

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

to be held at  
**The Hyatt Regency Hotel**  
Tampa, Florida  
April 14 to April 17, 2004

## **AAPA Scientific Program Committee:**

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## **Local Arrangements Committee:**

Lorena Madrigal (Chair)  
David Himmelgreen  
Robert Tykot  
Curtis Weinker  
and many other student volunteers

## Message from the Program Committee Chair

The 2004 AAPA meeting, our seventy-third annual meeting, will be held at the Hyatt Regency Hotel in Tampa, Florida. There will be 644 podium and poster presentations in 38 sessions, with a total of almost 1,250 authors participating. The program includes eight podium symposia and one poster symposium on a variety of topics: Melanesian genetics, ecological immunity, paleoanthropological research in Asia and at the Asian frontiers, special senses in primates, quantitative trait loci, life history and energetics, and pregnancy. The program also includes the Second Annual Wiley-Liss Symposium; this year's topic is the study of human biology and globalization in Latin America, and includes talks by a number of distinguished colleagues from Latin America.

As in past years, this year's meetings reflect the international nature of our meetings. Roughly 21 percent of the senior authors live outside the United States, representing 27 nations. The largest representation is from the United Kingdom, Canada, Germany, Japan, Austria, Italy, Russia, Belgium, and Australia. Our meeting also serves as an important avenue for presentation of student research; roughly 40 percent of all first authors are students.

This is the third year that we have used an online registration system for payment of registration fees and submission of abstracts. As was the case for the past two years, we have put together a searchable online database of the abstracts in this issue, which are available at the AAPA web site: <http://www.physanth.org>. By entering key terms, you can explore the contents of the entire meeting supplement to find presentations on topics of special interest to you. The search engine allows you to obtain abstracts and determine when and where specific posters and papers will be presented.

As in the past, 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, the Paleopathology Association, and the Primate Biology and Behavior Interest Group. The Paleopathology Association has its meeting on Tuesday, April 13 and Wednesday, April 14. The Human Biology Association will meet on Wednesday, April 14 and Thursday, April 15.

The following pages provide a map of the Hyatt Regency Hotel; a summary table of conference events; a 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 showing the session numbers of their presentations.

AAPA activities commence on Wednesday evening, April 14, with a panel discussion organized by our Career Development Committee on "A First-hand Look at the Job-Search Process," where successful applicants for a variety of recent jobs will give their insights into the job-search process. This event will be followed by our annual reception. Poster and podium sessions begin Thursday morning and continue through Saturday afternoon.

The plenary session, held on Thursday evening, is an event entitled "A Funny Thing Happened on the Way to the Podium," where three distinguished scholars (John Blangero, Milford Wolpoff, and one additional speaker to be named) will each present a talk for which we have prepared a set of random, unrelated, and irrelevant slides. Come see how fast the speakers can think on their feet! Our annual luncheon on Friday fea-

tures Clyde Snow speaking on “Adventures in the Bone Trade.” Our annual business meeting is on Friday evening. On Saturday evening, we will have our Student Awards Reception.

We acknowledge the generous support for the 2004 meetings that has been provided by the following donors:

- Department of Anthropology, University of South Florida
- College of Arts and Sciences, University of South Florida
- Office of the Provost and Vice President for Academic Affairs, University of South Florida
- Department of Pathology and Laboratory Medicine, University of South Florida School of Medicine
- C.A. Pound Human Identification Laboratory, University of Florida
- Integrated DNA Technologies, Inc., Coralville, IA
- Bone Clones, Canoga Park, CA
- Florida Association of Medical Examiners
- Alvin and Barbara Wolfe

The AAPA Program, Local Arrangements, and Executive Committees cordially invite you to our seventy-third annual meeting. We look forward to seeing you in Tampa.

*John H. Relethford*

*AAPA Vice President and  
Program Committee Chair*

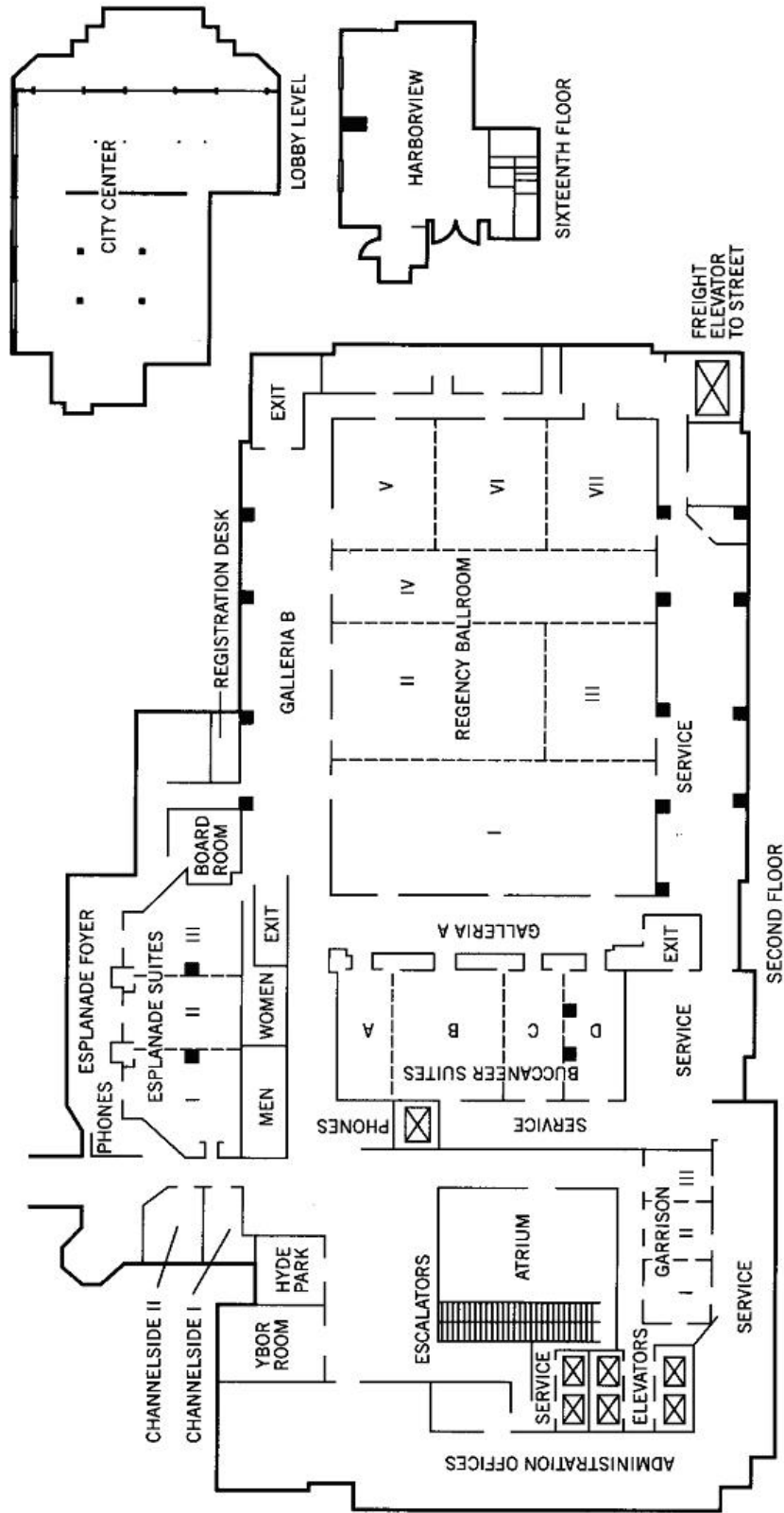
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On the cover: St. Joseph Bay, Gulf County, Florida, location of a small Woodland period shell midden, and, in the distance, a Middle Woodland (AD 300-600) burial mound. Image courtesy of Nancy White, University of South Florida.

# Hyatt Regency Tampa Hotel



## The Conference at a Glance

(Note: Regency Ballroom and Buccaneer Suites are configured differently depending on day and event)

	Tue Morning	Tue Afternoon	Tue Evening	Wed Morning	Wed Afternoon	Wed Evening
<b>Regency 1</b>				PPA Poster Session	PPA Poster Session; HBA poster session	
<b>Regency 2</b>						AAPA Career Development, 6 – 7:45 pm
<b>Regency 3</b>						
<b>Regency 5</b>						
<b>Regency 6</b>						
<b>Regency 7</b>						
<b>Buccaneer A</b>	PPA Workshop	PPA Podium Session		PPA Podium Session	PPA Podium Session	
<b>Buccaneer B</b>	PPA Workshop					
<b>Buccaneer C</b>				HBA Podium Session	HBA Poster Session	
<b>Buccaneer D</b>						
<b>Galleria A</b>	PPA Registration, 8 am – 5 pm			HBA Registration, 8 am – 5 pm PPA Registration 8 – 10 am		
<b>Galleria B</b>	HBA Registration, 8 am – 5 pm			AAPA Registration, 9 am – 5 pm		
<b>Hyde Park</b>			HBA Executive Committee dinner, 6 – 10 pm	AJPA Editorial Board Meeting, noon – 2 pm		HBA Student Reception 5 – 7 pm
<b>Outside Esplanade</b>						AAPA Reception, 8 – 11 pm
<b>City Center and Patio</b>				AJHB Editorial Board breakfast, 7:30 – 9 am		
<b>Garrison</b>			<i>Human Biology</i> Editorial Board Dinner, 6 – 8 pm	AAPA Executive Committee Meeting, 8 am – 6 pm		
<b>Esplanade Suite</b>				Book Exhibitors, 8 am – 5 pm		
<b>Channelside 1</b>	Press/job Interviews	Press/job interviews		Press/job interviews	Press/job interviews	
<b>Channelside 2</b>	Speaker Ready	Speaker Ready		Speaker Ready	Speaker Ready	

### 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*  
**NCSE** National Center for Science Education  
**PPA** Paleopathology Association

## The Conference at a Glance (continued)

	Thurs Morning	Thurs Afternoon	Thurs Evening	Fri Morning
<b>Regency 1</b>	Session 1. Human Biol. I Posters, 8:30 am – noon Session 2. Mol. Biol. Genet. Posters, 8:30 am – noon Session 3. Population Genet. I posters, 8:30 am - noon	Session 8. Primate Evol. I Posters, 1:30 – 5 pm Session 9. Human & Primate Brain Evol. I Posters, 1:30 – 5 pm Session 10. Primate Biology II Posters, 1:30 – 5 pm		Session 15. Primate Behav. II Posters, 8:30 am – noon
<b>Regency 2</b>	Session 4. Skeletal Biol. I, 8 am - noon	Session 11. Hominid Evol. II, 1 – 5 pm	HBA reception 7:30 – 10:30 pm	Session 16. Symposium: Paleoanth. Research in East & Southeast Asia, 8 am - noon
<b>Regency 3</b>				Session 17. AAPA/HBA Symposium: Ecological Immunology, 8 – 11:45 am
<b>Regency 5</b>	Session 5. Hominid Evol. I, 8 am – noon	Session 12. Symposium: Island Melanesian Genetic Diversity, 1 – 4:30 pm	AAPA Plenary Session, 6:15 – 7:45 pm	
<b>Regency 6</b>				
<b>Regency 7</b>	Session 6. Primate Biol. I, 8– 11:30 am	Session 13. Primate Behav. I, 1 – 5 pm		
<b>Buccaneer A</b>	HBA Plenary Session	HBA Plenary Session, 2 – 4 pm	DAA Business Meeting, 7:45 – 8:45 pm	Session 18. Primate Evol. II, 8 am – noon
<b>Buccaneer B</b>		Raymond Pearl Lecture, 4– 5 pm	HBA Business Meeting, 5:30 – 6:30 pm	
<b>Buccaneer C</b>	Session 7. Dental Anth. I, 8– 11:15 am	Session 14. Paleopath. I, 1 – 4:30 pm	AAAG Business Meeting, 7:45 – 8:45 pm	Session 19. Population Genet. II, 8 am – noon
<b>Buccaneer D</b>			Primate Biology/Behavior Interest Group Meeting, 7:45 – 8:45 pm	
<b>Galleria A</b>				
<b>Galleria B</b>	AAPA Registration, 8 am – 8 pm			AAPA Registration
<b>Hyde Park</b>		NCSE Lunch Meeting, 12 – 1:30 pm	ADA Business Meeting, 7:45 – 8:45 pm	
<b>City Center and Patio</b>		HBA Lunch, noon – 1:30 pm	Wiley-Liss Reception, 8:30 – 10:30 pm	
<b>Garrison</b>	Book Exhibitors, 8 am – 5 pm			Book Exhibitors
<b>Esplanade Suite</b>	Book Exhibitors, 8 am – 5 pm			Book Exhibitors
<b>Channelside 1</b>	Press/job interviews	Press/job interviews	Press/job interviews	Press/job interviews
<b>Channelside 2</b>	Speaker Ready	Speaker Ready	Speaker Ready	Speaker Ready

*For a schedule of all conference events, see page 8.  
For a detailed listing of individual AAPA poster and podium presentations, see page 14.*

	Fri Afternoon	Fri Evening	Sat Morning	Sat Afternoon
<b>Regency 1</b>	Session 20. Poster Symposium: Paleoanth. Research at the Asian Frontiers, 2:30 – 6 pm Session 21: Hominid Evol. III Posters, 2:30 – 6 pm		Session 26. Skeletal Biol. III Posters, 8:30 – noon Session 27. Dental Anth. II Posters, 8:30 - noon	Session 33. Paleopath. II Posters, 1:30 – 5 pm Session 34. Forensic Anth. Posters, 1:30 – 5 pm
<b>Regency 2</b>	Session 22. Symposium: Pregnancy, 2 – 4:45 pm	AAPA Business Meeting, 8 – 11 pm	Session 28. Health and Disease, 8 – 9:30 am Session 29. Wiley-Liss Symposium: Human Biol. & Globalization in Latin America, 10 am – noon	Session 35. Symposium: Evol. Of Special Senses in Primates, 1 – 5 pm
<b>Regency 3</b>	Session 23. Skeletal Biol. II, 2 – 6 pm			
<b>Regency 5</b>	AAPA Luncheon, noon – 2 pm		Session 30. Hominid Evol. IV, 8 am - noon	Session 36. Symposium: Life History, Energetics, & Human Evol., 1 – 4:45 pm
<b>Regency 6</b>				
<b>Regency 7</b>			Teaching Outreach Program, 8 am – noon	
<b>Buccaneer A</b>	Session 24. Symposium: QTL Mapping, 2 – 6 pm		Session 31. Primate Behav. III, 8 am - noon	Session 37. Skeletal Biol. IV, 1 – 4:45 pm
<b>Buccaneer B</b>				
<b>Buccaneer C</b>	Session 25. Human & Primate Brain Evol. II, 2 – 6 pm		Session 32. Primate Biol. III, 8 am – noon	Session 38. Human Biol. II, 1 – 5 pm
<b>Buccaneer D</b>				
<b>Galleria A</b>				
<b>Galleria B</b>	AAPA Registration		AAPA Registration, 8 am – noon	
<b>Hyde Park</b>				Student Awards Committee Meeting, 4 – 5 pm
<b>City Center and Patio</b>		JHE Editorial Board Dinner, 5:30 – 8 pm		
<b>Garrison</b>	Book Exhibitors		Book Exhibitors, 8 am – 5pm	
<b>Esplanade Suite</b>	Book Exhibitors		Book Exhibitors, 8 am – 5pm	
<b>Channelside 1</b>	Press/job interviews		Press/job interviews	Press/job interviews
<b>Channelside 2</b>	Speaker Ready		Speaker Ready	Speaker Ready

**Saturday evening:** Student Awards Reception, City Center & Patio, 5 – 7 pm

## Conference Schedule

*For a schedule of individual AAPA poster and podium presentations, see page 14.*

### **Tuesday, April 13, 2004**

#### **Paleopathology Association**

8:00 am – 5:00 pm     Registration. *Galleria A.*

8:00 am – 5:00 pm     Workshops, Scientific Sessions. *Buccaneer A–B.*

#### **Human Biology Association**

8:00 am – 5:00 pm     Registration. *Galleria B.*

6:00 pm – 10:00 pm    Executive Committee Meeting. *Hyde Park.*

#### **Human Biology (Journal)**

6:00 pm – 8:00 pm     Editorial Board Dinner. *Garrison.*

### **Wednesday, April 14, 2004**

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

9:00 am – 5:00 pm     Registration. *Galleria B.*

8:00 am – 6:00 pm     Executive Committee Meeting. *Garrison.*

12:00 pm – 2:00 pm    *American Journal of Physical Anthropology* Editorial Board Luncheon. *Hyde Park.*

6:30 pm – 7:45 pm     Career Development Committee Panel: “A First-Hand Look at the Job-Search Process.” Panelists: Gregory Berg, Troy Case, Heather Edgar, Christopher Vinyard. Moderator: Elizabeth A. Miller. *Regency 2.*

8:00 pm – 11:00 pm    Reception & Cash Bar. *Outside Esplanade and City Center and Patio.*

#### **Paleopathology Association**

8:00 am – 10:00 am    Registration. *Galleria A.*

8:00 am – 5:00 pm     Poster Session. *Regency 1.*



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**Wednesday, April 14, 2004 (continued)**


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8:00 am – 5:00 pm      Scientific Session. *Buccaneer A-B.*

**Human Biology Association**

7:30 am – 9:00 am      *American Journal of Human Biology* Editorial Board  
Breakfast. *City Center and Patio.*

8:00 am – 5:00 pm      Registration. *Galleria A.*

8:00 am – 12:00 pm      Podium Session. *Buccaneer C-D.*

1:00 pm – 5:00 pm      Poster Session. *Regency 1.*

1:00 pm – 5:00 pm      Poster Session. *Buccaneer C-D.*

5:00 pm – 7:00 pm      Student Reception. *Hyde Park.*

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**Thursday, April 15, 2004**


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**American Association of Physical Anthropologists**

8:00 am – 8:00 pm      Registration. *Galleria B.*

8:30 am – 12:00 pm      **Session 1. Human Biology I.** Contributed Posters.  
*Regency 1.*

8:30 am – 12:00 pm      **Session 2. Molecular Biology and Genetics.** Contributed  
Posters. *Regency 1.*

8:30 am – 12:00 pm      **Session 3. Population Genetics I.** Contributed Posters.  
*Regency 1.*

8:00 am – 12:00 pm      **Session 4. Skeletal Biology I: Diet, Disease, and Demog-**  
**raphy.** Contributed Papers. *Regency 2-3.*

8:00 am – 12:00 pm      **Session 5. Hominid Evolution I: Hominid Origins and**  
**Early Hominid Evolution.** Contributed Papers.  
*Regency 5-6.*

8:00 am – 11:30 am      **Session 6. Primate Biology I: Locomotion and Skeletal**  
**Biology.** Contributed Papers. *Regency 7.*

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**Thursday, April 15, 2004 (continued)**


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- 8:00 am – 11:15 am **Session 7. Dental Anthropology I.** Contributed Papers. *Buccaneer C–D.*
- 1:30 pm – 5:00 pm **Session 8. Primate Evolution I.** Contributed Posters. *Regency 1.*
- 1:30 pm – 5:00 pm **Session 9. Human and Primate Brain Evolution I.** Contributed Posters. *Regency 1.*
- 1:30 pm – 5:00 pm **Session 10. Primate Biology I.** Contributed Posters. *Regency 1.*
- 1:00 pm – 5:00 pm **Session 11. Hominid Evolution II: Australopithecines and Early *Homo*.** Contributed Papers. *Regency 2–3.*
- 1:00 pm – 4:30 pm **Session 12. A Second Biological Garden of Eden: Island Melanesian Genetic Diversity.** Symposium. *Regency 5–6.*
- 1:00 pm – 5:00 pm **Session 13. Primate Behavior I.** Contributed Papers. *Regency 7.*
- 1:00 pm – 4:30 pm **Session 14. Paleopathology I.** Contributed Papers. *Buccaneer C–D.*
- 6:15 pm – 7:45 pm Plenary Session. “A Funny Thing Happened on the Way to the Podium.” Three speakers (John Blangero, Milford Wolpoff, and one additional speaker to be named) will each present a talk where they have not seen the random slides prepared for them! *Regency 5–7.*
- 8:30 pm – 10:30 pm Wiley-Liss Reception. *City Center and Patio.*

**Human Biology Association**

- 8:00 am – 12:00 pm Plenary Session. *Buccaneer A–B.*
- 12:00 pm – 1:30 pm HBA Lunch. *City Center and Patio.*
- 2:00 pm – 4:00 pm Plenary Session (continued). *Buccaneer A–B.*
- 4:00 pm – 5:00 pm Raymond Pearl Lecture: Stephen Stearns. “Human Genetic Variation and Selection Arenas.” *Buccaneer A–B.*
- 5:30 pm – 6:30 pm Business Meeting. *Buccaneer B.*

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**Thursday, April 15, 2004 (continued)**


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7:30 pm – 10:30 pm Reception. *Regency 2.*

**Dental Anthropology Association**

7:45 pm – 8:45 pm Business Meeting. *Buccaneer A.*

**American Association of Anthropological Genetics**

7:45 pm – 8:45 pm Business Meeting. *Buccaneer C.*

**American Dermatoglyphics Association**

7:45 pm – 8:45 pm Business Meeting. *Hyde Park.*

**Primate Biology & Behavior Interest Group**

7:45 pm – 8:45 pm Business Meeting. *Buccaneer D.*

**National Center for Science Education**

12:00 pm – 1:30 pm Lunch Meeting. *Hyde Park.*

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**Friday, April 16, 2004**


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**American Association of Physical Anthropologists**

8:00 am – 5:00 pm Registration. *Galleria B.*

8:30 am – 12:00 pm **Session 15. Primate Behavior II.** Contributed Posters. *Regency 1.*

8:00 am – 12:00 pm **Session 16. The Current State of Paleoanthropological Research in East and Southeast Asia.** Symposium. *Regency 2.*

8:00 am – 11:45 pm **Session 17. Human Ecological Immunity: Models and Methods for Future Research.** Symposium. *Regency 3.*

8:00 am – 12:00 pm **Session 18. Primate Evolution II.** Contributed Papers. *Buccaneer A–B.*

8:00 am – 12:00 pm **Session 19. Population Genetics II.** Contributed Papers. *Buccaneer C–D.*

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**Friday, April 16, 2004 (continued)**


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- 12:00 pm – 2:00 pm    AAPA Luncheon. *Regency 5–7.*  
Speaker: Clyde Snow. “Adventures in the Bone Trade: Some Musings on a Peripatetic Journey in Physical Anthropology.”
- 2:30 pm – 6:00 pm    **Session 20. Paleoanthropological Research at the Asian Frontiers.** Poster Symposium. *Regency 1.*
- 2:30 pm – 6:00 pm    **Session 21. Hominid Evolution III.** Contributed Posters. *Regency 1.*
- 2:00 pm – 4:45 pm    **Session 22. From Conception to Birth: Selective Pressures Shaping Pregnancy and its Outcomes.** Symposium. *Regency 2.*
- 2:00 pm – 6:00 pm    **Session 23. Skeletal Biology II: Biomechanics.** Contributed Papers. *Regency 3.*
- 2:00 pm – 6:00 pm    **Session 24. QTL (Quantitative Trait Loci) Mapping in Biological Anthropology.** Symposium. *Buccaneer A–B.*
- 2:00 pm – 6:00 pm    **Session 25. Human and Primate Brain Evolution II.** Contributed Papers. *Buccaneer C–D.*
- 8:00 pm – 11:00 pm    Annual Business Meeting. *Regency 2–3.*

***Journal of Human Evolution***

- 5:30 pm – 8:00 pm    Editorial Board Meeting. *City Center and Patio.*

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**Saturday, April 17, 2004**


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**American Association of Physical Anthropologists**

- 8:00 am – 12:00 pm    Registration. *Galleria B.*
- 8:00 am – 12:00 pm    Teaching Outreach Program. *Regency 7.*
- 8:30 am – 12:00 pm    **Session 26. Skeletal Biology III.** Contributed Posters. *Regency 1.*
- 8:30 am – 12:00 pm    **Session 27. Dental Anthropology II.** Contributed Posters. *Regency 1.*

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**Saturday, April 17, 2004 (continued)**

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- 8:00 am – 9:30 am     **Session 28. Health and Disease.** Contributed Papers.  
*Regency 2–3.*
- 10:00 am – 12:00 pm   **Session 29. Human Biology and Globalization in Latin America.** Second Annual Wiley-Liss Symposium.  
*Regency 2–3.*
- 8:00 am – 12:00 pm     **Session 30. Hominid Evolution IV: Archaic and Modern Humans.** Contributed Papers. *Regency 5–6.*
- 8:00 am – 12:00 pm     **Session 31. Primate Behavior III: Biology, Ecology, and Demography.** Contributed Papers. *Buccaneer A–B.*
- 8:00 am – 12:00 pm     **Session 32. Primate Biology III: Skulls, Teeth, and Sex.** Contributed Papers. *Buccaneer C–D.*
- 1:30 pm – 5:00 pm      **Session 33. Paleopathology II.** Contributed Posters.  
*Regency 1.*
- 1:30 pm – 5:00 pm      **Session 34. Forensic Anthropology.** Contributed Posters.  
*Regency 1.*
- 1:00 pm – 5:00 pm      **Session 35. Evolution of the Special Senses in Primates.** Symposium. *Regency 2–3.*
- 1:00 pm – 4:45 pm      **Session 36. Life History, Energetics, and Human Evolution.** Symposium. *Regency 5–6.*
- 1:00 pm – 4:45 pm      **Session 37. Skeletal Biology IV: Bioarchaeology and Biodistance.** Contributed Papers. *Buccaneer A–B.*
- 1:00 pm – 5:00 pm      **Session 38. Human Biology II.** Contributed Papers.  
*Buccaneer C–D.*
- 5:00 pm – 7:00 pm      Student Awards Reception. *City Center and Patio.*

# APA Poster and Podium Presentation Schedule

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

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## Thursday Morning – April 15, 2004

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### Session 1. Human Biology I. Contributed Posters. *Regency 1.*

Chair: LOREN R. LEASE, Southwest Foundation for Biomedical Research.

