hominid subsistence patterns.

All individuals displayed similar pre-weaning isotopic signatures, but significant differences are seen between young juvenile male and female chimpanzees (t-test;  $p \leq 0.03$ ). Females show enriched  $\delta^{13}\text{C}$  values in their M3s relative to males. This suggests that young males who survive to adulthood may be nursed longer than their female age-mates. Alternatively, or additionally, the weaning diet of males and females may differ, with greater use of technologically extracted nuts or insects by young females, or preferential access to fruits by young males. Metabolic differences, including growth and hormone-mediated responses, may also contribute to the observed variation. Adult male and female bone collagen  $\delta^{13}\text{C}$  values (males  $-21.6 \pm 0.5$  ppm,  $n=17$ ; females  $-21.4 \pm 0.5$  ppm,  $n=19$ ) show less intra-sample variation than expected based on isotopic profiles of other primate species.

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#### **Patterns of mitochondrial and nuclear DNA variation in Chinese rhesus macaques (*Macaca mulatta*).**

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Chinese populations of the rhesus macaque show greater genetic and morphological variation than regional populations of Indian rhesus macaques, probably due to lower levels of gene flow induced by the more varied topography of the Chinese range. Additionally, genetic surveys of both captive and wild animals sampled throughout China reveal a significant correlation between mitochondrial lineage and geographic location. However, the amount of mitochondrial genetic variation and the level of nuclear genetic structure present in local populations, as well as the genetic correspondence between wild and captive populations, remain unclear. To examine this issue, we analyzed mitochondrial DNA sequences of wild rhesus from ten provinces across China (downloaded from GenBank) and mitochondrial DNA and nuclear microsatellite genotypes from captive rhesus in five regional breeding centers within China. Preliminary results reveal significant mitochondrial divergence between

local wild populations, but little variation within them. Early results of the microsatellite surveys reveal much less geographic structuring of nuclear alleles relative to mitochondrial haplotype. This lack of correlation among mitochondrial and nuclear results suggests the presence of strongly sex-biased gene flow in wild Chinese rhesus, while also demonstrating the lack of concordance between the genetic profiles of wild populations and animals in captive breeding centers.

#### **Which cranial regions reflect genetic distances most reliably in humans? Evidence from three-dimensional morphology.**

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As various regions of the skull respond to diverse pressures and develop at different times during ontogeny, it is likely that they will vary in the degree to which they reflect genetic distances. The knowledge of which cranial regions are reliable indicators of genetic relationships is crucial for studies of fossil hominins and other specimens for which DNA is unavailable. This study assessed the strength of the correlation between molecular distances and morphology of several different cranial regions. Ninety-five three-dimensional landmarks from around the skull were digitized in fourteen modern human populations. Landmarks were divided into six anatomical regions: basicranium, face, palate, mandible, temporal bone, and vault. Matrices of pairwise population distances based on the morphology of each region were then compared to two molecular distance matrices based on *Alu* insertion polymorphisms and short tandem repeats.

The morphology of the temporal bone and basicranium were found to have the highest correlations with genetic distances. The morphology of the vault and palate demonstrated very little association with genetic distances. The mandible and face were intermediate in their correlations with the molecular matrices, with certain subsets of data reaching significance, depending upon which populations were included in the comparison. As the 3D morphology of the temporal bone and basicranium appear to consistently reflect genetic relationships in humans, it would be preferable to focus on these regions when attempting to determine the genetic relationships of specimens with no molecular data, such as fossils.

This research was supported by the National Science Foundation (BCS-0622570) and the Wenner-Gren Foundation.

#### **Gestural Communication in Captive Gorillas (*Gorilla gorilla*) at the Bronx Zoo, New York.**

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New York Consortium in Evolutionary Primatology (NYCEP).

Despite their integral role in primate communication, facial and manual gestures have been much less studied than vocal signaling. Prior research on captive African apes has shown that gestures are used flexibly with sensitivity to audience effects, and gorillas appear to have larger gestural repertoires than either species of *Pan*. However, it remains unclear why gestural signaling varies within and across species.

This study compares the gestural repertoires of two groups of western lowland gorillas (*Gorilla gorilla*) at the Bronx Zoo to determine the social factors that influence gestural signaling across age and sex classes. Data were collected from June-August 2005 for 17 gorillas in two social groups, A and B. Gestures were coded from continuous video recordings of social interactions, and analyzed in terms of functionality, flexibility, and frequency of use.

Twenty-seven gestures were recorded (3 auditory, 10 visual, and 14 tactile), six of which had not been observed in previous studies. Gestures were used most often in the Sit Near and Play contexts and juveniles (3.5-5 yrs) used gestures more frequently than any other age class. Group A performed significantly more gestures than Group B because Group A contained more young gorillas who gestured most frequently. These preliminary findings suggest gorillas have a rich gestural repertoire driven by younger gorillas, and group composition is influential in gestural communication. Future work will investigate the role of locomotor and positional behavior on shaping gestural communication across African apes.

#### **Contextualizing Conflict: War and peace in Neolithic Europe.**

M.J. Smith and M.B. Brickley, University of Birmingham, UK.

Recently, views of the European Neolithic have changed dramatically. Rather than a tranquil, egalitarian time, it is increasingly apparent that this was a period characterised by social divisions, local and regional cultural variations and at times by conflict between groups. The existence of the latter is apparent in several strands of data. These include evidence for attacks on settlement and enclosure sites, a variety of implements previously seen as tools which have appear to have been used as weapons and most strikingly an increasing number of cases of skeletal trauma consistent with interpersonal violence.

The fact that interpersonal and intergroup violence took place during the Neolithic in Europe now seems undisputable. We would argue that the next step should be to characterise and interpret the available data in light of wider social and environmental changes occurring at the time. In this paper we present new skeletal data from our own

studies and discuss these in relation to other published evidence in order to characterise the kinds of conflict prevalent during this period. By considering types of injury, demographic patterning and the depositional context of human remains we demonstrate that it is possible to discern several different types of conflict being conducted at varying scales. A number of conclusions are drawn regarding the frequency, causes and social context of such hostilities, which enable a more rounded and realistic picture of Neolithic life to be produced.

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### Genetic Diversity of Native Peruvian Populations: mtDNA Analyses of Two Native Amazonian Populations.

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Recent molecular studies have shown that native Andean populations exhibit substantial intra-population genetic variation and comparatively low inter-population genetic diversity. This pattern is in contrast with the distribution of genetic diversity in South American populations east of the Andes, which display a low intra-population and a high inter-population genetic variation. To further investigate the pattern of genetic diversity in South America, we analyzed the mitochondrial DNA (mtDNA) of two previously uncharacterized native Peruvian populations from San Martin and Amazonas, both located in the Western Amazon basin. We sequenced the first hypervariable region of the mtDNA of 80 individuals from this region. Approximately 30% of the individuals exhibit unique haplotypes, with an overall mitochondrial haplogroup frequency of 30% A, 52% B, 7% C, and 11% D. In this study we compared these data with those of other published populations native to South America. Our analyses indicate that the individuals representing the native populations from the localities of San Martin and Amazonas exhibit a pattern of genetic diversity that is similar to that of Andean populations: these populations are in fact characterized by an elevated intra-population diversity and a comparatively reduced inter-population genetic diversity.

### Molar crown development in wild orangutans.

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During the past decade, numerous studies have quantified molar development in fossil and extant hominoids, revealing developmental variation in the early and middle Miocene, as well as between African

apes and humans. Relatively little is known about postcanine development in orangutans, which represent the only extant great ape with an extensive fossil record. Recent work has hinted at a slightly prolonged period of somatic development in orangutans relative to other great apes, including later age at M1 emergence and later sexual maturation, which may be reflected in aspects of crown growth. This study aimed to characterize incremental enamel development and molar crown formation in several wild-shot Bornean and Sumatran individuals. The following aspects of incremental enamel development were quantified: cuspal enamel daily secretion rate, cuspal enamel thickness, cuspal formation time, Retzius line number, Retzius line periodicity, imbricational formation time, and cusp-specific crown formation time. When compared to chimpanzees, orangutans showed differences in cuspal enamel thickness, cuspal formation time, and mean Retzius line periodicity, resulting in longer crown formation time. These variables were generally more similar to modern human values, resulting in similar crown formation times. Some similarities were also found between orangutans and Eurasian fossil hominoids, although slight differences in certain variables often led to different crown formation times. In conclusion, molar crown formation does not appear to be equivalent among extant great apes, and given the variation seen in Miocene hominoids, the primitive hominoid developmental condition is unclear at this time.

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### Tails of two macaques: Terrestrial locomotion, niche differentiation and a possible function of bipedalism in forested habitat.

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It has long been supposed that bipedal locomotion arose in our hominin ancestors in conjunction with a shift from forest to savanna habitat. Increasingly, discoveries of fossil hominins (*Ardipithecus* spp., *Orrorin tugenensis* and, perhaps, *Sahelanthropus tchadensis*) suggest that the earliest bipedal hominins lived in forested habitats. Consequently, hypotheses for bipedal origins that rely upon the savanna environment seem less likely.

Numerous hominoid species apparently coexisted in African Miocene forests, and initial differentiation of ancestral bipeds would have dated to the Miocene. We propose that bipedalism could have arisen among some Miocene hominoids as a response to niche differentiation. Two sympatric macaque species occupying forests of Southeast Asia, *Macaca nemestrina* and *M. fascicularis*, illustrate morphological differentiation in response to niche

differentiation possibly analogous to differentiation among Miocene hominoids. Tropical forests are heterogeneous in both structural features and resources. *M. nemestrina* and *M. fascicularis* eat very similar diets but utilize the same forest in very different ways. As a result of niche differentiation, *M. fascicularis* shows clear adaptation to arboreality. *M. nemestrina* has clearly adapted to terrestrial locomotion over large home ranges, while continuing to feed in the canopy. The morphology and ecology of *M. nemestrina* provide a tenable model for functions of bipedal locomotion for one or more of several coexisting hominoids in Miocene African forests.

### Assessing individual variability among sternal rib ends for the purpose of skeletal aging: intercostal consistency in an archaeological assemblage.

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Chronological changes sternal rib morphology have long been known to have applications for the determination of skeletal age. Unfortunately, the technique has seen limited application in some circles due to a perception that it is only applicable to the fourth rib, which can be difficult to identify in archaeological or incomplete assemblages. This study demonstrates a reasonable consistency in sternal rib morphology within individuals from an archaeological collection recently excavated from the site of Viminacium--a provincial Roman urban center located in modern day Serbia. It thereby reveals that identification of the fourth rib is not necessary and, in fact, the use of multiple rib scores is likely to improve the accuracy of the technique--although by somewhat decreasing its precision.

Of 56 individuals from which multiple sternal rib scores could be obtained (out of a sample population of 168), only seven (12.5%) manifest morphology characteristic of more than two consecutive age phases. Thirty-three (59%) were scored into two consecutive phases and 16 (28.5%) were scored into a single phase. The results are consistent with other studies that found no significant intercostal variation between the 'typical' (3rd-9th) ribs. Furthermore, both the 2<sup>nd</sup> and 10<sup>th</sup> ribs were found to agree with the rest of each assemblage in a great majority of the cases. Only the 1<sup>st</sup> rib manifested a high proportion (46.6%) of disagreement. Even when scored to two consecutive phases, the results are often more precise than those obtained from either the pubic symphysis or auricular surface alone.

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### Genetic structure and implications for human biological and cultural evolution: a case study of the Yanomamo.

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Many studies document pronounced genetic structure both within and among Native South American groups. This structure may influence the rate and pattern of biological and cultural evolution in important ways (Neel, 1984; 1989; Wright, 1967). The goal of this paper is to examine the factors that affect human genetic structure in one Native South American group, the Yanomamo. In particular, we examine the effects of geographic distance, village fissions, language, and mating systems on Yanomamo genetic structure. To accomplish this goal, we apply F-statistic, matrix correlation and multidimensional scaling analyses to autosomal, Y-chromosome and mtDNA sequence data collected from hundreds of individuals who speak different language dialects and live in different villages. Our results suggest that village fissions are the predominant factor shaping population structure but that fissions affect Y-chromosome and mtDNA sequences differently. We conclude by exploring the implications of village fissions and related sex differences for human biological and cultural evolution.

### Compensatory scaling within the feeding complex of haplorhine primates.

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Large-bodied primates are likely to be at a disadvantage in the mechanical reduction of foods relative to smaller primates because: 1) scaling of postcanine occlusal area does not keep pace either with the volumetric increase in body mass or with the basal metabolic rate, 2) the lower quality diet of larger primates requires intensive processing, and 3) chewing cycle frequency decreases as body size increases. Therefore we predict that in larger primates the feeding complex will be under increased selective pressure to reduce food particle size rapidly to offset these scaling-related trends.

We tested this hypothesis using comparative morphometric data from haplorhine primates. Dental dimensions from 108 species support the premise that postcanine occlusal area scales isometrically or with slight negative allometry relative to body size in this suborder. Measures of masticatory system configuration in a sample of 39 haplorhine species indicate that the estimated leverage of the primary jaw adductors relative to incisor or molar bite points does not vary with size. However, the force producing potentials of the masseter

and temporalis muscles appear to scale with strong positive allometry based on measures of zygomatic arch cross-sectional geometry and of the area subtended by the zygomatic arch. This relative increase in muscle force may lead to increased postcanine occlusal pressures in larger primates, facilitating rapid reduction of food particles. These results support the hypothesis that changes in food properties, tooth size, and chewing frequency with body size put a premium on efficient food processing in large primates.

### Dietary analysis of DISH: using stable isotope analysis to investigate disease.

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Diffuse Idiopathic Skeletal Hyperostosis (DISH) is a disorder about which very little is known. It creates distinct patterns of bone fusion in the skeleton, most notably the thick flowing osteophytes that are said to resemble dripping candlewax in the thoracic vertebrae, but also large enthesophytes throughout the remainder of the skeleton. The prevalence of DISH appears to increase with age, rarely appearing in those under 40 years of age and is reported as being more prevalent in males than females, and also in monastic communities. Although its pathogenesis has been well documented, the aetiology of DISH is still not fully understood. Several theories regarding the underlying causes of this disease exist, the most prevalent of which is that DISH is related to diet and obesity.

The relationship between DISH and diet was investigated in this study through carbon and nitrogen stable isotope analysis of skeletal samples from monastic and non-monastic sites in late medieval Britain. Stable isotope analysis has been used to study the diet of past populations for several decades now but it has rarely been applied to the study of disease. The results of the study demonstrate the complexity of the relationship between diet and DISH. This research has been funded by NERC (Natural Environment Research Council) NER/S/A/2004/12245.

### Primate locomotion and the semicircular canal system.

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Paleontologists reconstruct the locomotion of extinct primates by analogy with living species and by biomechanical studies of postcranial skeletons. But they can rarely check the repertoires inferred against footprints of the species. Inspired by previous observations we examined the potential to

test such hypotheses about an extinct primate's locomotion with an independent system – the semicircular canals commonly preserved in cranial fossils. The semicircular canal system enables stabilization of gaze and integrates changing retinal images during locomotion.

Quantitative studies of 91 extant and subfossil primate species and 116 other mammals provide a framework for interpreting the locomotion of extinct species independent of their postcranial skeletons. The jerkiness of locomotion was quantified as 5 categories from slow to fast, based on the field observations of 3 researchers. Primate and other mammalian species studied here that are agile and have fast, jerky locomotion, have much larger canals for their mass than those that move cautiously. Conventional multiple regressions indicated strong effects of body mass and jerkiness on the radius of curvature of all three semicircular canals and the mean radius in primates. Regression slopes show a strong negatively allometric relationship between log canal radius and log body mass in all analyses. Phylogenetic generalized least squares (GLS) analyses generally confirmed the conventional multiple regressions. Addition of two Early Miocene fossils to the current phylogenetic analyses suggests that inclusion of fossils in phylogenetic analyses can influence the results.

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### Craniofacial secular change and the African Diaspora.

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The hypothesis of the present research is that significant craniofacial secular change has taken place in the American Black population since the American colonies entered the slave trade. The objectives are to use new craniometric data dating from 1700 to 1975 in order to assess the significance of the proposed craniofacial secular changes; and to compare the craniometric data to published genetic data (classical markers, autosomal population specific alleles, and single nucleotide polymorphisms) from West Africans, American Blacks, and American Whites. Comparison of craniometric and genetic data will help elucidate the roles of environmental plasticity and genetics regarding craniofacial morphology.

A canonical correlation procedure was used to evaluate the specific craniofacial variables that have changed over time and their significance. Genetic distances were derived from both craniometric and genetic data using R matrix analysis. Genetic distances from the craniometric data were then compared the genetic distances derived from the differing genetic data sets using Procrustes analysis. Significant secular changes were observed in facial height. The Procrustes analysis, using eigenvectors from the single nucleotide polymorphisms and the

craniometric data, supports that there is a genetic component to craniofacial morphology.

**The “Primate Site A” - A new Pliocene fossil-bearing Site in the Southern Afar Triangle, Ethiopia.**

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The Mount Galili research area (West Harerge Administrative Region, Somali Region, Eastern Ethiopia) of the PAR Team in the Southwest of the Afar Triangle has yielded over 1400 fossil specimens in the last seven years of field work (Seidler et al. 2000, Weber et al. 2001, Macchiarelli et al. 2004, Urbanek et al. 2005). The fossiliferous sediments of the Mount Galili Formation are preliminary dated by Ar/Ar method to 3.75 – 4.5 million years and a biostratigraphical comparison to other East African sites supports this time range.

Here we present a fossil-bearing site within the Shabeley Laag subformation of the Mount Galili Formation that is referred to as “Primate Site A”. The fossiliferous sediments are of sheet flood origin. Sedimentation seemed to have occurred in a rather short period of time. Apart from several other fossils, including postcranial elements of primates, the fossiliferous layer at this locality has yielded an isolated hominid tooth, three mandible fragments and more than fifty mostly isolated cercopithecoid teeth within only a few square meters.

This poster will describe the cercopithecoid material that includes both colobines and cercopithecines of different age groups in detail, and discuss the taphonomical processes that might have led to the accumulation of this faunal assemblage which is characterized by its abundance of primate elements.

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**Chimpanzee nesting tree preferences; implications for early hominid nesting patterns.**

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Great apes are the only primates that construct sleeping nests. Early hominids living in forest habitats may have also slept in nests for safety. We investigated nesting

patterns of chimpanzees in Bwindi Impenetrable National Park, Uganda, to better understand ecological influences on nest tree selection, with implications for understanding early hominid behavioral ecology.

We collected data on 3,414 chimpanzee nests from 2001-2004. Chimpanzees were selective in their use of nest trees. Of 163 tree species found in Bwindi (Butynski, 1984), chimpanzees utilized 38 for nesting. Four tree species (*Cassipourea* sp., *Chrysophyllum* sp., *Drypetes* sp. and *Teclea nobilis*) accounted for 72.1% of all nest trees. Ninety-three per cent of all nests were constructed in food tree species, although not necessarily while the tree bore food items used by chimpanzees. For instance, chimpanzees fed in *Ficus* sp. during 82.4% of all scan sampling periods between 2001 and 2004, but only 2% of all nests were made in *Ficus* spp. We found no relationship between tree species density and nesting frequency. A series of binomial tests found significant differences in nesting frequencies for each of the top four species between some years and months, but the overall preference for these four species over other species was a consistent pattern across all months and years.

These results indicate that nesting tree species preferences are highly stable, and suggest that Bwindi chimpanzees' choice of nesting tree species is not dependent on tree species density or use of the tree for food.

**Unimagining the past in Spain: Anthropological, political and statistical issues of human rights investigations.**

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Despite nearly 30 years of democracy following the death of General Franco in 1975, recognition and investigation of atrocities committed by the fascists during the Spanish Civil War (1936-1939) and Franco's subsequent dictatorship have stalled. The current political climate changes constantly but is predominantly based on a platform of forgetting the past, including war crimes. In many cases the government has created legal and political obstacles to excavations. In 2004 Spanish archaeologists and American forensic anthropologists began a collaborative effort to scientifically investigate Civil War mass graves. This paper presents the results of three excavations. While two projects have not yielded the expected mass graves, investigations of multiple mass graves excavated in Santaella, Andalucia containing twenty-two men killed in 1936 have yielded identifications. The varying degrees of success among the projects are due to a number of factors, including availability of accurate information of grave location, geophysical changes over the past seven

decades, inadequate antemortem data, and political resistance.

The lack of sufficient antemortem information for identifications is particularly challenging. Medical records are virtually nonexistent and formal dental intervention is rare. Genetic identifications are limited by preservation and availability of appropriate living relatives for comparison. Presumptive identifications at Santaella are based on photographs and oral history of physical and health attributes provided by surviving family members. Bayesian statistics are applied to quantify the strength of one such putative identification from Santaella. A likelihood ratio of 17,855 based on sex and the dental pattern strongly supports a positive identification.

**A unique case of maxillary premolar rotation: Evidence in support of premolar morphogenic fields.**

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Dental morphological variation can be considered to fall within two broad categories; 1) those that involve major deviations from the basic dental blueprint, and 2) those that involve minor, subtle variations in crown and/or root morphology (Hillson, 1996; Scott and Turner, 1997). Included within the first category are such dental anomalies as: supernumerary teeth (polygenesis or polydontia), missing one or more teeth (agenesis or hypodontia), fusion of adjacent teeth, transposition of teeth, rotation of teeth, malposition of teeth, deviations from the “normative” crown morphology (conical lateral incisors, 3-cusped upper premolars, ‘mulberry’ molars) and other sundry anomalies. The second category of dental variation include minor variations in secondary cusps, fissure patterns, marginal ridges, supernumerary roots, etc. (Scott and Turner, 1997:3). Many of the dental anomalies in the first category involve developmental errors in the number and/or positions of individual tooth germs or tooth morphogenic fields. However, the existence of dental morphogenic fields has been debated (Henderson and Greene, 1975), specifically the presence of a premolar morphogenic field.

Within the skeletal collection of the American Museum of Natural History, New York, are two specimens displaying unique rotation of a maxillary P3-P4 unit: AMNH 99.1/1395 – an individual from the collection of the Marquesas Islands and AMNH 99/8478 – an individual from the collection of Cañon del Muerto, Arizona. This presentation will highlight these two specimens which provide evidence illustrating an extremely rare form of dental rotation, as well as supporting the presence of a premolar morphogenic field.

**The energetic cost of human running: factors affecting its variability.**

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Here we document two sources of variability in the cost of human running, first through our own experiments on the effect of lower limb length and second through analyzing data on cost in elite athletes versus recreational runners. It has recently been shown that longer lower limbs (relative to body mass) reduce the energetic cost of human walking. Here we report that a similar relationship exists between lower limb length and cost for human running. Eighteen human subjects ran on a treadmill at 2.68 m s<sup>-1</sup>, while their expired gases were collected and analyzed and stride length was determined from videotapes. The partial correlation between net cost of transport and lower limb length controlling for mass was  $r = -0.69$  ( $p = 0.002$ ). The partial correlation between the gross cost of locomotion at 2.68 m s<sup>-1</sup> and lower limb length controlling for mass was  $r = -0.61$  ( $p = 0.009$ ). Thus subjects with longer lower limbs tend to have lower locomotor costs than those with short lower limbs, similar to the results found for human walking. Reported values for the cost of running in human elite athletes versus non-athletes were also compared. Elite athletes show consistently lower costs than do non-athletes. This raises the possibility that early hominins that may have run long distances may not have done so at particularly high energetic cost.

#### **Directional asymmetry in the knee joint of *Homo sapiens*: greater than previously supposed?**

S.D. Stevens, U. Strand Vidarsdottir. Department of Anthropology, University of Durham, UK.

In humans, the most influential type of asymmetry of skeletal form is bilateral directional asymmetry. Although footedness has been a less well studied phenomenon than handedness, research indicates that right footedness is also strongly preferred in humans. Of such research, relatively little has been done on estimating asymmetry of the distal and proximal ends of long bones in either the upper or lower limbs. On the assumption that no discernable morphological variation exists between right and left sides of the knee joint from the same individual, analyses have frequently used measurements from the best preserved side. In substantiating this assumption, matched samples of the distal femur and proximal tibia have been analysed from 169 and 180 individuals (respectively) from five distinct populations of modern *Homo sapiens*, using geometric morphometric techniques. In the distal femur, directional asymmetry is strong at a high level of statistical significance, with samples from all populations being most

similar in shape to other samples of the same side but from different populations before the matching joint from the opposite limb. In the tibia, the degree of asymmetry is statistically significant but less pronounced than in the femur. These results show that if overall knee joint shape is to be compared between samples, it is not viable to use measurements from right and left bones to form a single data set.

#### **Using Rasch analysis to describe the developmental sequence of osteoarthritic change for individuals from a Middle Anglo-Saxon cemetery.**

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The development of osteoarthritis as seen in an archaeological population tends to follow a particular trajectory reflecting both unique and shared etiological factors. Typically individual joint comparisons are made, subdivided by age and sex categories. Underlying patterns may be difficult to discern partly due to the proportion of incomplete individuals. Rasch analysis is based on a stochastic mathematical model and is used here to characterize the osteoarthritic changes in a sample of 117 adult individuals from the Middle Anglo-Saxon cemetery at Sedgeford, England. Rasch analysis provides objective, fundamental, linear measures from observations of ordered category responses, in this case, assessments of increasing degree of arthritic pathology on a 1-4 scale. Missing data are largely irrelevant.

Only individuals that were aged and sexed were included and most of the major appendicular load-bearing joints were evaluated. The resulting osteoarthritis scale represents a unidimensional construct. Minimum age correlated significantly with individual Rasch scores ( $r = 0.34$ ,  $p < 0.000$ ). The developmental trajectory derived from the cross-sectional data indicated that lowest on the scale (shared by most) were spine and hip regions followed by elbows, shoulders, wrists, knees, hands, ankles. The sequences for males ( $N=54$ ) and females ( $N=63$ ) run separately were largely similar to each other and the total sample, although developing earliest in females were lumbar and hip arthritis followed by spine, and in males, all of spine before hips. Further analyses indicated which variables were less informative and which individuals were "outliers" with perhaps unique status.