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.

- Hunter-gatherer health at the Ernest Witte site (41AU36), southeast Texas. CORY J. BROEHM.
- Naviculo-cuneiform I coalition: Evidence of statistically significant population variation in tarsal coalition frequencies. SCOTT E. BURNETT, D. TROY CASE.
- Skeletal Analyses of Umm El-Jimal, Jordan (300-400AD). CHRISTOPHER R. CRAIN, PAMELA K. STONE.
- Dental asymmetry through time in coastal Florida and Georgia populations. SHANNA E. WILLIAMS, MICHAEL W. WARREN.
- A prospective study of maternal prenatal dietary intakes and the formation of enamel growth disruptions. SALLY E. KRAYNIK, ALICIA CARRASCO, ALAN H. GOODMAN, DONNA M. WINHAM, ALEXIS E. DOLPHIN.
- Acculturation and bone density: Is there a link? JENNIFER L.Z. RICE.
- Modeling the effects of social and economic change on health and nutritional status: Historical microenvironments. SUSAN L. JOHNSTON.
- Obesity in East-Indian and African derived groups in Costa Rica. ELIZABETH KENNEY, LORENA MADRIGAL.
- Ethnic differences in plasma lipid profiles among female school teachers in Hawaii: Japanese-Americans versus Euro-Americans. DANIEL E. BROWN, GARY D. JAMES, NICOLA M. NICCOLAISEN, ERIN A.K. KALUA, HAROLD A.T. TEFFT.
- State regulation across the generations: Children's autonomic arousal and their parents' daily schedules. JASON A. DECARO, CAROL M. WORTHMAN.
- Are overnight norepinephrine and epinephrine excretion rates reproducible baseline measurements for diurnal stress studies? GARY D. JAMES.
- Preliminary study of nighttime parenting behaviors among primiparous adolescent and adult mothers. LANE E. VOLPE, JAMES J. MCKENNA.
- Western research in a non Western world: HIV in rural Tanzania. LINDA A. WINKLER, NATHAN DARITY, JESSICA HUFF, JESSICA MILEY, VALERIE HESS, FAITH BREBNOR.
- Patterns of genetic diversity and linkage disequilibrium at interleukin-4 (IL-4) and interleukin-13 (IL-13) in human populations. ALESSIA RANCIARO, EDUARDO TARAZONA-SANTOS, SARAH A. TISHKOFF.
- Reproductive measures, fitness and migrating Mennonites: An evolutionary analysis. JOAN C. STEVENSON, MICHAEL GRIMES, PHILLIP M. EVERSON.
- How well does paternity confidence match actual paternity? Evidence from worldwide nonpaternity rates. KERMYT G. ANDERSON.
- Diversity of paternal and maternal surnames in the Argentinean colonial period: Isonymy by ethno-social category. SONIA E. COLANTONIO, VICENTE FUSTER, MARIA DEL CARMEN FERREYRA, JAVIER LASCANO.

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**Thursday Morning – April 15, 2004 (continued)**

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18. Demography and kinship responses to livestock reduction amongst historic Navajo pastoralists. J. CHRISTOPHER DUDAR.
19. Ancient Maya population structure and social dynamics. A palaeodemographic approach to the Classic coastal site of Xcambó, Yucatán. VERA TIESLER, ANDREA CUCINA, THELMA SIERRA SOSA, RICHARD MEINDL.
20. Differential subsistence adaptations of agriculturalists and herders of the early intermediate period in the Lurin Valley, Peru: New data from stable isotope analysis. NICOLE L FALK, ROBERT H. TYKOT, MERCEDES DELGADO, EKATERINA A. PECHENKINA, JOE VRADENBURG.
21. Dietary adaptations in the Maya Lowlands through time and space: First results of stable isotope analysis of the Yucatan. EUGENIA BROWN MANSELL, ROBERT H. TYKOT.
22. Salivary amylase gene copy number: Have humans adapted to high starch diets? ELIZABETH F. CALDWELL, NOREEN VON CRAMON-TAUBADEL, MICHAEL E. WEALE, MARK G. THOMAS.
23. Roman Period fetal skeletons from the east cemetery (Kellis 2) of Kellis, Egypt. MATTHEW W. TOCHERI, TOSHA L. DUPRAS, PETER SHELDRIK, J. ELDON MOLTO.
24. Subadult growth in prehistoric Southeast Asia. SIAN E. HALCROW.
25. Testing a theory explaining the adaptive value of secondary osteons (Haversian systems). NEIL C. TAPPEN.
26. Regression modelling to predict energy expenditure: Comparison between adults and children. ISABELLE SARTON-MILLER, PATRICIA A. KRAMER.
27. Validating subjective signals of ovulation. LYNNETTE LEIDY SIEVERT, CATHERINE DUBOIS.
28. Effect of psychogenic stress on ovarian cycle dynamics in the baboon. KATHLEEN A. O'CONNOR, ELEANOR BRINDLE, K. DEE CAREY, KAREN RICE, REBECCA C. MILLER, JENNIFER ARANDA, MARC TATAR.
29. Biomechanical model of the index finger during simulated hardhammer percussion. CAMPBELL ROLIAN.
30. Functional differentiation between the clavicular and caudal heads of the pectoralis major muscle in *Homo sapiens*. KRISTI L. LEWTON, EMILY K. LANDIS, TRACY A. GAYHEART, MARC C. JACOFISKY.

**Session 2. Molecular Biology and Genetics. Contributed Posters. Regency 1.**

Chair: ERIC J. DEVOR, Integrated DNA Technologies.

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.

31. Life history variables and nucleotide substitution rate variation in the catarrhine primates. RYAN L. RAAUM, KIRSTIN N. STERNER, ANTHONY J. TOSI, SARAH A. FARLEY, LEI ZHANG, MARGARET S. HARPER, KATIE E. KRASINSKI, TODD R. DISOTELL, CARO-BETH STEWART.
32. The rhesus macaque (*Macaca mulatta*) corticotropin-releasing hormone gene: Sequence analysis and variation. RACHEL L. DVOSKIN, CHRISTINA S. BARR, TIM K. NEWMAN, DAVID GOLDMAN, STEPHEN J. SUOMI, J. DEE HIGLEY.
33. Comparative sequence analysis of a repeat polymorphism in the monoamine oxidase A (MAOA) gene promoter region in primates: Evidence for selection? TIMOTHY K. NEWMAN, J. DEE HIGLEY, DAVID GOLDMAN.
34. Expanded X-chromosomal dataset offers increased phylogenetic resolution in the Cercopithecini. ANTHONY J. TOSI, TODD R. DISOTELL.
35. Mitochondrial phylogeny of southern African baboons. ANDREW S. BURRELL, CLIFFORD J. JOLLY, JEFFREY ROGERS, TODD R. DISOTELL.

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**Thursday Morning – April 15, 2004 (continued)**


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36. Alpha-globin gene triplication in orangutans. MICHAEL E. STEIPER, MARYELLEN RUVOLO.
37. RNase 9, a unique new member of the primate RNase A superfamily: Evidence of diversifying selection and its role in host-defense innate immunity. ERIC J. DEVOR, KRISTIN A. MOFFAT-WILSON, MEREDITH P. MILLIS.
38. Nucleotide sequence variation of the Arginine Vasopressin Type II Receptor (AVPR2) gene in ethnically diverse human populations. LISA A. PFEIFER, BRIAN C. VERRELLI, SARAH A. TISHKOFF.
39. Genotype/phenotype analysis of lactase persistence in Tanzanian populations. KWELI B. POWELL, SARAH A. TISHKOFF.
40. A phylogenetic comparison of oxidative damage to DNA across European mitochondrial haplogroup clades. ANGELA M. HANCOCK, JON SEGER, RICHARD CAWTHON, ALAN ROGERS.
41. Mitochondrial DNA variation in Uto-Aztecan speaking populations. BRIAN M. KEMP, ANDRES RESENDEZ, DAVID G. SMITH.
42. Mitochondrial DNA analysis of the prehistoric people of Eel Point Locus C San Clemente Island, California. AMIEE B. POTTER, P. SCOTT WHITE.
43. Intact non-collagenous extracellular matrix proteins in ancient human bones from different time periods. TYEDE H. SCHMIDT-SCHULTZ, MICHAEL SCHULTZ.

**Session 3. Population Genetics I. Contributed Posters. Regency 1.**

Chair: ERIC J. DEVOR, Integrated DNA Technologies.

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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.                                       |

44. Pattern of mitochondrial genetic variability of the black howler monkey (*Alouatta caraya*): An example of post-glacial range expansion in South American fauna. MARINA S. ASCUNCE, ESTEBAN HASSON, GABRIEL ZUNINO, CONNIE J. MULLIGAN, MARTA D. MUDRY.
45. Genetic studies of *Mandrillus sphinx* in Gabon. STEPHEN L. CLIFFORD, KATE A. ABERNETHY, LEE J.T. WHITE, PRESTON A. MARX, TODD R. DISOTELL, E. JEAN WICKINGS.
46. Y chromosome genetic variation in Tanzanian populations: Implications for modern human origins. JIBRIL B. HIRBO, MARY K. GONDER, JOHN HODAX, JOANNA MOUNTAIN, ALEC KNIGHT, SARAH A. TISHKOFF.
47. Complete mitochondrial genome sequencing of Tanzanians implies an east African origin of modern humans. MARY K. GONDER, SARAH A. TISHKOFF.
48. Linked autosomal genetic marker systems and pre-Out of Africa subdivision. MATTHEW J. JOBIN, UMA RAMAKRISHNAN, JOANNA L MOUNTAIN.
49. Reconstructing the peopling of Cameroon through the analysis of mitochondrial DNA. VALENTINA COIA, FABIO VERGINELLI, ILARIA BOSCHI, GABRIELLA SPEDINI, DAVID COMAS, FRANCESC CALAFELL, CINZIA BATTAGLIA, GIOVANNI DESTRO-BISOL.
50. A clinal pattern of human Y chromosome diversity in North Africa. BARBARA ARREDI.
51. Genetic Diversity in an urban population in West Africa: A preliminary analysis. JADA P. BENN TORRES, ANNE C. STONE.
52. African-American lineage markers: Determining the geographic source of mtDNA and Y chromosomes. JOSEPH G. LORENZ, ANDREA VOSBIKIAN, JEANNE BECK, PATRICK K. BENDER, ALICE WHITTEMORE, FATIMAH JACKSON.
53. Interregional gene flow in the eastern Mediterranean: A Cypriot melting pot? NATHAN KAYNE HARPER.



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**Thursday Morning – April 15, 2004 (continued)**


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54. mtDNA Variation in Old Believer and ethnic Russian populations of Northern Siberia. SAMARA RUBINSTEIN, NISHI MEHTA, SERGEY I. ZHADANOV, MAGGIE A. COCCA, LUDMILLA P. OSIPOVA, THEODORE G. SCHURR.
55. mtDNA variation in Kazakhs of the Southern Altai Republic, and their relationship to Turkic-speaking populations. OMER GOKCUMEN, SERGEY I. ZHADANOV, LUDMILLA P. OSIPOVA, THEODORE G. SCHURR.
56. Comparison of Y-chromosome and mitochondrial genetic diversity in Panamanian Amerinds. ANGELICA GONZALEZ-OLIVER, MARINA S. ASCUNCE, CONNIE J. MULLIGAN.
57. Mitochondrial sequence variation in the Canadian Mohawk. KAY S. GRENNAN, D. ANDREW MERRIWETHER.
58. Mitochondrial DNA analysis of the ancient Peruvian highlanders. NOBORU ADACHI, KEN-ICHI SHINODA, IZUMI SHIMADA.
59. An alternative model for Clovis colonization that retains Amerind genetic diversity. ALAN G. FIX.
60. Comparative mtDNA analysis of adapting to life at high altitudes. KRISTEN M. SAARI, DAVID M. REED, CYNTHIA M. BEALL, D. ANDREW MERRIWETHER.
61. Mitochondrial DNA analysis for the study of variation and determination of geographic identity of indigenous human skeletal remains. HATTIE B. WETHERINGTON, JAMES GAREY, LORENA MADRIGAL.
62. Native American interests and human genetic research. KARI BRITT SCHROEDER, RIPAN S. MALHI, JASON A. ESHLEMAN, DAVID G. SMITH.
63. Dermatoglyphic ridge counts compared to short tandem repeats as measures of population distance. ELIZABETH A. DIGANGI, RICHARD L. JANTZ.
64. Dermatoglyphic phenotypic heterogeneity among individuals with non syndromic cleft lip with or without cleft palate (CL/P) and their relatives in China and the Philippines. NICOLE M. SCOTT, SETH M. WEINBERG, KATHERINE NEISWANGER, CARLA A. BRANDON, JEFFREY C. MURRAY, YOU-E LIU, MARY L. MARAZITA.
65. "Race" and anthropology's public face: Carleton S. Coon and the segregationists. KEVIN A. YELVINGTON.
66. Social network structure and human/HIV coevolution. STEVEN M. GOODREAU.

**Session 4. Skeletal Biology I: Diet, Disease, and Demography. Contributed Papers.**  
*Regency 2–3.*

Chair: NIELS LYNNERUP, University of Copenhagen.

- 8:00 am Early *Homo* remains from Georgia (Southern Caucasus). D. LORDKIPANIDZE.
- 8:00 am Breast-feeding variability in the French Modern Period: A comparison of the effects of differential social-economic status. ESTELLE HERRSCHER, M. ANNE KATZENBERG, FRÉDÉRIQUE VALENTIN, RENÉE COLARDELLE.
- 8:15 am Inca-period diet for the central coast of Peru: A preliminary report on the isotopic analysis of human bone collagen from Puruchuco-Huaquerones. JOCELYN S. WILLIAMS.
- 8:30 am A contribution to the nutritional history of prehistoric Sardinia (Italy): Preliminary results of isotopic analyses of bone collagen, bone apatite and tooth enamel. LUCA LAI, ROBERT H. TYKOT.
- 8:45 am The effects of growth velocity on stable nitrogen isotope ratios in subadult long bones. ANDREA L. WATERS, M. ANNE KATZENBERG.
- 9:00 am Mesolithic and Neolithic subsistence in Belgium: Evidence from stable isotopes. CAROLINE POLET, HERVE BOCHERENS, MICHEL TOUSSAINT.
- 9:15 am Developmentally mediated intra-individual variation in inorganic stable isotopes. ELIZABETH A. QUINN, JOHN D. KINGSTON, GEORGE J. ARMELAGOS.

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**Thursday Morning – April 15, 2004 (continued)**


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- 9:30 am Single osteons and seasonality: A SIMS analysis of human bone from Wadi Halfa. HENRY P. SCHWARCZ, CHRISTINE D. WHITE, MOSTAFA FAYEK.
- 9:45 am Break
- 10:00 am Prehistoric subsistence adaptations in west-central Florida as determined by stable isotope analysis. JENNIFER A. KELLY, ROBERT H. TYKOT, JERALD T. MILANICH.
- 10:15 am Histological analysis of ribs from a 20th century Black South African population: Differentiating a microstructural pattern for pellagra and general malnutrition. ROBERT R. PAINE, BARRETT P. BRENTON.
- 10:30 am Evaluation of diagnostic criteria for coding osteoarthritic lesions: Correlation between lipping, porosity, and eburnation. ERIC J. BARTELINK.
- 10:45 am A new method to quantify the 3D morphology of bone surfaces, with application to muscle entheses rugosity. ANN C. ZUMWALT.
- 11:00 am The right preferences? Bilateral asymmetry in the upper and lower limbs of modern humans. BENJAMIN M. AUERBACH, CHRISTOPHER B. RUFF.
- 11:15 am Evidence of interpersonal violence in the W. Montague Cobb skeletal collection. JENNIFER L. MULLER.
- 11:30 am Variation in the microscopic appearance of the frontal bone in a cadaveric population. JANENE M. CURTIS, JOHN H. LANGDON, STEPHEN P. NAWROCKI, ALEX ROBLING.
- 11:45 am Tooth cementum annulations in paleodemography- The exemplary case of Lauchheim. URSULA WITTEW-BAKOFEN, JAMES VAUPEL.

**Session 5. Hominid Evolution I: Hominid Origins and Early Hominid Evolution. Contributed Papers. Regency 5–6.**

Chair: CHARLES MUSIBA, North Dakota State University.

- 8:00 am Anthropoid taxonomic diversity at Rudabánya, a late Miocene subtropical swamp forest in central Europe. DAVID R. BEGUN, MARIAM C. NARGOLWALLA.
- 8:15 am Bovid metapodials, late Miocene paleoenvironments, and hominoid evolution. ROBERT S. SCOTT.
- 8:30 am *Oreopithecus bambolii*: An unlikely case of hominid-like grip capability in a Miocene ape. RANDALL L. SUSMAN.
- 8:45 am The bipedal brachiator: A kinematic analysis of bipedal walking in *Hylobates lar*. EVIE E. VEREECKE, KRISTIAAN D'AOÛT, PETER AERTS.
- 9:00 am Arboreal bipedalism in Bwindi chimpanzees: Implications for models of the evolution of hominid bipedalism. CRAIG B. STANFORD.
- 9:15 am Lumbar vertebral number in early hominids: Anatomical and developmental considerations. BURT A. ROSENMAN, KINGSBURY G. HEIPLE, C. OWEN LOVEJOY.
- 9:30 am The effect of leg length on human locomotor performance. HERMAN PONTZER.
- 9:45 am Megadontia and bipedalism: Did habitual bipedalism evolve in early hominids to reduce the energetic costs of increasing head weight? EDWARD H. HAGEN.
- 10:00 am Break
- 10:15 am Bipedality, Hox genes, hominid origins and chromosome two. EVELYN J. BOWERS.
- 10:30 am Patterns of dental variation in chimpanzees and gorillas: A comparison with implications for the choice of model in reconstructing fossil taxonomy. VARSHA C. PILBROW.
- 10:45 am The significance of the capitate/metacarpal II articulation for grasping in early hominids. THERESA M. FRANZ, RANDALL L. SUSMAN.

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**Thursday Morning – April 15, 2004 (continued)**


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- 11:00 am Postcranial sexual dimorphism at the A.L. 333 site. DEBORAH CUNNINGHAM, THEODORE M. COLE III, CAROL WARD, DANIEL J. WESCOTT.
- 11:15 am Facial heights: Implications of postnatal ontogeny and facial orientation for skull morphology in humans and chimpanzees. MARKUS BASTIR, ANTONIO ROSAS.
- 11:30 am Comparing ontogenetic trajectories of *Homo*, *Pan* and *Australopithecus africanus*. PHILIPP GUNZ, PHILIPP MITTEROECKER, FRED L. BOOKSTEIN, GERHARD W. WEBER.
- 11:45 am Identifying pleiotropy in hominid dental evolution: Results from a baboon model. LESLEA J. HLUSKO, MICHAEL C. MAHANEY.

**Session 6. Primate Biology I: Locomotion and Skeletal Biology.** Contributed Papers.  
*Regency 7.*

Chair: NAYUTA YAMASHITA, University of Southern California.

- 8:00 am Geometric modeling of the center of gravity in *Pan troglodytes*. ADAM D. SYLVESTER.
- 8:15 am The effects of limb mass distribution on primate quadrupedalism. DAVID A. RAICHLEN.
- 8:30 am Vertical climbing kinematics in specialized and generalized prosimians: Implications for morphology and performance. JANDY B. HANNA.
- 8:45 am External forces on the limbs of jumping lemurs. BRIGITTE DEMES, THERESA M. FRANZ, KRISTIAN J. CARLSON.
- 9:00 am Duty factors and lateral-sequence gaits in primates and chameleons. MATT CARTMILL, DANIEL SCHMITT, PIERRE LEMELIN.
- 9:15 am Muscle-bone interactions in a mouse gene knockout model: Implications for functional analysis of the primate postcranial skeleton. MARK W. HAMRICK, CATHERINE PENNINGTON.
- 9:30 am Cross-sectional geometry and locomotor behavior of habituated chimpanzees from the Tai and Mahale National Parks. KRISTIAN J. CARLSON, DIANE M. DORAN, KEVIN D. HUNT, TOSHISADA NISHIDA, ATSUSHI YAMANAKA, CHRISTOPH BOESCH.
- 9:45 am Break
- 10:00 am Multivariate comparison of divergent ossification patterns in the mammalian proximal femur. MARIA A. SERRAT, PHILIP L. RENO, MELANIE A. MCCOLLUM, RICHARD S. MEINDL, C. OWEN LOVEJOY.
- 10:15 am Patterns of phylogenetic signal in primate long bones. MATTHEW C. O'NEILL, SETH D. DOBSON.
- 10:30 am Morphological variation in the hominoid vertebral column: Implications for the evolution of human locomotion. LAUREN S. STEVENS, C. OWEN LOVEJOY.
- 10:45 am A comparative three-dimensional geometric morphometric study of growth and similarity in the primate scapula. NATHAN M. YOUNG.
- 11:00 am An evaluation of the coefficient of variation and average taxonomic distance to detect multiple taxa in extant hominoid samples. MATTHEW SKINNER, BRIAN RICHMOND, NICOLE SILVERMAN, BERNARD WOOD.
- 11:15 am Conservation biology of Malagasy strepsirrhines: A phylogenetic approach. SHAWN M. LEHMAN.

**Session 7. Dental Anthropology I.** Contributed Papers. *Buccaneer C–D.*

Chair: DEBBIE J. GUATELLI-STEINBERG, Ohio State University.

- 8:00 am The Italian populations during the Copper Age (III millennium BC): Analysis of the genetic barriers. ALFREDO COPPA, ANDREA CUCINA, MICHAELA LUCCI, FRANZ MANNI, RITA VARGIU.

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**Thursday Morning – April 15, 2004 (continued)**


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- 8:15 am Dental anthropology in Scotland: Morphological comparisons between medieval Scotland and northern Europe. ALMA J. ADLER, M.E. WATT, C.G. TURNER II.
- 8:30 am Origin of the inhabitants of Bronze Age Bactria: A dental morphological investigation. REBECCA NOSAKA, BRIAN E. HEMPHILL.
- 8:45 am Amazons of the Amu Darya?: A dental pathological investigation of gender and status in Bronze Age Bactria. SARAH BLAYLOCK, BRIAN E. HEMPHILL.
- 9:00 am Occlusal Fingerprint Analysis (OFA) - Quantifying individual wear pattern of tooth crowns using optical 3-D topometry. OTTMAR KULLMER, KERSTIN ENGEL, MATHIAS HUCK, LILIAN ULHAAS, OLAF WINZEN, FRIEDEMANN SCHRENK.
- 9:15 am Dental microwear at Mission San Luis de Apalachee. JASON M. ORGAN, MARK F. TEAFORD, CLARK S. LARSEN.
- 9:30 am Woodland to Mississippian dietary transitions in Indiana as indicated by dental microwear analysis. CHRISTOPHER W. SCHMIDT.
- 9:45 am Dental reduction and diet in the Prehistoric Ohio River Valley. MOLLY K. HILL.
- 10:00 am Break
- 10:15 am The size of the dentition. PETER W. LUCAS.
- 10:30 am Molar shear crests as dietary indicators: Evidence from primate ecological analogs. AARON S. HOGUE.
- 10:45 am Weaning in early medieval England. PAMELA M. MACPHERSON, CAROLYN A. CHENERY.
- 11:00 am Investigation of age at weaning using Sr/Ca ratios in human tooth enamel. LOUISE T. HUMPHREY, TERESA E. JEFFRIES, M. CHRISTOPHER DEAN.

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**Thursday Afternoon – April 15, 2004**


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**Session 8. Primate Evolution I. Contributed Posters. *Regency 1.***

Chair: MARK COLLARD, Washington State University.

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. The effects of time and habitat differences on the dentition of *Victoriapithecus macinnesi* from middle Miocene deposits at Maboko. BRENDA R. BENEFIT, ELIZABETH LYNCH.
2. The Middle Miocene Maboko Island primate locality: New data and the integration and reinterpretation of existing data suggest the paleoenvironment was lacustrine. BRADLEY T. WATKINS.
3. Phyletic and locomotor affinities of the *Victoriapithecus* forelimb. KATHLEEN T. BLUE, MONTE L. MCCROSSIN, BRENDA R. BENEFIT.
4. Incisor variation in Miocene proto-hominoids: A comparative study across 12 fossil genera. CANDACE A. DAVIS.
5. An infant skull of *Lufengpithecus* from Yuanmou, Yunnan Province, China. FENG GAO, JAY KELLEY, LIANG ZHENG, WU LIU.
6. Locomotor diversity among Miocene catarrhines: Another look at retroflexion of the medial epicondyle of the humerus. MONTE L. MCCROSSIN.
7. A geometric morphometric comparison of *Gigantopithecus giganteus* and *Gigantopithecus blacki* with implications for hominoid taxonomy and phylogeny. STEVEN F. MILLER, RUSSELL L. CIOCHON.

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**Thursday Afternoon – April 15, 2004 (continued)**


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8. Did *Proconsul heseloni* have a tail? MASATO NAKATSUKASA.
9. Metric variation in the dentition of *Ouranopithecus macedoniensis* (de Bonis and Melentis, 1977). CAITLIN M. SCHREIN.
10. Apical tuft morphology in subfossil lemurs and living primates: Function and phylogenetic inertia. HEATHER F. SMITH, WILLAM L. JUNGERS, ELWYN SIMONS, PIERRE LEMELIN.
11. Reconstruction of ear ossicles from the most primitive primate cranium known using ultra high resolution computed tomography. MARY T. SILCOX, JONATHAN I. BLOCH.
12. Thinking small: A comparative study of dental microstructure in *Cantius*, *Otolemur*, *Perodicticus*, and *Saimiri*. WENDY DIRKS, FERNANDO V. RAMIREZ ROZZI, DONALD J. REID, ROBERT L. ANEMONE.
13. Variation in omomyid ankles and its implications for phylogeny reconstruction. MATTHEW A. TORNOW.
14. Phylogenetic implication on humeral and calcaneal morphologies of Amphipithecidae. NAOKO EGI, MASANARU TAKAI, SOE THURA TUN, NOBUO SHIGEHARA, TAKEHISA TSUBAMOTO.
15. New eosimiid species from the latest middle Eocene of Pondaung, Myanmar. MASANARU TAKAI, NAOKO EGI, TAKEHISA TSUBAMOTO, NOBUO SHIGEHARA.
16. Testing for hyperpaedomorphosis in southern African Plio-Pleistocene baboons. FRANK L. WILLIAMS.
17. Size, shape, and integration in hominoid crania. JOSHUA M. POLANSKI.
18. Heterochrony and geometric morphometrics: A comparison of cranial growth in *Pan paniscus* versus *Pan troglodytes*. PHILIPP MITTEROECKER, PHILIPP GUNZ, GERHARD WEBER, FRED L. BOOKSTEIN.
19. Sexual selection, homoplasy and fossil primate phylogenetics. MARK COLLARD.
20. Primate speciosity, taxonomic distributions, and power law behavior. ANTHONY J. OLEJNICZAK.
21. Muscle recruitment in primates: Preliminary results on the question of neuromuscular conservation in primates. SUSAN G. LARSON, JACK T. STERN, JR.
22. Humeral torsion in anthropoids and its relationship to upper thoracic and/or pectoral girdle shape. AMY E. JUDD.
23. Character analysis of hominoid trunk and forelimb morphology: Synapomorphy or homoplasy? STEVEN WORTHINGTON.
24. Quantifying curvature in fragmentary fossil hominoid phalanges using the anatomical curve fitting (ACF) method. ANDREW S. DEANE, DAVID R. BEGUN, ERIK P. KREMER.

**Session 9. Human and Primate Brain Evolution I. Contributed Posters. Regency 1.**

Chair: MARK COLLARD, Washington State University.

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|----------------|---|
| 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.                                       |
25. Comparative volumetric analysis of the hominoid amygdala. NICOLE L. BARGER, LISA STEFANACCI, NATALIE SCHENKER, KATERINA SEMENDEFERI.
  26. A comparative volumetric analysis of the human and ape hippocampus. KATE TEFFER, NATALIE SCHENKER, KATERINA SEMENDEFERI.
  27. *Papio* brain and sulcal growth: A comparison with *Macaca*. MELISSA L. RAGUET-SCHOFIELD, STEVEN R. LEIGH.
  28. The spindle neurons of frontoinsular cortex (area FI) are unique to humans and African apes. ATIYA HAKEEM, JOHN ALLMAN, NICOLE TETREAU, KATERINA SEMENDEFERI.

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**Thursday Afternoon – April 15, 2004 (continued)**


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29. Accelerated cell column development: A Comparison between normal and Down Syndrome in four areas of cortex. DANIEL P. BUXHOEVEDEN, MANUEL F CASANOVA.
30. Molecular evolution of ASPM, a gene involved in human brain development. BENJAMIN M. BURKLEY, CONNIE J. MULLIGAN.
31. Timing characteristics of two different facial signals: Deliberate and spontaneous smiles. KAREN L. SCHMIDT, ZARA AMBADAR, L. IAN REED, JEFFREY F. COHN.

**Session 10. Primate Biology II. Contributed Posters. Regency 1.**

Chair: SARAH ELTON, Hull York Medical School.

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|----------------|---|
| 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.                                       |

32. The primates of Phu Khieo Wildlife Sanctuary. ANDREAS KOENIG, EILEEN LARNEY, KITTI KREETIYUTANONT, CAROLA BORRIES.
33. Phayre's leaf monkeys - multimale groups with female dispersal. CAROLA BORRIES, EILEEN LARNEY, ABIGAIL DERBY, ANDREAS KOENIG.
34. Parapatric groups of black and common squirrel monkeys (*Saimiri vanzolinii* and *Saimiri sciureus*) in the central Amazon. DYLAN M. SCHWINDT, JOSÉ M. AYRES.
35. Patterns of ecological diversity in modern small mammal communities of Madagascar. KATHLEEN M. MULDOON.
36. The slow pace of primate infancy: Lengthened lactation in long-lived learners. MEREDITH L. BASTIAN.
37. Serum leptin reflects ecological differences in vervet monkey (*Cercopithecus aethiops*) populations. PATRICIA L. WHITTEN, TRUDY R. TURNER.
38. A quantitative analysis of the ecological niche space of savanna baboon populations, and its taxonomic implications. JASON M. KAMILAR.
39. Effects of habitat on fluctuating asymmetry in a population of wild ring-tailed lemurs (*Lemur catta*). KRISTA D. FISH, MICHELLE SAUTHER, FRANK CUOZZO.
40. Dental variation and dental health in a wild population of ring-tailed lemurs (*Lemur catta*) from Beza Mahafaly Special Reserve, Madagascar. FRANK P. CUOZZO, MICHELLE L. SAUTHER, KRISTA D. FISH.
41. A captive infant female gorilla with vitamin D and calcium deficiency: Preliminary description. ANNA BELLISARI, DANA L. DUREN, RICHARD J. SHERWOOD, MICHAEL BARRIE.
42. Stress, life history, and dental development in the vervet (*Chlorocebus aethiops*) and baboon (*Papio hamadryas*) from dental histology. DONALD J. REID, WENDY DIRKS, CLIFFORD J. JOLLY, JANE E. PHILLIPS-CONROY, FREDERICK BRETT.
43. Age changes in the adult skulls of Old World monkeys (Primates: Cercopithecidae). NINA G. JABLONSKI.
44. Muzzle morphology and size in *Mandrillus leucophaeus*. SARAH ELTON, BETHAN J. MORGAN.
45. Sex differences in growth patterns in proboscis monkeys and crested langurs. DEBRA R. BOLTER.
46. A comparison of craniofacial sexual dimorphism in *Papio ursinus* and *P. cynocephalus*. RIASHNA SITHALDEEN, REBECCA ROGERS ACKERMANN.
47. Relationship between tooth size and mandibular size and shape in primates. DELISA L. PHILLIPS, J. MICHAEL PLAVCAN, DAVID J. DAEGLING.

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**Thursday Afternoon – April 15, 2004 (continued)**


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48. Analysis of cranio-mandibular shape differences between *Pan paniscus* and *Pan troglodytes* using geometric morphometrics. CHRIS A. ROBINSON, KATERINA HARVATI.
49. Variation of the mandibular molars in extant lemuriform primates: A qualitative and quantitative study. JESSICA L. WHITE.
50. Attrition in the dentition of a population of Peruvian tamarins (*Saguinus mystax mystax*). ALEXANDRA M. ROBINSON, SUSAN M. FORD, PAUL A. GARBER.
51. Skeletal and dental development in wild chimpanzees from Tai National Forest, Ivory Coast and Gombe Reserve, Tanzania. ADRIENNE L. ZIHLMAN, DEBRA BOLTER, CHRISTOPHE BOESCH.
52. Body composition and proportions in gibbons (*Hylobates*) and siamangs (*Symphalangus*): A preliminary report. MARISSA SOUSA, ADRIENNE ZIHLMAN.
53. Anatomical components of locomotion in five genera of apes: A preliminary overview. ROBIN K. MCFARLAND, MARISSA SOUSA, ADRIENNE L. ZIHLMAN.
54. Postcranial, cranial, and body mass dimorphism in three sympatric West African primates. JULIE E. MARVIN, J. MICHAEL PLAVCAN, W. SCOTT MCGRAW.
55. Locomotor adaptations in primates and other mammals. HELEN J. CHATTERJEE, WILLIAM PARR.
56. Precocial development of hindlimb muscle mass ratios in quadrupedal and leaping. MADELIENE ATZEVA, MELISSA L. KIRKBRIDE, ANNE M. BURROWS, TIMOTHY D. SMITH.
57. Bilateral asymmetry in the upper arm bones of chimpanzees (*Pan troglodytes*). LAUREN A. SARRINGHAUS, JAY T. STOCK, WILLIAM C. MCGREW, LINDA F. MARCHANT.
58. The relationship between locomotor behavior and the fabric principal direction of trabecular bone. TIMOTHY M. RYAN, RICHARD A. KETCHAM.
59. Comparison of size and shape patterns in the postcranial skeleton of *Macaca*, with attention to locomotor variation in *M. fascicularis* and *M. nemestrina*. KIMBERLY A. NICHOLS-BOWN, KATHLEEN RATTEREE.
60. Influence of arboreal support type upon stride duration and duty factor during primate arboreal quadrupedalism. NANCY J. STEVENS.
61. The relationship between midcarpal joint morphology and ulnar deviation of the hand in strepsirhine primates. PIERRE LEMELIN.
62. Head kinematics during locomotion in a gibbon and Japanese macaques. EISHI HIRASAKI, HIROO KUMAKURA.
63. Morphological variation in the genus *Perodicticus*. DAVID P. STUMP.
64. Using SEM to qualitatively identify structural differences in the hairs of nectar feeding prosimians. MAGDALENA N. MUCHLINSKI.
65. Quantifying male ejaculate volume: High-resolution x-ray computed tomography scanning of primate sperm plugs. JOYCE A. PARGA, MURAT MAGA, DEBORAH J. OVERDORFF.
66. Modeling the precision of landmark location data. DENNIS E. SLICE, CHRISTINE UNTEREGGER, KATRIN SCHAEFER, FRED L. BOOKSTEIN.

**Session 11. Hominid Evolution II: Australopithecines and Early *Homo*.** Contributed Papers.  
*Regency 2–3.*

Chair: SUSAN ANTÓN, New York University.

- 1:00 pm Early Pliocene hominids and their environments from Gona, Ethiopia. SCOTT W. SIMPSON, J. QUADE, N. LEVIN, P. RENNE, B. BUTLER, W.C. MACINTOSH, S. SEMAW.

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**Thursday Afternoon – April 15, 2004 (continued)**


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- 1:15 pm Fossil excavations of the Makapansgat Member 2 and adjacent breccias. TAFLINE C. CRAWFORD, JEFFREY K. MCKEE, GLENN C. CONROY, KEVIN L. KUYKENDALL, ALF G. LATHAM.
- 1:30 pm Species richness in early hominins: A reply to Conroy. GLENN C. CONROY.
- 1:45 pm Canine dimorphism in *Australopithecus anamensis*. CAROL V. WARD, J. MICHAEL PLAVCAN.
- 2:00 pm Sexual dimorphism in the Hadar *A. afarensis* sample: Another look. SANG-HEE LEE.
- 2:15 pm Can sexual dimorphism in skeletal size be used to assess sexual dimorphism in body size? CHRISTOPHER B. RUFF, HENRY M. MCHENRY.
- 2:30 pm Interpretation of postcranial variation in South African Plio-Pleistocene hominids. PATRICIA S. VINYARD.
- 2:45 pm Molar topography and dental functional morphology of *Australopithecus afarensis* and early *Homo*. PETER S. UNGAR.
- 3:00 pm Break
- 3:15 pm Seasonality and australopithecine diets: New high-resolution carbon isotope data. MATT SPONHEIMER, JULIA LEE-THORP, DARRYL DE RUITER.
- 3:30 pm The scarcity of African mid-Pleistocene hominin fossils. RICHARD POTTS.
- 3:45 pm The roles of infant crying and motherese during prelinguistic evolution in early hominins. DEAN FALK.
- 4:00 pm The geometry of anthropometrics: A new typology of landmarks FRED L. BOOKSTEIN, KATRIN SCHAEFER, PHILIPP MITTEROECKER, PHILIPP GUNZ, HORST SEIDLER.
- 4:15 pm An analysis of variation in early Indonesian mandibles. FANG-YI CHIANG, RACHEL CASPARI.
- 4:30 pm A multivariate analysis of the postcranium of KNM-ER 3735 (*Homo habilis*). MARTIN HAEUSLER, HENRY M. MCHENRY.
- 4:45 pm Predicting the location of well-preserved Palaeolithic archaeological sites in Africa and Asia based on the likelihood of bone preservation. KATHRYN M. HOLMES, KATE ROBSON BROWN, MATTHEW COLLINS.

**Session 12. A Second Biological Garden of Eden—Island Melanesian Genetic Diversity.**  
 Symposium. *Regency 5–6.*

Organizer and Chair: JONATHAN S. FRIEDLAENDER, Temple University.

This symposium brings together new findings on the remarkable genetic diversity in Island Melanesia—the region extending from New Guinea to Fiji. Diversity in Island Melanesia reflects a very old and relatively isolated settlement history. For this reason, it has sometimes been called a “Second Biological Garden of Eden.” During the past 8 years, Pacific population genetics has focused on a controversy surrounding hypothesized migrations from approximately 5,000 to 3,000 years ago which included the colonizations of Polynesia and Micronesia. The symposium necessarily addresses these relatively recent episodes, since the focus of our collaborative efforts is on the Bismarck Archipelago and Solomon Islands, a key region in these expansions. In addition, the papers identify the genetic signatures of considerably earlier population movements and isolation in the region extending back 40,000 years. The different roles of drift, migration, and selection at a series of loci are discussed, using data from the same set of diverse populations.

- 1:00 pm Island Melanesian pasts - A view from archaeology. GLENN REGINALD SUMMERHAYES.
- 1:15 pm Recent research on the historical relationships of the Papuan languages. ANDREW PAWLEY, MALCOLM ROSS.
- 1:30 pm Marital migration rates, malaria epidemiology, and biological diversity within Island Melanesia. GEORGE KOKI, JONATHAN FRIEDLAENDER.
- 1:45 pm Patterns of mitochondrial variation in Melanesia and implications for the settling of the Pacific: Haplogroup 8. LYDIA SMITH, KAY GRENNAN, JONATHAN FRIEDLAENDER, D. ANDREW MERRIWETHER.



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**Thursday Afternoon – April 15, 2004 (continued)**


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- 2:00 pm Minding the P's and Q's: New mtDNA haplogroup data from Melanesia. FRED GENTZ, FRANÇOISE THOMPSON, JONATHAN FRIEDLAENDER, THEODORE SCHURR, MOSES SCHANFIELD, D. ANDREW MERRIWETHER.
- 2:15 pm Peopling Melanesia: A genetics synthesis. D. ANDREW MERRIWETHER, JONATHAN FRIEDLAENDER.
- 2:30 pm Y chromosome variation in Melanesian populations. LAURA SCHEINFELDT, JONATHAN FRIEDLAENDER, FRANÇOISE THOMPSON, RENATO ROBLED0, D. ANDREW MERRIWETHER, WILLIAM BEGGS, PATRICK BENDER, TATIANA KARAFET, MICHAEL HAMMER, JOSEPH LORENZ.
- 2:45 pm Break
- 3:00 pm Pigmentation variation in Island Melanesia and associated candidate gene variation. HEATHER L. NORTON, JONATHAN S. FRIEDLAENDER, D. ANDREW MERRIWETHER, GEORGE KOKI, CHARLES MGONE, MARK D. SHRIVER.
- 3:15 pm An informative 9.1-kb in/del polymorphism on chromosome 22 across Island Melanesian populations. RENATO ROBLED0, LAURA SCHEINFELDT, FRANÇOISE THOMPSON, GEORGE KOKI, CHARLES MGONE, D. ANDREW MERRIWETHER, JONATHAN FRIEDLAENDER.
- 3:30 pm Charting genomic variability for clues on population history and genetic adaptation. MARK D. SHRIVER.
- 3:45 pm Patterns of genomic variation in the Baining of New Britain in relation to other world populations. MICHAEL F. HAMMER, ELIZABETH.T. WOOD, MAYA M. PILKINGTON, ABIGAIL W. BIGHAM, ZAHRA MOBASHER, GEORGE KOKI, CHARLES MGONE, JONATHAN FRIEDLAENDER.
- 4:00 pm JC Virus genotype distribution in Papua New Guinea. JILL CZARNECKI, JONATHAN FRIEDLAENDER, CHARLES MGONE, GERALD STONER.
- 4:15 pm Discussion: JEFFREY C. LONG, JONATHAN FRIEDLAENDER.

**Session 13. Primate Behavior I: Social Behavior.** Contributed Papers. *Regency 7.*

Chair: CHERYL D. KNOTT, Harvard University.

- 1:00 pm The cohesive nature of gestural communication among *Pan paniscus* in the wild. ELLEN J. INGMANSON.
- 1:15 pm Idiosyncratic social behaviors of brown capuchins in an anthropogenic landscape are consistent with prevalent socioecological theory. SUE BOINSKI.
- 1:30 pm Copulation calls and female mate choice in baboons. DARIO MAESTRIPIERI, MARCO LEONI, JAMES R. RONEY, JESSICA C. WHITHAM.
- 1:45 pm Stained v. clean males: Female power maintains male bimorphism in Verreaux's sifaka (*Propithecus verreauxi verreauxi*). REBECCA J. LEWIS.
- 2:00 pm The Jack Sprat hypothesis: Diet competition in a female-dominant species. SHARON T. POCHRON, PATRICIA C. WRIGHT.
- 2:15 pm The efficacy of female choice in chimpanzees of the Taï National Park, Côte d'Ivoire. REBECCA M. STUMPF, CHRISTOPHE BOESCH.
- 2:30 pm Does estradiol modulate sexual solicitations in the female Sichuan Golden Monkey (*Rhinopithecus roxellana*)? CAIE YAN, ZHIGANG JIANG.
- 2:45 pm Nice chimps don't always finish last: Dominance rank and behavioral style in chimpanzees. STEPHANIE F. ANESTIS.
- 3:00 pm Break
- 3:15 pm Dominance, cortisol and stress in wild chimpanzees. MARTIN N. MULLER.
- 3:30 pm Resident male replacement in *Cebus capucinus* groups. KATHARINE M. JACK, LINDA M. FEDIGAN.

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**Thursday Afternoon – April 15, 2004 (continued)**


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- 3:45 pm Increased male-male cooperation among brown capuchin monkeys (*Cebus apella*) in Suriname. LAURIE M. KAUFFMAN, ERIN E. EHMKE, SUE BOINSKI.
- 4:00 pm Adult male relations with juveniles among brown capuchins (*Cebus apella*) in Suriname: Affiliation, antagonism, or benign neglect? ERIN E. EHMKE, LAURIE M. KAUFFMAN, SUE BOINSKI.
- 4:15 pm Meat sharing by chimpanzees at Ngogo, Kibale National Park. DAVID P. WATTS, JOHN C. MITANI.
- 4:30 pm Correlates of territorial boundary patrol behavior in wild chimpanzees. JOHN C. MITANI, DAVID P. WATTS.
- 4:45 pm Leveling coalitions in primate males: Toward an explanation of human egalitarianism. CAREL P. VAN SCHAIK, SAGAR PANDIT.

**Session 14. Paleopathology I. Contributed Papers. *Buccaneer C–D.***

Chair: BRENDA J. BAKER, Arizona State University.

- 1:00 pm Food and the state: Bioarchaeological investigations of diet in the Moche Valley of Perú. CELESTE M. GAGNON.
- 1:15 pm An investigation of the range of skeletal indicators of vitamin D deficiency in adults and juveniles. MEGAN B. BRICKLEY, SIMON MAYS, RACHEL IVES.
- 1:30 pm Synergistic musculoskeletal attachment sites in the upper extremity and activity patterns at Tell Abra, United Arab Emirates, 2300 BC. JANET M. COPE, LOUIS M. ADLER, DEBRA L. MARTIN, DAN D. POTTS.
- 1:45 pm Progress in the aDNA identification of syphilis in archaeological human remains. TANYA E. VON HUNNIUS, DONGYA YANG, SHELLEY R. SAUNDERS.
- 2:00 pm Microscopic diagnosis in ancient treponema diseases. MICHAEL SCHULTZ, TYEDE H. SCHMIDT-SCHULTZ.
- 2:15 pm Growth, stress and deprivation in the Old Frankfort Cemetery: An evaluation of stature, hypoplasias and Harris lines in a nineteenth century population. PETER E. KILLORAN, DAVID POLLACK, CHRISTOPHER TILLQUIST, MINDI KING, ASA HELM, AMY HOWARD.
- 2:30 pm When size does not matter: An examination of aggregate osteoarthritis. ELIZABETH WEISS.
- 2:45 pm Break
- 3:00 pm Sacroiliac joint ankylosing: From evolution to paleopathology. ISRAEL HERSHKOVITZ, GALI DAR.
- 3:15 pm Why Erik "Not al all" - A possible case of Marfans Syndrome. TORBJORN P. AHLSTRÖM.
- 3:30 pm An empirical test of mortality bias in the skeletal series from Hasanlu. DIANA B. SMAY.
- 3:45 pm Preliminary report on the human skeletal remains from the Kubinski site (11WI1186), a Middle Woodland period ossuary. WILLIAM J. PESTLE, MICHAEL D. COLVARD, SCOTT J. DEMEL.
- 4:00 pm Patterns of damage in Egyptian mummies and related causes. ELLEN SALTER-PEDERSEN.
- 4:15 pm Developmental enamel defects of deciduous dentition from Taumako Island, Southwest Solomon Islands, Pacific Islands. HALLIE R. BUCKLEY.