#### **The biogeography and genomic patterns of primate endogenous retroviruses support a long Asian sojourn of the ancestral human lineage.**

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Any plausible scenario of hominid evolution must be compatible with both the genomic and fossil records. Many studies have revealed that the genomes of all African apes and monkeys are littered with copies of endogenous retroviruses that are related to certain feline retroviruses. These primate retroviruses are absent from the genomes of Asian apes and, surprisingly, humans. It is now clear that these retroviruses independently invaded the genomes of the African species fairly recently — certainly after the gorilla, chimpanzee, and human lineages diverged. How the human genome avoided the invasion of these African retroviruses remains a mystery. We hypothesize that the hominid lineage that led directly to modern humans lived outside of Africa during the critical period when these 'new' primate retroviruses were most actively cross-infecting the African hominoids, and thereby avoided contact with infected species. Indeed, a growing body of fossil evidence suggests that *Homo erectus* had dispersed from Africa to Eurasia by about 1.8 Myr. In our scenario, the human lineage must have evolved from a Eurasian *H. erectus* population, rather than from a contemporaneous African one. This scenario requires that the human lineage, most likely as *H. heidelbergensis*, dispersed back into Africa around 0.6 Myr and subsequently gave rise to modern humans, *H. sapiens*. This long 'Asian sojourn' taken by the ancestral human lineage can help explain why endogenous retroviruses found in African anthropoids are absent from the human genome, and may further help explain our species' susceptibility to HIV/AIDS.

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#### **Relative dating of South African Middle Stone Age (MSA) sites using variation in ostrich eggshell morphology.**

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Dating and correlating fossil sites within the MSA of South Africa is problematic, as absolute dating techniques often are not applicable. This poses a significant problem because it is difficult to assess the timing and pace of technological or cultural change among MSA sites except at a gross scale. Examination of ostrich eggshell from South African MSA sites, including locations in the Sterkfontein Valley, the Free State, and the Western Cape, demonstrates that the pattern of change in eggshell morphology from the Pliocene to the present is not simple. While the density of pores per square centimeter does not appear to have changed in the Pleistocene of South Africa, the thickness of the eggshell varies. Eggshell fragments that are relatively thin (average < 2.0 mm) have been found at Erfkroon site 17, Driefontein, Plovers Lake, and the lower part of the Ysterfontein sequence. Thicker eggshell

fragments (average near 2.0 mm) are from other apparently younger sites including Swartklip and Boegoeberg 1. The observed change in thickness might be a synchronous event across Africa. This change is older than the resolution of carbon dating and based on previous absolute dating and faunal correlation estimations at the study sites, the change appears to have occurred between approximately 60-80,000 years ago. This change in thickness may be a marker to relatively date MSA sites to the period of time with thinner (earlier) or thicker (later) eggshell, thus providing a method of dating that is independent of the currently employed techniques in South Africa.

**Climate, human dispersals, and adaptation in body size and physique among indigenous populations of the Americas and Siberia.**

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Environmental conditions play a central role in determining variability in the human postcranial skeleton. When considering variation among the ancient populations of the Americas, two central issues need to be considered as potential influences on morphology: a) the climatic gradient from the periarctic region to Tierra del Fuego, and b) genetic relationships and the origins of ancient American populations. The study of morphological variation among indigenous populations of the Americas may provide insights into the process of microevolution associated with human dispersals into North and South America.

The current study provides an evaluation of evidence for postcranial adaptation in body size and physique among populations of the Americas including the Pericúes, Chumash, Zuni, Archaic foragers of the Great Lakes region, Yahgan of Tierra del Fuego, and Inuit. All populations but the Zuni practiced a hunting and gathering subsistence strategy. Morphological variation among these groups is compared to the physique of mid-Holocene foragers of Siberia, and other populations globally. The results show that stature and body size are lower among recent populations than those of the mid-Holocene. Clinal variation in physique and limb proportions in the Americas broadly follows ecogeographic predictions. However, mid-Holocene hunter-gatherers of Siberia show relatively higher body mass and crural indices than populations of the Americas, while the Pericúes have particularly high brachial and crural indices suggestive of adaptation to heat stress.

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**Individuals and populations: complementary domains in bioarchaeology.**

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Commentaries on recent trends in skeletal biology decry the apparent return to description and the retreat from population based studies that test broader hypotheses about human adaptation (Armelagos and Van Gerven 2003, Larsen 2005). These observations provoke us to address the issue of how the study of individuals can contribute to contemporary bioarchaeology. What is the role of osteobiography? In addition to differential diagnosis in paleopathology and individuation in forensics, bioarchaeologists have many good reasons for complementing population studies with the contextualized interpretation of the lives of specific people in prehistory. After decades of population-based research, North American bioarchaeologists in particular may well look back and wonder what happened to the interesting people they encountered in their work.

Individual-based narratives of life in the past are enduring sources of fascination to the reading and museum-going public, but these are usually excluded from the professional literature. In a research paradigm that emphasizes statistical results and excludes the small assemblages produced by typical excavations, most bioarchaeological data are never synthesized and osteobiographies are relegated to site report appendices and regional meeting papers. When individuals disappear in the biological data we overlook their roles and contributions in life. By deleting the spatial, morphological, or statistical outliers we may be ignoring those who were the most influential people of their times. Without this complementary domain of individuals - the typical and the unique - the population paradigm constrains the contribution of bioarchaeology to contemporary studies of agency and social process in the past.

**Genetic evidence concerning modern human origins.**

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Genetic evidence played an important role in resolving debate over modern human origins in favor of a recent African origin of modern humans; our genome contains an overwhelmingly strong signal of a recent expansion out of Africa. Now, attention is focusing on what genetics can tell us about the nature, timing, origin, and (perhaps even) reasons for the biological differences that distinguish us from other apes, i.e. what makes us human. I shall discuss what we have learned and what we might reasonably expect to learn from a variety of approaches, including comparisons of the human genome with the chimpanzee (and other) genomes, analysis of gene expression differences

between humans and other primates, and the Neandertal Genome project.

**A master artisan? Tribute to the founder of a Teotihuacan apartment compound.**

R. Storey. Department of Anthropology, University of Houston.

One of the main research goals of the Tlajinga 33 project was to recover and study a skeletal sample to understand about demography, health, and life at Teotihuacan, Mexico. Tlajinga 33 was a modest compound of full-time artisans in the southern section of this large pre-industrial city during the Classic Period (c. 300-500 AD for this compound). Apartment compounds were a distinctive residential type, housing several families who shared craft workshops and ritual/public spaces. Excavation determined that the residents had been lapidaries working in a variety of media in the earliest period.

Important individuals within the compound were accorded burial in the ritual/public courtyards under altars. The Pre-Columbian Mesoamericans often had elaborate rituals surrounding "dedication" and "termination" events, as well as special mortuary treatment for founders of places. Out of all the burials in the compound, one of the earliest had the most elaborate mortuary treatment. The death of this middle-aged male caused the construction of a very elaborate shrine-altar in the earliest courtyard. It is the manner of burial, the fine shell work making up his burial shroud, and how this individual continued to be commemorated, even though the ritual center of the compound changed to another location, that indicates he is probably the founder of the compound. The insights about life history garnered from the skeleton itself round out the osteobiography of a respected Teotihuacano.

**A high prevalence of premature craniosynostosis at the medieval Hospital of St. James and St. Mary Magdalene, Chichester, England.**

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The purpose of the current research is to investigate the prevalence of premature craniosynostoses at the medieval Hospital of St. James and St. Mary Magdalene, Chichester, West Sussex, England, and to explore the circumstances that led to these individuals being interred at this site. One hundred and eight crania were examined from Chichester, which was initially founded as a *leprosarium* prior to AD 1118 and then converted into an almshouse in AD 1450. As diagnosing premature closure of a suture in adults can be difficult, individuals were only considered if all of the following features were

present: the closure of one or more sutures, compensatory cranial shape changes, and abnormal levels of asymmetry. The results of the analysis indicate that there are eight individuals with clear cases of premature craniosynostosis within the Chichester population. A further six may have been affected, but these individuals were discounted in this assessment due to the possibility of age related suture closure. This indicates that 7% of individuals analysed were affected, a prevalence that is well above reported modern and archaeological rates. Further, four of these individuals would have had noticeably deforming conditions during life, and possible mental deficiencies, such that their condition may have led to a negative social stigma and isolation. The high prevalence of premature craniosynostoses at Chichester may be evidence that this hospital not only served to care for and segregate lepers from society, but also provided for and isolated those with congenital deformities.

**Masticatory biomechanics in *Australopithecus africanus* examined using finite element analysis: a preliminary study based on Sts 5.**

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Biomechanical hypotheses concerning mastication in early hominids have been extremely influential, but the complex geometry of the facial skeleton has made many of these hypotheses difficult to test. Here we examine masticatory biomechanics in *Australopithecus africanus* using finite element analysis, an engineering technique used to examine how objects of complex design resist load. A tessellated surface model of Sts 5 was assembled from CT scans using medical imaging software and then converted into a smooth Nonuniform Rational B-Spline (NURBS) surface. This surface was then converted into a solid model, and then finally into a finite element mesh. Sts 5 is edentulous, so teeth were generated for the model using those of Sts 52 as a guide. The model was assigned the elastic properties of bone and loaded with forces corresponding to the muscles primarily responsible for adducting the jaw during mastication (temporalis, deep and superficial masseter,

medial pterygoid). Nodes were constrained at the articular eminences and at various unilateral bite points along the postcanine tooth row. Resulting patterns of strain were used to evaluate the effect of bite point position on chewing biomechanics in this species.

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**Tools and strategies for online instruction in physical anthropology.**

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The purpose of this presentation is to present strategies and demonstrate sample tools produced for use in an online introductory physical anthropology. Although an introductory level course is the model, and only physical anthropology exercises will be demonstrated, the concepts presented here are applicable to general online course design. The primary need for efficient online course production is a development team capable of productive interface with instructors. This external team processes, designs and inputs the textual, audio, and visual media, and possesses the software skills to match the creative demands of the instructor. This interaction results in instruction tools, such as animations, exercises, and audio/video files, which can also be employed in standard lecture courses. Working from the educational software Blackboard Academic Suite™ as a base, traditional educational tools (e.g., lecture notes or voice lectures) are combined with other typical resources (e.g., images and links to external webpages) as well as interactive exercises, still or animated figures, or downloads, to create a self-paced course containing some elements of the lecture environment and enhancing the learning environment of the student. Security during examination and course assessment in the online environment are also described. In addition to demonstrating online instruction tools, this presentation will also focus on the costs and benefits of providing online course instruction. Online course development should particularly be balanced with the instructor's career goals, departmental goals, and when applicable, general education requirements.

**Variation in craniofacial suture fusion in the Galagidae.**

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The group of primates commonly known as galagos has undergone periods of revision ranging from the reduction to five morphologically and geographically distinct groups ranked as species (Schwarz 1930) to a proposed expansion to four times as many species (Bearder, Honess, Bayes, et al. 1996).

The biology of these primates, in particular behavioral and genetic variation, has been extensively studied in recent years to both propose and test systematic hypotheses concerning diversity and speciation, which in turn has led to more taxonomic revision (Grubb, Butynski, Oates, et al. 2003) and competing hypotheses of relatedness. It has been suggested that observations and measurements from the morphology, vocalizations, genetic data, and geographic ranges are incongruous (Masters and Brothers 2002) and additional data is desirable.

The crania of specimens allocated to *Euoticus elegantulus* (n=18), *Euoticus inustus* (n=1), *Galago gallarum* (n=4), *Galago moholi* (n=16), *Galago senegalensis* (n=8), *Galagoidea demidovii* (19), *Galagoidea thomasi* (n=1), *Galagoidea zanzibarius* (n=5), *Otolemur crassicaudatus* (n=9), *Otolemur garnetti* (n=3), and *Schiurocherius alleni* (n=11) were described and compared to identify features displaying variation with a more heavily obligate basis.

An examination of the craniofacial features of several galagid taxa suggests they may possess developmental differences in the regulation of craniofacial suture fusion. The sutures were divided into different regions scored for degree of patency. Consistent differences observed include the degree of overall suture closure and fusion, the order in which the sutures fuse, and the direction in which the sutures fuse. This study explores the systematic and taxonomic implications of these results.

**Juvenile Copulation Interference among Wild Chimpanzees.**

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Juvenile chimpanzees commonly interfere in copulations between adults by approaching the mating pair playfully, aggressively or plaintively. Hypotheses to explain juvenile copulation interference (JCI) include maternal-offspring conflict over the timing of the next birth, incipient male-male competition, and play. To address these hypotheses, we studied JCI in Tai National Park, Côte d'Ivoire and the Kanyawara community of Kibale National Park, Uganda. Data came from focal follows and ad lib sampling, and were expressed as the rate of JCI per copulation. The maternal-offspring conflict hypothesis predicts that JCI should peak in juveniles without infant siblings, before weaning. The incipient male-male competition hypothesis predicts that JCI is a predominantly male behavior. The play hypothesis predicts that more JCI will occur during seasons of high play frequency, and among more playful individuals. We found that JCI was associated with an increase in the duration of copulation, mostly involved

mothers and offspring, occurred at varying rates per mother and juvenile, was practiced more by juvenile males than females, and that it occurred at significantly higher rate in Tai than Kanyawara. While none of the three hypotheses can be completely rejected, our data suggest that JCI is subject to substantial cultural variation and/or variation in group demographics.

#### **The paradox of drug reward in human evolution.**

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Neurobiological and psychological models posit that "recreational" drug use and abuse is initiated and maintained by reward and reinforcement. Most commonly-used recreational drugs, however, are plant neurotoxins that evolved to punish, not reward, consumption by insect and mammalian herbivores. Reward models therefore implicitly assume an evolutionary *mismatch* between recent drug-profligate environments and a relatively drug-free past in which a reward center easily but inadvertently triggered by neurotoxins could evolve.

Emerging insights from evolutionary ecology and pharmacogenetics indicate, in contrast, that animal taxa, including hominins, have been exposed to plant neurotoxins throughout their evolutionary trajectories. Specifically, evidence of conserved function, stabilizing selection, and population-specific selection of human cytochrome P450 genes indicates recent evolutionary exposure to plant neurotoxins.

Thus, the human propensity to seek out and consume neurotoxins is a paradox with far-reaching implications for current drug-reward theory. A much richer variety of hypotheses for drug use must be considered that are not bound by the imperatives of reward and reinforcement. These include the possibility that humans, like other animals, have evolved to counter-exploit plant neurotoxins.

#### **Nonmetric Dental Variation Among Prehistoric Andeans.**

R.C. Sutter. Department of Anthropology, Indiana University Purdue University Fort Wayne.

This paper reports on nonmetric dental variation among 44 prehistoric Andean mortuary populations that include samples from all regions of the Andes and date from the Paleoindian period (>8,000 BC) through the protohistoric. Phenetic relations among the samples indicate that prehistoric Andeans cluster into two groups: the Paleoindians, all Archaic Period samples, and post-Archaic samples of the Southern Cone, while the second group consists of food producing populations of the northern Andes.

Three competing models (a single migration with subsequent differentiation, Paleoindian replacement, and a north-to-south demic expansion driven by food production) are tested using matrix correlations of the resulting biodistance matrix with hypothetical matrices developed for each of the three models. While both the Paleoindian replacement and demic expansion models are significant, partial Mantel results provide a better fit for the demic expansion model, suggesting that following the initial peopling of the Andes there was a subsequent demographic expansion of food producers from the north that only proceeded as far as the Southern Cone. The implications of these results are put into a broader context. This research was funded by both a Fulbright Scholarship and National Science Foundation Grant #9816958.

#### **Early prevalence of tuberculosis in Japan and Korea, as a biological indicators of population movement across the Japan sea during antiquity—**

T. Suzuki. Tokyo Metropolitan Institute of Gerontology

Historically, tuberculosis has been recognized in both Japan and Korea for more than a thousand years. However, the origin and early prevalence of tuberculosis remain unknown. Very recently, the newest evidences of skeletal tuberculosis found in both Japan and Korea from the Aneolithic period.

In Japan, two cases of spinal tuberculosis and at least four ribs showing inflammatory changes probably cause by tuberculosis have been found among about 5,300 pieces of human skeletal remains from at least 109 individuals from the Aoyakamijichi site dated to be between 454 B.C. and A.D.124, which belongs to the Aneolithic (Yayoi) period. In Korea, only one possible case of spinal tuberculosis among about 120 individuals excavated from the Nukudo archeological site which was dated to be corresponding to the Yayoi period.

As to the origin and early prevalence of tuberculosis in Japan, along with huge number (about a million estimated) of immigrants from the Korean Peninsula, tuberculosis was transmitted to Japan and spread quickly during Aneolithic period.

#### **Ape body plans as examples of carcinization.**

D. Swartz, Department of Earth and Environmental Science, C.W. Post campus of Long Island University

Gould (1995) discussed carcinization ("crabification"), a process identified in 1916. He cited Cunningham, et al.(1992), who demonstrated that large, broad-carapaced, short-tailed king crabs evolved from small, narrow, long-tailed hermit crabs. He posited that this occurred by carcinization, the king crab's broadened carapace and diminished

tail resulting from "a single co-ordinated transformation of growth" (1995: 399). With homology of invertebrate and vertebrate pattern formation genes confirmed (Carroll, 1995; DeRobertis and Sasai, 1996; Strickberger, 1996; Hall, 1998; Gould, 2002) and the same heterochronic processes observed in invertebrates and vertebrates (Gould, 1977; Raff and Kaufman, 1983; McKinney and McNamara, 1991), body plan transformations seen in crabs might occur in vertebrates.

Relative trunk broadening has been correlated with relative and absolute tail shortening in primates (Swartz, 1993). Statistically significant correlations were produced with untransformed and transformed data, with individuals and species means as data points, among many primate groups, across all taxonomic ranks and weight categories, and among many functional adaptations (Swartz, 1998). It appears that this widespread phenomenon is expressed to an extreme degree in apes, and that this is carcinization. Literature review and preliminary data show that carcinized body plans are associated with suspensory behavior in apes, some subfossil prosimians, and tree sloths (Napier and Napier, 1967; Szalay and Delson, 1979; Oxnard, 1984; Jungers, 1985; Fleagle, 1988; MacDonald, 1987), but also with flying, burrowing and quadrupedal behavior in mammals (Nowak and Paradiso, 1983; MacDonald, 1987). Ape body plans, therefore, are not solely the product of selection for their locomotor modes.

#### **Reconstructing the AL 288-1 femur using three-dimensional computer models.**

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The fragmentary nature of fossil hominin specimens frequently requires reconstruction prior to functional and taxonomic analyses. Traditionally undertaken by reassembling portions of casts, three-dimensional computer modeling provides an innovative and sophisticated approach to this task. Here we describe the reconstruction of the AL 288-1 femur using such an approach.

We generated three-dimensional triangulated mesh models of the AL 288-1 femur fragments and of AL 129-1a from computed tomography data of casts. The AL 288-1 femur shaft fragment models were assembled manually by referencing the casts and original descriptions. Next, all damaged areas of the distal two sections (sections 4 and 5 in Johanson et al., 1982) were removed and then scaled (1, .95, .90, .85) in the medial-lateral and anterior-posterior dimensions to compensate for described dilation. To reconstruct the condyles and damaged/missing portions of the distal end, a mirror image of AL 129-1a was isometrically scaled (1, .95, .90, .85, .80) and positioned onto the end of each scaled version of AL 288-1 both manually and using an iterative closest point algorithm. Maximum length for each model was calculated and then compared to published lengths.



The process resulted in forty reconstructions which varied in length between 260 and 292mm, although most estimates fell below the previously estimated length of 281mm. Comparable measurements on AL 288-1 and AL 129-1a suggest that a scaling factor of 0.8-0.9 is the most appropriate for AL 129-1a, which results in a maximum length of between 260 and 280mm.

#### **Costal process of sacrum is an obstetrical adaptation in humans.**

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The human sacrum is sexually dimorphic, with males being larger than females in most dimensions. Previous studies suggest that females may have a longer costal process of the first sacral vertebra (S1) than males. However, these studies neither quantified nor tested statistically the costal process of S1. This study compares S1 with the five lumbar vertebrae (L1 to L5) for a number of dimensions, including costal process length. Four issues are addressed, the: (1) hypothesis that females have a longer costal process of S1 than males; (2) hypothesis that homologous structures (i.e., costal processes of L1 to S1) differ in their sexual dimorphism; (3) importance of the costal process of S1 to the obstetrical capacity of the pelvis; and (4) evolution of sexual dimorphism in the costal process of S1. Skeletons of 197 males and females of American blacks and whites are studied. Results show that males are significantly larger than females for most vertebral measurements, except that females have a significantly longer costal process of S1 than males. The magnitude of sexual dimorphism in costal process length of S1 ranks this measure among the most highly dimorphic of the pelvis. Compared with the humans in this study, australopithecines have a relatively long costal process of S1, but their broad sacrum was not associated with obstetrical imperatives.

#### **Distribution of Osteoarthritis in the Jomon era of Japan**

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Osteoarthritis is the a disease due to aging in modern clinical examples and most people above 60 years old have osteoarthritis in the articular facet. In the Jomon era, there is a great deal of evidence of osteoarthritis. However a detailed examination was not done until now Generally speaking, Jomon era society is hunter-gatherer based, therefore we can suspect that their lifestyle was not an easy one compared to ours.

In this paper, examination was done concerning in the shell mound of Ubayama and the shell mound of Kasori in Chjba Prefecture. The results show that there is a high percentage(90%) of OA in the articular facet of the patella Also the articular facet of

shoulder joint is 20% and the percentage in the articular facet of the lower limb is 10 %,excluding the patella..Also the frequency of OA in individual articular facet is high compared to that of modern Japanese and this result is key in understanding the daily activities based on the surrounding environment The Jomon era has a long span of 9000 years, so the situation is not the same from the early Jomon to the late Jomon. Therefore we must consider the different phase of the Jomon when using skeletal materials .

#### **Modeling parental investment relative to energy costs.**

S.D. Tardif, Barshop Center for Longevity and Aging Studies, University of Texas Health Science Center at San Antonio

Many forms of argument are used to explain the efforts that females and males put into the care of offspring. Many of these arguments have, at their base, sets of assumptions regarding the costs associated with caregiving behaviors. One of the most difficult aspects of caregiving costs to validate is the energetic cost. There are few studies that have actually measured the caloric expense of specific caregiving activities and those studies that have the most precise measures of such energetic costs are often conducted with captive animals, where it can be reasonably argued that costs, relative to available energetic resources, will be lower than in the wild. More often, estimators or biomarkers of costs have been used to examine the possible role of energy cost as a driver of the types and amounts of caregiving activity performed by females and males. In terms of paternal behavior, these estimators have been used both to argue for the role of high maternal energy costs as a driving force behind paternal investment and to argue that paternal investment represents a meaningful energetic cost for the male that must, therefore, be balanced by some form of return for the male, in terms of reproductive success. This talk will review the use of estimators of energetic costs and recommend caution in their use as the basis for adaptive arguments regarding paternal investment.

#### **Jaw-muscle fiber architecture in *Cebus*.**

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*Cebus apella* has been described as a hard-object feeder that occasionally ingests exceptionally tough foods. *C. apella* is also craniodentally well-suited to generating and dissipating large jaw forces. While the masseter and temporalis muscles are important for generating the jaw forces necessary to facilitate specific feeding

behaviors, little is known about the architecture of these muscles in *Cebus*.

I evaluated jaw-muscle fiber architecture in adult *C. apella* (n = 10) and in two non-hard-object feeders (*C. albifrons* and *C. capuchinus*; n = 8). I then compared muscle mass, fiber length, and physiological cross-sectional area (PCSA) between these *Cebus* groups.

Despite substantial intraspecies variation in adult muscle mass, muscle mass was significantly (P < 0.05) greater in *C. apella*. Average muscle mass was at least two times greater in *C. apella* for the masseter (7.25g versus 3.67g) and temporalis (14.88g versus 6.52g). Relative PCSAs of the superficial masseter, deep masseter and temporalis muscles were all greater in *C. apella*, significantly so only for the temporalis. There were no differences in fiber length. Considerable overlap was observed between *Cebus* groups for relative PCSAs so that the degree of difference was not as great as might be predicted given their divergent feeding behaviors and skull morphology. Plausible explanations for this overlap include the incorporation of both wild and captive animals as well as the inherent plasticity of muscle.

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#### **Diachronic change (or lack thereof) in molar size of early inhabitants of the Texas Gulf Coastal Plain**

Matthew S. Taylor, Texas Archeological Research Lab, The University of Texas at Austin, Austin

In many parts of the world, including native North America, the size of molar teeth has decreased over time. This decrease has been explained by a variety of mechanisms, including genetic drift, accumulation of random mutations, gene flow, and natural selection. Natural selection models link the decrease in tooth size to dietary changes associated with refinements in food preparation and increasing reliance on agriculture. Another model, the Probable Mutation Effect, states that teeth decreased in size because of a relaxation of natural selection for large teeth. In order to test the natural selection model, a total of 2,727 molar teeth representing 517 individuals from 24 sites on the Texas Central Gulf Coastal Plain were selected and measured. These samples represent populations from five time periods: Paleoamerican (c. 9000 BP), Early/Middle Archaic (c.7500-1500 BC); Late Archaic (1500 BC – AD 600); Late Prehistoric (AD 600-1500); and Protohistoric (AD 1500-1700). A conservative hunting and gathering lifestyle was practiced during all of these periods. Results indicate that there was no significant change in the size of molars from the Middle Archaic to Protohistoric periods. In fact, molar size slightly, but insignificantly, increased across time. Despite gene flow and the introduction of cultural innovations in food procurement, such as pottery and the bow and arrow, the persistent hunting and

gathering lifestyle of these peoples resulted in selection for consistently large teeth.

#### Faunal and behavioral context of earliest Pleistocene *Homo* in East Asia.

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The oldest recorded hominin evidence in China is constrained to ~1.71 to 1.66 Ma. This evidence consists of Oldowan archeological traces (from Nihewan and Yuanmou) and incisors (from Yuanmou) indistinguishable from early African and later Chinese *H. erectus*. Comparison of East Asian and African faunas provides a means of assessing whether environmental and behavioral similarities were important in the spread of *Homo* across this wide geographic range.

Plio-Pleistocene large mammal faunas of East Africa and East Asia were taxonomically distinct, but the ecological differences were more subtle. Faunas of many East African sites from this time reflect increasing aridity and the spread of open vegetation, while East Asian faunas associated with earliest Pleistocene hominins indicate ecologically diverse settings rather than any one predominant habitat. At the Yuanmou site in south China, mammalian species are typical of grassland, bushland, and forest. In the oldest Nihewan sites of north China, the faunas reflect woodland, open country, and steppe habitats. Later (1.25-1.15 Ma), the fauna from Gongwangling (Lantian), near the mountainous division between north and south China, indicates montane forests during a period when a broad geographic distinction was developing between more forested southern regions and more open northern areas.

By at least 1.7 Ma, Oldowan toolmakers were capable of adapting their behavior to diverse climate and environmental settings in Asia. Carcass processing evident in the oldest Nihewan sites suggests that animal consumption was associated with the dispersal of earliest Pleistocene *Homo* into East Asia.

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#### Seasonality phenology and feeding by *Eulemur rubriventer* in two sites in Ranomafana National Park, Madagascar.

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Feeding ecology should track phenology during low-resource periods if lemurs have timed reproduction with the availability of resources. Five red-bellied lemur (*Eulemur rubriventer*) groups were studied in one secondary (Tala) and one primary (Vato) rain

forest within Ranomafana National Park, Madagascar to test the hypothesis that populations are limited by food resources during fruit-scarce periods. 2685 hours of behavioral data, including 322 hours of feeding (3445 bouts), were collected. Phenophases of 1674 trees and lianas  $\geq 2.5$ cm dbh in 6 botanical plots were recorded monthly. 15 consecutive months of data were used for this analysis. Feeding and phenophase were temporally distinct between sites. In Tala the scarcity period was prolonged (February-March 2004, October, December-March 2005) compared with Vato (September, December 2004). Tala fruit feeding decreased slightly in May 2004 and February 2005. While ripe fruit feeding plummeted in March, Tala groups fed solely upon unripe Chinese guava (Myrtaceae). During the subsequent scarcity period when fruit feeding remained high, groups relied heavily upon Moraceae and Lauraceae species. In Vato fruit feeding decreased in May and June, yet fruit availability remained high. During fruit scarcity, fruit feeding remained high, and groups relied heavily upon Lauraceae. Families exploited most during the scarce season were in the top 4 families exploited overall. Rubiaceae, the top family exploited, was eaten consistently throughout the year. These results suggest that adjacent sites subject to similar abiotic factors but differentially subjected to habitat alteration can differ substantially, potentially affecting reproduction in species who time events with food availability. Supported by NSF DIG #0424234, PCI, ASP, and the Primate Action Fund.

#### An unusual arrow wound in the distal humerus of a male Bell Beaker skeleton from Saxony (Germany) – a CT investigation and 3D reconstruction.

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We report an unusual case of an arrow wound in a Neolithic specimen from Germany. 12 Late Neolithic burials of the Bell Beaker Culture were found during a rescue excavation near Leipzig (Saxony), of which only two individuals reached adulthood.

The anthropological/paleopathological analysis was carried out by WRT and the archaeological background was studied by MC. Radiocarbon dating of the two adult skeletons (Hd 22134; 22154) revealed calibrated dates between 2400 and 2200 BC (2 $\sigma$  range).

In the left distal humerus of the approx. 25-35 year old male, a fragment of a flint object was discovered. In the burial, a fragmented flint arrow head was discovered near by. The humerus was scanned with a Siemens Somatom Volume Zoom Spiral-CT by FS, and processed in Amira by PG. We carefully

segmented the flint object on every slice of the CT scan to create a 3D reconstruction of the tip of a fragmented arrowhead. The scan also reveals a small bone lacuna at the tip of the object.

The unusual location of the arrow tip in the distal part of the humerus, just distal from the fossa olecrani suggests that the left arm was strongly flexed during impact, and that the shot came from behind.

The bone itself showed no signs of a vital reaction; i.e. the man died shortly (at least within days) after the impact. However, no other signs of violence were detected.

Arrow wounds in long bones of the upper extremity, are quite rare in the osteoarchaeological record.

#### Dental caries, dietary variation, and behavior among the prehistoric Yayoi of Japan

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The objective of this study is to understand the interaction between prehistoric Yayoi dietary behavior and oral health. The Yayoi were the earliest agricultural people on the Japanese islands dating from approximately 2500 to 1300 yBP. These prehistoric people consumed wet-rice as a primary subsistence base and more plant foods than Jomon foragers. Dental caries prevalence is used to determine the impact of dietary change on the oral health of the Yayoi by testing the hypotheses that 1) Yayoi agriculturalists had greater frequencies of carious lesions than Jomon foragers 2) regional variation in carious lesion frequencies will be observed among the Yayoi, while 3) variation in carious lesion frequencies will be observed between Yayoi males and females.

Statistically significantly greater frequencies of carious lesions are observed among the Yayoi from southern Honshu than Jomon foragers. These results indicate that the Yayoi from southern Honshu were consuming greater amounts of cariogenic foods, possibly mixing the starchy plant foods consumed by the Jomon with wet rice. Regional variation in carious lesion frequencies is observed between the southern Honshu Yayoi and those from northern Kyushu and Tanegashima Island. Such findings indicate that Yayoi subsistence behavior varied between regions. In addition, the consumption of rice alone is not a *more* cariogenic dietary choice than the starchy roots or tubers consumed by the Jomon. Finally, statistically significantly greater frequencies of carious lesions are observed among Yayoi females than males. Greater caries prevalence among Yayoi females is consistent with the consumption of more cariogenic foodstuffs.

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Office of International Affairs at The Ohio State University.

**Genetic, geographic, and environmental correlates of human temporal bone variation.**

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The means by which a particular aspect of morphology may be shaped by environmental or genetic factors remains a topic of considerable debate in physical anthropology, and understanding the relative contribution of these factors is important for reconstructing phylogenies. The morphology of the temporal bone provides an appropriate test case for assessing these effects; while the general form of the temporal bone is generally accepted to be governed by genetic factors, the extent to which this morphology reflects differences in environment or geography among populations is unclear.

To investigate possible influences on temporal bone morphology, twenty-two 3D landmarks on the temporal bone were digitized on 243 crania from eleven modern human populations. Possible correlations between matrices describing the morphological, molecular, geographic, and environmental differences between these populations were assessed using multiple Mantel tests. Significant differences were found in temporal bone shape among all populations, and a comparison of morphological distances to molecular distances based on short tandem repeats revealed a significant correlation between shape and genetic distance. Further analyses suggested a significant correlation between morphology and geographic distance, and significant correlations were found between temporal bone shape and rainfall, and between temporal bone size and both temperature and latitude. These data therefore suggest that temporal bone morphology covaries dependably with genetic and geographic distances, and may also be influenced to a lesser degree by environmental variables.

**Integrating the SWGDAM forensic mitochondrial DNA database into the anthropology community.**

R.M. Thomas, B. Budowle, D. Polansky. Laboratory Division Federal Bureau of Investigation.

The Scientific Working Group on DNA Analysis Methods (SWGDM) maintains a mitochondrial DNA (mtDNA) database through the Federal Bureau of Investigation (FBI) for forensic analyses. This database is available publicly for use by all investigators and researchers. In an effort to continuously improve the quality and utility of the database, public examination and critiques of

the database are welcome. This poster provides a description of the structure and content of the database and details its usefulness to forensic science as well as the biological anthropology community. The purposes for the database are compared and contrasted to those of databases compiled by researchers in biological anthropology. Additionally, this poster outlines how anthropology researchers can participate in the further development of the database to help achieve the goals of SWGDAM, provide crucial assistance to the law enforcement community, and have a tool that may be useful for anthropological studies.

**Feeding, hormones and body composition: a reproductive ecological approach to the study of infant growth.**

A.L. Thompson, P.L. Whitten, M. Lampl, Department of Anthropology, Emory University.

Anthropological investigations of reproductive function have documented differences in individual and population-wide sex steroid levels related to ecological conditions during development. Within this framework, childhood development serves as a "bioassay" of environmental conditions, adaptively tuning the timing of maturation and adult levels of reproductive function to environmental resource availability. Recently it has been documented that size at birth may also affect adult responses to ecological conditions, with women exposed to energetic constraint *in utero*, measured as low PI at birth, having suppressed estradiol levels in response to moderate physical activity (Jasienska et al 2006). Here we test whether these relationships between energetics and reproductive hormones can also be evidenced in infancy, a sensitive period when the HPG axis is active and hormonal levels are at their highest until adolescence. Specifically, we asked: 1) how is size in infancy related to estradiol and testosterone levels and 2) are these hormone levels responsive to energy availability, measured by diet and body composition, during this period of HPG organization?

Weekly length, weight and body composition were measured longitudinally in a sample of 30 infants, aged 1 week to 12 months. Steroid hormones were assessed from weekly fecal samples using methanol extraction and microassay RIA techniques. Feeding style, amount and duration and physical activity were measured through parental diaries. Relationships between sex steroids, body composition and feeding measures suggest that energy availability in infancy may influence hormone levels during development, potentially having functional and evolutionary consequences for later growth and adult reproductive fitness.

**Assessing how experimental and surgical manipulations during in vivo laboratory research influence chewing**

**speed in tufted capuchins (*Cebus apella*).**

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Much of what we know about how primates chew comes from laboratory research where recording devices are implanted in living animals to measure bony deformation and/or muscle function during chewing. Unfortunately, it has proven essentially impossible to address the assumption that the experimental and surgical manipulations themselves have a minimal influence on masticatory mechanics. To initially assess this assumption, we compare one mechanical parameter, chewing speed, in two female *Cebus apella* during experimental and unmanipulated chewing. Subsequently, chewing speeds from these two animals are compared to those of wild *C.apella* at Brownsberg NP, Suriname.

We estimated chewing speed as the time to complete a single chewing cycle. We filmed chewing (at 250 frames/second) unmanipulated in cages and during a series of experimental manipulations ranging from sedation and restraint to surgical implantation of recording devices.

Not surprisingly, our results demonstrate that normal chewing speeds differ significantly between individuals. Both animals chewed significantly slower during experiments ( $\bar{x}$ =421.2 milliseconds) than in their cages ( $\bar{x}$ =331.4,  $P<0.000$ ). Post-hoc tests indicate no additional decrease in chewing speeds after surgical implantation, suggesting that anesthesia and handling were sufficient to decrease chewing speeds. Captive individuals chewed at similar speeds as wild individuals ( $\bar{x}$ =363.7). Average chewing speeds for all experimental settings fell within the 95% prediction interval for wild chewing speeds. Our results indicate that conventional methodology for studying masticatory mechanics likely alters an animal's chewing behavior although not so much as to remove them from the typical range of chewing speeds observed in the wild. Supported by NSF (BCS-0552285), NEOUCOM Summer Research Fellowship Program, and OBR-Research Challenge

**Biological evidence for increased sedentism during the mid-late Holocene at Dakhleh Oasis, Egypt.**

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The shift to agriculture is marked by a number of biological effects including changes in health, disease, workload, and activity patterns (Larsen, 1995). In Dakhleh Oasis, a shift from nomadic pastoralism to

agriculture likely took place in the mid-late Holocene but the exact timing of the transition is unclear. Using the available dental and skeletal evidence, from a small sample of seven individuals, this paper addresses the question to what degree, if any, had the Dakhleh people made a change in economic strategy. An assessment of dental health reveals a pattern of dental caries, antemortem tooth loss, and wear consistent with the practice of agriculture. Diseases like anemia and skeletal inflammations provide evidence of an increase in population density. However, the results of a biomechanical analysis of the limb bones were mixed. Lower limb bones indicate a decrease in mobility, consistent with data from other, agricultural populations, while the degree of humeral bilateral asymmetry is similar to that of pre-agricultural populations. The reason for this is unclear, but may mean that some biomechanical changes associated with the shift from pastoralism to agriculture differ from those in populations transitioning from hunting-gathering to agriculture. Alternatively, it may indicate that a full shift in economy had not yet taken place. Regardless, biological evidence points to an increased level of sedentism in the mid-late Holocene occupants of Dakhleh Oasis.

**Mitochondrial data suggest Pliocene splits within extant African colobine lineages.**

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The living African colobines are represented by three distinctive groups – the black and white colobus, the olive colobus, and the red colobus. Although there is a fossil record of colobines in Africa from the Miocene, none of them can be phylogenetically linked to any of the living forms. Furthermore, with the exception of a few specimens, the African Plio-Pleistocene colobine fossils also bear little resemblance to their extant relatives. This raises questions concerning the temporal depth of the extant colobine radiation. In order to further investigate these issues, 4000 basepairs of mitochondrial DNA were sequenced and analyzed from various species representing the black and white, olive, and red colobus groups, making this the most comprehensive molecular study of the African colobines to date. Standard phylogenetic methods were then used to build gene trees and estimate the timing of vicariance events between African colobine species. The data supports previous work based on mitochondrial DNA, suggesting that the extant colobine radiation had begun by the end of the Miocene. They also support lineages within the black and white colobus and red colobus groups that extend into the Pliocene and early Pleistocene. This indicates that the extant African colobine lineages were contemporary with the radiation of diverse Plio-Pleistocene

colobines that have since gone extinct. It also leads to the possibility that fossils found from that time period can be phylogenetically linked to the modern species. This provides important information concerning colobine systematics and insights into African colobine biogeography.

This work was funded by the National Science Foundation, the New York Consortium in Evolutionary Primatology, and Primate Conservation INC.

**Ancient Population Structure and Migration in Africa Inferred from Genome-wide Genetic Markers**

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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. Knowledge of genetic variation within Africa will have important implications for reconstructing modern human origins and African demographic history, including ancient population expansion and migration events. A dataset consisting of ~3.7 million genotypes has been generated from the Marshfield panel of 773 microsatellites and 392 in-del polymorphic genetic markers. These markers were genotyped in ~3,200 individuals from >100 diverse ethnic populations across Africa as well as in 118 African Americans and in the CEPH Human Genome Diversity Panel, consisting of 1048 individuals from 51 globally diverse populations. Analysis of population structure indicates considerably more genetic heterogeneity amongst African populations than had previously been recognized<sup>1</sup>. Population clusters are correlated with self-described ethnicity and shared cultural and/or linguistic properties (e.g. Pygmies, Khoisan-speakers, Bantu-speakers, etc), but with considerable admixture among some genetically defined populations. Although genetic variation is often correlated with natural geographic boundaries, we also observe evidence for long-range migration events (e.g. Bantu- and Khoisan-speakers). African Americans have predominantly West African Bantu (~80%) and European (~17%) ancestry, although individual admixture levels vary considerably. These results justify the need to include a broad range of geographically and

ethnically diverse African populations in studies of human genetic variation. <sup>1</sup>Rosenberg NA, et al. Science 298:2381-5 (2002). Funded by BWF and David and Lucille Packard Career awards, Leakey Fund, Wenner Gren, and NSF grants BCS-1096183 and BSC-0552486 to ST and NSF IGERT training grant BCS-9987590.

***Alu* insertion polymorphisms and mtDNA in Peruvian populations: Implications for the genetic history and population structure of Peru**

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The present research is part of a larger study investigating the history and population structure of Peru. Despite a long history of complex societies and extensive present-day linguistic and ethnic diversity, relatively few populations in Peru have been sampled for population genetic investigations. In this study, 15 Peruvian populations were examined for nuclear autosomal markers (*Alu* insertions) and mitochondrial markers (hypervariable region I), and the genetic distances of populations living in different geographic regions of Peru and belonging to different linguistic groups (Quechua, Aymara, and Jacaru) were compared.

For mtDNA, the Peruvian populations have an extremely high frequency of Native American haplogroups, and only three individuals out of the entire sample were found to possess other haplogroups. This suggests an extremely low level of maternal admixture from non-native peoples in Peru. The low correlation between mtDNA distances and those based on *Alu* insertions may indicate a more substantial contribution of non-native males to modern Peruvian populations or / and differences in migration patterns between males and females. Compared to other world populations, Peruvian groups are most closely aligned with native North and South Americans and Asians, but less so with the Central American populations included in this analysis. No significant genetic structure was found at the geographic or linguistic level.

**Derived wrist anatomy in the genus *Homo* as evidenced by 3D quantitative analyses: the implications for understanding the evolution of stone tool behaviors in hominins**

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Three-dimensional analyses are used to quantitatively compare relative articular surface areas, orientations, and curvatures of the scaphoid, trapezium, trapezoid, and 1<sup>st</sup> and 2<sup>nd</sup> metacarpals in *Homo*, *Australopithecus*, *Pan*, *Gorilla*, *Pongo*, *Papio*, *Theropithecus*, and *Nasalis*. The genus *Homo* shows a combination of shared, derived features in this carpal region that are not observed in other primate genera, including *Australopithecus*. An exception is the OH7 wrist (*Homo habilis*), which does not exhibit the pattern in later *Homo*. Rather, OH7 shows a perplexing combination of features that may suggest its three carpals do not all belong to the same primate. Developmental evidence indicates that the carpal shape changes in *Homo* are present following cavitation of the carpal blastema, before chondrification and ossification occur. Biomechanically, the reconfiguration in *Homo* enables the wrist to withstand large loads and forces generated either internally (from muscle contraction) or externally (from object use) during manipulative behaviors; nonhuman primate wrists do not show this capacity and are instead better designed to withstand loads and forces generated during locomotor behaviors. Other aspects of hand and wrist anatomy, together with behavioral evidence from the extant great apes, suggest that all Plio-Pleistocene hominins likely made and used stone tools. However, the 3D quantitative evidence of this carpal region suggests that possibly only one of these hominin species underwent the morphological specializations necessary to significantly enhance both its power and precision grips. The fossil evidence presently suggests that this evolutionary event is associated with the emergence or early development of the Acheulian tradition.

**Acculturation and geographic origins: Integrative bioarchaeological and archaeological chemical analyses of an individual from Solcor 3, north Chile.**

C. Torres-Rouff<sup>1</sup> and K.J. Knudson<sup>2</sup>. <sup>1</sup>Department of Anthropology, Colorado College, <sup>2</sup>School of Human Evolution and Social Change, Arizona State University. Detailed life history information derived from multiple lines of evidence, including the identification of geographic origins, health and body use, can be used to elucidate the complex processes of acculturation in the San Pedro de Atacama oasis of northern Chile during the Middle Horizon. This paper presents the results of bioarchaeological and archaeological chemical analyses of the skeletal remains of an adult male (tomb 50, catalog number 1948) from the cemetery of Solcor 3 (c. AD 500-900). Strontium isotope ratios in human tooth enamel reveal information about where a person lived during their childhood, when enamel was being formed. Individual 1948 showed strontium isotope ratios decidedly outside the

range of the local San Pedro de Atacama strontium isotope signature. Given these data implying that individual 1948 was originally from elsewhere, an examination of his health status, social role, and mortuary context provides insight into the treatment of foreigners in San Pedro de Atacama.

Our data support the argument that individual 1948's foreign origin did not hinder his later assimilation into Atacameño society. He was buried in a local cemetery with a typical mortuary assemblage for a male of this time and no strong evidence of possible foreign origin. Skeletal indicators of diet and activity patterns do not distinguish him from the local population, suggesting that his lifestyle was similar to that of other members of Atacameño society. Therefore, our analyses suggest that individual 1948's acculturation into Atacameño society during his adult life was nearly complete and he retained little to no indication of his probable foreign birth. This project was supported by the National Science Foundation (BCS-0202329), the H. John Heinz III Foundation, Colorado College, and the University of Wisconsin at Madison.

**Incongruence of phylogenetic and geographic distances among members of the *Cercopithecus lhoesti* species group.**

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This is the first molecular phylogenetic study to include all three taxa of the *Cercopithecus lhoesti* species group: *C. lhoesti*, *C. preussi*, *C. solatus*. Representatives of each species were surveyed for two Y-chromosomal genes, TSPY (~2240 bp) and SRY (~780 bp), and one X-chromosomal intergenic region (~9300 bp) homologous to a portion of human Xq13.3. Maximum likelihood topologies inferred from these sequences confirm that the *lhoesti* group is monophyletic within the tribe Cercopithecini, as suggested by earlier karyotype studies. Interestingly, within this species group, phylogenetic distance is incongruent with geographic distance. *C. preussi*, located in Cameroon, Nigeria, and Bioko, is geographically closest to *C. solatus*, located in Gabon. However, phylogenetically, *C. preussi* clusters as sister-taxon to *C. lhoesti*, a species found in the Albertine region of East Central Africa. This phylogeographic pattern, evaluated in the context of Pleistocene glacial cycles and *lhoesti* group ecology, leads to new hypotheses of divergence times and dispersal paths among these three species.

**Diets of the Early Pliocene suids from Gona, Ethiopia.**

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The 4.3-4.5Ma Sagantole Formation deposits from the Gona Paleanthropological Research Project in the Regional Afar State of Ethiopia have yielded numerous suid fossils in association with a great diversity of other taxa, including the early hominid *Ardipithecus ramidus*. To date, >450 suid fossils, primarily dental remains, have been recovered. Three species are present including *Nyanzachoerus jaegeri* (most common), *Ny. kanamensis* (rare), and *Kolpochoerus deheinzeli*. To develop a better understanding of the biology of these species, special effort was devoted to reconstructing their diets based primarily on low-magnification enamel microwear and stable isotopic analyses of tooth enamel. Knowledge of the diet of these suids will contribute to a better understanding of the ecological context of the early hominids. Taxonomic assignment of the nyanzachoere third molars was based on crown dimensions and complexity of the talon/-id. *K. deheinzeli* is the earliest known kolpochoere in Africa. Upper and lower third molars of the three suid species were analyzed for dental microwear features via low-magnification stereomicroscopy. The variables 'gouges', 'puncture pits', and 'scratches' were the most informative in distinguishing the nyanzachoeres from the kolpochoeres.  $\delta^{13}\text{C}$  values of the two nyanzachoere suids were indistinguishable and indicate diets dominated by C4 grasses. Tooth enamel  $\delta^{13}\text{C}$  values of the kolpochoere specimens were lower and indicate diets with a C3 browse component. *K. deheinzeli* is the only kolpochoere known to have had a mixed browse/graze diet.

**A histological examination of the effects of burning on fragmentary deer bone**

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Bone histology as a means to assess and evaluate fragmentary remains is a useful tool for physical anthropologists. Not only can microscopic techniques serve to identify fragments as being human or non-human, they can also aid in the determination of age at death. The implementation of bone histology in identifying and aging bone has been the subject of numerous studies yet when fragmentary remains are burned, changes may occur in the very microstructure that makes the bone histologically unique. To understand these changes will aid in strengthening the use of histology for the physical anthropologist attempting to identify and age bone fragments.

In order to preserve the integrity of human remains, a comparison of fresh and burned deer bone assesses how the burning process affects the histological character of bone. Utilizing data from previous research that suggests no inter- or intra-bone variability

among white-tailed deer, this study places measurements of osteon and Haversian canal areas of the long bones of fresh deer against deer bones burned in a house fire at approximately 1200 degrees Fahrenheit.

Standard histological embedding and thin-sectioning techniques, a LEICA microscope, and computer software program Image Pro Express were utilized to assess the structure of the burned fragments. Preliminary results indicate that the histological structures are preserved during burning but they also suggest the shrinking of these histological structures. The significance of this shrinkage needs to be understood in order to ascertain the value of bone histology in assessing burned remains.

#### **Mating systems and male genital anatomy in strepsirhine primates.**

K. Treatman-Clark. IDPAS, Stony Brook University.

The elaborate genitalia of male strepsirhines has attracted much attention in primate literature. However, previous studies of the functional morphology of primate genitalia have yielded conflicting results. In a series of classic papers, Alan Dixson asserted that primates in multi-male groups scored higher in penis length, baculum length, distal penis complexity, and penile spinosity (1987). Other authors have revised Dixson's work to account for phylogenetic bias in his data set, but have used the same specimens and methodology (Verrell, 1992; Harcourt, 1995). Harcourt and Gardiner (1994) concluded that, considering only the strepsirhines, the correlation between penile morphology and mating system is weak, and in the case of penile spinosity, nonexistent.

This paper presents the results of a new functional analysis of strepsirhine genitalia, which differed from previous studies in that it used (1) living specimens rather than preserved cadavers, (2) a more diverse sample consisting of thirty-four strepsirhine taxa, (3) continuous data rather than rank data, and (4) phylogenetically independent contrasts.

Several aspects of male genital morphology were associated with mating system. For instance, penis lengths were found to be significantly longer in taxa with high degrees of sperm competition ( $p=0.019$ ). This study was also the first to demonstrate a conclusive link between penile spinosity and sperm competition. There was a significant positive correlation between penile spine length and relative testis size ( $p<.001$ ). These results demonstrate that male genital anatomy has indeed been subject to selection in the strepsirhine lineage.

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#### **Recognition of Primate Facial Displays by Humans: A Case of Chimpanzee Facial Signals**

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It seems that the recognition of facial expressions is strongly influenced by innate factors. Many human and chimpanzee facial displays share common features. It is usually assumed that women are better at recognizing of facial expressions. This study examined sex differences in the recognition of chimpanzee facial displays by humans.

A sample of 100 men and 101 women evaluated 10 basic facial displays of adult chimpanzees. Each slide, which had 6 predefined answer choices, was presented to an informant for 13 seconds. The informant had 4 additional seconds to choose an answer. The answers consisted of the terms commonly used for the description of primate displays.

The results did not support the hypothesis about a female's advantage in recognition. The recognition accuracy was 26% for men and 25% for women; the difference was not significant. The most recognizable chimpanzee display was the pout face (54%) followed by the play face (50%), whimper (49%), the scream face (28%), the cry face (22%), and horizontal bared teeth (22%).