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**Friday Morning – April 16, 2004**


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**Session 15. Primate Behavior II. Contributed Posters. Regency 1.**

Chair: LESLIE J. DIGBY, Duke 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. Littoral forest primate fauna in the Tolagnaro (Fort Dauphin) region of southeastern Madagascar. MATTHEW A. BANKS.
2. Population viability analysis of ring-tailed lemurs (*Lemur catta*) of the Beza-Mahafaly Special Reserve, Madagascar. DANA WHITELAW, KRISTA FISH, MICHELLE SAUTHER, LISA GOULD, ROBERT SUSSMAN.
3. Howler monkey (*Alouatta pigra*) populations in five Maya archaeological zones in southern Mexico and northern Guatemala. LEANDRA G. LUECKE.
4. Group size resurgence in mantled howlers (*Alouatta palliata*). MARGARET R. CLARKE.
5. Changes in social structure in *Eulemur fulvus rufus* in southeastern Madagascar from 1988-2003. ELIZABETH M. ERHART, DEBORAH J. OVERDORFF, THOMAS MUTSCHLER.
6. Optimal size of feeding and traveling subgroups of spider monkey (*Ateles belzebuth*). LUISA ARNEDO, JORGE AHUMADA.
7. The response of the Ngogo chimpanzee (*Pan troglodytes*) community to a period of ripe fruit scarcity. KEVIN B. POTTS.
8. A preliminary study of the demography and ecology of mouse lemurs (*Microcebus griseorufus* and *Microcebus murinus*) in the Beza Mahafaly Special Reserve, southwest Madagascar. EMILIENNE RASOAZANABARY.
9. Feeding and ranging of hoolock gibbons (*Hylobates hoolock*) in the Borajan Wild Life Sanctuary, Assam, India. GAYATRI S. THAMPY, JAYANTA DAS, W. SCOTT MCGRAW.
10. Reconstructing human behavioural evolution through phylogenetic analyses of extant hominoid behaviour. SAMANTHA J. BANKS, MARK COLLARD.
11. Development of foraging skills in the aye-aye (*Daubentonia madagascariensis*). ELISSA B. KRAKAUER.
12. Looking for safety at the top: Sleep site selection by *Propithecus diadema edwardsi* within Ranomafana National Park, Madagascar. SUMMER J. ARRIGO-NELSON.
13. A taphonomic analysis of crowned hawk-eagle nests from Tai National Forest, Ivory Coast. CATHERINE A. COOKE, SUZANNE SHULTZ, W. SCOTT MCGRAW.
14. Seed dispersal by black howler monkeys (*Alouatta caraya*) in a northeastern Argentinean flooded forest. ANA SALLENAVE, SUSANA P. BRAVO.
15. A preliminary study of seed dispersal by white-faced capuchins (*Cebus capucinus*) and mantled howlers (*Alouatta palliata*) in Costa Rica. SARAH J. SMITH.
16. Habitat structure of a non-forest corridor used by a group of Tana mangabeys (*Cercocebus galeritus*). JULIE WIECZKOWSKI.
17. Foraging, ranging, and spatial memory in the mantled howler monkey (*Alouatta palliata*). CHRISTOPHER A. SHAFFER.
18. Lemur latrines: Do "latrines" of wild primates function in inter-group olfactory communication? MITCHELL T. IRWIN, KAREN E. SAMONDS, JEAN-LUC RAHARISON, PATRICIA C. WRIGHT.
19. Allo-mothering in black and white colobus monkeys (*Colobus guereza*). TARA R. HARRIS.
20. Behavioral differences in hierarchical relationships: Aggression and grooming among male and female *Macaca fascicularis* at Pedangtegal, Bali, Indonesia. MARIO E. NIETO, AGUSTIN FUENTES.

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**Friday Morning – April 16, 2004 (continued)**


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21. A comparison of female dominance in blue-eyed black lemurs (*Eulemur macaco flavifrons*) and gray gentle lemurs (*Haplemur griseus griseus*). LESLIE J. DIGBY, ALEXANDER M. STEVENS.
22. A preliminary study of social behavior and pair-bonding in wild titi monkeys (*Callicebus discolor*) in Amazonian Ecuador. ANTHONY DI FIORE, DYLAN M. SCHWINDT.
23. Adult male-immature interactions in long-tailed macaques (*Macaca fascicularis*) at Padangtegal, Ubud, Bali, Indonesia. JAMES B. MILLETTE, BEN Z. FREED, AGUSTIN FUENTES, JAMES E. LOUDON.
24. Male-infant interactions in wild sifaka (*Propithecus verreauxi*). DIANE K. BROCKMAN, PATRICIA L. WHITTEN.
25. Behavioral and hormonal estrus cycles in captive geriatric lowland gorillas (*Gorilla gorilla*). SYLVIA ATSA LIS, SUE MARGULIS.
26. Perimenstrual behavior in captive female chimpanzees (*Pan troglodytes*). RACHEL W. JOHNS, LEANNE T. NASH.
27. Play patterns in small juvenile white-faced capuchin monkeys (*Cebus capucinus*) in Costa Rica. KATHERINE C. MACKINNON.
28. Social behavior and aggression among semi-free ranging ringtailed lemurs. ROBERT W. SUSSMAN, ANNA STARK, RACHEL KRIWINSKY, LINDSAY MEADOR, JOHN SEVERSON, DAVID ULEVITCH, DUNCAN WARD.
29. Social dynamics of captive male western lowland gorillas living in all-male groups. TARA S. STOINSKI, CHRISTOPHER W. KU HAR, KRISTEN E. LUKAS.
30. Influence of availability on food transfer patterns in a captive Angolan colobus monkey group. PETER J. FASHING.
31. A stone in their hands... are monkeys tool users?. BERNARDO URBANI, PAUL A. GARBER.
32. Possible intergeneric differences in finding objects among lemurs. ANJA M. DEPPE, PATRICIA C. WRIGHT.
33. Vocal communication within a troop of mantled howling monkeys (*Alouatta palliata*). MARTHA C. MCKEON, KRISTIN WINNOR.
34. Acoustic variation in the long calls of wild spider monkeys (*Ateles belzebuth belzebuth*). STEPHANIE SPEHAR.
35. Cross species communication? Video analysis of human-monkey interactions. KATHERINE A. BERANEK, AGUSTIN FUENTES.
36. Chimpanzees and humans: The role of spatial analysis in primate conservation. AMANDA G. CLAPP, JILL D. PRUETZ.
37. Effect of human cohabitation on activity budgets in white-fronted capuchin monkeys (*Cebus albifrons*) in Ecuador: A pilot study. MICHELLE Y. FIELD.
38. Sacred cropraiders? An examination of sympatric associations among *Homo sapiens* and *Macaca fascicularis* on the island of Bali. JAMES E. LOUDON, AGUSTIN FUENTES, MICHAELA E. HOWELLS, JESSICA FRAVER, ARTA PUTRA, NENGAH WANDIA, I. GEDE SOMA, I. NYOMAN SUARHTA, SRI WIDYASTUTI, AIDA ROMPIS.
39. Ontogenetic influences on prehensile-tail use in *Cebus capucinus*. MICHELLE F. BEZANSON.
40. Sifaka positional behavior: Ontogenetic and quantitative genetic approaches. RICHARD R. LAWLER.
41. Kinematics and kinetics of bonobo (*Pan paniscus*) climbing. KIRSTEN SCHOONAERT, KRISTIAAN D'AOÛT, DRIES LAUWERS, PETER AERTS.
42. Creating the collection: Ontogeny of locomotion in Vietnamese colobines. CATHERINE C. WORKMAN.
43. Intraspecific differences in positional behavior of the white-faced saki, *Pithecia pithecia*, and the influence of habitat characteristics. SUZANNE E. WALKER.

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**Friday Morning – April 16, 2004 (continued)**


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**Session 16. The Current State of Paleoanthropological Research in East and Southeast Asia.**  
 Symposium. *Regency 2*.

Organizers: SHEELA ATHREYA, Texas A&M University, and MICHELLE M. GLANTZ, Colorado State University.

Chair: SHEELA ATHREYA, Texas A&M University.

This symposium explores the current state of research on human evolution in Asia, bringing together scholars whose work focuses on two historically well-researched regions of the continent, namely China and island Southeast Asia (Indonesia). Skeletal, biogeographic, and paleoenvironmental studies of hominid occupation during the Middle and Late Pleistocene are highlighted. In addition, methodological and technological advancements in fossil and site analysis as applied to the Asian evidence are presented. The purpose of this symposium is to review the latest research in these two regions of the Old World in order to explore more in-depth issues related to evolutionary trajectories in Asia, and the role of these populations in the origin of modern humans.

- 8:00 am A test of the multiregional hypothesis of modern human origins using the basicranial evidence from Southeast Asia and Australia. ARTHUR C. DURBAND.
- 8:15 am Discovery of Sambungmacan hominid fossils and its contribution to the study of human evolution in Australasia. FACHROEL AZIZ, YOSUKE KAIFU, HISAO BABA, TEUKU JACOB, SHUICHIRO NARASAKI.
- 8:30 am Morphology of Sambungmacan 4 skull and the evidence of discontinuity in Australasia. HISAO BABA, FACHROEL AZIZ, YOSUKE KAIFU, REIKO T. KONO, TEUKU JACOB.
- 8:45 am Taxonomic affinities and geochronological age of RH1, the first fossil hominid from West Java, Indonesia. ANDREW KRAMER, TONY DJUBIANTONO, FACHROEL AZIZ, JAMES S. BOGARD, ROBERT A. WEEKS, WILLIS E. HAMES, JAMES M. ELAM, DANIEL C. WEINAND, ARTHUR C. DURBAND, MR. AGUS.
- 9:00 am The post-cranial functional morphology of Javanese bovids as an indicator of paleoenvironment. DANIEL C. WEINAND.
- 9:15 am Niah Cave paleoanthropology in late Pleistocene regional context. JOHN S. KRIGBAUM.
- 9:30 am Biogeography of *Homo erectus*: Insights from Indonesia and China. SUSAN ANTÓN, ETTY INDRIATI.
- 9:45 am Break
- 10:00 am Assessing the relationship of Asian Middle Pleistocene *Homo* to other regional populations using frontal bone morphology. SHEELA ATHREYA.
- 10:15 am Human evolution in the far northeast: The significance of the Jinniushan fossil for models of modern human origins. ZUNE LU, KAREN R. ROSENBERG.
- 10:30 am The uplift of the Qinghai-Xizang plateau and its effects on human evolution in East Asia. YOUPIING WANG.
- 10:45 am Affinities of the Middle Pleistocene crania from Dali and Jinniushan, China. G. PHILIP RIGHTMIRE.
- 11:00 am Three-dimensional digital restoration of the Yunxian crania. TIANYUAN LI, M. AMELIE, M. LIAO, X. FENG.
- 11:15 am Three-dimensional mapping of the *Homo erectus* Loci at Zhoukoudian, China. RUSSELL L. CIOCHON, NOEL T. BOAZ.
- 11:30 am Late Pleistocene human evolution in China: East Asian pathways to modernity. DENNIS A. ETLER.
- 11:45 am Discussion: MILFORD WOLPOFF.

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**Friday Morning – April 16, 2004 (continued)**


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**Session 17. Human Ecological Immunity: Models and Methods for Future Research.**

 Symposium. *Regency 3*.

Organizer and Chair: THOMAS McDADE, Northwestern University.

There is growing interest in field-based research on immune function and its implications for infectious disease, adaptation, ecology, and life history. The complexity of the immune system raises a number of methodological and conceptual challenges that have limited prior research. This symposium brings together scholars working on a wide range of immunological issues in non-clinical settings, and invites them to discuss the models and methods that have informed their research. Comparative, adaptationist, developmental, and ecological perspectives have the potential to contribute greatly to our understanding of this critical host defense system, and to establish human ecological immunology as a vibrant area of investigation. Cosponsored by the Human Biology Association.

- 8:00 am Human ecological immunology: Challenges and opportunities. THOMAS W. McDADE.
- 8:15 am Comparative studies of immune system parameters and disease risk in nonhuman primates. CHARLES NUNN.
- 8:30 am Co-evolution of malaria infection and the human genome: Implications for human evolutionary history. SARAH TISHKOFF, BRIAN C. VERRELLI, EDUARDO TARAZONA-SANTOS, ALESSIA RANCIARO.
- 8:45 am Population-pathogen histories, MHC efficiency, and vaccine efficacy. JENNIFER L. KUZARA.
- 9:00 am Immunity and micronutrient status: New directions for field research. BETTINA SHELL-DUNCAN.
- 9:15 am Iron, stress, and immunity: A monkey model. GABRIELE R. LUBACH, CHRISTOPHER L. COE.
- 9:30 am Puberty, immunity and malnutrition in *Schistosoma japonicum*. STEPHEN T. MCGARVEY.
- 9:45 am Break
- 10:00 am Testosterone, parasitemia, and cytokine correlates during human malarial infection. FRANK B. COGSWELL, JACKELINE ALGER, MARK JAMES, MICHAEL P. MUEHLENBEIN.
- 10:15 am Balancing the immunological demands of pregnancy and infection. JESSE KWIEK, ELIZABETH T. ABRAMS, DAN MILNER, VICTOR MWAPASA, STEVEN R. MESHNICK.
- 10:30 am Fluctuating asymmetry and immune status: Implications for intrauterine growth in a population of South American natives. A. MAGDALENA HURTADO.
- 10:45 am How important is immunostimulation in causing growth stunting? CATHERINE PANTER-BRICK, PETER G. LUNN.
- 11:00 am What's stress got to do with it? The social ecology of immune function. CAROL M. WORTHMAN.
- 11:15 am Are there critical periods in the ontogeny of stress response and immune function? MARK V. FLINN, BARRY G. ENGLAND.
- 11:30 am Discussion: THOMAS McDADE.

**Session 18. Primate Evolution II. Contributed Papers. *Buccaneer A–B*.**

Chair: WILLIAM L. JUNGERS, Stony Brook University.

- 8:00 am New hypothesis of primate supraordinal relationships and its bearing on competing models of primate origins: A test from the fossil record. JONATHAN I. BLOCH, MARY T. SILCOX, DOUG M. BOYER, ERIC J. SARGIS.
- 8:15 am Developmental basis of canine dimorphism in early Eocene Notharctines. GARY T. SCHWARTZ, ELLEN MILLER, GREGG GUNNELL.
- 8:30 am New dental and postcranial remains of late Eocene *Wadilemur elegans* (Galagidae, Lorisiformes). ERIK R. SEIFFERT, ELWYN L. SIMONS, TIMOTHY M. RYAN.

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**Friday Morning – April 16, 2004 (continued)**


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- 8:45 am MicroCT analysis of the ontogeny of mandibular biomineralization in *Archaeolemur*. MATTHEW J. RAVOSA, STUART R. STOCK, ELWYN L. SIMONS.
- 9:00 am The semicircular canals of subfossil lemurs and their functional significance. ALAN WALKER, GAIL E. KROVITZ, MARY T. SILCOX, ELWYN L. SIMONS, FRED SPOOR.
- 9:15 am Radiocarbon dating of the extinctions in late prehistoric Madagascar. DAVID A. BURNEY, LIDA BURNEY, WILLIAM L. JUNGERS, LAURIE R. GODFREY.
- 9:30 am The interorbital region of *Dolichocebus gaimanensis* (Platyrrhini, early Miocene, Argentina) based on high resolution X-ray CT imaging—phylogenetic implications. TERRY R.T. MITCHELL, RICHARD F. KAY, MATTHEW W. COLBERT, TIMOTHY B. ROWE.
- 9:45 am *Paradolichopithecus*: A large-bodied terrestrial papionin (Cercopithecidae) from the Pliocene of western Eurasia. ERIC DELSON, STEPHEN R. FROST.
- 10:00 am Break
- 10:15 am Description and analysis of postcranial elements of *Paradolichopithecus arvernensis*: A large-bodied papionin from the Pliocene of Eurasia. NELSON C. TING, WILLIAM E.H. HARCOURT-SMITH, STEPHEN R. FROST, ERIC DELSON.
- 10:30 am Sternebrae morphology in extant primates and *Proconsul*. HEATHER DROUGHT, NATALIE VASEY, ALAN C. WALKER.
- 10:45 am A new species of stem catarrhine from the early Miocene of Uganda. JAMES B. ROSSIE, LAURA MACLATCHY.
- 11:00 am Which species of hominoids are present at the early Miocene sites Napak and Moroto, Uganda? LAURA M. MACLATCHY, JAMES B. ROSSIE.
- 11:15 am Dental microwear analyses of *Sivapithecus* and contemporaneous fauna. SHERRY V. NELSON.
- 11:30 am Evolution of primate life histories. STEVEN R. LEIGH, ROBIN M. BERNSTEIN.
- 11:45 am Selective forces and size change in the evolution of sexual size dimorphism in Primates. ADAM D. GORDON.

**Session 19. Population Genetics II. Contributed Papers. *Buccaneer C–D*.**

Chair: MICHAEL C. MAHANEY, Southwest Foundation for Biomedical Research.

- 8:00 am The analysis of variation of mtDNA hypervariable region-1 suggests that Eastern and Western Pygmies diverged before the Bantu expansion. GIOVANNI DESTRO-BISOL, VALENTINA COIA, ILARIA BOSCHI, FABIO VERGINELLI, CINZIA BATTAGLIA, FRANCESC CALAFELL, GABRIELLA SPEDINI.
- 8:15 am Ancient migrations and population expansions in East Africa: Genetic evidence for Tanzanian prehistory. HOLLY M. MORTENSEN, MARY K. GONDER, EDUARDO TARAZONA-SANTOS, JIBRIL HIRBO, SARAH A. TISHKOFF.
- 8:30 am Patterns of human variation as reflected by multi-locus genetic comparisons. MAYA M. PILKINGTON, ABIGAIL W. BIGHAM, SARAH B. KINGAN, ZAHRA MOBASHER, JASON A. WILDER, ELIZABETH T. WOOD, MICHAEL F. HAMMER.
- 8:45 am African Y-chromosome haplotypes strongly correlate with linguistic groups. ELIZABETH WOOD, DARYN A. STOVER, CHRISTOPHER EHRET, GIOVANNI DESTRO-BISOL, GABRIELLA SPEDINI, A. SILVANA SANTACHIARA, HOWARD MCLEOD, BEVERLY I. STRASSMANN, HIMLA SOODYALL, MICHAEL F. HAMMER.
- 9:00 am Mitochondrial D-loop analysis of bovid skeletal material from Eritrea. CONNIE J. MULLIGAN, MARINA S. ASCUNCE, ANDREW KITCHEN, PETER R. SCHMIDT.
- 9:15 am Inference of recent migration following complete population isolation. JOANNA L. MOUNTAIN, MARCELA MIYAZAWA, UMA RAMAKRISHNAN.

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**Friday Morning – April 16, 2004 (continued)**


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- 9:30 am A population-genetic study of the Etruscans. GUIDO BARBUJANI.
- 9:45 am Insight into demographic events and population history of Siberian populations: A comparison of Y-chromosome, X-chromosome and mitochondrial data. TATIANA M. KARAFET, LUDMILA P. OSIPOVA, SARAH B. KINGAN, ABIGAIL BIGHAM, LAURA MAYER, JASON A. WILDER, MICHAEL F. HAMMER.
- 10:00 am Break
- 10:15 am MtDNA variation in indigenous Altaians, and their genetic relationships with Siberian and Mongolian populations. THEODORE G. SCHURR, SERGEY I. ZHADANOV, LUDMILLA P. OSIPOVA.
- 10:30 am High levels of variation at the mitochondrial 9bp repeat locus in the Sakha of Siberia. LARISSA A. TARSKAIA, REBECCA GRAY, BEN BURKLEY, CONNIE J. MULLIGAN.
- 10:45 am Does Greenberg's linguistic classification predict patterns of New World genetic diversity? KEITH L. HUNLEY, JEFFREY C. LONG.
- 11:00 am Using Y-chromosome and mtDNA variation to reconstruct eastern North American population history. DEBORAH A. BOLNICK.
- 11:15 am An examination of Aleut and Eskimo genetic variation: Implications for divergence estimates and migration hypotheses. STACY E. MCGRATH, D. ANDREW MERRIWETHER.
- 11:30 am Detecting relationships in the Great Lakes region using ancient mtDNA. BETH A.S. SHOOK.
- 11:45 am Haplotype resources in dbSNP: NCBI's database of genetic variation. STEPHEN T. SHERRY.

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**Friday Afternoon – April 16, 2004**


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**Session 20. Paleoanthropological Research at the Asian Frontiers. Poster Symposium.**  
*Regency 1.*

Organizers: MICHELLE M. GLANTZ, Colorado State University, and SHEELA ATHREYA, Texas A&M University.

Chair: MICHELLE M. GLANTZ, Colorado State University.

The purpose of this symposium is to explore the state of paleoanthropological research in relatively underrepresented regions of Asia. Papers focus on Central Asia, North Asia (Japan and Korea), and peninsular South and Southeast Asia. Skeletal morphometric and archaeological evidence for hominid occupation and behavior in this area of the Old World during the Pleistocene and early Holocene is reviewed. The Asian evidence is examined from the standpoint of theoretical modeling, historical developments, and comparative analyses with other regions. The goal of this symposium is to allow a more focused discussion of issues related to human evolutionary trajectories in historically underrepresented regions of the Asian supercontinent.

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|----------------|--------------------------------|
| 2:00 – 2:30 pm | Poster set-up.                 |
| 2:30 – 4:00 pm | Authors present for questions. |
| 4:00 – 4:30 pm | Discussion (in Atrium).        |
| 6:00 – 6:30 pm | Poster take-down.              |

1. The earliest stages of human colonization of the Central Asian arid zone: New discoveries in Mongolia and Kazakhstan. ANATOLY P. DEREVIANKO, ANATOLY N. ZENIN.
2. The Early Paleolithic of Kazakhstan: Eastern boundary of the Acheulian culture? SERGEI A. GLADYSHEV.
3. The Paleolithic of southern Kyrgyzstan: New discoveries and revision. ANATOLY N. ZENIN.
4. New hominid remains from the Obi-Rakhmat rockshelter, northwestern Uzbekistan: Insights into the makers of the Initial Upper Paleolithic of Central Asia. ANDREI I. KRIVOSHAPKIN, MICHELLE M. GLANTZ, BENICE VIOLA, TATIANA CHIKISHEVA, PATRICK J. WRINN, A.P. DEREVIANKO, UTKUR I. ISLAMOV, HORST SEIDLER.
5. A reanalysis of the Neandertal status of the Teshik-Tash child. MICHELLE M. GLANTZ, TERRENCE B. RITZMAN.



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**Friday Afternoon – April 16, 2004 (continued)**

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6. The Middle to Upper Paleolithic interface in Central Asia and the status of Obi-Rakhmat. LEONID VISHNYATSKY.
7. Vertebrate taphonomy and geochronology of Initial Upper Paleolithic occupation horizons at Obi-Rakhmat Grotto, Uzbekistan. PATRICK J. WRINN, ANDREI I. KRIVOSHAPKIN, ANATOLY P. DEREVIANKO, UTKUR I. ISLAMOV.
8. A craniometric view from the Late Pleistocene and Early Holocene of East Asia: The Zhoukoudian Upper Cave and Minatogawa. NORIKO SEGUCHI.
9. Biobehavioral adaptations in a Late Upper Paleolithic Southeast Asian population (Tam Hang, Laos). LAURA L. SHACKELFORD.
10. Craniofacial variation of prehistoric and recent populations from Far East, Oceania, and New World: Model-free and model-bound approach. TSUNEHICO HANIHARA, MAYUMI KAWANO, HAJIME ISHIDA.
11. An odontometric and craniometric perspective on past and present population relationships in East and Southeast Asia, Australia and the Pacific. C. LORING BRACE, NORIKO SEGUCHI.
12. East of Eden, west of Cathay: An investigation of Bronze Age interactions along the Great Silk Road. BRIAN E. HEMPHILL.

**Session 21. Hominid Evolution III. Contributed Posters. Regency 1.**

Chair: PATRICIA A. KRAMER, University of Washington.