Pout and whimper are frequently used in the mother/infant interaction. Also the play face is often used by infants. Our results suggest that facial displays typically used by infants as a cue for positive interaction were identified by humans more easily. On the contrary, recognition of threats was quite poor. The present study supports possible homologies of the play face, pout, and whimper with some of human facial expressions.

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#### **"New equations for estimating stature in forensic cases".**

A.J. Tuck, J. Albanese. Department of Sociology and Anthropology, University of Windsor.

Stature, along with sex and age at death are typically used by forensic anthropologists to narrow down possibilities when identifying unknown individuals. The goal of the research is to maximize the usability of the equations in a forensic context: provide useful information about stature that can be used to exclude possibilities when attempting to positively identify unknown individuals. The stature estimation equations that are currently available to forensic anthropologist are difficult to apply because they are race-specific. On a theoretical level, racial categories (more recently referred to as ancestry) are not supported by skeletal or genetic data. On a practical level, race-specific methods are more difficult to apply because "race" must first be determined for the unknown. Some methods have been developed for determining "race" using the femur, but these methods perform very poorly

when independently tested. Even proponents of the racial approach admit that it is difficult to assess "race" outside of the cranium. Thus, when dealing with an isolated long bone, which of the traditional race-specific equations should be applied? In this paper, we present a new series of equations developed using a sample from the Terry Collection ( $n = 244$ ) for estimating stature that are designed to be universally applicable. We present sex-specific equations, and equations where stature can be estimated even when sex cannot be determined.

Funding for this research was provided by the Social Science and Humanities Research Council of Canada.

#### **Comparative craniofacial morphology of archaeological populations from Mongolia.**

D. Tumen. Department of Anthropology and Archaeology, National University of Mongolia.

Archaeological studies of Neolithic, Bronze and Iron Age sites have shown that western Mongolian Bronze and early Iron Age societies belonged to the Altai-Sayan variants of the South Siberian cultural complex, while the Slab grave culture was situated in central and eastern Mongolia, the Lake Baikal region, and Manchuria. This study examines craniofacial variation among the populations of Mongolia from the Neolithic to modern periods, and then compares them to worldwide populations. The results show that during the Neolithic period western Mongolia was inhabited by people with European morphological features, while central and eastern Mongolia were inhabited by populations with Asian traits. The early Bronze Age was characterized by migrations of Asians from eastern Mongolia into western Mongolia, southwestern Siberia, and eastern Central Asia. Western Mongolian sites of the Bronze and early Iron Ages included more individuals with Asian features than those from earlier times. Comparisons with East Asian data show that the Neolithic, Bronze, and early Iron age populations from Asia are divided into two major clusters. The first cluster included all populations from southern Siberia and western Mongolia, along with the Jomon from Japan. A second cluster included populations from Manchuria, Inner Mongolia, northwest and central China, Korea, Transbaikalia, and eastern Mongolia. The Asian sites within Mongolia show population continuity between the Neolithic, Bronze, early Iron, Xiongnu (Hunnu) Medieval, and contemporary Mongolians.

#### **Is it trauma? Identifying pre- peri- and post-mortem skeletal fractures.**

T.A. Tung. Department of Anthropology, Vanderbilt University.

Identifying trauma in archaeological skeletons is crucial for reconstructing past lifeways, yet differentiating between pre- peri- and post-mortem fractures can be difficult, particularly if skeletal preservation is poor. This study attempts to document and distinguish between fracture types through detailed analyses of human skeletal remains from four archaeological sites in the Peruvian Andes. This study builds upon previous works that have shown how human bone can fracture similarly under similar circumstances, thereby providing methods for documenting and interpreting skeletal trauma. However, given particular weaponry, cultural and mortuary practices (re-interment or addition of bodies), and burial conditions (water damage or looting), it may also be useful to examine types and patterns of skeletal breaks for specific regions and time periods.

Through description and presentation of several images of pre- peri- and post-mortem breaks from prehispanic skeletons, this study documents specific characteristics for each. Importantly, this study gives considerable attention to local weaponry, which includes wood clubs, maces with round stones, and bola stones and slings, all of which result in blunt force trauma that can be observed on numerous specimens. At three of the four sites in the study, most blunt force trauma cases are pre-mortem: 88% of the cranial wounds are healed (N=82 wounds). In contrast, the fourth site shows nearly equal numbers of pre- and peri-mortem cranial trauma (minimum number of wounds = 42). Some of the peri-mortem trauma is easily diagnosed, while others are more ambiguous, providing a rich dataset for documenting (and debating) fracture characteristics.

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#### **Skeletal and genetic determination of spatial social patterns in cemeteries.**

B.M. Usher, R.S. Polmateer. Department of Anthropology, State University of New York, College at Potsdam.

Physical anthropologists and archaeologists use the spatial arrangement of cemeteries to support inferences about social structure in past populations. This poster presents the different, and often conflicting, ways that horizontal and vertical aspects of social position have been represented in medieval Scandinavian cemeteries. There is written, archaeological, and osteological evidence that the position of individual graves was influenced by age, sex, land ownership, home location within the parish, and location of other family members; and that the relative importance of each of these variables changed over time. Determining the pattern or patterns used by a community is essential to the interpretation of the social

organization. The goal of our project is to show that spatial analysis of a combination of skeletal and genetic data can differentiate between these different patterns.

Using six generations of a simulated population, models of each cemetery pattern were created. The standard osteological attributes of age (adult versus child) and sex for the adults were recorded for each individual. Genetic data about maternal (mitochondrial) and paternal (Y chromosome) lineage was determined from the simulated population. Burial location was determined using an algorithm based on the cemetery pattern, and location was recorded as Cartesian coordinates. Using SatScan spatial scan software ([www.satscan.org](http://www.satscan.org)), it was shown that the combination of osteological and genetic data differentiated between the burial patterns, when neither set of data was sufficient by itself.

This project was supported by a Dr. Nuala McGrann Drescher Affirmative Action Leave grant from State University of New York and United University Professions, an American Scandinavian Foundation Fellowship, and Lois Roth Fund Award.

#### **Men in transition: Impact of lifestyle changes on paternal care practices in Toba and Wichí populations of Argentina.**

C.R. Vaggia. Department of Anthropology, University of Pennsylvania.

Indigenous communities all over the world are experiencing dramatic changes in their lifestyles. The Toba and the Wichí, two indigenous groups from northern Argentina, currently live on an acculturation gradient that spans from traditionally living, hunter-gatherer populations (Western region) to more urban communities (Eastern populations). In this study, we explored the impact that the changes in lifestyle may have on patterns of paternal care.

We collected information on subsistence activities, diet, infant and child care, and general time budget from several Western Toba (n=16), Wichí (n=12), and Eastern Toba families (n=70). We also conducted 24-hs recalls to describe activity patterns of 89 Wichí and 122 Western Toba men. Western Toba and Wichí men differ significantly from Eastern Toba in the time they devote to direct paternal care. Men in the more traditionally living populations exhibit very low frequencies of direct paternal care (< 2% of observation points), whereas these values reach almost 10% in the Eastern Toba. Younger fathers in the Eastern Toba population tend to be more involved in childcare practices than older ones.

This study suggests that paternal care practices are responsive to changes in the social and physical environment, and, as such, are flexible and dynamic. There seems to be a constellation of biocultural factors affecting whether and when men provide direct care. The study of how those factors impact childcare practices in traditional

societies can shed some light to our understanding of the evolution of the human family.

#### **The effect of gut passage by *Cebus capucinus* on rates of seed germination and time to germination.**

K. Valenta and L.M. Fedigan, Department of Anthropology, University of Calgary.

White-faced capuchins (*Cebus capucinus*) are reported to play a role as seed dispersers. We examine the effect of gut passage on germination potential and time to germination.

We compare the germination rates, as well as average time to germination of seeds ingested and defecated by capuchins (N=2014) and seeds removed directly from fruit (N=1028) for the five most commonly passed seed species: *Genipa americana* (GA), *Sciadodendron excelsum* (SE), *Trichilia martiana* (TM), *Acacia collinsii* (AC) and *Casearia arguta* (CA). Seeds were collected from feces during the course of full-day follows on 15 individuals over a 7 month study period (May-July 2005 and January-June 2006). All seeds were planted in florist's foam, watered as needed, and checked daily for germination.

For 3 of the 5 species (AC, CA and GA) differences in proportion of germinated seeds was significantly higher for gut passed seeds than for controls (AC,  $z=3.24$ ,  $p<0.001$ ; CA,  $z=4.02$ ,  $p<0.001$ ; GA,  $z=2.92$ ,  $p<0.001$ ). For one species there was no difference (TM,  $z=0$ ,  $p=1$ ), and for the fifth species, the difference was not significant (SE,  $z=1.83$ ,  $p=0.03$ ). For four of the five species, the mean time to germination was faster for gut passed seeds than for controls (GA: 14.5 versus 23 days, TM: 7.4 versus 8.5 days, AC: 12.8 versus 21.4 days, CA: 6.8 versus 10.4 days). For the fifth species, there was no difference (SE: 22.6 days).

These results indicate that capuchins benefit some of their food trees via seed dispersal. Further measures of seed dispersal effectiveness are discussed.

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#### **Food Cravings and Aversions in Pregnancy: An Evolutionary Perspective on Gender Differences in Dental Health.**

Helen Vallianatos. Department of Anthropology, University of Alberta

Men and women have differential patterns of dental health, with women suffering poorer dental health in general. Part of the reason for this is that food consumption may be gendered, in that particular foods may be pre/proscribed for women or men, or that specific foods may be consumed to a greater or lesser extent based



on gender. Other explanatory factors relate to women's life histories, in particular the earlier eruption of teeth among females and the effects of pregnancy, in particular the effects of hormonal fluctuations on susceptibility to cariogenic bacteria. An evolutionary medicine perspective adds to investigations into health discrepancies between men and women by contextualizing health in terms of evolutionary life histories.

In this paper, I propose that one causal factor for women's poorer dental health relates to their experiences of food cravings/aversions while pregnant. Building on evolutionary explanations for the role of cravings and aversions during pregnancy, I present cross-cultural and historical patterns of cravings/aversions. I then discuss cultural beliefs that support pregnant women's experiences of cravings/aversions, and how this molds food consumption. Data is derived from literature surveys of 6 databases and fieldwork conducted in India. I suggest that the adaptive aspect of food cravings/aversions does not represent a "perfect" adaptation to environmental hazards, but rather an adjustment involving tradeoffs. Specifically, common cravings include sweet (e.g. honey) and sour (e.g. citrus) foods; these are etiological agents for caries and dental erosion. Dental erosion is also affected by vomiting, an aspect of "pregnancy sickness" commonly experienced.

#### **Metric Variation in the Hominid Mandibles from Dmanisi, Georgia**

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The Plio-Pleistocene locality of Dmanisi, Georgia, has produced an abundant hominid fossil sample, including four mandibular specimens. Within this sample are two subadult and two adult mandibles, including one of the smallest Lower Pleistocene mandibles assigned to *Homo*, one of the largest assigned to *Homo*, and the earliest known edentulous hominid mandible. This paper tests the hypothesis that the variation in the Dmanisi sample is the result of sampling different age and different sex individuals from a single taxon. The results of these analyses suggest that the Dmanisi mandibular variation is greater than expected based on a model of sampling different age and different sex individuals using a low dimorphism, human or chimpanzee comparative model, but fits within the expected range for a high dimorphism, gorilla model. However, tests of an alternative hypothesis that the Dmanisi mandibles represent a mixed-taxa sample produce results inconsistent with a two-species model. These results, in conjunction with the anatomy and context of the Dmanisi sample, support the notion of a single hominid taxon at Dmanisi, but one with greater variation than could be reasonably sampled from either extant humans or chimpanzees. This increased variation may

be the result of elevated levels of sexual dimorphism.

#### **Infection and human evolution.**

L.M. Van Blerkom. Department of Anthropology, Drew University.

Infectious disease almost certainly played a major role as an agent of selection during human evolution. Up to 10% of our genome is involved in body defenses, and host-pathogen interaction was no doubt instrumental in maintaining the considerable diversity found in the MHC and other regions. Except for the connection between hemoglobin S and malaria, evidence for this interaction has been mostly circumstantial. Today, however, genome-wide comparisons of human and other DNA (chimpanzee, mouse) allow the identification of loci that have undergone strong positive selection and many of these are related to immune response or involved in antiviral or antimicrobial activity. In addition, many pathogen genomes have now been sequenced and their evolutionary histories are becoming known. This paper summarizes some of this evidence and uses it to identify several important periods in the history of primate-pathogen interaction. These include the late Oligocene, when antiviral genes proliferated in the catarrhine ancestor, and the Plio-Pleistocene boundary, when hominins moved into open environments and began eating more meat. The agents of several important infections such as tuberculosis and typhoid show evidence of clonal expansion correlated with modern human population increase and expansion out of Africa. The Neolithic saw the acquisition of other diseases and the evolution of anthropophilic mosquitoes (and falciparum malaria). This "host-pathogen arms race" is still on-going, as emerging and re-emerging infections continue to plague human populations and contribute to microevolution.

#### **Compensatory benefits to sustain the costs of encephalization: a mammal-wide analysis.**

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It is well established that evolving a relatively large brain inflicts costs in terms of energy requirements and development time. For larger brains to have evolved, therefore, fitness benefits of encephalization must compensate these costs. There are three possible benefits: (i) increased adult survival (and hence, over time, a longer maximum adult lifespan), (ii) increased infant or juvenile survival, and (iii) a higher number of offspring. Here, we present a thorough test of these predictions using phylogenetically corrected analyses of a new data compilation of mammalian species. We confirm the positive correlation between adult survival and brain mass, if the effect of body size is

removed. In addition, we find a positive correlation between juvenile survival rates and relative brain mass. This effect may arise at least in part because larger-brained species give birth to larger infants. We find a negative correlation between brain size and annual fecundity (correcting for body size), but no correlation for lifetime fecundity, suggesting that the lower reproductive rate in large-brained species is canceled by their longer reproductive lifespan. These patterns thus corroborate the hypothesis that evolutionary increases in brain size are necessarily accompanied by compensatory benefits. Because we also found that relatively large-brained mothers show an increased energy investment per offspring, regardless of their mode of development, the mammalian data also support the maternal energy hypothesis.

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#### **A Preliminary Analysis of Associations and Time Budgets in Wild Orangutan Females in the Period Preceding and Following Birth**

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Reproduction is an extra burden on the tight energy budget of female orangutans. Here we compare data on time-budget and association patterns before and after two wild female orangutans gave birth.

A nulliparous orangutan female (*Pongo pygmaeus wurmbii*) in the Tuanan Orangutan Research, Central Kalimantan, Indonesia, gave birth during a follow day. The female was followed during 2 years preceding conception (787 hrs), during her pregnancy (536 hrs), and after giving birth (400 hrs). A parous female (*P. abelii*) in Suaq Balimbing, Sumatra had been followed during 5 years (955 hrs, 430 hrs and 658 hrs resp.)

To analyze changes in association patterns for both females, we examined the changes over time within each female. Results showed that during (late) pregnancy and the first few months' postpartum females travelled over shorter distances than before conception. The frequency of association with males (either flanged or unflanged) was significantly higher before conception than afterwards, when more aggregations were formed with parous females. This suggests that associating with males is more costly than with females, as is apparent in the greater distance travelled in association with males.

In addition, results will be shown concerning changes in time budgets of the two females to compare different reproductive states (nulliparous, parous and lactating). To compensate for seasonal effects the focal



females were also compared to females with semi-dependent offspring (Tuanan total 2000 hrs, Suaq 3400 hrs) during the same periods.

**A paleopathological assessment of Imperial Roman burials excavated from the Necropoli of San Donato and Bivio CH, Urbino, Italy.**

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We examine the frequency of paleopathological lesions exhibited by 71 Imperial Roman burials recovered from the sites of San Donato and Bivio, located in the city of Urbino, Italy. The frequency of dental defects and lesions are extremely high for this sample; 97% of the adults exhibited at least one enamel hypoplasia and 60% of the adults showed at least one carious lesion. In general, chronic health problems appear to be common among all adults; 92% of the males and 76% of the females exhibit at least one skeletal lesion. On average, the adult males exhibit greater rates of skeletal pathologies than the females for many of the skeletal/dental lesions (DJD 68%, cribra orbitalia 45%, trauma 22%, periostitis 41%, and enamel hypoplasia 100%) but none of the differences are significant. Females did exceed males in the following lesions (osteoarthritis of vertebral bones 58%, vertebral nodes 42%, and caries 64%) these differences are not significant. It appears that the Urbino adults, regardless of sex, were subjected to similar stressors. Only one of 26 sub-adults (3.8%) exhibited skeletal lesions. It appears that acute health problems may have been the contributing factors for the deaths of the Urbino sub-adults. Our findings are compared to the paleopathological findings (cribra orbitalia and dental defects) offered for the Imperials Roman sites of Valleranno, Lucus Feroniae, Quaderella, and Rimini & Ravenna. Our results confirm the idea that Romans of this period were under considerable biological stress as they supported the infra-structure of the city of Rome and its vast Empire.

**Worldwide analysis of phenetic distances among Holocene populations from the evidence of morphological dental traits**

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The study of nuclear and mitochondrial DNA offers an excellent way to better understand the evolutionary relationships among extant human populations. However,

this type of analysis has never been carried out before using classic (metric) anthropological data. This occurred because some authors have called into question the possibility to define clearly such relationships through skeletal metric traits, given that environmental pressure may affect their expression. On the other hand, morphological dental traits have proved to be highly discriminant in the phenetic analysis among populations because of their abundance, strong hereditary component and low environmental influence.

In the present study, we analyzed the frequency of 29 morphological dental traits of 519 Holocene samples worldwide. To these we added 573 more samples data from the literature for a total of 1092 groups that were pooled into 30 distinct major geographic groups. The relationships between these groups were assessed applying the standard statistical techniques used in the analysis of genetic data (Mean Measure of Divergence, Multidimensional Scaling, Maximum Likelihood), which produced similar results. The samples clearly separate following a geographic criterion. Furthermore, as previously found for many and different sets of genetic markers, African Subsaharan populations significantly differ from all the other populations. Finally, the well-known dental complexes named "Sundadont" and "Sinodont" were clearly identified among the Pacific populations in this study. Our research was supported by MIUR COFIN 2005 and "Progetti di Ateneo" Università di Roma "La Sapienza".

**A behavioral test of visual acuity in the cathemeral strepsirrhine *Eulemur macaco flavifrons*.**

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Studies of visual acuity in primates have shown that diurnal anthropoids have higher acuity (30-75 c/deg) than all other mammals. However, relatively little is known about visual acuity in non-anthropoid primates, and published estimates are only available for 4 strepsirrhine genera (*Microcebus*, *Otolemur*, *Galago*, and *Lemur*). Comparative study of strepsirrhine visual acuity can offer insight into the evolution of primate visual systems. As such, a larger sample of strepsirrhine acuity estimates is needed. We present here the first measurements of visual acuity in a cathemeral strepsirrhine species, the blue-eyed black lemur (*Eulemur macaco flavifrons*). Acuity in two subjects, a 3-year old male and a 16-year old female, was assessed behaviorally using a two-interval forced choice discrimination task. Visual stimuli consisted of high contrast square wave gratings of seven spatial frequencies. Acuity threshold was determined using a 70% correct response criterion. Results indicate a maximum visual acuity of 5.1 cycles per degree (c/deg) for the female (1718 trials) and 3.8 c/deg for the male (718 trials).

To examine ecological sources of variation in primate visual acuity, we also estimated maximum acuity for *Cheirogaleus medius* (2.8 c/deg) and *Tarsius syrichta* (8.9 c/deg) using peak retinal ganglion cell densities reported in the literature. These data suggest that visual acuity in non-anthropoid primates may be influenced by both activity pattern and diet. In particular, the relatively high visual acuity of *Tarsius syrichta* and *Galago senegalensis* suggests that nocturnal visual predation may be an important selective factor favoring high acuity.

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**The Biological Diversity of the Early Medieval European Population, in Light of Discrete Traits: Central versus Southwest Europe.**

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The socio-economic conditions of past societies is possible to study with the help of the biological characteristics of human skeletons. We intend to focus on the early medieval population of the Frankish Empire, which represented a centre of the medieval civilisation in Western Europe, as well as on the Great Moravian population that inhabited Central Europe. The subject of our contribution is a study of the biological diversity of both populations on the basis of discrete traits. The aims were: (1) to establish the range of morphological variability, based on these trait frequencies; (2) to evaluate the hypostotic discrete traits, for the assessment of ontogenetic stress; and (3) to test to distinguish "family-specific traits" and possible kinship. We evaluated (1) about 620 skeletons from the Great Moravian cemeteries of Mikulčice and Josefov (9<sup>th</sup> – 10<sup>th</sup> century AD), and (2) about 110 skeletons from the Merovingian burial-ground of Seyssel-Albigny (Aquitania) (5<sup>th</sup> – 7<sup>th</sup> century AD). Approximately seventy discrete traits have been scored (skull sutural ossicle, vessel and nerve related foramina, accessory of joint facets, manifestations of hyperostotic activity). Some of these traits have been interpreted as the result of a non-specific physical load on the human organism. The traits showing a statistically significant dependences of occurrence on sex, age or the prevalence of asymmetry incidence were excluded from the comparisons. Our conclusions contribute to the knowledge of the biological heterogeneity and/or homogeneity of the early medieval inhabitation of these two parts of Europe,

which always reflect population migration and coexistence.

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**Elegant in life, ambiguous in death: a high-status female mummy from northern coastal Peru.**

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Mortuary analysis involves the integration of bioanthropological data with archaeological context and associations. On occasion, these data sets are not congruent, such as when "male" grave goods are found buried with females. Such cases call into question assumptions commonly made about sex, gender, and their expression through normative mortuary behavior. In this paper, the tomb of a high status Moche (c. AD 450) female from northern Peru is presented as a case of gender ambiguity in mortuary practices. While bioanthropological analysis indicates that the biological sex of the individual is unequivocally female, grave offerings directly associated with the body include a mix of what Moche specialists consider classic "male" items (war clubs and spear throwers), and classically "female" items (needles and weaving tools). In this paper, bioanthropological data (paleopathology, skeletal morphology) will be used in conjunction with a critical evaluation of the mortuary context to test alternative hypotheses about the social identity of the woman buried in this unusual tomb.

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**Bipedal apes and humans: how do they compare and what can we learn from it?**

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A traditional way to get insight into our human ancestry is looking at hominin fossil remains. Although the fossil record is steadily increasing and analytic tools are continually being improved, it remains difficult to reconstruct the locomotor behaviour of early hominins. A way to get out of this impasse is to study the morphology and locomotor behaviour of living apes. Apart from allowing us to establish viable form-function relationships which can be used to interpret fossil traits, they might teach us something about the bipedal gait of early hominins.

This paper integrates the results of previous experimental studies on gibbon and bonobo bipedalism with available human data. The gibbon and bonobo data were collected from

zoo animals during spontaneous bipedal locomotion, using an instrumented walkway with built-in force plates and pressure mats and surrounded by four cameras. We analysed dynamic plantar pressure distributions, 3D ground reaction forces and determined spatiotemporal gait parameters and kinematics from the video images.

Although there are similarities between gibbon, bonobo and human bipedalism, the habitual bipedal gait of humans remains distinct from the occasional bipedalism of both apes. Most differences are related to differences in habitat: humans being specifically adapted for terrestrial bipedality, bonobo and gibbon for locomotion in an arboreal context. Overall our results show that while arboreal adaptations influence bipedal gait, they do not necessarily compromise it, so that bipedalism might readily have been an integral part of the locomotor repertoire of an arboreally adapted protohominin.

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**The complex evolutionary history of gorillas.**

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We know relatively little concerning the evolutionary and demographic histories of one of our closest living relatives, the gorilla. To address this topic, we generated DNA sequences from 16 non-coding autosomal loci from 15 western gorillas (*Gorilla gorilla*) and three eastern gorillas (*G. beringei*), including two non-invasively sampled wild individuals. Analysis of the approximately 14 kb of data per individual confirmed that the genetic diversity of gorillas is similar to that of chimpanzees, but almost twice as high as that of bonobos and humans. The significantly positive Fu & Li's D observed for western gorillas suggests a complex demographic history with a constant, long-term population size and ancestral population structure. We used simulations to test the fit of our data to various models describing the population split between western and eastern gorillas. Our data support a scenario of an initial split between western and eastern gorillas about 1 million years ago with gene flow, predominantly from east to west, until about 200,000 years ago. These results will be discussed in the context of recent findings based on similar data from chimpanzees.

**Origins of the Chamorros: A mtDNA perspective.**

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The Marianas Islands in Western Micronesia were settled approximately 3,500 years before present. Similarities in composition and form of the "Marianas Red" pottery from that time period and similarly-aged pottery found in the Philippines and Sulawesi suggest the Marianas were settled directly from island Southeast Asia. Likewise, the modern Chamorro language is classified within the Western-Malayo-Polynesian branch of the Austronesian language family along with languages of the Philippines and Indonesia, in contrast to the languages of central-eastern Micronesia that are more closely related to those from Polynesia.

In order to better understand the prehistoric settling of the Marianas we analyzed ~400bp of the hypervariable region I of the mtDNA of 80 Chamorros and compared them to other Southeast Asian and Pacific mtDNA lineages.

Preliminary results reveal that 86% of Chamorro sequences belong to haplogroup E, also common in the Philippines, Indonesia, and among Aboriginal Taiwanese. Some of these Chamorro lineages are identical to those currently present in the Philippines and Taiwan. The majority of the remaining sequences (8%) belong to haplogroup B characteristic of most other Micronesian and Polynesian populations.

These data suggest that the Marianas were initially settled directly from island Southeast Asia, followed by substantial gene flow from other Micronesian archipelagoes with little influence on the Chamorro language.

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**Modern Frequency of os acromiale in the William M. Bass Skeletal Collection.**

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As a non-metric trait, os acromiale was first described by Gruber in 1859, and has frequently been referred to as a genetic marker in African-American skeletal series. However, Blakey (2000) and Rankin-Hill (1997) point out that biomechanical stress could be an underlying cause of this trait. A lower frequency of the trait among modern samples may support the functional argument as a result of technological advancements but a modern African-American sample is lacking. Frequency rates of %, in the modern population of the William M. Bass donated skeletal collection, were compared to data from several historic African-American skeletal series spanning the last 300+ years. The comparative samples, in chronological order, include: New York African Burial Ground (3.3%), First African Baptist Church (20%), Mother UAME (3.1%), and the Hamann-Todd Collection (13.2%). In the Bass collection, from a sample of 406 individuals, the overall frequency of os acromiale is 2.7% (n=11). This is a decrease from the average frequency of 7-8% cited in

the clinical literature. However, the frequency rate among the African-American component of the Bass collection yielded a frequency rate of 8.5% (n=3/35), close to the average "historic" frequency. The European-American frequency from the collection is quite low at 2.1% (n=8). In general, the African-American os acromiale frequencies continually fluctuate over time. Further investigation may reveal the underlying cause of the fluctuations in os acromiale frequencies thereby shedding light as to the true cause of the trait.

#### Evaluating character independence for hominin systematics using geometric morphometrics.

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One underlying assumption of phylogenetic analyses is that characters represent independent data points. Since the phylogenetic algorithm ultimately attempts to use identified character changes as proxies for different evolutionary "events", if multiple instances of character change actually represent a single evolutionary "event", then the analysis is biased in favor of supporting clades identified by the correlated characters.

Rak (1983) and McCollum (1999) have offered models of functional integration of the infraorbital region of early hominins. These models proposed a functional/adaptive relationship among *A. aethiopicus*, *A. africanus*, *A. boisei*, and *A. robustus* for prognathism, facial dish, nasoalveolar clivus, position of the zygomatic root, anterior pillars, and the incisor alveolus.

To test these hypotheses, I used the methods outlined in Villmoare (2006) to derive univariate measures from the complex three-dimensional morphology using geometric morphometric techniques. Relative warps that described the variation were calculated from the distributions of landmark data.

Once the variation in the characters was captured by relative warps, the warp scores could be examined for patterns of covariation. The results found a unique pattern of covariation among *A. aethiopicus*, *A. boisei* and *A. robustus* for facial dish, the shape of the clivus, the shape of the incisor alveolus, and the position of the zygomatic. Among the other early hominin species, these characters were found not to covary. This suggests that the hypotheses of functional integration may be correct, and that, for *A. aethiopicus*, *A. boisei*, and *A. robustus*, these characters should be collapsed in phylogenetic analyses.

#### Genetic contributions to normal variation in expression of a gene associated with susceptibility to multiple human autoimmune disorders (*PTPN22*) in baboons.

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Polymorphisms in *PTPN22* (located on human chromosome 1p13; HSA1p13) recently have been associated in several human populations with susceptibility to multiple systemic and organ-specific autoimmune diseases, including Type 1 diabetes, rheumatoid arthritis, systemic lupus erythematosus, vitiligo, and Graves disease. While at least partial homology of *PTPN22* has been described by others in rodents, zebrafish, nematodes, and yeast, little is known about this gene in nonhuman primates. The aims of this study were to examine the contribution of genes to phenotypic variation in *PTPN22* expression in pedigreed baboons (*Papio hamadryas*) and to localize QTL affecting this variation. As part of a larger transcriptional profiling study using the Illumina Human Sentrix-6 BeadChip microarray system, we measured *PTPN22* expression in lymphocytes from 500 healthy, pedigreed baboons. Using maximum likelihood-based variance decomposition methods, we found that over a third of the variance in *PTPN22* expression is due to the additive effects of genes (heritability, or  $h^2 = 0.36$ ;  $p < 0.00001$ ). A genome-wide multipoint linkage analysis based on the same approach detected suggestive evidence for a QTL affecting variation in *PTPN22* expression on baboon chromosome 15, the ortholog of HSA9 (LOD = 2.08). These results indicate the possibility of *trans* regulation of the *PTPN22* structural locus on HSA1p13 in baboons. This is the first report in nonhuman primates of heritable variation in a gene affecting general susceptibility to autoimmune disease in humans. These results should motivate further study to determine if baboons and humans exhibit genetic similarities in susceptibility to spontaneous immune dysregulation.

#### Masseter muscle strain during chewing in tufted capuchins (*Cebus apella*).

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The jaw-closing muscles create bite force and move the mandible during mastication. These dual functions confound a straightforward mechanical interpretation of jaw-muscle activity as typically documented via electromyography. To better understand masseter mechanics during chewing, we combine electromyography with sonomicrometry to measure masseter strain (i.e., length changes) during muscle activation. By combining these technologies, we can determine when the masseters shorten, as might occur while moving the jaw, or contract isometrically, as might occur when creating bite force.

We surgically implanted pairs of sonomicrometry crystals along individual muscle fascicles in the superficial and deep masseters of two female tufted capuchins. Indwelling electrodes were inserted in these same muscles. After recovery from anesthesia, we fed individuals various foods while recording masseter activity. We collected data from four experiments per muscle.

Muscles typically shortened while active. Shortening of the superficial masseter during activation averaged 5.8% on the working-side and 5.4% on the balancing-side. The balancing-side deep masseter shortened 6.1% on average during activation, while shortening 9.2% as a working-side muscle. Although not statistically significant, both the superficial and deep masseters shortened more on the working-side than the balancing-side in each experiment. We also commonly observed periods of isometric contraction during activation and more rarely eccentric contractions where muscles were lengthened. Masseter strains were related to peak EMG levels and food properties, but patterns tended to be individual specific.

Clarifying these complex muscle strain patterns during chewing will help further our understanding of jaw-muscle function and masticatory apparatus evolution in primates.

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#### Do ovarian steroid levels covary within and between populations?

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Progesterone levels are typically lower in non-industrialized populations than in U.S. women, and also vary with socioeconomic status, season, work patterns, and weight loss. Several hypotheses have been developed to explain the origin and significance of progesterone variation. Some authors argue that low progesterone (either in an individual or a population) is necessarily indicative of subfecundity, due to favoring somatic maintenance over reproductive effort when

energetically stressed. If so, one might predict that estradiol levels would also vary with reproductive effort and would, therefore, covary with progesterone levels.

Peri-urban poor and middle-class urban Bolivian women contributed every-other-day saliva samples, assayed for progesterone, for a complete ovarian cycle. Blood-spot samples, assayed for estradiol, were also collected on 5 days spanning the mid-cycle period encompassing ovulation.

Mean progesterone in ovulatory cycles was significantly lower in both Bolivian samples than in U.S. women, and in poorer compared to middle-class Bolivian women (Vitzthum et al. 2002). Similarly, mean estradiol in both Bolivian samples was lower than is typically reported for U.S. samples. However, the small difference (<10%) in mean estradiol levels between the poorer and middle-class women was not statistically significant. To evaluate hormonal covariation, indices were constructed based on area-under-the-curve for specified days of the ovarian cycle. None of the indices of estradiol level correlated with any index of progesterone level (all correlation coefficients were <0.12).

These findings demonstrate that ovarian steroids cannot be assumed to vary in tandem and argue that the causes and significance of variation in gonadal steroids are likely to be diverse and complex.

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### The mechanical properties of hominoid foods: I. *Pongo pygmaeus wurmbii*.

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The intermediate molar enamel thickness and robust jaw morphology of *Pongo* is distinctive among extant apes. The evolution of these traits has long been associated with a diet of relatively hard (deformation-resistant) foods, such as bark, seeds, and unripe fruit. Yet the concept of food hardness is based on the subjective impressions of human observers. Few data exist on the mechanical properties of primate foods, particularly those of great apes. Here we present data on the Young's modulus, *E*, and fracture toughness, *R*, of foods consumed by orangutans (*Pongo pygmaeus wurmbii*) in Central Kalimantan, Indonesia. We used a portable universal tester to measure food objects from more than eighty plant species. Significant differences in both *E* and *R* existed among the different fruit structures (exocarp, mesocarp, and endosperm), and among different stages of ripeness. Orangutan food choice appeared to be based, in part, on mechanical properties: individuals tended to discard fruit parts with relatively high *R*-values and select parts with

relatively low *R*-values. Edible inner bark, seeds, and leaves were significantly tougher than fruits. When compared to unpublished data available for gibbons (*Hylobates lar*) and chimpanzees (*Pan troglodytes*), orangutans fed on fruit parts that were significantly more resistant to deformation and fracture. We conclude that these data are in agreement with the hypothesis that the cranio-dental characteristics of *Pongo* are adaptations to a hard-object diet.

This research was funded by the A.H. Schultz Foundation, the Denver Zoological Society, and the Leakey Foundation.

### Health and wealth: preliminary research at the Cox site (40AN19), Anderson County, Tennessee.

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The Cox Site, excavated by the Tennessee Valley Authority and the University of Tennessee during the Norris (mid 1930s) and Melton Hill (early 1960s) reservoir projects, yielded approximately 250 burials with associated mortuary items from mound and village locations. We report on demography and paleopathology and interpret burial artifacts to examine differences in health and mortuary treatments between mound and village interments.

The bioarchaeological analysis demonstrates tendencies in the overall population toward a high subadult mortality rate, nutritional deficiency, growth disturbances, and infection (evidenced by lesions indicating tuberculosis and non-venereal treponemal disease). Also present are a number of behavioral indicators, which include patterns of osteoarthritis, antemortem trauma, and enthesopathies. A spatial analysis shows that more females and children were buried outside of the mound rather than within it. This contrast is not true for males. Furthermore, of the females buried in the mound, most are in the older age range.

The Mississippian funerary objects found among mound burials include shell pendants and beads, as well as ceramic vessels, lithic tools, bone tools, and Dallas-phase projectile points. The village burials also include pipes and bone beads. We explore the relationships of these artifacts to the age, sex, and health status of the individuals with whom they were interred.

The ultimate goal of this study is to offer a biocultural perspective regarding this East Tennessee Mississippian society. By examining both human and artifactual remains, this mortuary analysis provides holistic inferences regarding the lifestyle and cultural values of this late prehistoric agricultural society.

### Cross-sectional geometry of the Roc de Marsal juvenile Neandertal femur, determined using high-resolution microtomography.

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Discovered in 1961 at Campagne-du-Bugue, close to Les Eyzies-de-Tayac (Dordogne, France), Roc de Marsal is a juvenile Neandertal skeleton from a Mousterian context dated to OIS 4. Its age at death has been assessed as between 2.5 and 4 years. Using SR- $\mu$ CT microtomography, we digitally reconstructed the 3D geometry of the left femur at a resolution of 350  $\mu$ m, then virtually sectioned it at a series of locations along the shaft for biomechanical analysis. Cross-sectional geometric properties were compared with those of femora from several Neandertals (La Ferrassie 6, Dederiyeh 1 and 2) and Lagar Velho 1, as well as 14 femora from a recent human sample (Isola Sacra, Imperial Roman), all of similar age to Roc de Marsal. To account for differences in body size, section properties were standardized to powers of bone length as previously described (Ruff et al., 1993).

Roc de Marsal's femur falls within the known range of variation in relative femoral strength for Neandertal infants. It is equivalent in size-standardized midshaft cortical area (CA) and polar second moment of area (J) to that of Dederiyeh 1, slightly greater than that of La Ferrassie 6, and considerably greater than that of Dederiyeh 1, as well as Lagar Velho 1. Compared to the recent human sample, Roc de Marsal's femur is very strong, falling above the observed range of variation in size-standardized CA and J. Similar to adult archaic *Homo*, this is due to both periosteal expansion and endosteal contraction of the cortex relative to modern humans.

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### The Problem of Assessing Landmark Error in Geometric Morphometrics: Methods and Modifications

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Geometric morphometric techniques are increasingly popular means of shape analysis in physical anthropology. These methods rely on the accurate identification and quantification of landmarks upon biological specimens. As in any empirical analysis, the assessment of inter- and intra-observer error is desirable. A review of methods currently being employed to assess measurement error in geometric morphometrics was conducted

and three general approaches to the problem were identified. One such approach employs Generalized Procrustes Analysis to superimpose repeatedly digitized landmark configurations, thereby establishing whether repeat measures fall within an acceptable range of variation. The potential problem of this error assessment method (the "Pinocchio effect") is demonstrated and its effect on error studies discussed. Other studies employed Euclidean distances between the configuration centroid and repeat measures of a landmark to assess the relative repeatability of individual landmarks. This method is also potentially problematic as the inherent geometric properties of the specimen can result in misleading estimates of measurement error. A third approach involved the repeated digitization of landmarks with the specimen held in a constant orientation in order to assess individual landmark precision. This latter approach is an ideal method for assessing individual landmark precision, but is restrictive in that it does not allow for the incorporation of instrumentally defined or Type III landmarks (i.e. extremal points of curves). Hence, a revised method for assessing landmark error is proposed and described with the aid of worked empirical examples.

#### **Lifespan health parameters: Evidence for take-off growth disruption among**

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This work describes an integrative approach for assessing development and aging trends in a traditional population. In addition to standard anthropometric measures such as height and weight, information on a range of physiological and cognitive variables was collected among the Ache, forager-farmers of eastern Paraguay. Electroencephalography and visual evoked potentials (VEP) were collected. VEP assesses the integrity of the visual system by measuring the latency between a visual stimulus and subsequent processing in the occipital cortex. Dividing head length by this latency produces an estimate of central nerve conduction velocity (CNCV). Two psychometric tasks were administered—Raven's Colored Progressive Matrices and serial spatial memory—and correlations among these tasks and CNCV fit with an emerging picture of the organization of human mental abilities. Phase angle, a measure derived from bioelectric impedance analysis of body composition, reflects cell capacitance and cellular membrane health. Cellular integrity is partially a function of essential dietary lipids, which were assessed in mother's milk and serve as good indicators of maternal and community nutritional status. Most of the above measures follow an inverted U-shaped pattern across the lifespan and were fitted with LOWESS smoother lines. Residual values calculated from this line indicate that a cohort of adult males fall

into a consistent pattern across these diverse measures. The possibility that this pattern is associated with mid-1970s contact experience is considered in light of this period coinciding with the age of take-off growth for this cohort.

#### **Differential social relationships and subgrouping among wild female chimpanzees at Ngogo, Kibale National Park, Uganda.**

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Chimpanzees (*Pan troglodytes*) live in fission-fusion societies and show great flexibility in party formation. Males form strong dyadic bonds, and those in the unusually large Ngogo community also form stable social subgroups. Females are less gregarious than males and bonding among females is considered rare or absent in East African populations. Although females in some populations are known to form "neighborhoods", no previous research has shown these to be social subgroups instead of merely spatial ones. In this study I used data on association, proximity and grooming to investigate whether female chimpanzees at Ngogo, Kibale National Park, Uganda have differentiated social relationships. I observed females for 1700 hours over 18 months. Analysis of dyadic association indices shows that females at Ngogo formed four subgroups, or cliques. Associations are significantly higher for females within than between subgroups. These subgroups are more than spatial neighborhoods, given that range overlap among females from different subgroups is high. In addition, females in the same clique actively maintain proximity to each other, and regularly groom and travel together. Matrix correlation tests demonstrate that after controlling for association, proximity and grooming rates are higher among individuals within subgroups than among those from different subgroups. Thus females at Ngogo demonstrate a level of social organization not previously documented among female East African chimpanzees. These findings are discussed in the context of ecology and demography of the Ngogo site.

I am grateful for funding from The Leakey Foundation and Yale University.

#### **The origins of anthropoid apes.**

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Over a century ago, G.H.F. Nuttall used immunological techniques to compare species. These methods were later refined by both Williams and Goodman to reconstruct primate phylogeny. Zuckerman and Pauling suggested the idea of a molecular clock in the early 1960's and this idea was developed quickly to look at ape and human phylogeny by Sarich and Wilson. Their work had a profound influence on primate paleontology and phylogenetics. More recently, with gene

sequencing being relatively cheap and easy to do, there have been many molecular studies of ape relationships. Almost all produced the same branching order, with gibbons first, then orangutans, gorillas, and last chimps and humans. But the molecular clock dates of the splitting times varied considerably. Recent attempts to reduce the confidence limits of the branching times show that this will not be easily accomplished by sequencing and analyzing more genes. Rather this will come about by more secure calibrations from the fossil record.

#### **Long Bone dimensions as an index of the socioeconomic change in ancient Asian populations.**

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During the Holocene, body sized decreased throughout the world with the economic shift from hunting and gathering to agriculture and the rise of densely aggregated urban populations. During the twentieth century, these declines have been reversed by secular trends toward body size increase in many areas. Although the decline in body size with the rise of agricultural societies has been well documented through studies of long bones from archaeological sites in the Western Hemisphere and Europe, less is known about the historical patterns of body size change in ancient African and Asian populations.

In this study we use new bioarchaeological data and published reports to reconstruct the regional patterns of change in body size that occurred with the rise of urban, agriculturally-based societies in Asia. Several broad patterns are apparent in these data. Femoral dimension indicate that in Asia a decline in body size occurred with agricultural intensification and urbanization that was comparable to that seen in Western Hemisphere and European societies. On the Asian mainland there are also clinal patterns with taller statures among the pastoralists of the Xinjiang region in northwestern China and shorter statures among the agriculturalists further south in China and Southeast Asia. In the Himalayan region stature varies inversely with altitude. Our research on Chinese collections reveals a complicated pattern of regional temporal-spatial variation that is likely to be explained by socioeconomic factors related to fluctuations in food production and status-related differences in resource access.

#### **Histomorphological variation in the human appendicular skeleton**

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Haversian remodeling is presumed in part to reflect response to mechanical forces bone is subjected to during life. Variation within/among bones may thus reflect life history, once variation due to other causes is understood. Previous work has demonstrated bilateral symmetry in density of haversian structures (complete and fragmentary osteons) in cats (Walker, *AJPA* Supplement 26: 224-225 (1998)), chickens, and the human forelimb (Walker and Lovejoy, *AJPA* Supplement 28: 272 (1999)). Here, we extend this work to examine histomorphology throughout the human appendicular skeleton. Densities of osteons and osteon fragments at the midshafts of the femur, tibia, fibula, humerus, radius, ulna and clavicle are examined in a pilot sample of contemporary human males and females (n = 21; 13 female, 8 male). Results demonstrate that there are significant differences in mean complete and fragmentary osteon densities among bones. The proximal bones of both upper and lower limb show lower osteon and fragment densities than more distal elements. Do these patterns reflect Wolff's law, or do they reflect not only loading, but underlying intrinsic developmental parameters specific to each limb element as well? Comparable sections from the bones of *Gallus* and *Felis* (Walker, *AJPA* Supplement 26: 224-225 (1998)) show a similar pattern. Given the diversity of locomotor patterns of the three species, and the resulting differences in loading environments of their limbs, this histomorphological patterning suggests that remodeling is an inherently complex phenomenon, subject to intrinsic developmental factors in addition to mechanical loading.

#### Density dependence in human life history variation.

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Previous attempts to explain variation in human growth and development emphasize the energetic constraints imposed by malnutrition and disease. However, this approach fails to explain the life history consequences of differential mortality. The conventional approach can be reconciled with life history theory by considering the effects of density-dependent mortality on the rates and timing of maturity in subsistence-based populations. High population density likely increases nutritional constraints and disease loads that make maintenance costs relatively more expensive. Humans likely slow down growth and development and demonstrate smaller adult body sizes in high population density contexts presumably because of increased competition for finite resources. In addition, there is evidence of mortality-based selection for relatively faster/earlier ontogeny in small-bodied hunter-gatherers living at high densities. One interpretation of this finding is an evolved reaction norm for earlier reproductive maturity, and consequent

smaller adult body size, in high mortality regimes. In sum, comparative results support density-dependent effects on body size that act through two pathways-nutritional constraints and juvenile mortality-at varying intensities contributing to a nearly two-fold range of body size across human societies.

#### Postcranial features of *Cacajao*, with comparisons to *Chiropotes* and *Pithecia*.

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Recent studies of the anatomy, behavior, and ecology of the pitheciin primates (genera *Cacajao*, *Chiropotes*, and *Pithecia*) have brought to light a great deal of information on this previously little-known group. These works have highlighted the distinctiveness of *Pithecia pithecia* as well as similarities among the other taxa. For example, *Cacajao* and *Chiropotes* are comparable in body size, diet, canopy use, and frequency of quadrupedal locomotion. This study presents previously unpublished data on metric and non-metric postcranial traits of *Cacajao calvus* and *C. melanocephalus*, and provides a comparison of these data to that for *Chiropotes satanas*, *Pithecia pithecia*, and members of the *Pithecia monachus* species group.

Overall, in accordance with Fleagle and Meldrum's (1988) findings, *Cacajao* is more similar to *Chiropotes* than to *Pithecia* in its postcranial traits, as expected given their shared positional profiles. But interestingly, where *Cacajao* differs from *Chiropotes*, it is often in the direction of increasing similarity to *Pithecia*. Similarities between *Cacajao* and *Pithecia* include several traits of the scapula, humerus, and innominate. We discuss the possibility that anatomical similarities between *Cacajao* and *Chiropotes* may be functionally correlated with general quadrupedalism while the differences may relate to different types of quadrupedal locomotion exhibited. Specifically, *Chiropotes* more often uses quadrupedal walk along single substrates while *Cacajao* more often uses pronograde clamber across various supports of mixed inclination. Additional interpretations of pitheciin anatomical adaptations are discussed.

#### Mechanical correlates of sexual dimorphism in the jaw muscles and bones of baboons.

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Female baboons are less than half the size of males, and their jaws and teeth are also much smaller. The impact of sexual dimorphism in craniofacial structures on feeding behavior and chewing mechanics is

potentially significant but poorly documented, particularly for the jaw-adductor muscles. To quantify the mechanical consequences of sexual dimorphism, we measured fiber type distribution, mass, fiber length, and cross-sectional area (PCSA) of the jaw-adductor muscles and other mechanically-relevant jaw dimensions in 2 female and 3 male baboons. We also have data on EMG activity of the jaw-adductors during mastication for these individuals. We compared 14 mechanical parameters derived from the measurements. Sexual dimorphism is apparent in many parameters: e.g., females have more slow-twitch fibers in the deep temporalis and superficial masseter, low PCSA, deep mandibular corpora relative to PCSA, and low PCSA-to-load arm ratio. These observations suggest the hypothesis that females may have more slow-twitch fibers in these large muscles because a given fiber is recruited more frequently or more fibers are recruited relative to total PCSA in order to generate bite force during chewing and incision. Males have absolutely and relatively long muscle fibers as predicted given their large display gapes and long canine teeth. A lack of dimorphism characterizes other measures relevant for the generation of rapid, high bite forces during hard-object feeding (fiber type and EMG of superficial temporalis). Together, these data provide insights into the mechanical effects of size variation on the feeding apparatus. Research supported by the NSF.

#### The role of infant carrying costs on early tool development.

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Among the costs of reproduction, carrying an infant incurs one of the greatest drains on maternal energy. Because of the dearth of archaeological evidence, however, how early bipeds dealt with the additional cost of having to carry infants that could no longer cling to them is not particularly well understood. We thus present evidence on the caloric drain of carrying an infant in one's arms versus having a tool with which to sling the infant and carry her passively. We created an infant shaped model with a mass of 7.7kg and a length of 66cm based on the fiftieth percentile value for a six month child as developed by the National Center for Health Statistics. As a control for the additional cost of the mass, one condition included strapping 7.7kg around the waist. The second control condition included the additional mass at the center of mass with no arm swing. In the third condition, the baby was carried in the arms of each participant and in the fourth, the baby was carried in a sling. Six females participated and walked on a treadmill at 1.15m/s under the four conditions.

The burden of carrying an infant in one's arms is on average sixteen percent greater than having a tool to support the baby's mass,

and is potentially a greater energetic burden even than lactation. An anthropometric trait that seems to offset some of the increased cost of carrying a baby in the arms is a wider bi-trochanteric width.

#### **Potential use of carpals in sex determination of human skeletal remains.**

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In forensic investigations ranging from crime scenes to ancient archeological sites one of the most critical facts that must be established is the sex of the individual. Sex is commonly determined from bones such as the pelvis and skull but large bones such as these are more likely to be broken or carried away by wild animals. The carpals present an opportunity to investigate a series of bones that often will be left undisturbed and unbroken at sites. The potential utility of the carpals in sexing human skeletal remains was investigated in this study as well as their potential in determining left vs. right side of the body. Carpals from 24 hands of contemporary, Caucasian cadavers were used. Maximum length, width, and height were measured directly from each carpal as well as length and width of various articulating surfaces. Additionally, a shape ratio was created for each bone. After data were arc-sine transformed, Student's independent t-tests were used to test for differences by sex and all differences were considered statistically significant if  $p < 0.05$ . Significant differences between the sexes were noted for the lunate with differences approaching significance in the hamate, triquetral and capitate. No significance differences were found for left vs. right. A need for further sex determination techniques is always needed and more exploration into the lunate, hamate, triquetral, and capitate with larger sample sizes could ultimately lead to valuable means of determining sex in highly-damaged skeletal remains.

#### **The effects of family composition on infant mortality in the early 20<sup>th</sup> century British Mediterranean.**

L. Walz, L.A. Sawchuk. Department of Anthropology, University of Toronto.

Part of a larger biocultural study that seeks to elucidate the determinants of elevated rates of infant mortality in two British Mediterranean colonies, Malta and Gibraltar, at the beginning of the 20<sup>th</sup> century, this paper examines the effects of fertility and family composition on infant mortality. The reconstitution of families based on census and Roman Catholic parish registers in Gibraltar ( $n=210$ ) and one Maltese community ( $n=109$ ) forms the basis for the analyses.