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

13. New and revised faunal samples from in situ and dumpsite breccia deposits at Gondolin, North West Province, South Africa. JUSTIN W. ADAMS, FRANK SENEGAS.
14. Examination of the paleoenvironments of two South African caves. ANNA G. BLACKBURN WITTMAN, JUSTIN W. ADAMS.
15. Assessing variation within commingled hominid fossil assemblages using nonparametric density estimation. THEODORE M. COLE, DEBORAH L. CUNNINGHAM.
16. Faunal composition and bone accumulating agents in the Plio-Pleistocene cave infills of South Africa. DARRYL J. DE RUITER.
17. Preliminary taphonomic analysis of microfaunal assemblage from Coopers D deposit, Gauteng Province, South Africa. KRISTIN A. FLESCNER, CONOR D. HARTMAN, PATRICK J. LEWIS, CHRISTINE M. STEININGER, LEE R. BERGER, STEVE CHURCHILL.
18. Trace element, strontium isotopic ratio and X-Ray Fluorescence (XRF) analysis of Pleistocene human teeth from the Altai. CHRISTOPHER LATKOCZY, MARIA TESCHLER-NICOLA, KATRIN SCHAEFER, DETLEF GUENTHER, THOMAS BENCE-VIOLA, HORST SEIDLER, GERHARD WEBER, ALEXANDER DEREVIANKO, THOMAS PROHASKA, GERALD SCHULTHEIS.
19. A preliminary assessment of the microfaunal assemblage from the Coopers D deposit, Gauteng, South Africa. PATRICK J. LEWIS, CHRISTINE M. STEININGER, NANCY BARRICKMAN, LEE R. BERGER, STEVE CHURCHILL.
20. Forelimb morphology of bovids found in swamps and edaphic grasslands: Reconstructing habitat preference. CAROLINE J. ROBB.
21. The habitat and trophic preferences of *Paranthropus*, a new theoretical model. ALAN B. SHABEL.
22. GIS and palaeoanthropological surveys-Experiences. T. BENCE VIOLA, CHRISTOPH URBANEK, KATRIN SCHAEFER, GERHARD W. WEBER, OTTMAR KULLMER, OLIVER SANDROCK, HASEN SAID, HORST SEIDLER.
23. Adaptive regimes and genus designations of Plio-Pleistocene hominins: A multivariate approach. BRANDON C. WHEELER.

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**Friday Afternoon – April 16, 2004 (continued)**


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24. The dynamics of vertical jumping in bonobos. KRISTIAAN D'AOÛT, MELANIE SCHOLZ, MAARTEN F. BOBBERT, PETER AERTS.
25. Size and power required for locomotion in early hominids: Paleobiology meets OH62 (again). ROBERT B. ECKHARDT, ADAM J. KUPERAVAGE, KAROL GALIK.
26. Descrying shapes from the dawn: Internal femoral architecture of BAR 1002'00. KAROL GALIK, ADAM J. KUPERAVAGE, BRIGITTE SENUT, MARTIN PICKFORD, DOMINIQUE GOMMERY, JACQUES TREIL, ROBERT B. ECKHARDT.
27. Estimating hominoid reciprocal joint congruence: A comparison of two morphometric techniques. WILLIAM E.H. HARCOURT-SMITH, JOHANN KIM, ERIC DELSON.
28. Comparing hominoid proximal femur morphology using geometric morphometrics. ELIZABETH HARMON.
29. Bipedalism in orangutans (*Pongo pygmaeus*). BRANKA HRVOJ-MIHIC, LINDA D. WOLFE.
30. Do body proportions matter when predicting the energy required to walk? PATRICIA A. KRAMER, ISABELLE SARTON-MILLER.
31. Knuckle walking signal in the digits of *Pan* and *Gorilla*: Examining the curvature of the proximal and middle phalanges of the apes. STACEY A. MATARAZZO.
32. Morphology of the proximal radius: Implications for locomotor adaptations of early hominins. BIREN A. PATEL.
33. Throwing ability in fossil hominids. HOLLY M. DUNSWORTH.
34. Comparison of "sex blind" dimorphism indices with application to the *A. afarensis* fossil assemblage. PHILIP L. RENO, RICHARD S. MEINDL, M.A. MCCOLLUM, C.O. LOVEJOY.
35. *Paranthropus* paleobiology: A review. PAUL J. CONSTANTINO, BERNARD A. WOOD.
36. Posterior facial height and mandibular tooth crowding in chimpanzees with reference to anterior tooth crowding in robust *Australopithecus*. BROOKE A. GARNER, MELANIE A. MCCOLLUM.
37. Geometric reconstruction of the MLD 37/38 endocranium. SIMON NEUBAUER, PHILIPP GUNZ, PHILIPP MITTEROECKER, GERHARD W. WEBER.
38. 'Meeting your ancestor': Some notes on Robert Broom's first encounter with the Taung Child. GORAN STRKALJ, QIAN WANG.
39. Are early hominin hypodigms equally biased samples? CATHERINE M. HARADON, ANNA K. BEHRENSMEYER, RENE BOBE, BERNARD WOOD.
40. Phylogenetic analysis of extant hominids using temporal bone morphometrics. CHARLES A. LOCKWOOD, WILLIAM H. KIMBEL, JOHN M. LYNCH.
41. An extant primate-based assessment of the likely importance of homology in hominid phylogenetics. STEPHEN J. LYCETT, MARK COLLARD.
42. Mandibular and craniofacial shape in the hominid lineage: A comparative analysis using 3D-morphometrics. MARY-ASHLEY HAZEL.
43. Cranial variation among the Plio-Pleistocene hominins from Dmanisi, Georgia. P. JAMES MACALUSO, JR., DAVID E. HOPWOOD, GEORGIA KIOUKIS, NASSER MALIT, ALEXANDER J. NEVGLOSKI, JR., JULIA B. MCCAUSLAND-GAINES, DAVID LORDKIPANIDZE.
44. Ontogeny of mandibular shape in Neandertals and modern humans. GAIL E. KROVITZ.
45. Variation in Neanderthal early ontogeny: Craniometric evidence from Dederiyeh children. HAJIME ISHIDA, OSAMU KONDO, TSUNEHICO HANIHARA, TETSUAKI WAKEBE, YUKIO DODO, TAKERU AKAZAWA.
46. Postcranial robusticity and limb-length proportion in Neanderthal children. OSAMU KONDO, HAJIME ISHIDA.

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**Friday Afternoon – April 16, 2004 (continued)**


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47. A 3-D analysis of shape differences in the scapula between Neanderthals and modern humans using geometric morphometrics. KAREN L. BAAB, KATERINA HARVATI.
48. Neandertal lumbar lordosis and pelvic orientation. CHARLES E. HILTON, RACHEL L. NUGER.
49. An analysis of Neandertal trauma patterns. JANET C. GARDNER.
50. Freezing, fighting and falling; an exploration of trauma causality in the Neanderthals, Fuegians, Eskimo and Aleut. SIMON UNDERDOWN.
51. Testing hypotheses for dental reduction in Late Pleistocene and Early Holocene hominids. CHARLES M. FITZGERALD, SIMON HILLSON.
52. New research on the Palaeolithic of Lurestan, West Central Iran. HAMED VAHDATINASAB, KOROOSH ROUSTAEI, FEREDON BIGLARI, SAMAN HEYDARI, GEOFFREY. A CLARK.

**Session 22. From Conception to Birth: Selective Pressures Shaping Pregnancy and its Outcomes.** Symposium. *Regency 2*.

Organizers and Chairs: ELIZABETH T. ABRAMS, University of Michigan, and CRYSTAL L. PATIL, Ohio State University.

Pregnancy necessitates acute shifts in maternal energetic, nutritional, immunological, and social strategies with long-term consequences for both the mother and fetus. Selective pressure in the pre- and post-pregnancy periods are well established; however, less is known about these pressures during the actual pregnancy. Research on maternal morbidity and mortality, pregnancy loss, and variation in birth outcomes demonstrates that there are strong selective forces at work during pregnancy. Life history theory and reproductive ecology provide an excellent framework from which to investigate the role of pressures shaping pregnancy in the past and present. This symposium aims to launch interest in a new and growing area in the human experience by synthesizing data on environmental, physiological, and social forces to unravel the influences that shape, and have shaped, pregnancy.

- 2:00 pm A time to be born: Why does human pregnancy last nine months? KAREN R. ROSENBERG, WENDA R. TREVATHAN.
- 2:15 pm Fetal load in bipeds: Selection pressure for female lumbopelvic adaptation. KATHERINE K. WHITCOME.
- 2:30 pm Reproductive suppression: The critical process of implantation. PABLO A. NEPOMNASCHY, BARRY G. ENGLAND.
- 2:45 pm Fetal adaptations to maternal nutritional status during pregnancy. LINDA S. ADAIR.
- 3:00 pm Alterations in growth rate underlie fetal adaptive strategies. AMANDA L. THOMPSON, MICHELLE LAMPL.
- 3:15 pm Placental adaptation to chronic hypoxia (high altitude residence) and pregnancy outcome. STACY ZAMUDIO, NICHOLAS P. ILLSLEY.
- 3:30 pm Poor outcomes following malaria during pregnancy. ELIZABETH T. ABRAMS, VICTOR MWAPASA, DEBORAH D. KAMWENDO, STEVEN R. MESHNICK.
- 3:45 pm Break
- 4:00 pm Maternal energy status during pregnancy and birth outcomes in Tanzania. CRAIG A. HADLEY, MONIQUE BORGERHOFF MULDER.
- 4:15 pm Negotiating the demands of pregnancy in a high fertility population. CRYSTAL L. PATIL.
- 4:30 pm Discussion: IVY PIKE.

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**Friday Afternoon – April 16, 2004 (continued)**


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**Session 23. Skeletal Biology II: Biomechanics.** Contributed Papers. *Regency 3.*

Chair: VALERIE BURKE DELEON, Johns Hopkins University School of Medicine.

- 2:00 pm The Wolff's law debate: Throwing out the water, but keeping the baby. BRIGITTE M. HOLT, CHRISTOPHER B. RUFF, ERIK TRINKAUS.
- 2:15 pm Correspondence of trabecular and cortical geometries: A natural test of Wolff's Law. MICHAEL T. BLACK.
- 2:30 pm Variations in cortical material properties of baboon mandibles. QIAN WANG, PAUL C. DECHOW.
- 2:45 pm Image-based weighted measures of skeletal stiffness: Case studies of great ape mandibles. ANDREW J RAPOFF, NEEL B. BHATAVADEKAR, DAVID J. DA EGLING.
- 3:00 pm Trabecular bone structure in human and chimpanzee knee joints. BRIAN G. RICHMOND, MASATO NAKATSUKASA, RICHARD KETCHAM, T. HIRAKAWA.
- 3:15 pm Mechanical regulation of tibiofemoral joint growth: A computational analysis. JEFFREY H. PLOCHOCKI, CAROL V. WARD, DOUGLAS SMITH.
- 3:30 pm Architectural and biomechanical alterations in medieval humeri: Is there a pre-adaptive relationship to humeral form? JILL A. RHODES, CHRISTOPHER J. KNUSEL.
- 3:45 pm The dynamic actions of the human fibula. THOMAS M. GREINER, KEVIN A. BALL, SCOT P. WOODWARD.
- 4:00 pm Break
- 4:15 pm Variation in estradiol level affects diaphyseal bone growth in response to mechanical loading. MAUREEN J. DEVLIN.
- 4:30 pm World-wide variation in the residual strength of the humerus, femur, and tibia. OSBJORN M. PEARSON, ROBIN CORDERO.
- 4:45 pm The examination of age and sex-related changes in cortical bone mineral density and geometric properties of the radius in a 19th century archaeological population. PATRICK BEAUCHESNE, SABRINA C. AGARWAL, SELBIE MICHELLE, SHELLEY SAUNDERS, CHRISTOPHER GORDON, COLIN WEBBER.
- 5:00 pm The mechanobiology of cranial sutures. CRAIG D BYRON, MARK W. HAMRICK, JIM BORKE, JACK YU.
- 5:15 pm Morpho-geometric functional analysis of New World cranial samples and the distribution of the Paleoamerican morphological pattern. ROLANDO GONZÁLEZ-JOSÉ, NEUS MARTÍNEZ-ABADÍAS, MARINA SARDI, ANTONIO GONZÁLEZ-MARTÍN, SILVINA VAN DER MOLEN, FERNANDO RAMÍREZ-ROZZI, MIQUEL HERNÁNDEZ, HÉCTOR PUCCIARELLI.
- 5:30 pm A test of the Fully anatomical method of stature estimation. KATHRYN A. KING.
- 5:45 pm Estimation of living body mass from multiple skeletal elements. SHAMSI DANESHVARI, OSBJORN PEARSON.

**Session 24. QTL (Quantitative Trait Loci) Mapping in Biological Anthropology.** Symposium. *Buccaneer A–B.*

Organizers and Chairs: JOHN BLANGERO and SARAH WILLIAMS-BLANGERO, Southwest Foundation for Biomedical Research.

Molecular and statistical advances in human genetics now permit the dissection of the genetic basis of quantitative traits. Knowledge of the underlying genetic architecture of such traits is essential for understanding and predicting their evolutionary trajectories. To date, most human evolutionary studies of quantitative traits, such as morphometrics, have assumed a classical polygenic form of inheritance. The papers in this symposium show how the specific genes influencing quantitative traits can be localized and identified, and how application of state-of-the-art techniques for gene mapping are informative for problems of long standing interest in biological anthropology. The first half of the symposium presents papers on QTL mapping in anthropologically relevant populations, and the second half presents papers on traits that have traditionally been of interest in biological anthropology, such as dental traits, stature, and obesity. Cosponsored by the American Association of Anthropological Genetics.

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**Friday Afternoon – April 16, 2004 (continued)**


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- 2:00 pm Quantitative trait linkage mapping studies in the Jirels of Nepal. SARAH WILLIAMS-BLANGERO, JOHN L. VANDEBERG, BRADFORD TOWNE, BHARAT JHA, JOHN BLANGERO.
- 2:15 pm Quantitative trait linkage mapping studies in Samoa. RANJAN DEKA, DANIEL WEEKS, STEPHEN T. MCGARVEY.
- 2:30 pm Quantitative trait linkage mapping studies in the Schmiedeleut Hutterites of South Dakota. BONNY L. SPECKER, MICHAEL C. MAHANEY, TERESA L. BINKLEY, LORENA M. HAVILL.
- 2:45 pm Quantitative trait linkage mapping in the Strong Heart Family Study of American Indians. LAURA ALMASY, BARBARA V. HOWARD, ELISA T. LEE, LYLE BEST, THOMAS K. WELTY, RICHARD DEVEREUX, RICHARD R. FABSITZ, SHELLEY COLE, SANDRA LASTON, HARALD H.H. GÖRING, VINCENT P. DIEGO, BENNETT DYKE, JEAN W. MACCLUER.
- 3:00 pm Quantitative trait linkage mapping in the Fels Longitudinal Study. ELLEN W. DEMERATH, STEFAN A. CZERWINSKI, ROGER M. SIERVOGEL, BRADFORD TOWNE.
- 3:15 pm The Nizwa Family Study: Mapping genes for complex metabolic diseases in the Arab Bedouins of Oman. ANTHONY G. COMUZZIE, RIAD BAYOUMI, SAYEED AL YAHYAE, SULAYMA AL BARWANI, JAWAD AL LAWATI, GUOWEN CAI, SARAH WILLIAMS-BLANGERO, MOHAMMED O. HASSAN.
- 3:30 pm Discussion: LYNN JORDE.
- 3:45 pm Break
- 4:00 pm QTL mapping in biological anthropology: Dental traits in pedigreed baboons. MICHAEL C. MAHANEY, LESLEA J. HLUSKO, JEFFREY ROGERS, LAURA A. COX, KENNETH M. WEISS.
- 4:15 pm Genome-wide linkage analyses of human stature in pedigree samples from different ethnicities. HARALD GÖRING, JOHN BLANGERO.
- 4:30 pm QTL mapping in biological anthropology: Skeletal maturation. BRADFORD TOWNE, JOHN BLANGERO, JOHN S. PARKS, SHELLEY A. COLE, MILTON R. BROWN, DANA L. DUREN, ALEX F. ROCHE, ROGER M. SIERVOGEL.
- 4:45 pm QTL mapping in biological anthropology: Bone density. STEFAN A. CZERWINSKI, BRAD TOWNE, ELLEN W. DEMERATH, ROGER M. SIERVOGEL.
- 5:00 pm QTL mapping in biological anthropology: Sex hormone variation. LISA J. MARTIN.
- 5:15 pm QTL mapping in biological anthropology: Genotype x age interaction in the growth hormone axis. VINCENT P. DIEGO, LAURA ALMASY, MICHAEL C. MAHANEY, ANTHONY G. COMUZZIE, JEAN W. MACCLUER, JOHN BLANGERO.
- 5:30 pm QTL mapping in biological anthropology: Obesity. RAVINDRANATH DUGGIRALA, RECTOR ARYA, CHRISTOPHER P. JENKINSON, LAURA ALMASY, PETER O'CONNELL, MICHAEL P. STERN, JOHN BLANGERO.
- 5:45 pm Discussion: KEN WEISS.

**Session 25. Human and Primate Brain Evolution II. Contributed Papers. *Buccaneer C–D.***

Chair: KATERINA SEMENDEFERI, University of California at San Diego.

- 2:00 pm Validation of plaster endocast morphology through 3D CT image analysis. BRIAN B. AVANTS, JAMES C. GEE, P. THOMAS SCHOENEMANN, JANET M. MONGE, JASON E. LEWIS, RALPH L. HOLLOWAY.
- 2:15 pm Dissection method in brain endocast reconstruction. MICHAEL S. YUAN, RALPH L. HOLLOWAY.
- 2:30 pm Another look at the brain volume and reorganization of the Stw505 *A. africanus* from Sterkfontein, S. Africa. RALPH L. HOLLOWAY.
- 2:45 pm The Monte Circeo Neandertal brain endocast. LYNN E. COPES, RALPH L. HOLLOWAY.

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**Friday Afternoon – April 16, 2004 (continued)**


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- 3:00 pm Two new Neandertal brain endocast reconstructions from Krapina. CHET C. SHERWOOD, RALPH L. HOLLOWAY, DOUGLAS C. BROADFIELD.
- 3:15 pm Analysis of chimp-human brain differences via non-rigid deformation of 3D MR images. P. THOMAS SCHOENEMANN, BRIAN B. AVANTS, JAMES C. GEE, L. DANIEL GLOTZER, MICHAEL J. SHEEHAN.
- 3:30 pm Endocranial capacity estimated from 3-D CT: Methodological issues. JASON E. LEWIS, P. THOMAS SCHOENEMANN, JANET M. MONGE.
- 3:45 pm Sex differences in the brain likely occurred after the ape-human split. DOUGLAS C. BROADFIELD, RALPH L. HOLLOWAY, JEFFREY T. LAITMAN.
- 4:00 pm Break
- 4:15 pm Behavioral correlates of neuroanatomical asymmetries in great apes. WILLIAM HOPKINS, CLAUDIO CANTALUPO.
- 4:30 pm Changes in human brain and skull during growth. ANNE-MARIE GUIHARD-COSTA, FERNANDO RAMIREZ-ROZZI, EMMANUEL CABANIS, MARIE-THÉRÈSE IBA-ZIZEN.
- 4:45 pm Development and evolution of morphological integration in the human brain. KRISTINA ALDRIDGE.
- 5:00 pm The aging brain: The cognitive reserve hypothesis and hominid evolution. JOHN S. ALLEN, JOEL BRUSS, HANNA DAMASIO.
- 5:15 pm A cellular aging pattern unique to humans and common chimpanzees. EMMANUEL P. GILISSEN, KARELLE LEROY, JEAN PIERRE BRION, JOE ERWIN, PATRICK R. HOF.
- 5:30 pm Pattern and scaling of baseline brain activity: A comparative analysis of regional cerebral glucose metabolism. JASON A. KAUFMAN.
- 5:45 pm Observations on the olfactory system of *Tremacebus harringtoni* (Platyrrhini, early Miocene, Sacanana, Argentina) based on high resolution X-ray CT scans. RICHARD F KAY, JAMES B. ROSSIE, MATTHEW W. COLBERT, TIMOTHY B. ROWE.

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**Saturday Morning – April 17, 2004**


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**Session 26. Skeletal Biology III. Contributed Posters. Regency 1.**

Chair: DONNA C. BOYD, Radford 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.                                       |

1. Isotopic analysis of life history and social stratification at two Wheeden Island mound Sites in central Florida. BETHANY L. TURNER, JOHN D. KINGSTON, GEORGE J. ARMELAGOS, JERALD T. MILANICH.
2. Prehistoric diet in the central Himalayas: Stable isotope results from Malari, Garhwal (India). ROBERT H. TYKOT, TAMSIN O'CONNELL, KAREN PRIVAT, SANJIV JUYAL, VINOD NAUTIYAL.
3. Reconstructing diet and dietary histories in a colonial Afro-Caribbean population from Guadeloupe, West Indies. TAMARA L. VARNEY.
4. Stable isotope analysis as an indicator of diet and social status in La Tène Bohemia. JONATHAN D. LE HURAY.
5. PIXE and paleodiet: Reconstructing subsistence of Florida's Middle Archaic using a new method of trace element analysis. ERICA N. CHAMBERS, JOHN S. KRIGBAUM, IVAN I. KRAVCHENKO, HENRI A. VAN RINSVELT.
6. Effects of load orientation and constraints on finite element analyses of a primate mandible. DAVID J. DAEGLING, RUXANDRA MARINESCU, ANDREW J. RAPOFF.

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**Saturday Morning – April 17, 2004 (continued)**

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7. The effect of parity on spinal and forearm BMD in the baboon (*Papio hamadryas*). LORENA M. HAVILL, MICHAEL C. MAHANEY, JEFFREY ROGERS.
8. Biomechanics of great ape and human hands and feet and its relationships with positional behavior. DAMIANO MARCHI.
9. Cross-sectional geometry of the human forefoot. NICOLE L. GRIFFIN, BRIAN G. RICHMOND.
10. Relative bone strength in the upper and lower limbs of a Predynastic Egyptian population. MELISSA ZABECKI, MATTHEW C. O'NEILL, CHRISTOPHER B. RUFF.
11. Differential constraints on the pattern of skeletal robusticity in human limbs relative to climatic and behavioral influences on morphology. JAY T. STOCK.
12. Modern human variation in the femoral bicondylar angle: Functional analysis and model-building. WILSON D. SWEITZER.
13. Angular dimensions are a good predictor of functional joint motion. THOMAS J. MASTERTSON, PETER V. LOUBERT, DAVID SCHMITZ.
14. Correlation between pelvic girdle measurements and foot length. KATHERINE A. MANLEY-BUSER, KATHLEEN M. TWIST.
15. A geometric morphometric study of cranial sexual dimorphism in selected indigenous populations of South Africa. DANIEL FRANKLIN, NICK MILNE, LEONARD FREEDMAN.
16. Geomorphometric evidence for a Caribbean multiple population dispersal. ANN H. ROSS.
17. Preliminary analysis of dental morphology and identity of an early iron producing population in the Mouhoun Bend, Burkina Faso. KENNETH C. MAES, JOEL D. IRISH, AUGUSTIN F.C. HOLL, PHILLIP L. WALKER, GEORGE J. ARMELAGOS.
18. Provenance of African origin individuals from the colonial cemetery of Campeche (Mexico) by means of LA-ICP-MS. ANDREA CUCINA, HECTOR NEFF, VERA TIESLER.
19. Diachronic patterns in health and dental metrics in historic African-Americans of Virginia. DONNA C. BOYD, C. CLIFFORD BOYD.
20. African-American biohistory at President's Island, Tennessee. MURRAY K. MARKS, ANNE M. KROMAN.
21. The effects of intentional cranial deformation on the development and pathology of the temporomandibular joint. ERICA TYLER.
22. Zygapophyseal facet distances of the lumbar vertebrae: A predictor for spondylolisthesis? ANNE D. HOLDEN, CAROL V. WARD, BRUCE LATIMER.
23. Identification of sex specific mining activities from enthesopathies on the ancient Hallstatt skeletons. DORIS E. PANY.
24. Musculoskeletal stress markers (MSM) as indicators of kneeling behavior in a Byzantine Jerusalem monastery. BRITTANY HAYDEN, ANDREA HATCH, JAIME ULLINGER, DENNIS P. VAN GERVEN, SUSAN GUISE SHERIDAN.
25. Femoral neck activity and kneeling at a Byzantine monastery. JULIA A. JENNINGS, JOELLE INMAN, JAIME ULLINGER, DENNIS P. VAN GERVEN, SUSAN G. SHERIDAN.
26. Non-metric traits of the femur and tibia related to Byzantine monastic prayer. MARY E. KOVACIK, LINDSAY TALARICO, JAIME ULLINGER, SUSAN G. SHERIDAN.
27. "Fall on your knees": Squatting facets and Byzantine monasticism. JAIME M. ULLINGER, SUSAN G. SHERIDAN, BERT DE VRIES.
28. A look at adult skeletal aging methods: A Mississippian example. CHARLES E. MINTON, DAWNIE WOLFE STEADMAN.