Data was pooled into two cohorts, 1900-1918 and 1919-1939, and the following

parameters were determined: age at marriage, birth spacing, starting and stopping behaviours, family size, within-family infant death rates, as well as overall fertility and infant mortality rates. Significant differences are noted between the two colonies; with higher fertility rates recorded in Malta for both cohorts (35.38 per 1000 in 1900-1918 and 32.24 in 1919-1939), as compared to Gibraltar (25.84 and 22.68, respectively). Further accentuating the disparity between the two communities, infant mortality rates in Malta increased from 245.4 per 1000 live births in 1900-1918 to 258.95 in 1919-1939, whereas they decreased in Gibraltar (from 123.67 to 82.83).

Additionally, the association between infant mortality and family-level determinants such as parity, sex, birth month, previous infant deaths, maternal age, and birth order is assessed. Significant relationships were detected between infant mortality and larger family size, the death of a preceding infant, and higher birth order ( $R^2=0.202$ ,  $df=567$ ,  $p<0.000$ ). The paper concludes with reflections on the relative importance of these factors and offers alternate explanations for the observed relationships.

#### **Crossing the lines: Suture biomechanics in the primate craniofacial skeleton examined using finite element analysis.**

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Bone strain experiments in pigs and primates have shown that patent craniofacial sutures affect skull biomechanics. A change in craniofacial biomechanics during ontogeny is predicted due to changes in the material properties and mechanical integrity of craniofacial sutures over time. Here we test the effect of sutural fusion on craniofacial strain patterns using finite element analysis. A finite element model of a *Macaca fascicularis* cranium was constructed using imaging, surface, and solid modeling software. The cranium model was subdivided into parts representing cortical bone, trabecular bone, and six patent craniofacial sutures. Elastic properties were assigned to each of these parts using data from our previous studies and the literature. The model was loaded with forces representing the muscles of mastication and was constrained at the articular eminences and a bite point. Resulting strain patterns were recorded, and then the model was re-analyzed

after replacing the elastic properties of patent sutures with that of cortical bone (thereby simulating sutural fusion). Differences in the strain pattern observed in the two analyses reflect the influence of sutural fusion on craniofacial biomechanics.

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#### **Canine tooth crown, root and facial dimorphism in anthropoid primates.**

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Canine root size is hypothesized to affect craniofacial form and dimorphism in anthropoids. For example, australopithecines reduced facial prognathism and canine crown height but appear to have retained large canine roots and large mandibles, and some species may have a unique pattern of facial and mandibular sexual dimorphism. Given that patterns of facial dimorphism may be associated with canine dimorphism at least partly independently of size dimorphism, this implies that impressions of size dimorphism based on craniofacial remains might be influenced by canine root dimorphism. This, in turn, may have direct bearing on the conundrum that early hominins were uniquely characterized by low canine dimorphism but strong size dimorphism.

We present data from an ongoing study of canine crown, root, facial and mandibular dimensions of 613 extant anthropoid primates representing 38 species of platyrrhines, cercopithecoids and hominoids. We quantify canine crown dimensions using standard caliper measurements, root lengths from calibrated radiographs, and mandibular and facial dimensions from 3D coordinate data.

Within species, canine crown height and root length tend to be weakly correlated within sexes. While crown and root dimensions are correlated with facial dimensions in some taxa, others show virtually no relationship between canine and facial dimensions, suggesting that patterns of facial dimorphism are not directly dependent on canine size. Crown-root and facial proportions do vary among subfamilies, suggesting that broader functional or developmental factors influence intrataxonomic crown-root and canine-facial variation. We conclude that canine crown height dimorphism is not a strong determinant of facial dimorphism in anthropoids.

This research is supported by the Wenner Gren Foundation.

#### **Facial Asymmetry in Relatives of Individuals with Oculo-Auriculo-Vertebral-Spectrum (OAVS)**

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Oculo-Auriculo-Vertebral-Spectrum (OAVS) is a category of presumably related conditions that share deformities of the ear, eye, and vertebra. The unilateral expression of the facial abnormalities in most cases suggests a non genetic origin for OAVS. However, examples of multigenerational expression of OAVS have been reported, suggesting a genetic influence. We hypothesized that the effects of a genetic predisposition to OAVS will present in undiagnosed relatives as an abnormal degree of facial asymmetry. We tested the hypothesis by assessing a series of 14 paired craniofacial measurements. Our samples consisted of 82 relatives from 19 families with an affected individual and 93 control individuals from 26 families. Asymmetry was assessed using the summed absolute differences for the fourteen paired anthropometric measurements. In addition, we examined those anthropometric variables most closely associated with clinical features previously determined to be critical to the diagnosis of OAVS. Finally, we compared the two samples for their relative degrees of fluctuating asymmetry. Relatives were twice as likely to have extreme values of total asymmetry and asymmetry related to clinical features and as a group had significantly higher fluctuating asymmetry compared to controls. OAVS families were twice as likely as control families to have individuals who showed abnormal asymmetry on two or more of our measures. It is reasonable to assume that identifying family members who have abnormal degrees of asymmetry might lead to more effective identification of individuals critical to successful linkage analysis.

**Alternative biomolecular approaches for the identification of *Mycobacterium tuberculosis* in archaeological skeletons.**

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With the recent worldwide rise in tuberculosis, increasing attention has been directed at the prehistoric origin and evolutionary history of Mycobacteriaceae pathogens. Ancient DNA (aDNA) studies employing PCR, SNPs, and spoligotyping techniques have pioneered new understandings of this ancient disease, but the steep challenges posed by poor aDNA preservation have proved a major limiting factor in the utility of these techniques. This paper explores the advantages afforded by protein-based approaches, including competitive ELISA assays and stable isotopic variation, in identifying *M. tuberculosis* in

pre-Columbian skeletal remains from North and South America.

**Normal magnetic polarity provenance for MLD 37/38, an *in situ* hominin from the Makapansgat Limeworks, South Africa.**

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The Makapansgat Limeworks, South Africa, is a well known Plio-Pleistocene fossil site with over one hundred species represented including *Australopithecus africanus*. Of the 35 fossil hominin fragments the majority have been recovered from lime miners' dumps and have been provenanced mostly to the Grey Breccia (Member 3). Two fragments were discovered *in situ*, one toward the rear of the cave and one, MLD 37/38, near the Entrance Quarry in the Pink Breccia (Member 4) of the Partridge Block. A chronology for the site currently relies on magnetostratigraphic matching of site sequences to the Geomagnetic Polarity Timescale. Re-assessment of the magnetostratigraphy of the sequence from the base to the Grey Breccia has yielded an age estimate between 2.58 and 3.04 Ma (Herries, 2003) that requires confirmation. Here we report on the partially overlapping sister sequence up to MLD 37/38. We collected block samples from this adjacent sequence in the Main Quarry beginning at the base of the Red Silts (Member 2) up to, and including, the Pink Breccia of the Partridge Block to the locus of MLD 37/38. Following demagnetisation and magnetic analysis we isolated stable polarity directions for the majority of samples. The polarity of the new Member 2 sequence is normal, whereas MLD 37/38 was found to be from a breccia block of intermediate to normal polarity. Our results suggest that the locus of MLD 37/38, being of a normal polarity breccia in a higher stratigraphic horizon, has a somewhat younger age than the Grey Breccia fossils.

**Bone microstructural variation in primates: an overview of significance for the study of fossil taxa.**

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Bone tissue both responds to and records the processes and behaviors that characterize individual life histories, offering a unique opportunity for expanding on insights derived from macro-morphological studies of the skeleton. However, the extent and significance of diversity in bone microstructure among primates is largely unknown. The goals of this project are therefore to explore how life history,

mechanical adaptation and phylogeny relate to variation in three bone microstructural features: 1) primary tissue type, 2) intracortical remodeling, and 3) collagen fiber orientation. These are examined via brightfield and polarized light microscopy in midshaft sections from the adult humerus, radius, ulna, femur and tibia in a sample of extant primates providing a range of body sizes, growth and metabolic patterns, positional behaviors, and evolutionary relationships.

Quantitative and qualitative results indicate that primary tissue type patterns reflect bone development, growth rate, body size, positional behavior and potentially phylogeny. Intracortical remodeling is likewise influenced by bone development, body size and, less obviously, positional behavior. In contrast to previous studies, collagen fiber orientation, in both primary and intracortically remodeled tissue, does not clearly correspond to hypothesized variation in mechanical loads. Rather, collagen is overwhelmingly aligned to resist tensile strain, with some variation due to primary tissue type and body size. Overall, the data suggest that, while micro-morphological features hold exciting potential as tools in the study of fossil taxa, they must also be employed with an understanding of current limitations, at least within this taxonomic group and range of body sizes. Supported by NSF (SBER, DDIG, and funding to NYCEP) and The Leakey Foundation.

**Partnering in a south Philadelphia dig: the Washington Avenue bioarchaeology project.**

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Known regionally as the birthplace of the "Philly cheesesteak", south Philadelphia gave birth to another gem: a grassroots effort to ensure proper treatment and burial for the skeletal remains of nine adults and six children discovered during a utilities project in October 2001. Initially thought to be the remains of Civil War soldiers, the demographics and coffin design helped to put that notion to rest.

The city water department, the Union League, a lawyer, the Philadelphia Orphan's court, employees of a cemetery, a senator, a dentist, members of the Southwark Civil War Historic District Committee, faculty members and students from Temple University, a faculty member from Utica College, the Pennsylvania Funeral Director's Association, and the General Meade Society of Philadelphia all willingly donated time and money to help excavate, curate, analyze, and eventually bury these 15 individuals in historic Laurel Hill Cemetery on Memorial



Day of 2006. During the 4 years since they were exhumed from their south Philadelphia burial ground, the 15 individuals spent time in an anthropology/archaeology lab, in vaults at a cemetery in Bala Cynwood, and then at Laurel Hill, until a decision was reached about their ultimate resting place.

In the absence of local legislation providing clear guidelines for dealing with human remains encountered in these situations, the "Washington Avenue Project" is a sterling example of effective partnering among varied constituents who share a common goal and recognize the significance of these discoveries.

#### **Health Status in Prehistoric Portugal: Dental Pathology and Childhood Mortality Patterns from the Late Neolithic burials of Feteira (Lourinhã).**

A.J. Waterman. Department of Anthropology, The University of Iowa.

This study examines over 1500 deciduous and permanent teeth from the Late Neolithic burials of Feteira (Feteira II). The Feteira burial cave is located in the Estremadura region of Portugal near the city of Lourinhã, and was used as a communal burial place for hundreds of years during the Neolithic and Copper Age (3500-2000 BC) of Portuguese prehistory. A detailed examination of these dental remains has found that this sample is comprised of a minimum of 68 individuals of which there are at least 26 subadults and 42 adults. When these remains were examined for instances of dental pathology, 7.88% of the teeth had carious lesions, and 6.98 % had at least one hypoplastic defect. When compared with other contemporary sites, attrition rates were similar, but pathology rates tended to be lower at later sites. This result was unexpected, as it was hypothesized that the increased levels of social complexity and stratification in these later sites would have resulted in higher levels of pathology. The subadult to adult ratio for Feteira II was also higher than for the skeletal collections from later sites, suggesting an increased level of childhood mortality in this community. Based upon these unexpected findings, I suggest that further investigation is merited.

Acknowledgements are extended to Cidália Duarte of the Instituto Português de Arqueologia (IPA) for allowing me to study the Feteira II material and to The University of Iowa Stanley Foundation for funding support.

#### **Activity-induced dental modification in Holocene Siberian hunter-gatherers.**

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Several forms of activity-induced dental modifications have been observed in five

prehistoric groups from Cis-Baikal, Siberia, including occlusal grooving of anterior teeth, interproximal grooving of molars, shortened anterior tooth roots, and hypercementosis of tooth roots. Specific tasks that may have caused dental modifications are explored within the context of boreal forest/sub-Arctic hunter-gatherer cultural adaptations. Possible habitual activities include the use of teeth in the production of cordage and sinew, fishing net production, basket weaving, and in activities where teeth are used for 'anchoring' or for pulling. Cis-Baikal groups are divided into pre- and post-hiatus periods by an approximately 1000-year gap in the archaeological mortuary record during the seventh millennium B.P. Significant differences exist among pre- vs. post-hiatus groups in the frequency of activity-induced occlusal grooves, which may be related to cultural differences in subsistence activities. In the post-hiatus cemetery of Ust'-Ida I activity-induced occlusal grooves are only found in males, however, in the pre-hiatus cemeteries of Shamanka II and Lokomotiv occlusal grooves are found in males and females in roughly equal proportion. This could be due to an absence of sexual division of certain activities that caused dental modifications, or that several types of activities produced similar dental modifications. A significant difference also exists between the sexes with the presence of hypercementosis of tooth roots, as it is only found in males in pre- and post-hiatus groups.

#### **Identification of polymorphic markers in the Rhesus macaque (*Macaca mulatta*) genome.**

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A comprehensive chromosomal map of genetic markers is essential for the quantitative trait linkage analysis of a genome. The Rhesus macaque is a commonly used research subject for research in neuroscience, behavioural biology, reproductive physiology, endocrinology and cardiovascular studies. At the time of the completion of this project, the Rhesus macaque genome remained as yet unsequenced. This project made use of microsatellites, or simple sequence repeat loci, that are highly susceptible to mutations that cause different numbers of repeats in individuals. Increased numbers of highly heterozygous microsatellites on the chromosomal map reduce recombination distances between loci. This makes it possible to identify potential genes responsible for a variety of diseases and behaviors with greater accuracy. Polymerase chain reaction (PCR) and polyacrylamide gel electrophoresis methods were employed to test human DNA primers against Rhesus DNA from eight animals to detect polymorphic microsatellites. Of 44 primers specific to chromosomes 19, 13, 11 and 7, 5 highly polymorphic markers and 28 distinct

monomorphic markers were identified. Future analysis includes genotyping of the successful polymorphic markers through fluorescent labeling to incorporate them into the linkage maps of the above chromosomes. The lesser recombination distances so obtained will greatly improve the specificity of gene loci identification in the future.

I would like to acknowledge the Southwest National Primate Research Center and the Student Internship Program, as well as Dr. Jeffrey Rogers, for their assistance in conducting this project.

#### **Long-term stability of male chimpanzee social relationships at Ngogo.**

David P. Watts. Dept. of Anthropology, Yale University.

Chimpanzees (*Pan troglodytes*) are considered male-bonded. Data from wild and captive populations show that extensive affiliation and cooperation among males distinguishes chimpanzees from other nonhuman primates. However, males should try to choose social partners based on assessments of partner value, which can change over time, but most studies have been too short to analyze the temporal stability of male social relationships. I collected data on grooming and coalition formation among males in the unusually large chimpanzee community at Ngogo, Kibale National Park, Uganda, during multiple periods between 1998 and 2006. Matrix permutation analyses show considerable temporal stability in grooming and coalition formation at group level and group level interchange of grooming and coalitionary support in all study periods. However, the group level perspective masks many changes in grooming effort and coalition formation at the dyadic level. Some males remained allies throughout the study, but many alliances formed and/or dissolved. Dominance rank and age independently influenced formation of coalitions, which occurred mostly between closely-ranked males and rarely involved low-ranking males. Allies groomed each other extensively in all study periods and grooming was more symmetrical between allies than in other dyads. However, some dyads -- in most of which males were similar in age -- maintained long-term relationships that involved high investment of grooming effort but only rare coalition formation. These results are consistent with the hypothesis that partner value affects the stability of social relationships, but also show that familiarity (indexed by age similarity) exerts influence.

#### **Measuring footprints: refining the methods.**

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This project was undertaken in order to develop a reliable technique for measuring foot angle, foot length and toe length. Two volunteers, one adult and one juvenile, made ink footprints on paper, and these were then photocopied many times to provide materials for testing observer errors. A third volunteer was footprinted and radiographed, to assess the position of several skeletal elements relative to the footprint. Various methods of making and measuring footprints were reviewed, and the most promising set of methods was evaluated in terms of inter-observer and intra-observer errors. After error analysis, the techniques were improved and retested, resulting first in the production of a very reliable method of delineating a longitudinal axis of the foot. This axis, based on the midpoints of the ball and the heel, became the basis from which to measure foot angle and foot length. The second advancement was the development of a new technique for measuring toe length, one that better reflects the functional length of the forefoot and can be consistently measured by any observer. While many methods described in the literature are used without thorough testing, studies like this one will eventually provide us with a set of valid and consistently used standards for footprint analysis. This research was funded by FAPESP (Fundação de Amparo à Pesquisa do Estado de São Paulo) and the Kutztown University Research Committee.

#### **Bone remodeling in historical African Americans.**

V.L. Wedel. Dept. of Anthropology, Univ. of California, Berkeley.

Understanding the health and nutritional status of historical African Americans is complicated by the paucity of material and the inherent historical biases. Few skeletal remains are available for study, and firsthand documentation is lacking. Bioarchaeological analyses of three historical African American skeletal series, the New York African Burial Ground (1646-1790) and the two First African Baptist Church cemeteries (1810-1841) from Philadelphia, focused on pathological conditions. In this paper, these paleopathology data are considered in concert with new histomorphometric data collected from midshaft femur sections.

The study consisted of a total of 110 adult individuals from the three cemeteries. Standard histomorphometric measures of bone turnover and mass were taken. The results were compared by sex and age category within and among the study populations and to published histomorphometric data from the Cedar Grove Baptist Church Cemetery (1878-1925), southwestern Arkansas.

A statistically significant trend of overall health decline and decreasing bone mass was from oldest to the most recent skeletal populations. During these years, bone mass

decreased while bone turnover increased. Simultaneously, osteoarthritis and signs of adult iron deficiency (both active and remodeled) increased in prevalence, while evidence of periostitis decreased. These data suggest complex individual- and population-based responses to the stressors these people faced. A biocultural approach is taken to interpret this analysis of freeborn, enslaved, and freed historical African Americans.

#### **Evolution in the Andes: postcranial adaptations to multiple environmental stressors.**

K.J. Weinstein. Department of Anthropology, Dickinson College.

The adverse effects of high-altitude environments on living Andean populations are well known. Biological responses to high altitudes, however, have rarely been studied in ancient Andean groups from the pre-Contact era. This paper compares four archaeological groups from the Andes (N=347): two groups from the central and south-central coasts, one from the Atacama Desert at 2500 m, and one from the southern Peruvian highlands at 2000-3800 m. I compare limb proportions to test for climatic adaptation and thoracic skeletal morphology to identify differential responses to hypoxic stress

Individuals from the two coastal sites and the Atacama Desert share long intralimb proportions while those from the southern Peruvian highlands have short proportions, a contrast that suggests cold stress in the southern Peruvian highlands but not in the Atacama Desert. Both highland groups have smaller body sizes than the coastal groups, a difference attributed to poorer quality diets in the highlands. Individuals from the Atacama Desert consistently have longer ribs, smaller degrees of rib curvature, and ribs that encompass greater area than individuals from the coastal sites. The enlarged thoracic skeletons in individuals from the Atacama Desert resemble the enlarged chests of living highland Andeans and may result from life-long exposure to high-altitude hypoxia.

The results of this study suggest that, despite relatively close geographic proximity, high-altitude populations faced different natural selective pressures from their local environmental conditions. Dietary practices, climatic conditions, and hypoxic stress differentially affected the biology of highland Andean populations during the pre-Contact Era.

#### **'Dangerous fertile ages' for women: a universal medieval pattern?**

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For most ancient populations there is a clear difference between male and female

mortality regimes. These patterns have changed noticeably over time. In ancient samples, women from their early twenties until the end of their fertile period usually showed higher mortality rates than men. Around age 50, male mortality started to exceed female mortality. Since the middle of the 18<sup>th</sup> century – at the latest – higher life expectancy for females can be observed universally, and was associated with lower female mortality for all age groups. This differential mortality between the sexes might be shaped by biological or cultural factors, such as higher female mortality due to childbirth or maternal depletion, women's role in daily life or limited access to resources.

On the basis of a skeletal sample from the late medieval cemetery S:t Jörgen (AD 1300 – 1530) in Malmö, Sweden, the change from an historical to a modern mortality regime can be recognized. The total collection comprises 4182 individuals. Only a subset (N=973) was analyzed, because they were aged by Transitional Analysis according to the "Rostock Manifesto".

The skeletons show no significant difference between male and female survival for all age groups. The Male/Female Mortality Ratio (M/F MR) is 1.03 for the ages 20 to 40 and 1.00 for the ages 40+. The comparison with the M/F MR for early medieval Danish skeletal samples and early modern parish records from Scania shows that the late medieval period might be the turning point between the different mortality regimes in Scandinavia.

#### **Secular trends in the cranial morphology of the Portuguese population from 1805-1960 assessed using three-dimensional morphometric data.**

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Significant secular changes in several populations over the past 150 years have been previously documented; these changes include increased stature and weight, increased cranial vault height, and a narrowing of the cranial vault width. The secular trends have alternately been attributed to changes in diet and masticatory stress, improved living conditions, and the breakdown of endogenous marital patterns. Three-dimensional cranial landmarks from 500 identified adults and subadults from the New Lisbon Skeletal collection in Lisbon, Portugal were collected along with available demographic data. The birth years represented in the sample range from 1805-1960. The data were analyzed using both linear measurements and geometric morphometrics methods. The results demonstrate a significant change in the population over time. The pattern of change is similar to that seen in the American population from the same time period. The Portuguese sample provides the opportunity

for understanding the relative genetic and environmental components of the observed changes. The highly circumscribed nature of the skeletal collection, which contains only individuals from the relatively homogenous Portuguese population, enables a comparison of the observed changes with changes in public health, such as decreased infant mortality. Also, information regarding the place of birth and place of death for individuals in the sample is used to model changes in migration patterns within the country. Moreover, the use of three-dimensional data enables a more exact description of changes in the cranial form and provides the opportunity for a more precise understanding of the basis for change.

#### Frequency and distribution of osteoarthritis in the Orendorf adult population sample.

M.C. Welzein, D.W. Steadman. Department of Anthropology, Binghamton University

Examining osteoarthritis from a paleopathological perspective may provide insight into subsistence-based activity patterns and serve as a general indicator of health. This study examines the incidence, location, and patterns of osteoarthritis in the Orendorf sample, a Middle Mississippian group which occupied the Central Illinois River Valley from about A.D. 1150-1250. A sample of 41 Orendorf adults, aged twenty and older, was analyzed. Evidence of osteoarthritis of all major joints, as well as wrists and hands, were scored following Buikstra and Ubelaker (1994) and severity scores followed Bridges (1991). Based on the nature of their subsistence economy and social stratification, differences in osteoarthritis between load-bearing and non-load bearing joints was expected to be present based on age and sex. Evidence indicating sexual dimorphism for osteoarthritis prevalence in Orendorf adults was also examined with the expectation that the hands would show differences between the sexes. Statistical tests including Friedman's test and Mann-Whitney were conducted to look for significant differences of osteoarthritis prevalence amongst the joints as well as for evidence of sexual dimorphism and correlations between the joints affected. Preliminary results indicate that there are significant differences of osteoarthritis in mean rank between the joints and that while there is evidence of sexual dimorphism for osteoarthritis prevalence it is only evident in the right elbow. More statistical analysis will help understand where patterns occur in the incidence and location of osteoarthritis and whether these results correspond to previous research on Native American groups with similar subsistence patterns.

#### Two Scythian skeletons from Alexandropol, Ukraine.

R.K. Wentz. Department of Anthropology, Florida State University.

In 2005, two skeletons were excavated from the periphery of the Scythian burial mound, Alexandropol, located in southern Ukraine. Dated to 325 BC, the remains are both male. The first is that of a youth in his late teens who exhibits indications of biological stress. The second is a middle-aged individual with extensive healed trauma to the right humerus and clavicle with associated bony changes to the elbow. Stable isotope analyses are currently being conducted to address issues of diet and mobility.

Both may have served as sacrificial victims, since historic records document the strangulation of attendants and their placement around the periphery of royal mounds. Grave goods indicate both were warriors, although the youth lacks the traumatic injuries exhibited by the older male. The individuals from Alexandropol may have served a Scythian king in life and in death.

#### Growth and development of femur shape, size, and strength among three Native American groups.

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To be able to reconstruct past lifestyles from adult long bone morphology, first it is vital to understand the how long bone shape, size, and strength changes with age in subadults. Growth and development of femur diaphyseal shape, size, strength is examined among prehistoric/historic Native American subadults (birth to 20 years) from three geographical regions: Alaska (N=60), South Dakota (N=74), and South Coastal Ecuador (N=16). In all three groups femur subtrochanteric shape is established by five to six years of age and midshaft shape is fixed slightly later. Diaphyseal shape changes rapidly from ages one to five years, and probably results from changes in biomechanical loads associated with walking and establishing an adult gait pattern. Growth in femur diameter follows a basic somatic growth pattern, with a rapid increase in diameter between one and three years of age followed by a slower increase until the midteens. Growth in the anteroposterior (AP) and mediolateral (ML) planes occurs at slightly different rates. In the proximal femur, bone is deposited more rapidly in the ML compared to AP plane beginning around one to two years of age. At midshaft, the AP diameter exceeds the ML diameter in growth beginning around five years of age. Group differences seen in the adult diaphyseal shape are established by the time subadults achieve a mature gait pattern, with variation between groups probably reflecting differences in body size and shape.

#### A new Uintan genus of omomyine primate from the Casa Blanca community, Laredo, Texas.

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The Casa Blanca community is a diverse fossil assemblage including plants, invertebrates, fish, reptiles and mammals. These were recovered largely through screen washing over 15 tons of "shell hash" matrix from the locality. An abundance of evidence indicates the fossils derived from a tropical, coastal mangrove forest. The mammalian sample includes over 1000 specimens attributed to at least 27 genera, including 40 teeth representing at least two primate genera.

The lower cheek teeth provide the best samples for comparison. In addition to *Macrotarsius*, a new primate genus is present. Initially attributed to *Omomys*, it actually differs in numerous characters. Diagnostic traits include a much broader mesial occlusal surface on P<sub>4</sub>. The lingual aspect of this tooth has a less vertical orientation and less concave surface. The trigonid of M<sub>1</sub>-M<sub>2</sub> is quite distinctive from all omomyines, in being completely enclosed by crests. The reduced paraconid has been incorporated into the paraacristid, which continues distally to contact the metaconid. The trigonid cusps are lower and more rounded than *Omomys* and "pinched in" from the occlusal margin in contrast to other omomyines. The talonid contrasts with *Omomys* and other omomyines in having very reduced cusps, surrounded by a crest with a smooth, well excavated talonid basin. The M<sub>3</sub> contrasts with *Omomys* and resembles *Ourayia hopsoni* in lacking an entoconid and having a straight lingual margin. The new Laredo primate is quite distinct from but most closely resembles *Ourayia* in size and morphology.