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**Saturday Morning – April 17, 2004 (continued)**


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29. Growing old on Black Mesa: A new look at aging in the past. JAMIE EDWARDS, DEBRA MARTIN.
30. A modern revision of E. Hooton's study of the Indians of Pecos Pueblo. KATHERINE E. WEISENSEE.
31. Adaptation and change in Gulf Coast Florida. DALE L. HUTCHINSON.
32. The CT Database at the University of Pennsylvania Museum. JANET MONGE, SCHOENEMANN P. THOMAS, JASON LEWIS, L. DANIEL GLOTZER.
33. Isotopic analysis of mummified human remains from northwestern Argentina: A dietary reconstruction. NICOLE R. SHELNUT, ROBERT H. TYKOT, ADOLFO A. GIL.

**Session 27. Dental Anthropology II. Contributed Posters. *Regency 1.***

Chair: ELIZABETH A. NEWELL, Elizabethtown College.

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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.                                       |

34. Health at Little Salt Spring: Frequency of dental pathologies at Middle Archaic site in Florida. CHRISTINE E. ALVAREZ.
35. A paleopathological assessment of the Bowser Site skeletal population. JENNIFER R. CARTER, ROBERT R. PAINE.
36. Dental caries distribution in the Anglo-Saxon population of Sedgeford, England. MARIA T. FASHING.
37. Microscopic openings of dentinal tubules on naturally heavily worn occlusal surfaces of specimens from a Japanese archaeological site using SEM. TERUYUKI HOJO.
38. Patterns of variation in enamel microdefect appearance in the first permanent molar and canine. REBECCA J. FERRELL, DONALD J. REID.
39. Individual chronology of enamel dental microdefects in the juvenile segment of the Portus Romae community. LUCA BONDIOLI, ALFREDO COPPA, CHARLES FITZGERALD, ALESSIA NAVA, ROBERTO MACCHIARELLI.
40. 'From the mouths of babes': Patterns of enamel hypoplasia in the deciduous teeth of non-human primates. ELIZABETH A. NEWELL.
41. Hypoplasia of the tooth root: A new unspecific stress marker in human and animal paleopathology. WOLF R. TEEGEN.
42. Asymmetry of three deciduous teeth and their replacements in the Gullah. DEBBIE J. GUATELLI-STEINBERG, PAUL SCIULLI, HEATHER EDGAR.
43. Cementum annulation: Problems and prospects for ageing of human remains. BRIAN J. DEAN, LYNNE S. BELL, MARGARET C. COX.
44. Different patterns of mandibular growth in Papio and Pan are produced by genus-specific developmental changes and rates of change in mandibular proportions. JULIA C. BOUGHNER, M. CHRISTOPHER DEAN.
45. Trace element analysis of dentin: A test of the application of PIXE and Laser Ablation methods to the assessment of childhood diet from archaeologically-derived adult human teeth. BARBARA R. HEWITT.
46. Effects of chorionicity on tooth size in monozygotic twins. EDWARD F. HARRIS.
47. An odontometric reduction trend among ancient Maya populations from northern Belize. GABRIEL D. WROBEL.
48. Tooth modification in late Iron Age in Cambodia. KATE M. DOMETT, NANCY TAYLES.
49. Purposeful manipulation of teeth in Final Neolithic burials from Upper Egypt. JOEL D. IRISH.



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**Saturday Morning – April 17, 2004 (continued)**


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50. Detecting subpopulations at Grasshopper Pueblo through the use of dental morphology. JOHN A. MCCLELLAND.

**Session 28. Health and Disease. Contributed Papers. *Regency 2–3.***

Chair: SUSAN L. JOHNSTON, West Chester University.

- 8:00 am Spatial distribution of childhood morbidity patterns in a Dominican village. COLLEEN H. NYBERG, MARK V. FLINN.
- 8:15 am Seasonality of health status measures of urban Bhutia women in Sikkim, India. SHARON R. WILLIAMS.
- 8:30 am Therapeutic effects of Bach Flower Essences: A double-Blind analysis. ROBERT A. HALBERSTEIN, LYDIA A. DESANTIS.
- 8:45 am Estimating inter-individual variation in human cortisol levels: Mixed models applied to data from Nepal, Mongolia and the U.S. DANIEL J. HRUSCHKA, BRANDON A. KOHRT, CAROL M. WORTHMAN.
- 9:00 am Early life stress and adult health: A view from the Western Hemisphere sample. RICHARD H. STECKEL.
- 9:15 am Biological indicators of social heterogeneity. EKATERINA PECHENKINA.

**Session 29. Human Biology and Globalization in Latin America. Second Annual Wiley-Liss Symposium. *Regency 2–3.***

Organizers and Chairs: LORENA MADRIGAL and DAVID HIMMELGREEN, University of South Florida.

The fields of biological anthropology and human biology provide an excellent framework for the study of the effects of globalization on human health. Globalization here is taken in a broad perspective, and includes ancient and recent population movements, as well as the incorporation of traditional communities into the world cash economy. Latin America has been an area of convergence and movements of different peoples for many centuries, from the trans-Atlantic trade following 1492 to more recent migrations. Also, it is an area in which human health is being affected by rapid modernization and incorporation into the cash economy. This symposium brings together human biologists and biological anthropologists who have researched various areas of human biology, from population genetics to nutrition, adaptation, and sexually-transmitted disease, in Latin America.

- 10:00 am Bio-cultural components of the co-existence of under-nutrition and obesity in Latin America. A. ROBERTO FRISANCHO.
- 10:15 am The emergence of obesity and related chronic diseases in developing countries: Causes and consequences. REYNALDO MARTORELL.
- 10:30 am An exploratory study of the nutrition transition in rural Costa Rica. DAVID A. HIMMELGREEN, CARA S. KLEMPNER, MARIBEL VEGA, JEFFERY LOPEZ.
- 10:45 am The spread of HIV/AIDS in Latin America: The impact of globalization and tourism. NANCY Y. ROMERO-DAZA.
- 11:00 am The Cul's of Costa Rica: An initial health assessment of an East-Indian-derived group in Costa Rica. LORENA MADRIGAL, FLORY OTAROLA, MWENZA BLELL, ERNESTO RUIZ.
- 11:15 am Molecular variability and sociocultural change - past, present, and future. FRANCISCO M. SALZANO.
- 11:30 am Admixture estimates in a Mexican population stratified by socioeconomic status. RUBEN LISKER, A. MALACARA, E. RAMIREZ, O. MUTCHINICK.
- 11:45 am Discussion: THOMAS LEATHERMAN.

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**Saturday Morning – April 17, 2004 (continued)**


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**Session 30. Hominid Evolution IV: Archaic and Modern Humans.** Contributed Papers.  
*Regency 5–6.*

Chair: PATRICIA S. VINYARD, Northeastern Ohio Universities College of Medicine.

- 8:00 am Paleodeme genetic diversity: Pitfalls and prospects. JOHN HAWKS.
- 8:15 am Neanderthals from El Sidrón cave (Asturias, Spain). Presentation of a new sample. ANTONIO ROSAS, JAVIER FORTEA, MARCO DE LA RASILLA, MARKUS BASTIR, CAYETANA MARTÍNEZ-MAZA.
- 8:30 am Newly discovered Neandertal remains from the Les Pradelles site (Marillac-le-Franc, Charente, Southwest France). BRUNO MAUREILLE, ALAN MANN, BERNARD VANDERMEERSCH.
- 8:45 am The functional correlates and consequences of Neandertal pelvic morphology. J.W. YOUNG.
- 9:00 am Functional morphology and evolution of the Neandertal pelvis. ANDREW GALLAGHER.
- 9:15 am New data on early developmental differences between Neanderthals and modern humans. CHRISTOPH P.E. ZOLLIKOFER, MARCIA S. PONCE DE LEÓN, OSAMU KONDO, HAJIME ISHIDA, YUKIO DODO, HIROMASA SUZUKI, Y. KOBAYASHI, K. TSUCHIYA, TAKERU AKAZAWA.
- 9:30 am Longevity and the evolution of modernity. RACHEL CASPARI, SANG-HEE LEE.
- 9:45 am A new model for the Neanderthal vocal tract. MARGARET CLEGG.
- 10:00 am Break
- 10:15 am Derived morphology in Neandertal maxillary molars: Insights from above. SHARA E. BAILEY.
- 10:30 am Causal modeling of nasal breadth and intercanine distance in fossil and recent *Homo*. NATHAN E. HOLTON, ROBERT G. FRANCISCUS, VALERIE L. FORMAN-HOFFMAN.
- 10:45 am A tale of two morphs? A craniometric analysis of the Near Eastern hominids. JAMES H. KIDDER, ARTHUR C. DURBAND.
- 11:00 am Toward a phylogenetic classification of late Pleistocene *Homo* in Africa, the Levant, and Australasia and its implications for the biological origins of the first Australians. MICHAEL C. WESTAWAY.
- 11:15 am Are Neandertal males really male? JASON W. WILSON, MILFORD H. WOLPOFF.
- 11:30 am Neandertal taxonomy reconsidered: Implications from multivariate models of intra- and inter-specific differences. KATERINA HARVATI, STEPHEN R. FROST, KIERAN P. MCNULTY.
- 11:45 am The Upper Paleolithic Mladec assemblage: Cranial geometry compared with anatomically modern humans and Neanderthals. GERHARD W. WEBER, PHILIPP MITTEROECKER, PHILIPP GUNZ, SIMON NEUBAUER, FRED L. BOOKSTEIN, MARIA TESCHLER-NICOLA.

**Session 31. Primate Behavior III: Biology, Ecology, Demography.** Contributed Papers.  
*Buccaneer A–B.*

Chair: ELLEN J. INGMANSON, Bridgewater State College.

- 8:00 am Subtleties in African monkey positional behavior and support use: The influence of microhabitat variation within a single site in the Kibale Forest, Uganda. GARY P. ARONSEN.
- 8:15 am Kinematic analysis of trunk-to-trunk leaping in Goeldi's monkey (*Callimico goeldii*). PAUL A. GARBER, GREGORY BLOMQUIST, GUSTL ANZENBERGER.
- 8:30 am Does digestion time limit group size in folivorous primates? OLIVER SCHUELKE, MUKHESH K. CHALISE, JULIA NIKOLEI, DORIS PODZUWEIT, J. U. GANZHORN, CAROLA BORRIES, ANDREAS KOENIG.
- 8:45 am Food mechanical properties and niche partitioning in a community of Neotropical primates. BARTH W. WRIGHT.

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**Saturday Morning – April 17, 2004 (continued)**


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- 9:00 am How primates eat: An analysis of food handling and processing in a community of African cercopithecoids. JOANNA E. LAMBERT.
- 9:15 am Chimpanzee juveniles constrain their mothers' gregariousness. RICHARD W. WRANGHAM, HERMAN PONTZER.
- 9:30 am Losing the edge: Tooth wear and life history in rainforest sifakas of Madagascar. STEPHEN J. KING, SHARON POCHRON, PAT C. WRIGHT, JUKKA JERNVALL.
- 9:45 am Break
- 10:00 am Extraordinary demography and life history in patas monkeys (*Erythrocebus patas*). LYNNE A. ISBELL, TRUMAN P. YOUNG.
- 10:15 am Population demography of northern muriquis (*Brachyteles hypoxanthus*). KAREN B. STRIER, JEAN PHILLIPE BOUBLI, ITALO MOURTHE, CARLA DE BORBA POSSAMAI, SERGIO L. MENDES.
- 10:30 am Differential maternal investment and sex allocation in wild Hanuman langurs. JULIA OSTNER, ANDREAS KOENIG, CAROLA BORRIES.
- 10:45 am Chimpanzees at Ngogo - The noble savage? SIMONE TEELEN.
- 11:00 am The effects of logging on the densities of the Pagai, Mentawai Island primates. LISA M. PACIULLI.
- 11:15 am GPS collars for monkeys: The state of technology. DAVID S. SPRAGUE.
- 11:30 am Genotyping aids field study of unhabituated wild chimpanzees. LINDA F. MARCHANT, AMANDA L. ENSMINGER, WILLIAM C. MCGREW, JILL D. PRUETZ, LINDA VIGILANT.
- 11:45 am Elementary technology of the wild chimpanzees of Fongoli, Senegal. WILLIAM C. MCGREW, SUSANNA JOHNSON-FULTON, JILL D. PRUETZ.

**Session 32. Primate Biology III: Skulls, Teeth, and Sex.** Contributed Papers. *Buccaneer C–D*.  
Chair: MATT CARTMILL, Duke University.

- 8:00 am Cranial allometry, phylogeography and systematics of baboons inferred from geometric morphometric analysis of landmark data. STEPHEN R. FROST, LESLIE F. MARCUS, FRED L. BOOKSTEIN, DAVID P. REDDY, ERIC DELSON.
- 8:15 am Allometric influences on facial form in lesser apes. BRIAN T. SHEA, ERIN R. LESLIE.
- 8:30 am (Non)allometric craniofacial sexual dimorphism in hominoids. KATRIN SCHAEFER, PHILIPP MITTEROECKER, PHILIPP GUNZ, MARKUS BERNHARD, HORST SEIDLER, FRED L. BOOKSTEIN.
- 8:45 am Wide faces or large canines? The attractive versus the aggressive primate. ELEANOR M. WESTON, ADRIAN E. FRIDAY, RUFUS A. JOHNSTONE, FRIEDEMANN SCHRENK.
- 9:00 am Evidence that female choice impacts the evolution of dimorphism in primates. J. MICHAEL PLAVCAN.
- 9:15 am Biological variability of wild ring-tailed lemurs, *Lemur catta*: Effects of habitat and sex. MICHELLE L. SAUTHER, KRISTA FISH, FRANK CUOZZO.
- 9:30 am 50 years of chimpanzee demography at Taronga Park Zoo, Australia. JUDITH H. LITTLETON.
- 9:45 am Dentine shape as a taxonomic indicator and the origins of bilophodont molars. CHRISTOPHER C. GILBERT, ANTHONY J. OLEJNICZAK, LAWRENCE B. MARTIN.
- 10:00 am Break
- 10:15 am Relative enamel thickness in a large sample of *Pan* and *Pongo* molars. TANYA M. SMITH, SHANNON BENES, LAWRENCE B. MARTIN.

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**Saturday Morning – April 17, 2004 (continued)**


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- 10:30 am Can low-magnification stereomicroscopy reveal diet? LAURIE R. GODFREY, GINA M. SEMPREBON, NIKOS SOLOUNIAS, MICHAEL R. SUTHERLAND, WILLIAM L. JUNGERS.
- 10:45 am In vivo jaw kinematics and mandibular bone strain in *Eulemur fulvus* and *Chlorocebus aethiops* and the functional significance of phase II. CALLUM F. ROSS, MARK WOLFF.
- 11:00 am Assessing the role of biomechanical variables during primate mastication using finite element analysis. DAVID S. STRAIT, PAUL C. DECHOW, BRIAN G RICHMOND, CALLUM F. ROSS, MARK A. SPENCER.
- 11:15 am Food properties and jaw performance in three sympatric species of *Hapalemur* in Ranomafana National Park, Madagascar. NAYUTA YAMASHITA, CHRISTOPHER J. VINYARD, CHIA L. TAN.
- 11:30 am Where the wild things are: Linking lab and field work in studying tree gouging in common marmosets (*Callithrix jacchus*). CHRISTOPHER J. VINYARD, PETER W. LUCAS, MONICA M. VALENCA-MONTENEGRO, LEONARDO C.O. MELO, YUMMA M. VALLE, MARIA A.O. MONTEIRO DA CRUZ.
- 11:45 am Masseter muscle fiber architecture in tree-gouging (*Callithrix jacchus*) and non-gouging (*Saguinus oedipus*) callitrichids. ANDREA B. TAYLOR, CHRISTOPHER J. VINYARD.

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**Saturday Afternoon – April 17, 2004**


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**Session 33. Paleopathology II. Contributed Posters. Regency 1.**

Chair: ELIZABETH A. MILLER, California State University, Los Angeles.

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|----------------|---|
| 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.                                       |

- Dietary reconstruction of enslaved African from the New York African Burial Ground: Elemental concentrations in permanent molars. PORTIA BURTON, JOSEPH L JONES, STEPHANIE ALLEN, ALAN H. GOODMAN, DULASIRI AMARASIRIWARDENA, MARK MACK, MICHAEL L. BLAKEY.
- Metastatic carcinoma: Skeletal pattern and diagnosis. MICHELLE D. HAMILTON, MURRAY K. MARKS.
- Brucellosis in ancient Nubia: Morbidity in biocultural perspective through time at Semna South, Sudan. MARY M. AUBIN.
- Brucellosis at Abydos, Egypt. BRENDA J. BAKER.
- A possible early case of advanced treponemal disease from Tennessee. T.K. BETSINGER, N.J. KUEMIN DREWS.
- Presence of *Mycobacterium* infection at the Crystal River archaeological site: Preliminary findings. RHETA E. LANEHART, DAVID HIMMELGREEN, ROBERT H. TYKOT, HELEN D. DONOGHUE, MARK SPIGELMAN, JENNIFER KELLY, NICOLE FALK.
- Tuberculosis in Inuits from Pt. Hope, Alaska: A possible maritime resource connection. SARAH E. GOSSETT, CHARLES E. HILTON.
- Evidence of biomechanical stress in a Middle Mississippian skeletal population. VICKI L. WEDEL, LESLEY M. RANKIN-HILL.
- Disease and trauma in skeletal remains from a Fifth Dynasty cemetery at Giza, Egypt. DAWN M. MULHERN.
- Bilateral erosive arthropathy of the upper limbs: An Inuit case from Point Hope, Alaska. MEGAN R. LATCHAW, CHARLES E. HILTON.
- Bioarchaeological evidence for the heath status of an early Icelandic population. PHILLIP L. WALKER, JESSE BYOCK, JACQUELINE T. ENG, JON M. ERLANDSON, PER HOLCK, KAETHIN PRIZER, MARK TVESKOV.
- Human skeletal remains from the Island of the Sun, Lake Titicaca, Bolivia. CHRISTINA TORRES-ROUFF.

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**Saturday Afternoon – April 17, 2004 (continued)**


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13. Health as a reflection of bio-cultural discontinuity in the Neolithic Cis-Baikal. ANGELA R. LIEVERSE.
14. New evidence of human sacrifice in the North Coast of Peru: Middle Sicán ritual killing in the Lambayeque Valley. HAAGEN D. KLAUS, JORGE C. CENTURION, MANUEL C. CURO.
15. "Funked up and Yowza": A study of descriptive terms used in the evaluation of infectious lesions. KEITH P. JACOBI, MARIE DANFORTH, GABRIEL D. WROBEL.

**Session 34. Forensic Anthropology. Contributed Posters. Regency 1.**

Chair: ELIZABETH A. MILLER, California State University, Los Angeles.

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| 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.                                       |

16. Fracture patterns in drivers and front passengers of automobile collisions. HEATHER L. GRAY.
17. Biological distance analysis of Postclassic skull rows and pairs, El Petén, Guatemala. WILLIAM N. DUNCAN.
18. Lytic lesions of the cranial vault: Differential diagnosis in dry bone. MICHAEL W. WARREN, JOHN J. SCHULTZ.
19. A new method for measuring soft tissue thicknesses of the face using ultrasound. SHELLEY L. SMITH, GAYLORD S. THROCKMORTON, PETER BUSCHANG.
20. Where have all the hands gone? Anthropological case from biblical times. ALON BARASH, ISRAEL HERSHKOVITZ, YEHUDA HISS.
21. The evolution of forensic anthropology in Los Angeles County, California: A 23-year perspective. ELIZABETH A. MILLER, JUDY M. SUCHEY, ERIK ARBUTHNOT, CRAIG HARVEY.
22. Age at death determination. using the skeletal histomorphometry of the third metacarpal and third metatarsal from autopsy and cadaver samples ADRIENNE L. FOOSE, ROBERT R. PAINE, RICHARD A. NISBETT, SRIDHAR NATARAJAN.
23. Age related changes in arachnoid foveae: Test of a new quantitative method. STEPHEN M. DURAY, STACIE S. MARTEL.
24. Estimating individual age-at-death parameters through multi-trait Bayesian analysis. ERIN H. KIMMERLE, LYLE KONIGSBERG.
25. Estimating age at death from thoracic and lumbar vertebral ring epiphyseal union data. A. MIDORI ALBERT, KELLY A. MCCALLISTER.
26. The creation of an anthropometric and DNA database to aid in the identification of illegal immigrant remains. LORI E. BAKER, ERICH J. BAKER.
27. Assessing the uniqueness of frontal sinus outlines Using Elliptic Fourier Analysis. ANGI M. CHRISTENSEN.
28. Morphometric analysis of craniofacial traits used in ancestral identification. SUMMER J. DECKER, JENNIFER L. THOMPSON, BERNARDO T. ARRIAZA.
29. Analysis of four contemporary trophy skulls in Los Angeles County, California. SYLVERE C.M. VALENTIN, ELIZABETH MILLER.
30. Examination of the mortuary use of fire as a taphonomic process. MISTY A. WEITZEL.
31. Time since death: The problem of determining PMI in skeletal remains. ALEXANDER KNABL, CHRISTIAN REITER, HORST SEIDLER, MARIA TESCHLER-NICOLA.
32. Disturbing the dead: The displacement and destruction of skeletal remains in early medieval Wessex, c.600-1100AD. ANNIA K. CHERRYSON.

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**Saturday Afternoon – April 17, 2004 (continued)**


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33. Cremations of the Linearbandkeramik culture in relation to the burial practices of early Neolithic communities in South-western Germany. IRIS TRAUTMANN.
34. A bug's life: A paleontomological case study from Chachapoya Perú. KENNETH C. NYSTROM, ALAINA GOFF, M. LEE GOFF.

**Session 35. Evolution of the Special Senses in Primates. Symposium. *Regency 2–3.***  
**Organizers and Chairs: TIMOTHY D. SMITH, Slippery Rock University, CALLUM F. ROSS, State University of New York at Stony Brook, and NATHANIEL J. DOMINY, University of Chicago.**

Since the advent of the arboreal theory and visual predation hypothesis of primate origins, specialized sensory structures have been perceived as defining characteristics of the Order. Higher primate taxa are partly defined by specializations of one or a suite of sensory structures. Accordingly, the functional significance of these sensory modalities is pivotal for understanding the origin and present day variation of primate behavior and ecology. This symposium examines the evolution of primate special senses, with particular emphasis on primate origins and current debates in primate behavioral ecology.

- 1:00 pm Vision, olfaction and brain size in *Parapithecus grangeri*. ELIOT C. BUSH, ELWYN L. SIMONS, JOHN M. ALLMAN.
- 1:15 pm Evolutionary modifications of primate visual cortex. TODD M. PREUSS.
- 1:30 pm Loss of olfactory receptor genes is coupled to the acquisition of full trichromatic color vision. YOAV GILAD, V. WIEBE, M. PRZEWORSKI, D. LANCET, S. PÄÄBÖ.
- 1:45 pm Is primate hearing special? RICKYE S. HEFFNER, HENRY E. HEFFNER.
- 2:00 pm The evolution of somatosensory systems in primates. JON H. KAAS.
- 2:15 pm Scaling and adaptive radiation of sensory brain structures. ROBERT A. BARTON.
- 2:30 pm Effects of activity pattern on eye and orbit morphology in primates. EDWARD C. KIRK.
- 2:45 pm Diversity in primate auditory structure and its influence on hearing performance. MARK N. COLEMAN.
- 3:00 pm Break
- 3:15 pm Is there a valid morphological basis for primate macrosomia or microsomia? TIMOTHY D. SMITH, KUNWAR P. BHATNAGAR.
- 3:30 pm Comparative immunohistochemistry of the primate vomeronasal organ. JOHN C. DENNIS, TIMOTHY D. SMITH, KUNWAR P. BHATNAGAR, ANNE M. BURROWS, CHRIS J. BONAR, EDWARD E. MORRISON.
- 3:45 pm Human chemical communication: Should we fearamone? CHARLES J. WYSOCKI.
- 4:00 pm Co-evolution of brain size and orbit orientation in primates and other mammals. CHRISTOPHER P. HEESY.
- 4:15 pm A comparative analysis of olfaction and primate social behavior. LAURA J. ALPORT, DEBORAH J. OVERDORFF.
- 4:30 pm Sensory perception of food: A study of fruits, fingers, and fermentation. NATHANIEL J. DOMINY, PETER W. LUCAS, NUR SUPARDI NOOR.
- 4:45 pm Discussion: NATHANIEL J. DOMINY.

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**Saturday Afternoon – April 17, 2004 (continued)**


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**Session 36. Life History, Energetics, and Human Evolution. Symposium. *Regency 5–6.***  
**Organizers and Chairs: GRAZYNA JASIENSKA, Jagiellonian University, and RICHARD G. BRIBIESCAS, Yale University.**

This symposium focuses in emerging research on the role of human energetics in human evolution. Life history theory suggests that time and energy availability are finite, often resulting in selection for allocation mechanisms and strategies that most efficiently regulate somatic and reproductive needs. Energy allocation trade offs between the demands of growth, maintenance, storage, and reproduction, has played a central role in the evolution of humans and nonhuman primates. Consequently, human and nonhuman primate physiology is characterized by allocation mechanisms that can be quantitatively assessed to test various life history predictions. The papers in the symposium focus on the physiology of energetic and metabolic management.

- 1:00 pm Forty days and forty nights: biocultural perspectives on the energetics of the immediate postpartum period among subsistence horticulturalists in the Brazilian Amazon. BARBARA A. PIPERATA, DARNA L. DUFOUR.
- 1:15 pm The impact of a labor-saving technology on birth spacing in southern Ethiopia. MHAIRI A. GIBSON, RUTH MACE.
- 1:30 pm Energy status, energy balance and energy expenditure in relation to ovarian function in rural and urban women from Poland. GRAZYNA JASIENSKA, INGER THUNE, PETER T. ELLISON.
- 1:45 pm A longitudinal study of the proximate and ultimate causes of child mortality in the Dogon of Mali. BEVERLY I. STRASSMANN.
- 2:00 pm Neuroendocrine reflections of senescence in human males: Indications of decreased energy allocation ability with age? RICHARD G. BRIBIESCAS.
- 2:15 pm Age related changes in body composition among Turkana males. BENJAMIN C. CAMPBELL, PAUL W. LESLIE.
- 2:30 pm Human male testosterone variation viewed within a framework of mating and parenting effort. PETER B. GRAY.
- 2:45 pm Break
- 3:00 pm Body size and fat predict fertility and reproductive success among Hadza hunter-gatherers. FRANK W. MARLOWE.
- 3:15 pm The immunosomatic metabolic diversion hypothesis and testosterone correlates to intestinal parasitemia in wild male chimpanzees. MICHAEL P. MUEHLENBEIN.
- 3:30 pm Maternal and prenatal influences on male life history. CHRISTOPHER W. KUZAWA, ELIZABETH M MILLER, LINDA S. ADAIR.
- 3:45 pm Leptin, body composition and energy metabolism in the Buryat herders of Southern Siberia. WILLIAM R. LEONARD, ANTHONY G. COMUZZIE, MARK V. SORENSEN, M.J. MOSHER, VICTOR A. SPITSYN.
- 4:00 pm The energetic cost of arboreal motherhood in orangutans: Effects on the inter-birth interval. CHERYL D. KNOTT.
- 4:15 pm Measurement of urinary C-peptide in chimpanzees offers a noninvasive tool for comparative studies of energetics. DIANA SHERRY, BENJAMIN CAMPBELL, RICHARD W. WRANGHAM, PETER T. ELLISON.
- 4:30 pm Discussion: GRAZYNA JASIENSKA and RICHARD BRIBIESCAS.

**Session 37. Skeletal Biology IV: Bioarchaeology and Biodistance. Contributed Papers. *Buccaneer A–B.***
**Chair: CHRISTOPHER W. SCHMIDT, University of Indianapolis.**

- 1:00 pm Faunal remains from La Nuestra Senora de Atocha and Santa Margarita. MONICA FARALDO, LINDA L. TAYLOR.
- 1:15 pm Taphonomy, selective preservation and robusticity in human skeletal samples: The osteometrical paradox. SILVIA M. BELLO.

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**Saturday Afternoon – April 17, 2004 (continued)**


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- 1:30 pm Investigating cemetery diversity: Grave variation, osteology and social identity late Anglo-Saxon England, c. 700-1100AD. JO L. BUCKBERRY.
- 1:45 pm Culturally modified human remains from the Hopewell Mound Group. CHERYL A. JOHNSTON.
- 2:00 pm Raiding and ritual violence in the ancient Andes: A study of cranial trauma among populations from Majes valley, Peru. TIFFINY A. TUNG.
- 2:15 pm Bridging histories: The bioarchaeology of Seminole ethnogenesis. CHRISTOPHER M. STOJANOWSKI.
- 2:30 pm The variation of body proportions over a period of 7,000 years in Denmark. PIA BENNIKE.
- 2:45 pm A test of developmental causality of morphological integration. JESSICA H. HUNT.
- 3:00 pm Break
- 3:15 pm Assimilation pelvis in human obstetrics and evolution. ROBERT G. TAGUE.
- 3:30 pm Fluctuating asymmetry and stress in a medieval Nubian population. VALERIE BURKE DELEON.
- 3:45 pm Physique and climatic adaptations of Paleoindians. JOSEPH F. POWELL, OSBJORN M. PEARSON, J. SMART.
- 4:00 pm Intra population variation of cranial nonmetric traits compared to discrete dental traits of the Illinois Bluff Mounds. ARION T. MAYES.
- 4:15 pm Intra-population and temporal variation in ancient Egyptian crania. SONIA R. ZAKRZEWSKI.
- 4:30 pm A three-dimensional approach to intra-regional variation among Archaic populations of the Mid-South. NICOLE J. KUEMIN DREWS.

**Session 38. Human Biology II. Contributed Papers. *Buccaneer C–D.***

Chair: STACY ZAMUDIO, New Jersey Medical School.

- 1:00 pm Ventilatory control and exercise response in lowland born admixed Peruvians tested at 4,338 m. TOM D. BRUTSAERT, MELISA KIYAMU, ESTEBAN J. PARRA, MARK D. SHRIVER, ALFREDO GAMBOA, MARIA RIVERA-CH, FABIOLA LEON-VELARDE.
- 1:15 pm Using humanities to unwrap biology: The Qiang controversy. STEPHEN M. BAILEY, JUIPING XU, XSIAO HU.
- 1:30 pm Population structure of Irish migrants to northern England in the late nineteenth century. MALCOLM T. SMITH, ANTHONY C. HEPBURN, DANIEL JACKSON, DONALD MACRAILD, JAMES MACPHERSON.
- 1:45 pm What does the human biological perspective suggest concerning migration routes into the Americas? ROBERTA L. HALL.
- 2:00 pm The peopling of Americas. The 'Out of Beringia' model tested from cranio-functional morphology. FERNANDO V. RAMIREZ ROZZI, MARINA SARDI, ROLANDO GONZALEZ JOSE, HECTOR PUCCIARELLI.
- 2:15 pm Neighbours or sisters? Testing models of cultural transmission in the Pacific using phylogenetic methods. FIONA M. JORDAN, RUTH MACE.
- 2:30 pm Cold adaptations of the Polynesians: Nasal morphology. VINCENT H. STEFAN.
- 2:45 pm Break
- 3:00 pm Geographic patterns of nasal morphology in *Homo*. MARC MEYER, JODI BLUMENFELD, P. THOMAS SCHOENEMANN.
- 3:15 pm Brunhilde in Lilliput? Sexual dimorphism in English skeletal samples from the Romano-British period to post-medieval times. MARIANNE SCHWEICH, CHRISTOPHER J. KNUSEL.



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**Saturday Afternoon – April 17, 2004 (continued)**

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- 3:30 pm Patterns of sexual dimorphism in *Homo*. ADAM P. VAN ARSDALE, MARC MEYER.
- 3:45 pm Local, national and international variation in human secondary sex ratio as a function of maternal condition. RUTH H. MACE, MHAIRI GIBSON.
- 4:00 pm Intra-populational pattern of facial growth in humans: A geometric morphometric analysis. EKATERINA BULYGINA, PHILIPP MITTEROECKER, LESLIE AIELLO.
- 4:15 pm Is fluctuating asymmetry a stable trait? DAVID V. LEONE, MARK V. FLINN.
- 4:30 pm Growing up in diverse environments: Effects on adult salivary estradiol. ALEJANDRA NUNEZ-DE LA MORA, ROBERT T. CHATTERTON, OSUL CHOUDHURY, DORA NAPOLITANO, JORDANA HOCHMAN, GILLIAN R. BENTLEY.
- 4:45 pm Age estimation of human skeletal remains - a comparison of methods from Lauchheim, Germany. SVENJA WEISE, JESPER BOLDSSEN, JO L. BUCKBERRY, STEPHANIE DOPPLER, JUTTA GAMPE, GISELA GRUPE, GERHARD HOTZ, CLARK S. LARSEN, ARIANE KEMKES- GROTTENTHALER, DEBRA PRINCE, J.W. VAUPEL, J. WAHL. U. WITTEW- BACKOFEN.

## Abstracts of AAPA Poster and Podium Presentations

### Poor outcomes following malaria during pregnancy.

E.T. Abrams<sup>1</sup>, V. Mwapasa<sup>2</sup>, D.D. Kamwendo<sup>2</sup>, S.R. Meshnick<sup>3</sup>. <sup>1</sup>Department of Anthropology, University of Michigan, <sup>2</sup>Department of Epidemiology, University of Michigan, <sup>3</sup>Department of Epidemiology, University of North Carolina-Chapel Hill.

Malaria is associated with a number of poor pregnancy outcomes, including low birth weight and maternal anemia. Outcomes are worse in primigravids, and negative effects lessen with parity. Malaria parasites localize in the placenta during pregnancy; however, despite the proximity of the parasites, congenital malaria is rare. This suggests that selective pressure against fetal acquisition of malaria is strong. The immunological effects of placental malaria on low birth weight have been well demonstrated, and may represent a consequence of the inflammatory process that mechanically blocks malaria parasites from traversing the placenta to the fetus. In this study, we examined the effects of malaria on the relationship between maternal and neonatal anemia. We assayed markers of anemia, severity of malaria, erythropoietin (a marker of red blood cell production), immune markers, and markers of fetal stress in maternal, placental, and cord blood. The samples included malaria-infected (n = 33) and uninfected (n = 56) women who delivered at the Queen Elizabeth Central Hospital in Blantyre, Malawi. Malaria was associated with maternal anemia (t=2.66, p=0.012) and increased maternal erythropoietin levels (t=3.43, p=0.001). Increased maternal erythropoietin levels significantly correlated with neonatal head circumference and length but were not related to birth weight. Cord erythropoietin was not associated with any markers of anemia, inflammation, fetal stress, or birth outcome. These results suggest that the mother may allow temporary declines in her third trimester health to buffer the fetus.

### Mitochondrial DNA analysis of the ancient Peruvian highlanders.

N. Adachi<sup>1</sup>, K. Shinoda<sup>2</sup>, I. Shimada<sup>3</sup>. <sup>1</sup>Department of Anatomy and Anthropology, Tohoku University School of Medicine, <sup>2</sup>Department of Anthropology, National Science Museum, <sup>3</sup>Department of

Anthropology, Southern Illinois University.

Genetic background of the pre-Columbian populations is considered to be very important to know the genetic background of the founders of the Inca Empire; however, it has not yet been fully clarified. In the present study, we performed the mitochondrial DNA (mtDNA) analysis of the pre-Columbian Peruvian highlanders excavated from caverns in the highlands northwest of Cuzco during the Peruvian Expedition of 1914 and 1915 under the auspices of Yale University and The National Geographic Society (Grant and MacCurdy, 1923).

To identify their genealogy securely, we analyzed the coding region of mtDNA by using amplified product-length polymorphisms (Umetsu et al., 2001) and direct sequencing. We also sequenced the segments of the two hypervariable regions of mtDNA, and assigned the mtDNA under study to relevant haplogroups using the known mtDNA databases.

Like many other South American populations, haplogroup B4 was the most predominant among the specimens examined in the present study. However, distribution pattern of haplogroups and many of the sequence haplotypes of the hypervariable region were different from those of previously reported pre-Columbian Sicán and Sipán populations (Shinoda et al., 2002). Our result suggests that pre-Columbian Peruvian highlanders may have been genealogically different from the pre-Columbian populations who lived along the northern coast of Peru.

### Fetal adaptations to maternal nutritional status during pregnancy.

L.S. Adair. Department of Nutrition, University of North Carolina at Chapel Hill.

Maternal nutritional status during pregnancy, reflected in energy and nutrient stores and dietary intake, is a strong determinant of fetal growth, which affects infant survival. Maternal nutrition affects fetal growth directly in providing cellular building blocks and essential components of regulatory proteins. Further, nutritional sufficiency or insufficiency may stimulate or inhibit other regulatory functions or metabolic pathways, resulting in altered patterns of fetal growth. The increased energetic and nutrient demands of pregnancy represent significant stressors, particularly in popu-

lations with limited food resources. Maternal and fetal adaptations to nutritional inadequacies have developed to enhance survival of the fetus. For example, mothers may reduce energy expenditure through reduced physical activity and increased metabolic efficiency. In response to protein-energy undernutrition, the fetal growth trajectory can be altered in a "brain sparing" manner, that is, by reducing mass of other organs, in particular, skeletal muscle, while brain growth is largely preserved. Such patterns are typically manifested by low relative weight at birth, which can potentially be "corrected" by compensatory postnatal growth. However, such adaptations, which enhance survival in the short term, are not without short and long term costs such as increased risk of neonatal mortality and chronic disease in later life. There may be less plasticity in response to specific micronutrient deficiencies. For example, maternal iodine deficiency produces irreversible fetal brain damage. Maternal overnutrition and dysregulation of glucose metabolism also affect fetal growth and survival by increasing risk of macrosomia and hypoglycemia at birth.

### New and revised faunal samples from *in situ* and dumpsite breccia deposits at Gondolin, North West Province, South Africa.

J. W. Adams<sup>1,2</sup>, F. Senegas<sup>3</sup>. <sup>1</sup>Department of Anthropology, Washington University in St. Louis. <sup>2</sup>School of Anatomical Sciences, University of the Witwatersrand. <sup>3</sup>Department of Palaeontology and H.O.P.E, Transvaal Museum, P.O. Box 413, Pretoria 0001, South Africa.

This paper provides new and updated listings of macro- and micromammalian faunal remains recovered from several phases of excavation at Gondolin, a cave site with Plio-Pleistocene brecciated deposits situated 35km northeast of the Sterkfontein Valley. First, we present a revised and expanded listing of faunal remains from the GD 2 *in situ* excavations conducted in 1979, of which a portion had been previously described by Watson (1993). Second, we offer an expanded and updated catalogue of faunal remains excavated from a 1997 field season that sampled from a test trench dug into mixed, dumpsite deposits at the site (Menter *et al.*, 1999). Faunal specimens recovered from blocks and loose sediment from the test trench included the recovery

of artiodactyl and carnivore remains not represented in the GD 2 *in situ* deposits. Third, we provide the first listing and analysis of micromammalian remains sampled from various dumpsite deposits at Gondolin. Faunal representation and their distribution across several distinct breccia types indicate that there were multiple phases of infilling and faunal deposition, potentially both spatially as well as temporally, during the time period spanning approximately 2.5 to 1.5 million years ago.

### **Dental anthropology in Scotland: Morphological comparisons between medieval Scotland and northern Europe.**

A.J. Adler<sup>1</sup>, M.E. Watt<sup>2</sup>, C.G. Turner II<sup>1</sup>.  
<sup>1</sup>Dept. of Anthropology, Arizona State University, <sup>2</sup>Oral Sciences, Glasgow Dental School, University of Glasgow.

Throughout its diverse history, many groups have settled in Scotland. The question of homogeneity in Scotland is an interesting one as different regions have had varying degrees of impact from different parts of Europe. Previously, Adler, Watt and Turner (2003) looked at discrete dental morphological traits and showed that samples from different parts of Scotland significantly differed from each other. The question remains as to whether differences amongst the peoples of these regions can be traced to their biocultural histories.

To address this question, Medieval samples from five regions of Scotland (Whithorn, Aberdeen, Linlithgow, St. Andrews and Hallowhill) (Adler et al., 2003) were compared with those from regions of Europe which may have had the largest biocultural effects on Scotland. Data from England, Ireland, Holland, Norway and Denmark, were taken from previously published studies.

Samples were analyzed using the Arizona State University Dental Anthropology System (ASUDAS). Regional groups were compared both on a trait by trait basis, and using the multivariate MMD statistic. Given their long history of contact, it is not surprising that English and Irish samples were most similar to all groups within Scotland. Dutch samples were most dissimilar from Scottish samples, indicating less contact. Of the Scottish samples, Whithorn was most similar to Ireland, reflecting frequent contacts between these areas. Aberdeen was most dissimilar to all non-Scottish regions, suggesting they may have had the least amount of contact with outside areas.

### **Why Erik "Not at all"? - A possible case of Marfans syndrome.**

T. Ahlström. Institute of Archaeology and Ancient History, University of Lund.

Earl Birger Magnusson of Sweden (d.1266) founded a royal dynasty based on his own lineage. Two of his sons became kings, Valdemar and Magnus. However, a younger son, Erik, bore the pejorative epithet "Not at all", for reasons unknown. It is surmised that he chooses the epithet himself to mark his lower status compared to the brothers. Further, the cause of his untimely death, at an age of approximately 30 years, in a period of political turmoil, has not been resolved. Duke Erik was buried with his father, Earl Birger, in the Varnhem Abbey.

Earl Birger's grave was rediscovered in 1928 and reopened in 2001. The original report mentioned that the skeleton of the younger man, Erik, in the grave bore signs of osteoarthritis, but nothing else. The renewed osteological analysis demonstrated osteoarthritis in the cervical vertebrae, manifested unilateral osteophytosis in the thoracic and lumbar vertebrae. This is indicative of scoliosis. Abnormal chest shape is indicated by a *pectus carinatum*. Based on the paleopathological findings, possible diagnosis has been discussed.

Specifically, Marfans syndrome is presented as a probable cause to the skeletal changes. Marfans syndrome is a disease of the connective tissues. Apart from involving the skeleton, it also affects the eye sight as well as the structural integrity of the blood vessels. I will discuss how the new data enlightens our understanding of an historic event, an unusual epithet, as well as a paleopathological condition hitherto not described in the paleopathological literature.

### **Estimating age at death from thoracic and lumbar vertebral ring epiphyseal union data.**

A.M. Albert, K. McCallister. Anthropology Program, University of North Carolina at Wilmington.

This study further examined the relationship between age at death and stages of epiphyseal union of the superior and inferior thoracic (T1-T12) and first two lumbar (L1-L2) vertebral centra ("ring" epiphyses). We compared results to earlier findings by Albert and Maples (1995). Both studies showed final fusion often extended into the middle 20's, later than other epiphyses that generally fuse by the late teens to early 20's in most individu-

als. Thus, vertebral ring epiphyses may provide age information beyond ages for which other epiphyses are commonly active, possibly improving age estimations, with implications for paleodemography and forensic anthropology.

We obtained data from 57 individuals from the Terry Collection: 23 females, 34 males, black and white, aged 14 to 27 years. After stages of vertebral ring union were recorded, mean values were calculated for each individual, which correlated highly with age at death ( $r=0.777$ ). There were no statistically significant population or sex differences. However, females showed a higher correlation between vertebral ring epiphyseal union mean values and age at death ( $r = .862$ ) than did males ( $r = .714$ ). Observational analyses of the raw data revealed the earliest age at which union began was 14 and 17 years for females and males, respectively. The oldest ages of remaining activity, where fusion was not totally complete in all epiphyses, were 24 and 26 years for females and males, respectively. Additional findings will be discussed. Insofar as our results corroborated earlier findings, this method is recommended for use in skeletal age estimation.

### **Development and evolution of morphological integration in the human brain.**

K. Aldridge. Pennsylvania State University and Johns Hopkins University.

Studies have shown that human brain evolution has been accomplished through differential change in component parts of the brain. Morphological integration (MI) refers to the interdependency between parts of an organism that, together, produce an integrated, functional whole. The degree of integration between component parts reflects the functional and developmental relationships between those parts, and is related to whether characters evolve separately, or in concert. The goal of this study is to examine patterns of MI in the development and evolution of the human brain.

In this study, three-dimensional landmark coordinate data were collected from MRIs of human infants (N=12) and adults (N=19), and bonobos, chimpanzees, gorillas, and orangutans (N=10). A bootstrapping algorithm was used to determine whether patterns of MI differ significantly between infant and adult human brains, and between adult humans and great apes.

Results show that overall levels of MI are similar in infant and adult human brains. However, there are distinct re-

gions that display increased levels of integration in infants, and regions that display increased levels in adults. Overall levels of MI are similar in adult humans and great apes, though there are focal areas that are more highly integrated in humans while others are more highly integrated in great apes. These results suggest that the pattern of integration in the human brain changes over the course of development, and differs between humans and apes. Together, these differences in integration may serve as the developmental basis for phenotypic differences between human and non-human hominoid brains.

**The aging brain: The cognitive reserve hypothesis and hominid evolution.**

J.S. Allen, J. Bruss, H. Damasio. Dept. of Neurology, University of Iowa.

In mammals, including primates, there is a strong positive correlation between brain size and maximum lifespan. This correlation does not require that longevity *per se* has been selected for or that older individuals contribute to the fitness of younger kin. Among mammals, humans are among the most encephalized and live the longest, and intergenerational assistance is common in human societies.

Evolutionary models that incorporate the behavior of older individuals should take into account the physiological processes associated with the aging brain. Our high-resolution MRI analysis of gray and white volumes in a series of 87 healthy individuals (ages 22-88 years) indicates that gray matter decreases linearly over the adult lifespan of an individual. White matter volumes increase slowly, peaking in the 45-55 year range, before starting a decline that becomes precipitous beginning in the 65-70 year range. Although there is regional variation in the brain, all of the major lobes conform to this basic pattern.

The "cognitive reserve hypothesis" postulates that individuals with relatively larger brains may be more resistant to the effects of Alzheimer's disease, brain injury and seizures. If larger brain size is associated with "successful aging," then a positive evolutionary feedback loop between increased brain size and increased longevity could have been established, via intergenerational care of kin (including information transfer via language). Such a feedback loop may have contributed to rapid increases in brain size and longevity over the past 2 MY of hominid evolution.

Funding: Program Project Grant NINDS NS 19632 and the Mathers Foundation.

**Quantitative trait linkage mapping in the Strong Heart Family Study of American Indians.**

L. Almasy<sup>1</sup>, B.V. Howard<sup>2</sup>, E.T. Lee<sup>3</sup>, L. Best<sup>4</sup>, T.K. Welty<sup>4</sup>, R. Devereux<sup>5</sup>, R.R. Fabsitz<sup>6</sup>, S. Cole<sup>1</sup>, S. Laston<sup>1</sup>, H.H.H. Göring<sup>1</sup>, V.P. Diego<sup>1</sup>, B. Dyke<sup>1</sup>, J.W. MacCluer<sup>1</sup>. <sup>1</sup>Southwest Foundation for Biomedical Research, <sup>2</sup>Medlantic Research Institute, <sup>3</sup>University of Oklahoma Health Sciences Center, <sup>4</sup>Missouri Breaks Industries Research Inc., <sup>5</sup>Cornell Medical College, <sup>6</sup>National Heart, Lung, and Blood Institute.

The Strong Heart Study began in 1988 with the goal of investigating cardiovascular disease and related risk factors in American Indians. Strong Heart Study participants ages 45-74 were enrolled through centers in Arizona, South Dakota, and Oklahoma, with approximately 1500 individuals seen at each site. The Arizona participants are of Pima, Maricopa, and Tohono O'Odham descent. Participants in Oklahoma are Apache, Caddo, Comanche, Delaware, Fort Sill Apache, Kiowa, and Wichita whereas those in South Dakota are Sioux. In 1996, a genetics component was added and families were ascertained for linkage studies. Approximately 1250 individuals in 40 extended families are being collected at each center. Families were selected through a sibship of 2 to 8 siblings who had participated in the original epidemiological study. The parents, spouses, offspring, spouses of offspring, and grandchildren of these original participants were enrolled to build the extended pedigrees. Identical data collection protocols were used at all sites and a wide range of phenotypes is available, including lipid levels, blood pressure, carotid ultrasound and echocardiographic measures, hormone levels, reproductive and medical history, anthropometrics, and demographic variables. Genotyping is in progress for a genome-wide linkage screen. The Strong Heart Family Study is biomedically important because it investigates risk factors for cardiovascular disease, a prevalent cause of morbidity and mortality, in understudied populations. It is also of interest scientifically as a model in that it illustrates how epidemiological studies may have large families embedded in them and it provides an opportunity to compare across three fairly disparate populations.