#### The palaeodemography of the Black Death: the Hereford Cathedral Close cemetery.

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The cemetery from Hereford Cathedral Close in Hereford, England, yielded over 1100 skeletons dating from the late Anglo Saxon period to the late medieval period. Of particular importance were 188 skeletons originating from Black Death plague pits

(A.D.1348-1349), one of two excavated Black Death cemeteries in the U.K (the other being the Royal Mint site in London). Palaeodemographic data were collected from the skeletons to see if differences could be ascertained between the catastrophic burials (the plague pits) and the medieval attritional cemetery burials. Demographic and statistical tools, including life table analysis, Bayesian and non-parametric statistics, and the juvenility index, were employed to this end. Palaeodemographic comparisons with the Royal Mint site strongly suggest a pattern in the demographic profiles of Black Death plague cemeteries: a relative absence of infants, a peak among 5-14 year olds, and another peak among 25-34 year olds. Palaeodemographic comparisons with French plague sites from later outbreaks in 1590 and 1720-22 indicate significant differences in the mortality profiles, suggesting different diseases may have been responsible for these outbreaks.

**The function of alarm calling among wild tufted capuchin monkeys (*Cebus apella*).**

B.C. Wheeler. Interdepartmental Doctoral Program in Anthropological Sciences, Stony Brook University

Alarm calls have long been seen as an evolutionary paradox because of the inherent danger in producing a conspicuous vocalization in the presence of a predator. However, the ubiquity of alarm calls across avian and mammalian taxa, including many nonhuman primates, indicates that the production of alarms must benefit the caller in some way. Numerous hypotheses invoking both kin selection and individual selection have been put forth to explain how the caller may benefit, although very few studies have tested these hypotheses with primate subjects. This study tested seven of these hypotheses with wild tufted capuchin monkeys (*Cebus apella*) in Iguazú National Park, Argentina. Models of predators (including felids and raptors) and venomous snakes were placed in front of the group in the direction of group movement. Focal, scan, and all-occurrence sampling techniques were used to note vocal reactions (if any) upon detecting the models and the subsequent behavior of the group. Results indicate that kin selection does not account for the maintenance of alarm calling behavior in this population. Rather, calling seems to benefit the caller directly by alerting predators that they have been detected (and a successful hunt is therefore unlikely) and by recruiting conspecifics to mob the potential predator. These results conflict with a previous study indicating support for kin selection for alarm calling behavior in a New World monkey, but conform to a more recent study supporting the "perception advertisement" hypothesis among several species of Old World monkeys. Supported by the American Society of Primatologists, NSF DDIG (BCS-0550971), and the Wenner-Gren Foundation.

**Understanding the power of proximate mechanisms: patterns of ring-tailed lemur (*Lemur catta*) infant survival at Beza Mahafaly Special Reserve.**

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While periodic demographic changes are documented among many primate populations, little is known about the minor mechanisms that may drive these fluctuations. Consequently, we often rely on climatic fluctuations or large-scale stochastic events to explain population increases or declines because we simply do not observe the basic events and habitat perturbations that may in fact be the agents of change. This poster addresses the proximate mechanisms that primates cope with by investigating the variables affecting of ring-tailed lemur (*Lemur catta*) infant and juvenile survival during the course of a year at Beza Mahafaly Special Reserve. Madagascar in general, and Beza Mahafaly in the southwestern part of the island, is known for its especially seasonal and harsh winter climate. In addition to the predictable seasonality of this area, anthropogenic disturbance has produced further challenges for the *Lemur catta* population to cope with. We describe the series of both predictable and unpredictable environmental conditions and situations that the Beza Mahafaly *Lemur catta* population faced. Furthermore, we will compare lemur groups that use the protected habitat and those that inhabit more marginal, anthropogenically disturbed habitats and discuss different strategies infants and juveniles employ to cope with the challenges of their environment. Results indicate that lemur groups utilizing the protected reserve habitat have differential survival relative to groups living exclusively outside of the reserve. This research addresses the proximate mechanisms of infant and juvenile survival based on habitat differences, different behavioral strategies, group dynamics, and environmental perturbations.

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**Female reproductive state, ecology, and serum leptin in wild vervet monkeys (*Chlorocebus aethiops*).**

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Leptin is a signal of adiposity regulating satiety, energetics, and reproduction. Leptin

research on wild primates is necessary for interpreting the high leptin values seen in Western human populations and captive animals. We have previously reported that naturally occurring differences in vervet monkey (*Chlorocebus aethiops*) habitats are associated with comparable differences in serum leptin in adult males. This study tested the hypothesis that serum leptin in female vervets varies with ecology and reproductive state.

Serum and morphometric measurements were obtained from 367 vervet monkeys sampled from four Kenyan sites differing in altitude, temperature, rainfall, and access to human foods. Female reproductive state was assessed by radioimmunoassay of serum estradiol and progesterone and comparison to levels reported for pregnant, cycling, and acyclic vervets. Leptin was measured in serum available from 62 adult females, using a radioimmunoassay for primate leptin (Linco).

In acyclic females, leptin varied significantly across populations with lower levels in the site with lower rainfall and body mass. Population differences in leptin in pregnant females was explained by gestational stage. Leptin varied significantly with reproductive state, with higher levels in lactating and pregnant females and increasing levels over the course of gestation. Although leptin levels in acyclic females were markedly lower than levels reported in Western women, pregnancy levels were very similar. These data show that leptin is a sensitive index of natural variation in habitat and seasonal reproductive state in wild primate populations.

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**Diet, Disease and the Paleopathological Record**

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Osseous manifestation of infectious disease is of paramount importance to paleopathologic interpretation of ancient health. However, the ability of an infectious agent to cause disease depends on multiple host, pathogen, and environmental characteristics. Mycobacterial diseases are particularly influenced by these factors, and following onset of active disease, differences in severity and course are often apparent. This has particular implications for the osteological record, as within- and among-individual skeletal lesion prevalence and distribution represents the confluence of host and pathogen characteristics, many of which may be assessed independently through the archaeological record.

Here, we explore the contributions of nutrition and immune function with respect

to tuberculous skeletal lesions. We discuss the roles of two key nutrients, protein and iron, in the immune response to tuberculosis, emphasizing the ways in which each may influence dissemination of tuberculosis bacilli to the skeleton and the formation of characteristic lytic lesions. We then present a model informed by this interplay, and develop expectations for the paleopathological record. Case studies drawn from areas of the ancient Americas where tuberculosis could have been present are discussed. Finally, we incorporate data from recent mycobacterial phylogenetics studies to generate hypotheses concerning the patterning of ancient tuberculosis throughout the world.

#### Co-occurrence of DISH and HFI in the Terry Collection.

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Diffuse idiopathic skeletal hyperostosis (DISH) and hyperostosis frontalis internus (HFI) are both characterized by abnormal bone growth, a late age of onset, and an association with obesity, hyperinsulinemia, and acromegaly, leading several researchers to postulate commonalities in the pathogenic mechanisms. Clinical studies showing an increased prevalence of HFI in individuals diagnosed with DISH support this hypothesis, but the data are limited. Our research tests this association in a large osteological sample.

The sample included 406 blacks and whites aged 40 years or older from the Terry Collection, NMNH, Smithsonian Institution. Average age of the subsamples by sex and ethnicity showed no significant difference (mean = 61.3 to 65.6 years). Diagnosis of DISH was based on vertebral hyperostosis criteria although data on extravertebral enthesophytes were also collected. HFI was scored based on the standards of Hershkovitz et al. (1999). In all subsamples, individuals with DISH were more likely to have HFI than control samples without DISH. Fisher's exact test showed the co-occurrence was significant for females with HFI present in 84.6% of black and 94.1% HFI of white females with DISH. The respective frequencies were 52% and 48.1% for the controls without DISH. HFI incidence for individuals younger than 60 years was 41.7% in those with DISH vs. 25.6% in those without DISH, suggesting that the association is not purely a phenomenon of ageing. Similar results from a logistic regression with age included as a variable showed DISH was a significant determinate for the presence of HFI in females but not males.

#### Origin of the genus *Papio* at Plio-Pleistocene South African cave sites

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Pleistocene southern African cave sites, such as Kromdraai, Swartkrans, Drimolen, Gladysvale and Cooper's Cave, and the late Pliocene site of Taung, have all yielded fossils attributed to the genus *Papio*, including *Papio robinsoni*, *Papio angusticeps*, *Papio izodi* and possibly two additional species, *Papio speleus* and *Papio wellsi*. In addition to this diversity in *Papio*, other papionins have been found in the same cave deposits, such as *Parapapio antiquus*, *Dinopithecus ingens*, *Theropithecus oswald* and *Gorgopithecus major*. The degree to which these papionins represent an adaptive radiation of *Papio*-like forms, stemming from a *Parapapio*-like ancestor, has been postulated but never systematically examined. In this investigation, patterns of morphological variation are explored in bivariate and multivariate space by comparing linear distances obtained from 115 fossil specimens attributed to *Papio*, *Parapapio*, *Theropithecus*, *Gorgopithecus* and *Dinopithecus*. *Gorgopithecus major* exhibits a particularly broad piriform aperture in contrast to narrow nasal region of *Parapapio antiquus*. The broad and long palate of *Gorgopithecus major* deviates strongly from the narrow palate of *Dinopithecus ingens*, and the small palate of *Papio wellsi*. The short face of *Gorgopithecus major*, like *Parapapio antiquus*, contrasts with the tall snout of *Theropithecus*. *Papio wellsi* and *Papio speleus* are at the extremes of variation both among the fossils and extant baboon variation. Unfortunately the paucity of the individuals comprising these species precludes determining whether these individuals are outliers from well-established species or whether they represent additional species.

#### Diet and health at Puruchuco-Huaquerones, a Late Horizon cemetery on the central coast of Peru.

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As part of larger bioarchaeological investigations at the Late Horizon cemetery of Puruchuco-Huaquerones (PH), Peru indicators of diet and health were assessed. Stable carbon and nitrogen isotope analysis of bone collagen and stable carbon isotope analysis of bone bioapatite indicated a mixed subsistence strategy relying heavily on maize, a C<sub>4</sub> plant, but also incorporating lower trophic level animals (e.g., camelid and guinea pig) and C<sub>3</sub> plants (e.g., tubers). Stable carbon and nitrogen isotope analysis of hair, nail, skin and muscle indicated short term variability in diet, likely related to the seasonal availability of C<sub>3</sub> versus C<sub>4</sub> foods. If we accept that variation in diet is linked to diet quality, nutrition at PH appears to have been adequate. Osseous indicators of stress

from 219 individuals were analyzed and compared to isotope data to investigate the relationship between diet and health. Overall, the frequency of porotic hyperostosis, cribra orbitalia and periostitis were high relative to other precontact Peruvian populations. Compared to growth charts for modern populations, the stature at PH was below the 5<sup>th</sup> and 10<sup>th</sup> percentile for males and females respectively. Based on skeletal data, health at PH appears to have been poor. This paper attempts to reconcile the stable isotope and osseous data by examining the following explanations: 1) persistent stress, specifically parasitic infection that could inhibit proper nutrient absorption or cause blood loss; 2) cyclical/periodic food shortages; 3) infectious disease preceding Spanish contact; 4) nutrient adequacy that increased the ability to resist stress long enough to develop skeletal lesions.

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#### Geospatial bioarchaeology: using geographic information systems to model terrain and population patterns of osteoarthritis and long bone structural adaptation.

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Geographic Information Systems (GIS) is an important tool for modeling the activity patterns and behavior of past people because it promotes a multidimensional analysis of factors that influence land use and settlement patterns. The introduction of this technology to questions in the field of bioarchaeology demonstrates its value, particularly for exploring environmental variables that contribute to quality of life and health. This study presents methods used to create GIS models of terrain from a diverse sample of Pre-Columbian archaeological sites located in eastern North America. These models are then used to test hypotheses regarding growth, development, and age/activity related changes to the skeleton.

Physical activity is perhaps the most important factor influencing structural adaptation of the long bones and prevalence of osteoarthritis in human populations, past and present. A novel model of the importance of physical environment on overall physical activity experienced by past populations is presented. Data used in this study include a large component of the History of Health and Nutrition in the Western Hemisphere database and data not previously included in the database. Results indicate that populations who lived in terrain with a high

degree of heterogeneity of elevation and slope consistently demonstrated higher prevalence of osteoarthritis of all joint surfaces, suggesting an overall increase in mechanical stress for populations living in the most rigorous environments. The results for long bone structural adaptation are less clear, however, examination of the models suggest several other hypotheses about behavior in variable terrains that may modify the mechanical stress experienced.

Research supported by the National Science Foundation and Sigma Xi.

#### **The eleven percent solution? Reducing growth cycle error in isotopic analysis of hair segments using tissue rehydration and phase identification**

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One of the recent trends in stable isotope analysis has focused on resolving short-term variations in diet using hair segments, as hair provides a stable archive of temporal fluctuations in diet isotope composition. However, human hair samples typically contain a growth cycle error, which may confound more current isotopic information. At any given time, approximately 89% of scalp hairs are in the anagen (growth) phase, while the remaining 11% have transitioned into the telogen (inactive) phase, lasting up to four months before hairs are shed from the scalp.

This study investigates a means of reducing growth cycle error through tissue rehydration and microscopic identification of anagen phase hair prior to isotopic analysis. Two rehydration solutions, Ruffer I (1921) and Grupe et al. (1997), were used on scalp tissues with intact hair follicles from ten mummified individuals. After rehydration, hairs were plucked from the scalp tissues and examined under microscope to determine the growth phase of each root sheath. Anagen hairs from each sample were separated out and prepared for segmental isotopic analysis as well as a comparative mixed growth phase sample. The Grupe et al. (1997) solution provided the highest quality rehydration for the purpose of identifying root sheath growth phases. Isotopic analyses of the anagen phase hair segments were compared with those from the mixed growth phase hair segments of each individual to determine the reduction in rate of growth cycle error resulting from this method of sample preparation.

#### **A telemetry system for studying jaw-muscle activity in free-ranging primates: pilot data from howling monkeys (*Alouatta palliata*) at La Pacifica, Costa Rica.**

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University, <sup>4</sup>Center for Functional Anatomy and Evolution, Johns Hopkins University School of Medicine, <sup>5</sup> Department of Anthropology, Kent State University.

Laboratory-based electromyographic (EMG) studies are integral for understanding primate masticatory function and evolution. By directly linking jaw-muscle function during chewing to mandibular form, these studies provide the foundation for adaptive hypotheses relating primate jaw form to diet. However, because these studies elicit mastication using foods not consumed by wild primate diets, their ecological and evolutionary relevance is unclear. This lack of an ecologically-relevant biological role is further confounded by the fact that jaw-muscle activity is influenced by food mechanical properties, which may influence primate food choice in the wild. To more critically test adaptive hypotheses of primate masticatory form and function, jaw-muscle EMGs need to be analyzed in an appropriate environmental context.

To this end, we developed a telemetry system for recording jaw-muscle EMGs during mastication by free-ranging wild primates feeding in their natural habitat. The telemetry system amplifies, filters and transmits up to eight electrode signals as an FM radio signal to a receiver. This signal is digitally recorded and demultiplexed producing separate EMG waveforms for each electrode. Prior to use in the field, we verified that the system performed similarly to a non-telemetered system used in collecting primate EMG data. We tested the telemetry system in the field on mantled howling monkeys at La Pacifica, Costa Rica. Jaw-muscle EMGs were collected from two individuals during the mastication of leaves and berries, revealing a qualitative variation relative to food toughness. This study demonstrates the feasibility of integrating laboratory-based experimental techniques with field research on primate feeding ecology.

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#### **Anemia and physical function in older adults – results from the National Social Life Health and Aging Project.**

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Among older adults, functional limitations and loss of mobility result in high financial, social, and personal costs. Understanding how pathology and disease lead to functional limitation is key to increasing quality of life and decreasing health care costs, psychological burden, and further health risk. Anemia, an increasing health concern in the United States, is a mechanism through which disease affects functional health. Hemoglobin levels are directly related to physical health;

hemoglobin provides oxygen to muscles. However, this relationship has not been documented in a large community based sample. The National Social Life, Health and Aging Project (NSHAP) is a population-based, nationally representative sample of older adults (age 58-85) in the United States (n = 3002). Data was collected in the homes of participants during 2005-2006; and included interviews, measures of physical and sensory function, and collection of dried blood spots. Because anemia is an independent risk factor for death as well as decline in physical performance and poor outcomes in many chronic diseases, the prevalence of anemia in this population will be highlighted in addition to its relationship to physical function.

The National Health, Social Life and Aging Project (NSHAP) is supported by NIH - the National Institute on Aging, Office of Women's Health Research, and Office of AIDS Research (5R01AG021487).

#### **The genetic dissection of human susceptibility to parasitic infection.**

S. Williams-Blangero, Southwest Foundation for Biomedical Research.

Infectious disease has been a major force throughout human evolution, and anthropologists have long been interested in how populations evolve under varying disease pressures. Knowledge of the genetic mechanisms underlying patterns of disease susceptibility will improve understanding of the microevolutionary processes associated with adaptation to infection. In this presentation, the genetic approaches to localizing and identifying the individual genes which influence infectious disease susceptibility are described. These techniques have been applied to data on parasitic infections from large extended pedigrees in two populations which have experienced very different disease histories.

In our studies of the Jirels of eastern Nepal we have utilized a single pedigree containing over 2000 individuals to localize genes influencing susceptibility to soil-transmitted intestinal worm infections. Such helminthic infections affect over a quarter of the world's population and are major public health problems in developing countries. Utilizing a quantitative trait linkage design we have scanned the genome using approximately 400 highly polymorphic STR markers. The approach has provided localizations for 10 quantitative trait loci that significantly contribute to differential worm burdens for hookworm, roundworm and whipworm.

Similarly, in a study of extended kindreds in Brazil, we have used genome scanning approaches to localize several QTLs influencing differential susceptibility to infection with the protozoan parasite *Trypanosoma cruzi*, the causal agent of Chagas disease. Chagas disease is the leading cause of heart disease in South and Central America. In addition, we have localized a number of genes which influence

differential disease outcome subsequent to infection with *T. cruzi*.

**Energy intake when the stakes are high: Sifaka reproductive strategies in seasonal and disturbed habitats.**

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In Madagascar, low plant productivity and an unpredictable climate have long been argued to place severe reproductive pressures on the Island's primate species; resulting in female dominance and/or female feeding priority. That habitat degradation is imposing new limits on resource availability and potential energy intake makes understanding lemur strategies for overcoming such barriers crucial to ongoing conservation efforts. This study examines the energy intake (and expenditure) strategy of Milne-Edwards' sifakas (*Propithecus edwardsi*) living in both pristine and disturbed forest habitats in an attempt to better understand how habitat disturbance and reproductive costs interact to shape their behavior. Over 3,375 hours of continuous focal follow data, collected from seven sifaka groups, were used to calculate and compare the activity budgets of adult sifakas living in both forest types. Initial comparisons of activity budgets revealed that female sifakas spent significantly more time feeding than did their male group mates, regardless of the quality of the habitat. However, while subsequent analyses found that this difference was also reflected in sifaka activity budgets when compared between the lactation and weaning seasons, it did not persist when activity budgets were compared between the lush and lean seasons. This suggests that females are *not* choosing to spend additional time feeding because their dominance status allows it, but that they are *forced* to spend more time feeding -to meet their physiological requirements- during reproductively costly times of the year. Funding for this project was provided by: Fulbright (IIE), St. Louis Zoo (FRC), National Science Foundation (DDIG), Earthwatch Institute, Primate Conservation, Inc., Stony Brook University, and University of Notre Dame.

**Are the Koh an indigenous population of the Hindu Kush? I: an odontometric investigation.**

N. Willits and B.E. Hemphill. Dept. of Sociology & Anthropology, California State University, Bakersfield.

Considerable debate surrounds the origins of the Koh, the dominant ethnic group of the Hindu Kush Mountains of Chitral District, Pakistan. Some scholars emphasize that the Koh lifeway is the consequence of

long-standing indigenous isolation. Others stress the equestrian tradition among Koh villagers indicate they are descendants of Central Asians who emigrated across the Hindu Kush Mountains during the second millennium BC. To still others, an array of Persian linguistic inclusions indicates the Koh are more recent emigrants from the Iranian Plateau.

This research tests these hypotheses for Koh origins. Maximum mesiodistal and buccolingual diameters were measured for all permanent teeth, except third molars, from 100 Koh schoolchildren from Booni, Pakistan, located 85 kilometers north of the district capital. These data were contrasted with 17 additional samples. Comparisons are in two stages and include cluster analysis and principal components analysis.

First, sex-pooled and sex-specific data compared Koh to six contemporary ethnic groups from India. Results indicate the Koh share closer affinities to Indo-European-speaking ethnic groups of North India than to Dravidian-speaking ethnic groups of South India.

Second, sex-pooled data compared the Koh to 11 prehistoric samples from Neolithic to Early Iron Age sites located in the Indus Valley, Central Asia and the Iranian Plateau. Results indicate that the Koh share little affinity to prehistoric Indus Valley or Central Asian groups. Rather, the Koh share affinities to prehistoric inhabitants of the Iranian Plateau.

**Genetic and phenotypic variation in craniofacial dimorphism in baboons.**

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A major determinant of craniofacial form and its evolution is the degree and structure of variation, both at the phenotypic and genetic levels. We hypothesize that differences in variation between sexes are directly related to differences in form. We have quantified differences in phenotypic variation and form using 3D landmarks taken from CT images of 140 baboons (82 females, 58 males) of known pedigree from the Southwest Foundation for Biomedical Research. Heritability has been estimated for a subset of distances that represent overall skull form. Results indicate that all measures of cranial form show dimorphism and that these differences are most marked in the muzzle. Although males have greater variances for all regions of the skull, the structure of variation is similar between the sexes, with the muzzle showing greatest variation in both sexes. The increased

variation found in males is largely due to size variance in the male sample. Heritability estimates were strong throughout the cranium, particularly for facial measurements. When similarly sized males and females were compared, there were few significant differences in form. The similarity in variation structure, the heritable nature of these cranial traits, and the apparent shared allometric scaling of both sexes, suggests that males and females would respond similarly to evolutionary forces. Further analyses using this baboon population and comparative samples of model organisms will be used to determine if, and to what extent, the degree and structure of cranial variation can be used to predict the response of craniofacial traits to evolutionary factors.

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**Dental health, heterogeneity, and mortality in a Middle Mississippian skeletal sample from west-central Illinois.**

J.J. Wilson, D.W. Steadman. Department of Anthropology, Binghamton University (SUNY).

Bioarchaeological investigations routinely assume there is a straightforward relationship between a prehistoric community's level of health and the patterning of bony lesions and age-at-death observed in an associated skeletal sample. Selective mortality and hidden heterogeneity can play a significant role in the formation of a skeletal sample. These non-random processes are dominated by entry of the most frail individuals in a population into a cemetery sample regardless of their observed skeletal health. Given these considerations, the current study examines the dental health and mortality patterns for the Middle Mississippian Orendorf skeletal sample (AD 1150 to AD 1250) from west-central Illinois. The goal of the study is to explore the heterogeneity in frailty associated with dental health.

Age-at-death for each adult skeleton in the Orendorf sample (n = 125) was estimated using transition analysis. Using both the Cox proportional hazards and logistic regression models, the dental health component of the study examined the co-variation of dental attrition, caries, ante-mortem tooth loss (AMTL), abscesses, and enamel hypoplasias with the maximum likelihood estimates (MLE) for age-at-death. The results indicate that while individuals with early childhood stress markers (i.e. enamel hypoplasias) did not have an elevated risk of death as adults, there was an elevated age-specific risk of death for more recent indicators of health and stress (i.e. dental caries, abscesses, AMTL). Further, those individuals exhibiting the co-occurrence of recent dental pathologies and early childhood stress markers were at the highest risk of death.

### Demographic trends within the Forensic Anthropology Center's body donation program.

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The Forensic Anthropology Center's body donation program at the University of Tennessee is different than a traditional anatomical gift program for various reasons and provides the opportunity to examine the social variables surrounding such a donation. A sample of 'self donations' (n=76) from the curated adult donations (n=536) was compared to a future donor sample (n=161) from the 905 on file. Fifty-nine of the 'self donations' were received after 2000 with 20 in 2005. A similar trend is apparent in future donors in which 18 registered prior to 2000 and 30 registered in 2005. The mean age at death among donations is 65 ranging from 42 to 90 years, while the average age of future donors is 58 years ranging from 19 to 87. Most donations originate from the Southeast (n=68), but the Northeast (n=3) and Southwest (n=1) are represented. While future donors show the same Southeast bias (n=403), the Northeast (n=50), Southwest (n=31), Northwest (n=9), North Central (n=36) United States comprise a large portion of recent registrants. Both current and future donors primarily identify themselves as White, 98% and 90% respectively, and males outnumber females 3 to 1. Most donors are low-middle to middle income (60%), have laborer-type occupations (40%), and a high school diploma. Income level is similar in future donors, but more future donors (25%) than current donations (12%) hold advanced degrees. We posit that this increase in registrants and diversity of donor profiles is indicative of improved public awareness of body donation as an alternative practice.

### Effects of paternal care among Tsimane forager-horticulturalists.

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Numerous studies have explored the impact of fathers on children's wellbeing by comparing the outcomes of children raised in fatherless homes to those raised in complete homes. This technique, however, fails to take into account the problem of self-selection and the fact that other individuals may compensate for a father's loss by boosting their own investments. Using data collected among the Tsimane, a foraging/horticultural population in central Bolivia, we explore alternative methods utilizing continuous measures of paternal involvement and offspring wellbeing. All methods reveal that the impact of father involvement is relatively weak, despite the fact that they account for nearly one-third of their children's caloric intake. This finding follows the general trend

in the cross-cultural paternal literature. We provide tentative evidence that this lack of an effect among the Tsimane is due to compensation by other caretakers. We must therefore ask: Why do men stay within marriages and provide investment when others may be willing to fulfill such responsibilities and when it ultimately results in relatively small net increases in offspring fitness? We argue that men's parental investments may allow women to reduce their own investments in existing children, thereby freeing more resources for continued reproduction. This would result in men exhibiting true paternal devotion towards their children yet small net effects of paternal involvement on offspring quality.

### Community health and cultural bias in predicting HIV rates in Tanzania.

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Global assessment of HIV rates is dependent on data from HIV testing programs, particularly in developing countries where they are the most reliable indicator of prevalence. However, cultural and community health factors affect HIV testing programs. This study examines HIV program rates in rural Tanzania, comparing HIV prevalence and factors affecting program participation.

This research is part of a project begun in 2002 examining HIV rates in Karagwe District in northwestern Tanzania. The present study compares HIV rates from individuals who were tested for HIV (September 2004-May 2006) in one of three programs: Nyakahanga hospital blood donors (N=3280), maternal health clinics (N=2482), and a voluntary testing clinic (N=3132). The clientele and HIV rates of these programs vary substantially. Over 75% of the clients at the maternal clinics are less than 30 years old and all are female (HIV prevalence = 3.3%). Women tend to come to the maternal health clinic only for first or second deliveries and tend to be better educated than average. In comparison, 80% of the blood donors are males and older (donor HIV prevalence = 5.4%). The voluntary testing clinic had a more equal sex and age distribution of clientele with an average HIV rate of 10%. The prevalence goes sharply up in individuals over the age of 30. Cultural factors affecting client participation include cost and availability of testing, reproductive status of females, i.e., pregnant women are never blood donors, kin relationships, presence of other diseases, and client perception of HIV exposure risk.

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### Food sharing as a form of paternal care in wild owl monkeys (*Aotus azarai*).

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Among primates, food transfers from mothers to offspring are common, but males rarely transfer food to young. Males are expected to invest heavily in this form of care only when paternity is relatively certain since sharing food is costly. Owl monkeys (*Aotus* spp.) are socially monogamous primates with intense infant care by the resident males. Although it is known that males carry, groom and play with infants and juveniles, the extent of food sharing in wild owl monkeys has not been quantified. We observed four groups of owl monkeys (*A. azarai azarai*) in Formosa, Argentina to compare sex differences in the pattern of food sharing with young. All types of food that were readily obtained and eaten were transferred to infants and juveniles. Food interactions were significantly more frequent between resident males and young than between mothers and young. Infants and juveniles investigated and begged for food from the males more often than from their mothers, and males transferred food to them more often in three of the four studied groups. In the group that did not conform to this pattern, the resident male was unlikely to be the true father. Our data provide the first evidence of food sharing as a form of paternal care in wild owl monkeys. It is possible that males share food with infants more so than females because males are free from the energetic burden of lactation. It remains to be determined, however, whether their sharing is contingent on certainty of paternity.

### Does craniofacial variation among *Rhinopithecus* species follow an altitudinal cline?

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Sun *et al.* (1999:14) state that snub-nosed monkeys exhibit a "step-wise gradation of morphology and behavior" along an altitudinal cline. While Sun *et al.*'s report suggests an increase in size and masticatory rugosity in *Rhinopithecus* as one moves from the tropical rainforest living *R. avunculus* to the alpine dwelling *R. bieti*, our preliminary findings reveal a more complex pattern. We have begun to explore this hypothesis with both dietary and morphometric data, primarily on *R. avunculus*. Tough foods, such



as stems (26%) and unripe fruit (24%) were found to be the major contributors to the diet of *R. avunculus* at the site of Khau Ca in northern Vietnam. The average toughness of the diet of *R. avunculus* (1393 Jm<sup>-2</sup>) was found to exceed that of two *Pygathrix* (1238 Jm<sup>-2</sup>) and two *Trachypithecus* (1156 Jm<sup>-2</sup>) species at the Endangered Primate Rescue Center in Vietnam. Size adjusted measurements of the mandibular corpus and symphysis of *R. avunculus* were found to exceed those of eight non-congeners, as well as those of the alpine dwelling *R. roxellana*. The rainforest dwelling *R. avunculus* has massive jaws and a diet that appears to exceed that of other South East Asian colobines in toughness, bringing into question, but not completely negating, the altitudinal cline model of *Rhinopithecus* adaptation and evolution. We are presently augmenting our findings with data on the diet and craniofacial morphology of other *Rhinopithecus* species. Funded in part by Primate Conservation Inc., Zoological Society of San Diego, and National Geographic Society.

#### Long bone articular and diaphyseal structure in douc langurs: evidence of suspensory adaptations.

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Early research focusing on the postcranial morphology and positional behavior of Colobines (langurs and leaf-eating monkeys) determined that these primates were best described as "Old World semi-brachiators". Subsequent work on the locomotor and postural behavior of Malaysian and African colobines determined that this category did not provide a valid description of langur positional behavior. Studies focusing on the positional behavior of red-shanked douc langurs (*Pygathrix nemaeus*) have established that these primates exhibit relatively high frequencies of suspensory locomotion and posture, compared to other langur species (Byron & Covert, 2004; Workman & Covert; 2005). More recently work by Wright *et al.* (2006) combined naturalistic behavioral observations and kinematics to show that douc langurs and gibbons are similar in body and upper limb posture during suspension. In the present study we examine long bone articular and diaphyseal structure using the methods of Ruff (2002). For ratios of joint size to diaphyseal strength of the upper limb, douc langurs appear to be intermediate between lesser apes and other colobines. Femoral head articular surface area appears to be large relative to femoral shaft strength. These preliminary findings are discussed in

light of locomotor adaptations and habitat use.

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#### The impact of craniosynostosis on patent suture complexity.

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The evolution of the human brain has been pivotal to our success as a species and at the core has been the ability of the cranial vault to provide rigid protection while not inhibiting the growth of the brain. Previous research has shown that during normal growth, mechanical stress on the vault bones has a direct impact on the complexity of cranial sutures and that the resulting suture pattern is not random. However, few have studied the effect of abnormal growth in the form of premature cranial suture fusion (craniosynostosis) on the complexity of the patent sutures. The purpose of this study was to measure the complexity of cranial sutures in synostotic skulls by examining 14 synostotic skulls and 17 controls selected from the Repatriation Lab at the Smithsonian Institution in Washington, DC. Utilizing a Polhemus 3Draw Pro model digitizing pen, x, y, and z coordinate data were collected from 9 sutures (right and left coronal, sagittal, right and left lambdoidal, right and left squamosal, right and left occipitomastoid) at a scale of 0.2mm. To quantify sutural complexity, fractal dimensions (D<sub>b</sub>), were calculated using the Benoit software program. A Wilcoxon Signed Ranks Test revealed that only the sagittal suture showed a significant change in complexity at P<.006 when synostosis is present and that it was less complex than the control sample. Although not statistically significant, all other sutures, except for the right lambdoid suture, on the synostotic skulls were less complex than those on the normal skulls.

#### Reflections of life in death: mortuary use of an abandoned prehistoric Maya site as a form of resistance by Colonial populations.

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Excavations at the Classic period Maya site of Chau Hiix, located in northern Belize, uncovered two Protohistoric (c. AD 1600) burials within a palace structure. Both individuals were young males and an analysis of their dental morphology shows them to be Maya. At the time of the interments, Chau Hiix had been abandoned for approximately 400 years. The context of the burials shows a form of syncretism, in which the mortuary treatment reflects both Maya and Catholic conventions, similar to that reported from the nearby settlements of

Lamanai and Tipu, where *visita* missions were established. These communities were in constant conflict with the Spanish and eventually revolted against the Catholic Church, though still used the church for burial. The Protohistoric burials from Chau Hiix reflect this volatile relationship by their placement within an abandoned building also used for burial by the Prehispanic era Maya. This behavior denotes resistance through the maintenance of "traditional" aspects of Maya culture. An osteobiography of these individuals is consistent with biological patterns found within Colonial Lowland Maya skeletal populations, and similarly, when considered with the associated archaeological data, they evidence the biological and cultural disruptions typical of this period.

#### Cyanide tests of foods and excreta of three *Hapalemur* species in Ranomafana National Park (RNP), Madagascar.

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Specific bamboo parts eaten by three sympatric *Hapalemur* species in RNP are known to contain cyanide. How these lemurs avoid cyanide-poisoning remains unknown. In this study, we tested for the presence/absence of cyanide in foods and excreta to 1) determine if cyanide is absorbed from the diet, and if so, 2) identify potential routes of elimination.

We tested 52 food, urine, and fecal samples during the 'pre-dry' season (April) using Cyantesmo® test strips. We recorded color changes on each strip on a scale from 0 (no change) to 5 (cobalt) at 5-minute intervals for the first 30 minutes, then every hour for 3-4 hours, before leaving them overnight. A final score was taken at the end of 24 hours. Strips were then photographed and dried.

Time to color change ranged from almost instantaneous to >12 hours incubation. Of the foods tested, only bamboo indicated presence of cyanide, but the results differed among bamboo species, plant parts, and individuals (genets) of the same species. Specifically all growing parts of the giant bamboo (*Catharostachys madagascariensis*) produced strong, immediate reactions to the test paper, while some of the liana bamboo, *Cephalostachyum cf. perrieri*, produced weak color changes. Another liana bamboo, *Cephalostachyum sp.*, produced no change in the test strips, though the sample size was small. Cyanide was present in almost all urine samples but only one fecal sample. This suggests that dietary cyanide is being absorbed in the gastrointestinal tract of the *Hapalemur* species and excreted, at least in part, by the kidneys.

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### The biogeographic dietary ecology of *Theropithecus*: an isotopic approach.

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*Theropithecus* was once widely distributed across Pliocene Africa. Species ranged from the northwest Mediterranean coast to the southern Cape, developing unusually large body sizes across taxa. The little that is known about the paleoecology of *Theropithecus* is inferred from morphological and microwear data. Prior isotopic analyses of Pliocene *Theropithecus oswaldi* from South Africa support a graminivorous diet. We measured the  $\delta^{13}\text{C}$  and  $\delta^{18}\text{O}$  of *Theropithecus* populations from South Africa, East Africa, and North Africa to determine differences in feeding ecology across temporal and spatial ranges. Our results indicate a distinct difference in theropithecid  $\delta^{13}\text{C}$  values from East Africa (-0.4 to 1.2‰) compared to published values from South Africa (van der Merwe et al., 2003). North African Theropithecines reveal depleted  $\delta^{13}\text{C}$  values (-13.4 to -10.6‰), which are invariant from local browsers (*Equus*). This is not surprising given the Mediterranean Coast is nearly entirely composed of  $\text{C}_3$  grasses. Importantly, nutritional differences in  $\text{C}_3$  and  $\text{C}_4$  grasses, and the indication that different *Theropithecus* populations are partitioned among these resources, suggest possible physiological and socioecological implications.  $\delta^{13}\text{C}$  values of modern *Theropithecus gelada* (-7.8 to -6.4‰) reveal a  $\text{C}_3$  diet, due to the fact that they consume high altitude  $\text{C}_3$  grasses. Results of this study suggest dietary flexibility within *Theropithecus* throughout its radiation into southern and northern Africa during the Pliocene. This flexibility and partitioning may have contributed to the selective extinction of some *Theropithecus* species and the relative success of others.

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### Evolutionary Origins of Malagasy Primates.

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The primates of Madagascar, commonly known as lemurs, are an extraordinarily diverse group of mammals and represent stunning example of evolutionary diversity. The typical questions asked about their evolutionary origins are: How many times did they colonize Madagascar? Have colonizations been unidirectional? When did these colonizations occur? From what geographic point of origin did they arise? And, what have been the mechanisms of their

dispersal? We suggest that these questions have been answered rather conclusively via the acquisition and analysis of DNA data from living lemuriforms. These analyses indicate that there was only a single colonization of Madagascar by non-human primates, probably in the earliest Tertiary, and moreover, that the resulting clade also encompasses the now extinct "giant" lemurs. Further, consideration of the geographic distribution of both living and fossil primates in phylogenetic context indicates that Africa would have been the geographic center of origin for all tooth-combed primates, and thus the ancestor to the ancestral lemur. Recent studies of the living lemurs, particularly the nocturnal forms, are revealing that species diversity is even higher than previously imagined, with well over 60 species now recognized, and probably many more to be discovered. This explosion of species description coincides with closer inspection of the mechanisms responsible for lemur species diversity. The consideration of all of these data and patterns therefore reinforces what we already knew: The lemurs of Madagascar are the crown jewels of primate diversity.

### The effects of different sample treatments on bone apatite stable isotope analysis: implications for paleodietary reconstruction.

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Since the 1980s, researchers have debated the appropriateness of using stable isotope analysis from bone apatite for reconstructing ancient diets. Specifically, the debate has centered over the diagenetic effect of the burial environment on bone mineral properties. Several recent studies indicate that the use of different acetic acid concentrations and treatment times may affect carbon isotope ratios and lead to recrystallization of bone apatite. One such study by Garvie-Lok and colleagues recommends a sample preparation involving more dilute acetic acid concentration and a shorter sample soaking time. In this paper, we compare Garvie-Lok et al.'s recommended protocol with that of the standard preparation protocol to examine carbon and oxygen isotope ratios in human bone apatite from a variety of burial contexts. We measured  $\delta^{13}\text{C}$  and  $\delta^{18}\text{O}$  ratios through mass spectrometry and used FTIR (Fourier transform infrared spectroscopy) to measure carbonate content (C/P ratios) and apatite crystallinity (CI). The standard sample preparation technique did not significantly alter the resulting  $\delta^{13}\text{C}$  and  $\delta^{18}\text{O}$ , and C/P ratios or the CI. However, the protocol recommended by Garvie-Lok et al produced significantly different CI, suggesting that their recommended more dilute solution may result in a higher degree of recrystallization than the standard technique. Although not statistically significant, any sample

preparation method alters the resulting  $\delta^{13}\text{C}$  and  $\delta^{18}\text{O}$  ratios and therefore, we recommend that researchers use the standard preparation protocol to minimize error when comparing results with other studies.

### Substrate alters asymmetrical gait dynamics in common marmosets (*Callithrix jacchus*).

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Whereas several studies have demonstrated that primates adapt walking and running dynamics to improve stability on arboreal substrates, substrate influences on the dynamics of asymmetrical gaits (i.e., galloping and bounding) have received little attention. In this study, two juveniles (mean body mass=180g) and three adult (mean body mass=330g) common marmosets (*Callithrix jacchus*) were filmed traversing a 3m runway (T) or elevated pole (A) incorporating two force transducers. A total of 76 complete galloping and bounding strides were analyzed. Peak vertical force (scaled to body weight: Vpk), vertical and cranio-caudal kinetic energy (KE), vertical displacement of the center of mass (CMdisp), gravitational potential energy (PE) and the total mechanical energy required to move the CM (Etot) were calculated using standard methods (Cavagna et al., 1977). Based on previous studies, I predicted that individuals traveling on arboreal substrates would attempt to increase stability by reducing Vpk and CMdisp. However, decreased CMdisp should limit the opportunity for the efficient exchange of PE and KE, possibly increasing the cost of locomotion on arboreal substrates.

As predicted, Vpk (T: 2.2bw; A: 1.8bw), CMdisp (T: 1.7cm; A: 1cm) and PE (T: 0.04J; A: 0.02J) were significantly lower during arboreal trials, even when controlling for speed. Nevertheless, because decreases in PE were concomitant with decreases in Etot (T: 0.6J; A: 0.3J), locomotor efficiency did not differ between substrates (T: 21%; A: 24%). These results may have implications for interpreting the locomotor behavior of the ancestral primate, often reconstructed as a small-bodied arboreal animal.

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### Intraspecific Shape Variance in the Primate Scapula: The Role of Stabilizing Selection

N.M. Young. Department of Surgery, Stanford University.

In a stable population, selection modulates variance by affecting whether extreme phenotypes are eliminated or tolerated. Here it is hypothesized that the strength of stabilizing selection on scapular shape varies across primates and that intraspecific scapular shape variance is correlated with the function of the shoulder.

Primates that more frequently utilize their shoulder in stereotyped motions are hypothesized to be under greater stabilizing selection and exhibit lower population variance, while those that use a wider range of locomotor behaviors are hypothesized to be under reduced stabilizing selection and exhibit higher population variance. Results from three-dimensional landmark-based geometric morphometric analyses of scapular shape indicate that apes and ateline monkeys average twice the amount of intraspecific variance compared to Old World monkeys, *Alouatta*, and *Saimiri*. These two groups differ in the mobility of the shoulder and how frequently they engage in quadrupedal behaviors, which suggests selection for locomotor efficiency plays a primary role in reducing variance, although other possibilities include tolerance of higher amounts of variance in suspensory primates due to safety factors (e.g., avoiding falls is selectively more important than efficiency). Differences in shape variance are also patent from infancy and do not change over ontogeny. Consequently, differences between species in factors like growth, neuromuscular control, or environment (e.g., habitat structure/composition) do not explain this result. Instead genetic variation in embryonic factors that affect scapular shape is likely to be the primary contributor towards differences in population variance.

#### Activity and Asymmetry at Islamic Écija (Spain).

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Little is known archaeologically about the Islamic conquest of Spain in AD 711. With the support of the local Imam, this is being rectified by the excavation and analysis of a large cemetery in Écija (located east of Sevilla on the Guadalquivir plain in southern Spain). The cemetery contains an estimated 6000 inhumations.

A series of 87 metric measurements were taken on a sample of 108 adults from this cemetery. As expected, significant lateral differences were found in measurements of the upper limb (suggestive of right side preference or dominance in activity usage). However significant asymmetry was also found in lower limb measurements. Furthermore, males and females exhibited differing patterns of asymmetry in the humeri, radii and tibiae. This paper discusses these patterns in the context of documented activity patterns within the Spanish Medieval Islamic period. Partially funded by the British Academy, BABAO and the Arts & Humanities Research Council.

#### Ontogeny of digitigrade hand and foot postures in infant baboons (*Papio cynocephalus*).

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Primate variation in hand and foot postures is often discussed, but not fully understood from a functional perspective. In non-primate mammals that are digitigrade as adults, more stable postures, in which the majority or entirety of the ventral surface of the hand or foot contacts the substrate (palmigrade, plantigrade, and semiplantigrade) are known to occur during early locomotor development. By comparison, little is known about developmental transitions in primate hand/foot postures. The purpose of this study was to gain insight on the function of primate hand and foot postures by documenting ontogenetic transitions in a digitigrade primate, *Papio cynocephalus*. Longitudinal kinematic data were collected on four infant baboons as they aged from two to nine months, and then again at 2-3 years. Hand and foot joint angles at touchdown and midstance were measured for 827 walking strides.

By two months, the capacity for all hand and foot postures was present. In the foot, digitigrady was highly preferred over all other postures across individuals and ages, at touchdown and midstance. Semiplantigrady was also used at all ages but less frequently than digitigrady. Plantigrady was rarely used, restricted to touchdown, and absent by 2-3 years. In the hand, digitigrady was most prevalent overall, but certain individuals preferred palmigrady at the youngest ages. By 2-3 years, the hand was completely digitigrade. Postural data, combined with analyses of ontogenetic transitions in morphology and limb kinematics, offer a comprehensive understanding of locomotor biomechanics, and may offer insight into the evolution of primate terrestrial quadrupedalism.

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#### New perspectives on cariogenesis: Implications for anthropological and epidemiological research

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Dental caries remains one of the most common diseases afflicting mankind with 91% of adults' in the US experiencing caries (CDC, 2005). Changes in caries experience can be explained by two countervailing factors – the dramatic increase in the availability and consumption of fermentable carbohydrates (mainly sugars) and the widespread preventive use of fluoride in a variety of formulations and methods of delivery. The use of fluoride and other means of prevention such as dental sealants, and a better understanding of the dynamic and, in

some cases, reversible nature of the caries process has led to the need for developing new methods of detecting caries at an earlier stage before cavitation of the tooth surface. Early non-cavitated lesions that have failed to progress (arrested lesions) provide evidence of the caries process at an earlier time in the life of an individual and can be considered as scars. Once arrested these lesions then to remain stable and not progress further unless there is a major change in the oral environment favoring further demineralization.

Traditional approaches for caries detection have relied on visual/tactile examination aided by radiography, leading to dichotomous decisions (absence or presence of caries). The International Caries Assessment and Detection System (ICDAS) is one of the new visual methods for detecting caries, which involves seven codes to differentiate sound tooth surfaces through extensive cavitation. Other technology-based methods for detecting caries include the use of laser or light fluorescence, electro-conductivity and direct digital radiography. These newer approaches can provide a more detailed understanding of the dental caries process, which may have applications in anthropological and epidemiological research.

#### Paleodietary studies using stable carbon isotopes from human bone: an example from the late Bronze age Xindianzi cemetery, Inner Mongolia, China.

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The Xindianzi cemetery is located near the city of Hohhot, Helingeer county, Inner Mongolia, China. Fifty-seven tombs dating to approximately 2500 BP were excavated. In this study, we examine the Xindianzi human paleodiet, using stable isotope ratios of carbon and nitrogen in bone collagen (n=10). Nitrogen isotope ratios of bone collagen showed that the ancient inhabitants of Xindianzi primarily ate meat products, with only a minor dietary contribution from plant foods. Male individuals ate more animal protein than female individuals, suggesting a sex-based difference in either dietary habits or the social distribution of specific foods. Carbon isotope ratios of bone collagen show that most plant foods were derived from C4 plants sources.

#### What makes a good dad? Neuroendocrine factors influencing paternal care.

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Social structure and assurance of paternity are generally thought to influence

paternal care in primate societies. However, proximate causes of paternal care are poorly understood. Active biparental care is found in humans and several New World primate species where fathers will carry and nurture offspring. The common marmoset, *Callithrix jacchus*, and the cotton-top tamarin, *Saguinus oedipus*, are species where fathers are actively carrying from the first day of life and actually spend more time with their infants than mothers do. Males in both species have multiple hormonal and weight changes occurring during their mate's pregnancy. These physical changes ensure that the father is prepared for his energetic role as the primary caretaker. Common marmoset fathers can increase their weight up to 20% during the gestation while cotton-top tamarin fathers will increase their weight up to 8% from the start of the pregnancy. Fathers show elevated prolactin, testosterone and estradiol prepartum and are highly responsive to the female's hormonal changes. Unique infant responsiveness tests are beginning to reveal the large variation in motivation to parent that occurs even in experienced and responsive fathers. Male response to infant cues can be manipulated by altering hormones in the fathers. The biparental care that occurs in these species of primates provides excellent models for neuroendocrine control of human paternal care under controlled conditions.

**Growth of wild chimpanzees from Tai National Forest: implications for hominid evolution.**

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Studies on the dentition and skeleton of nonhuman primates initiated by Adolph Schultz in the early 20th century,

documented that human life stages—prenatal, infancy, juvenile, and adult—are extended compared to other primates. Fossil discoveries of immature individuals such as “Turkana Boy” (WT 15000 from Kenya) and Neanderthals such as Devil's Tower (Gibraltar) add another dimension to the evolution of human life history. Barry Bogin and others speculated on the “how and why” of longer life stages in humans and emphasized the distinctly human childhood and adolescent growth spurt as contrasted with growth patterns of chimpanzees, the species most closely related to humans. Comparative chimpanzee data on timing of dental eruption and bone growth necessarily relied on individuals from captive situations, so that chronological age and sex could be recorded. With new information forthcoming on wild chimpanzees, the captive data on growth must be reevaluated. Here we document dental and skeletal growth in individual wild chimpanzees with known age and sex from Tai Natural Forest (n=22). We demonstrate that captive chimpanzees are accelerated one to four years in dental eruption and in bone fusion compared to wild chimpanzees. We offer a new formulation regarding the evolution of human life stages based on these data. Wild chimpanzee growth may be more comparable with *Homo erectus* and even *Homo neanderthalensis* than previously appreciated. The pattern of growth in modern humans appears to be unique and to have developed late in human evolution.

**Anemia or scurvy: distinguishing the etiology of porotic hyperostosis via differential cranial vault thickness in juvenile humans.**

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Investigations suggest that cranial vault thickness (CVT) can be used as a diagnostic indicator for distinguishing between porotic hyperostosis (PH) caused by nutritional deficiencies, specifically scurvy and acquired anemia, in juvenile humans. PH (ie. Cribra cranii and Cribra orbitalia), occurs with great frequency and cultural, temporal, and geographic variability throughout archaeological populations. Though multiple pathological stimuli, particularly scurvy, produce superficially indistinguishable PH lesions, PH is most commonly attributed to acquired anemia. Consequent over-diagnosis of acquired anemia has generated skewed interpretations of past health. In remedy, anemic and scorbutic juvenile (0-15 yrs) long bone and dental aged Native American crania (n=30) from the NMNH's collections manifesting diagnostic cranial and systemic lesions were scanned using the NMNH Siemens Emotion scanner (slice 1mm interpolated at 0.5mm, medium sharp algorithm, mAs 83, voxel 0.375x0.375x1mm). Three CVT measurements were taken within 1cm of easily recognizable landmarks in characteristically affected regions (vault and orbit); CVT averages and ranges were calculated and compared to normal CVT from an ongoing study in preparation on normal, age-dependent CVT. Initial results indicate that CVT in multiple regions is significantly increased in anemic crania, independent of lesion severity ( $r^2=0.742$ ;  $p<0.001$ ). Pragmatically, caliper measurements can be used as a proxy, enabling improved diagnosis of nutritional deficiencies in juvenile crania. Used in concert with mosaic indicators, CVT is salient for improving case-based diagnosis of scurvy and anemia, and on a population level, improving estimations of environmental and social stress and past populations' health in archaeological contexts.