**A comparative analysis of olfaction and primate social behavior.**

L. Alport, D. Overdorff. Department of Anthropology, University of Texas at Austin.

Olfaction is an important means of communication among mammals, yet little is known about the specific functions of the olfactory system within the primate order. Primates vary considerably in their olfactory anatomy. For instance, while all primates possess a main olfactory bulb (MOB), only strepsirrhines and platyrrhines possess an accessory olfactory bulb (AOB). Although primates show wide variation in social behavior, few comparative analyses of sensory anatomy have considered the effects of social variables. The purpose of this analysis is to elucidate the role of olfaction in the context of social behavior. In this regard, we use phylogenetic analyses to compare the relative size of sensory structures, with social variables such as mating system and group size. Using data from 44 primate species, we test the following predictions: (1) Because the AOB is associated with mating in mammals, we predict that AOB size is correlated with mating behaviors. (2) In the absence of an AOB in catarrhines, we predict that the size of the MOB is correlated with social variables. (3) Alternatively, social communication in catarrhines may have shifted from olfaction to vision. Thus, we predict that visual anatomy is correlated with social behaviors. We show that in strepsirrhine primates only, relative AOB size increases with the number of males with which a female mates. Variables are not correlated with the MOB. However, size of the visual cortex is correlated with group size, suggesting that catarrhines may, indeed, rely more heavily on vision for social communication.

**Health at Little Salt Spring: Frequency of dental pathologies at Middle Archaic site in Florida.**

C. Alvarez. Department of Anthropology, Texas State University—San Marcos .

The Little Salt Spring site consists of a large sinkhole, basin and slough on the western coast of Florida which preserved organic material, including human skeletal remains from the Middle Archaic period (6000 BP). Remains of approximately fifty individuals were recovered at the site from 1959 through 2002. The purpose of this study is to determine the general health of individuals in the sample based on the frequency of dental pathologies.

From 84 individual bone elements, the total available dentition is analyzed, including eleven mandibles and four maxil-

lae. The following characteristics are examined: age, dental attrition, and pathologies, including the frequency of linear enamel hypoplasia (LEH), caries, abscesses, periodontal disease, calculus, and antemortem tooth loss.

When compared with other hunter-gatherer groups, the frequency of abscesses and tooth loss in the sample is low (under 5%). While calculus and periodontal disease occur more frequently (40%), the cases are mild rather than severe. The frequency of linear enamel hypoplasia is also low (12%). Due to the nature of the diet, the frequency of caries is low (less than 1%), and attrition is high, as expected. Based on these results, the dental health of the individuals in the sample is good, when good health is defined as the absence of disease. Overall health based on dentition is also good—indicators that point to high stress and disease such as LEH, abscesses, and tooth loss have lower frequencies. The data suggests a healthy, stable population at Little Salt Spring during the Middle Archaic period.

**How well does paternity confidence match actual paternity? Evidence from worldwide nonpaternity rates.**

K.G. Anderson. Anthropology, University of Oklahoma.

Men can never be fully positive of paternity, but must instead rely on indirect cues to assess paternity confidence. Nothing is known, however, of how well paternity confidence matches actual paternity. The costs of mistakenly assessing paternity may be different for actual fathers versus actual non-fathers, because men who unknowingly raise another man's child receive zero fitness benefits from doing so, while men who abandon a spouse and child may still receive fitness benefits if the child survives to maturity. Because of these differences in fitness costs, men with high paternity confidence should be more accurate in their assessment of paternity than men with low paternity confidence.

I test this hypothesis using published data on nonpaternity to compare nonpaternity rates from two groups of men, based on their presumed level of paternity confidence. Men with high paternity confidence (subjects in genetic studies) have very low rates of nonpaternity (median = 1.9%,  $N = 22$ ). Men with extremely low paternity confidence (cases of disputed paternity resulting in paternity tests) have much higher levels of nonpaternity (median = 30.2%,  $N = 30$ ). These levels are significantly different (Wilcoxon sign-rank test), confirming that men with high pa-

ternity confidence are more accurate in their assessment of paternity than men with low paternity confidence. Furthermore, the difference in nonpaternity between these groups remains when compared by geographical region (U.S., Europe, and elsewhere). Apparently not all men are equally good at assessing paternity, which raises interesting questions into the mechanisms by which men assess paternity confidence.

**Nice chimps don't always finish last: Dominance rank and behavioral style in chimpanzees.**

S.F. Anestis. Dept. of Anthropology, Yale University.

Primatologists have often remarked on "personality" differences among their study animals. They refer to alphas of both sexes as "mellow" or "mean," categorize females according to maternal style, and compare adolescents with respect to their interest in achieving high rank. Such variation in behavioral style is rarely quantified, despite recognition that it may have an important influence on individual reproductive success.

Young chimpanzees in captivity form dominance hierarchies that are unstable because of variation in individual growth rates and, often, because keepers move animals among groups. Individuals also show extreme variation in behavioral style, differing in such characteristics as how they respond to individual and coalitionary aggression and how frequently they initiate positive social interactions with groupmates. I documented variation in behavioral style among juvenile and adolescent peer groups of chimpanzees living at the New Iberia Research Center (University of Louisiana at Lafayette) over the course of 3 years. I show that individuals with similar dominance ranks can have very different behavioral styles; for example, alpha status can be maintained through overt aggressive acts or simply by signals that threaten aggression. I also test the hypothesis that high baseline urinary cortisol level is associated with particular styles. An understanding of behavioral style variation will help explain differences between individuals in such variables as response to acute and chronic stressors, probability of achieving high rank, and ultimately reproductive success.

**Biogeography of *Homo erectus*: Insights from Indonesia and China.**

S.C. Antón<sup>1</sup>, E. Indriati<sup>2</sup>. <sup>1</sup>Department of Anthropology, New York University,

<sup>2</sup>Gadjah Mada University, Yogyakarta, Indonesia.

Recent work has identified significant geographic variation in cranial shape within Asia. Specifically, cranial shape differentiates northern Chinese from Indonesian *H. erectus*, regardless of time period. Due to the discontinuous distribution of known fossils, whether the geographic pattern of shape difference forms a continuous (smooth) north-south clinal gradation, or a steep clinal gradation (i.e., conjunction) remains obscure. Interpretation of the pattern is further complicated by a lack of temporal overlap between localities in the two regions and by the diachronous nature of both samples. We evaluate temporal variation in cranial anatomy of the Indonesian and Chinese subsamples to further elucidate the nature of the biogeographic pattern.

To avoid large time gaps within sequences, we focus on the time transgressive samples from Sangiran, Java and Zhoukoudian, China which span from about 1.6 to 1.1 Ma and from about 600 to 200 ka, respectively. We consider craniodental characters and metrics, as well as cranial capacity. We compare within and across chronostratigraphic units of each sample to assess 1) sample homogeneity, 2) character change, and 3) size change through time. Overall the Javan sample is more variable than the Chinese. The Javan sample also exhibits clearer temporal trends in shape, in part related to reduced massiveness of cranial superstructures. Certain characters are stereotypic in the Chinese sequence including mastoid cresting patterns. However, distinctive Chinese skull shape is established in its earliest individuals (Skull III), and temporal trends toward the exaggeration of this shape exist (if Skull III is adult) as do other related trends.

**Optimal size of feeding and traveling subgroups of spider monkey (*Ateles belzebuth*).**

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Spider monkeys associate in subgroups to feed, travel, and rest. Several studies showed that subgroup size responds directly to the availability of fruit in the home range. However, it is unknown whether different types of subgroups respond differently to fruit availability. In this study we analyzed the effect of fruit availability in feeding subgroups and traveling subgroups

On a community of spider monkeys at Tinigua National Park – Colombia, data of activity and subgroup size were collected during fruit abundance and scarcity seasons. We found a correlation between feeding subgroup size and patch size, but feeding subgroup size was not different between seasons. On the contrary, traveling subgroups were significantly larger during the fruit abundance season (Mean scarcity = 3.4 individuals  $\pm$  2.6, median = 2 vs. mean abundance = 4.5 individuals  $\pm$  3.14, median = 3). On average, traveling subgroups were twice the size of feeding subgroups (Traveling subgroups mean = 4.3  $\pm$  3.06 vs. Feeding subgroups mean = 2.4  $\pm$  1.8 individuals). Feeding subgroups that had between 2 and 4 individuals presented the highest feeding rates. This suggests that although spider monkeys adjust the size of the feeding subgroup to patch size, there is an optimal subgroup size where individuals maximize food intake. Spider monkeys prefer traveling in large subgroups, but food availability during the fruit scarcity is hypothesized to decrease traveling subgroup size, guaranteeing that every individual in the subgroup will have access to fruit in the feeding subgroup.

**Subtleties in African monkey positional behavior and support use: The influence of microhabitat variation within a single site in the Kibale Forest, Uganda.**

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A central problem in interpreting primate positional behavior and support use is the influence of canopy architecture. From February-May 2003, I recorded positional behavior and support use in three monkeys (*Cercopithecus ascanius*, *Lophocebus albigena*, and *Ptilocolobus badius*) within the Kibale National Forest, Uganda. I also collected data on forest structure, including tree species, canopy height and continuity, support characteristics, and gap frequency.

My results indicate that *P. badius* spent the most time in the upper canopy, using wide-crowned trees with very large, stout supports. *L. albigena* used mid-sized branches in the middle canopy most often, and *C. ascanius* used small branches in the middle and lower canopy. These canopy height preferences correlate with the number of gaps encountered, and how they are crossed. *P. badius* faced the most gaps in the disjunctive upper canopy, and thus leaped the most. *L. albigena* used bridging in the more continuous middle canopy. *C. ascanius* also faced gaps in the

discontinuous lower canopy, but used lianas and undergrowth to facilitate bridging. For all taxa, short bounds were the most common gap-crossing method.

However, complex factors exist. The hypothesis that larger-bodied primates use more sturdy supports was unsupported, as *L. albigena* used pliant supports most often, while *C. ascanius* used the least, and *P. badius* was intermediate. Also, *L. albigena* canopy and support use varied considerably between 2001 (low canopy, small pliant branches) and 2003 (taller trees, large supports). Variance in forest microhabitats must be examined to properly evaluate primate positional behavior and support use.

**A clinal pattern of human Y chromosome diversity in North Africa.**

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We have used a method based on primer extension and mass spectrometry allele detection to analyse 118 Y-chromosomal SNPs from more than 250 unrelated individuals sampled from five North African populations, completing our set with published data on Moroccan populations. Two haplogroups, E3b2\* and J\*, make up 63% of the Y chromosomes observed in this region. E3b2\* rises in frequency from east (~10%) to west (~64%) while the within-sample gene diversity decreases, suggesting an increasing level of genetic drift in the west. The inferred level of populations genetic structure is significant ( $\Phi_{ST}$ =0.103,  $P<0.0001$ ) and fits the pattern expected under an isolation-by-distance model. Autocorrelation analyses reveal an east-west cline of genetic variation, compatible with the hypothesis of a demic diffusion. This expansion must have involved relatively small numbers of Y chromosomes to account for the reduction in gene diversity accompanying the frequency increase of E3b2\*, but with gene flow maintained to explain the observed pattern of isolation-by-distance. We speculate that the expansion forming the basis of Y-chromosomal variation in North Africa was associated with the Neolithic, since the estimations of the TMRCA of the most common hap-

logroups based on the variation at 15 STR loci are quite recent (C.I.<sub>95%</sub> < 13 kya). The Mediterranean Sea and the Sahara Desert probably imposed an east-west direction on the peopling of this area.

**Looking for safety at the top: Sleep site selection by *Propithecus diadema edwardsi* within Ranomafana National Park, Madagascar.**

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For diurnal primates, day-active predators can be deterred through a combination of crypticity, vigilance, alarm calling, and mobbing. However, when asleep, the selection of "safe" sleeping locations is the only thing that stands between these primates and their nocturnal predators. The *Propithecus* population within the rainforest of Ranomafana National Park (RNP), Madagascar is threatened by one nocturnal predator, the fossa (*Cryptoprocta ferox*). Long-term study of the *Propithecus* populations within the selectively logged habitat at RNP has revealed high levels of fossa predation (up to 19 of 39 animals within 10 years). This study explores the impact that habitat disturbance has on *Propithecus* behavior by comparing the sleep site selection and sleeping patterns of seven social groups from selectively logged and pristine forest areas over a one-year period. Data suggest that *Propithecus* within both habitats demonstrate similar preferences for sleeping partners and group spacing during the night. However, botanical inventory data collected from the sites suggest that habitat structure may limit sleep site choice, both in terms of sleep site height (absolute and/or relative) and the number of sleep sites used. These data increase our understanding of the broad impact that habitat disturbance, such as selective logging, can have on primate behavior and anti-predation strategies.

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**Pattern of mitochondrial genetic variability of the black howler monkey (*Alouatta caraya*): An example of post-glacial range expansion in South American fauna.**

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Primates, as long-lived and socially complex mammals, offer the opportunity to study the effects of behavior and demography on evolution. Genetic differentiation among populations is determined by the interaction between current demography and evolutionary factors such as natural selection, gene flow and genetic drift. However, historic processes can also affect the genetic diversity of populations. In this work, we analyze nucleotide variability at the mitochondrial control region in the black howler monkey (*Alouatta caraya*) at the southern marginal distribution of its geographical range.

A total of 674 bp were sequenced for the mitochondrial control region from 70 specimens sampled in seven localities. Twenty-six segregating sites and 33 haplotypes were recorded in the entire sample giving a haplotypic diversity of 0.943. Fu's ( $F_s$ ) statistic employed to detect demographic expansion, was significant ( $-10,760$ ;  $P 0,007$ ) allowing the estimation of population sizes and the time of the most recent common ancestor. Our results suggest that a demographic expansion occurred approximately 13,500–6,500 years ago based on three different mutation rates. These dates correspond to the end of the Pleistocene glaciations and the beginning of the global warming when a period of extreme dryness, known as the Younger Dryas, occurred. Benign climatic conditions may have allowed the expansion of the black howler monkey into the most southern distribution of all extant New World monkeys.

#### **Assessing the relationship of Asian Middle Pleistocene *Homo* to other regional populations using frontal bone morphology.**

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Models of Middle Pleistocene *hominin* evolution focus on the evolutionary relationship between African and European populations, with little detail given to the role of Asian groups. Evaluations of cranial morphology usually place Asian populations on evolutionary side branches. In this study, a quantitative assessment of the frontal bone is offered to understand patterns of trait evolution and to statistically evaluate the significance of morphological differences among Middle Pleisto-

cene regional groups. The goal is to identify the degree of distinctiveness of Asian populations.

Thirty-six fossils dated to between 1.8–0.9 kya are studied. Five aspects of the frontal bone are quantified using Elliptical Fourier Analysis. The x and y harmonic amplitudes are reduced using principal components analysis. Fossils are assigned to one of four regional groups and discriminant function analyses are performed for each aspect separately. The significance of Mahalanobis'  $D^2$  statistic between groups is reported.

The results indicate that Asian specimens are not significantly morphologically distinct in features of the frontal bone, with the exception of the mid-orbital browridge. Posterior probability misclassifications most commonly place the African specimens with the Chinese or Southeast Asians. This suggests that the morphological distinctiveness of Asians may not be sufficient to warrant considering them a separate evolutionary clade. The observed differences may represent population-level forces such as drift or range expansions rather than replacement events in Asia. This also demonstrates that the frontal bone varies in a mosaic fashion, which should be taken into account when relying on these traits to draw conclusions about population relationships.

#### **Behavioral and hormonal estrus cycles in captive geriatric lowland gorillas (*Gorilla gorilla*).**

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Research on great ape reproduction as females age may help in understanding reproductive aging and menopause in the human female. This study at Brookfield Zoo is part of a larger investigation underway on reproductive senescence in female gorillas in North American zoos where we compare behavioral estrus data to estradiol and progesterone cycles (through fecal hormone analysis) to evaluate if observed behavioral cyclicity in geriatric (40+) females is driven by ovarian activity.

Mean length of progesterone peaks ( $n=3$  cycles/female) are:  $22\pm 5$  days for the control, and  $26\pm 5$  and  $29\pm 8$  for the two aged subjects. Results point to strong physiological validation of progesterone; peaks show regularity and close coincidence with monthly estrus behaviors ( $n=13$  cycles/female for control and first aged female, estrus behavior in the second not

evaluated). In all females estradiol patterns are more variable.

In the first aged female, high degree of cyclicity in estrus behavior, regularity of progesterone cycles, and close concordance between hormonal cycling and estrus behavior, compare to patterns for prime-aged females. However, both aged females show longer average cycle lengths than the control, and progesterone peaks in the second female are even longer and more variable, possibly consistent with early indications of reproductive failure.

Starting in their mid-thirties, captive gorillas generally demonstrate less regular ovarian cycles and reduced pregnancy rates. Thus, given a maximum lifespan of 50+ years, 25% of female gorilla maximum lifespan can be nonreproductive. Through continued monitoring of aging captive gorillas we aim to evaluate whether gorillas experience reproductive termination akin to menopause.

#### **Precocial development of hindlimb muscle mass ratios in quadrupedal and leaping prosimians.**

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A recent study has shown muscle mass ratios reflect specialized modes of locomotion in adult primates. However, no studies have examined whether muscle mass ratios are specialized at birth. The present study tests the hypothesis that leaping primates differ in muscle mass distribution from arboreal quadrupeds at birth. Three species of primates were examined, *Microcebus murinus* (3 infants, 6 adults), *Cheirogaleus medius* (4 infants, 3 adults), and *Tarsius syrichta* (3 infants, 1 adult). Hindlimb muscles were dissected free from tendons and overlying fascia. Each muscle was lightly blotted dry and weighed to the nearest 0.001 gm. Average muscle/group masses were graphically compared among species/ages.

Overall, muscle mass ratios varied little between neonates and adults of any species. Quadriceps muscle mass predominated the thigh muscle mass in all species, but especially in *T. syrichta* (71% in neonates and 74% in adults). In the two cheirogaleids, quadriceps mass ranged from 44–48%. In the leg, the relative mass of superficial plantarflexors predominated in *M. murinus* (39% in neonates and 37% in adults) and *T. syrichta* (40% in neonates and 42% in adults), whereas in *C. medius*, the deep plantarflexors predominated (38% in neonates and 42% in

adults). Subtle differences in the leg may exist between these arboreal quadrupeds (reflecting more leaping in *M. murinus* and more grasping in *C. medius*). Overall, these results indicate that muscle mass ratios are highly conserved phylogenetic characteristics of primates, and are present at birth despite the altricial state of neonates.

#### **Brucellosis in ancient Nubia: Morbidity in biocultural perspective through time at Semna South, Sudan.**

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Brucellosis today causes considerable morbidity and economic distress worldwide and is rampant in many parts of the world, including north Africa (WHO, 1997). However, there has been a minimal amount of paleopathological work on brucellosis (e.g., Ortner, 2003) and only one study of the disease in an ancient population (Capasso, 1999). This study is an examination of the skeletal manifestations of brucellosis in the ancient Nubian population of Semna South, Sudan. It assesses the disease's impact on morbidity in the population as well as provides evidence of consumption of dairy products for a site in which archaeological data is lacking. It documents brucellosis lesions in Meroitic (n=374), Ballana (n=37) and Christian (n=12) period adult Nubians (350 B.C. - A.D. 1200).

Archaeological presence of the primary brucellosis vectors, especially goats and cattle, in Nubian and Egyptian sites indicates potential brucellosis presence. While isolated cases from ancient Egypt (Baker, n.d.; Hodgkins, 2003) have been reported, disease frequencies in archaeological north African populations are, so far, absent. Analysis of the Semna South skeletal materials, in accordance with clinically defined criteria (Özaksoy, 2001; Rajapakse et al., 1987), yields a total brucellosis frequency of 2.11% from vertebral lesions. All of those identified were from the Meroitic sub-sample; all but one were male, and all were at least 30 years old at time of death. However, chi-square statistics showed no statistical significance to these trends. All infections appeared long-standing and may have caused considerable debility in those affected.

#### **The right preferences? Bilateral asymmetry in the upper and lower limbs of modern humans.**

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Studies of post-cranial asymmetry have the potential to elucidate epigenetic effects on limb bone morphology, but are often limited in terms of numbers of individuals, representation of different populations, or dimensions included. This study examines postcranial bilateral asymmetry in a large world-wide sample of Holocene humans (n=775; 474 males and 249 females). 19 highly repeatable measures of bone length, average mid-shaft diaphyseal breadth, and articular breadth were taken on humeri, radii, femora, and tibiae. Asymmetries were calculated as  $(\text{right-left})/((\text{right+left})/2) \times 100$ .

Greatest asymmetries occur in upper limb diaphyseal breadths (humerus, 3.30%, radius, 2.30%), both right biased. Upper limb lengths and articular breadths demonstrate significant, but smaller right-side bias (0.5% -1.40%). Conversely, a small but significant left side bias is evident in many of the measures for the lower limb, with again the greatest lateralization in diaphyseal breadths (0.5% - 0.8%). Lower limb lengths and articular dimensions demonstrate smaller and more variable asymmetries. Sex differences in asymmetry are generally minor, except in humeral diaphyseal breadth, which is more asymmetric in males (4.5%, vs. 2.6% in females,  $p < .01$ ). There is little if any correlation between length and diaphyseal breadth asymmetry in any bone.

These results support the interpretation of greater epigenetic plasticity in limb bone cross-sectional dimensions than in lengths or articular breadths. The greater upper limb diaphyseal breadth (but not length) asymmetry in males is consistent with this interpretation. Previously observed "crossed symmetry" patterns between upper and lower limbs are supported. Effects of subsistence strategy and geography are further investigated.

#### **Validation of plaster endocast morphology through 3D CT image analysis.**

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A crucial component of research on brain evolution is the comparison of fossil endocranial surfaces with modern human and primate endocrania. The latter have gen-

erally been obtained by creating endocasts out of rubber latex shells filled with plaster. This process involves a number of procedures that, as with any casting process, could conceivably introduce subtle errors. The extent to which endocast replicas match the actual endocranial surfaces has been difficult to determine with any confidence. To investigate this, high-resolution CT scans were taken of two endocasts (made by Prof. Ralph Holloway) along with their corresponding crania. 3D virtual endocasts were created from the cranial CT scans and rigidly registered to their corresponding 3D latex/plaster endocast CT images. The degree to which points on the surfaces of the crania-derived virtual endocasts mismatch their registered latex/plaster versions can then be assessed on a voxel-by-voxel basis and viewed in 3D.

Analysis of the differences indicate that 84% of the voxels in one pair, and 92% of the voxels in the other are within 2 mm either way of the virtual endocast. Both comparisons show that the areas of largest mismatch occurs around the cranial base. While the average error is relatively small, variation in the pattern of error across the surfaces clearly differs between the two endocasts. This study gives an idea of the size of possible error inherent in plaster endocasts, thereby indicating the level of confidence we can have with studies relying on comparisons between them and, e.g., hominid fossil endocasts.

Image analysis research using MRI of human and primate brains has suggested that the frontal lobe as a whole in humans is not especially elaborated, while other research has suggested that the prefrontal itself is larger as a percentage of total cortex than in non-human primates.

#### **Discovery of Sambungmacan hominid fossils and its contribution to the study of human evolution in Australasia.**

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The Pleistocene deposits of the Sambungmacan District, Central Java, have so far yielded four hominid fossils. Sambungmacan 1 (Sm 1), an adult male cranial vault with an incomplete base, was found in 1973 during the construction of a canal at a meander site of the Solo River. Morphological evaluation of Sm 1 varies among researchers, but the specimen



shows somewhat intermediate conditions between the Sangiran and Ngandong remains in our view. Sm 2, the mid shaft of a right tibia of probable adult male, was found in 1977 among the surface collection of animal bones just near the canal of the Solo River. Recent multi-element analysis suggests that the bone was derived from the late Early to Middle Pleistocene Kabuh Formation (Matsu'ura et al., 2000).

Sm 3, a young adult female skull vault with an incomplete base, was picked up in 1997 by a worker who was collecting sand from the river bed of the Solo River between Mlare village and Cemeng village. The skull had been illegally transported to the USA by an unknown dealer and later returned to Indonesia by our effort in 1999. Although the vault is small and extremely rounded, its general morphology resembles that of the Ngandong skulls. In 2001, another skull with complete base was picked up, again, during the sand collection activity, at a spot only about 100 m upstream to the find spot of Sm 3. Sm 4 shows intermediate features between the Sangiran and Ngandong remains.

While these hominid fossils from Sambungmacan area demonstrate some degree of morphological variation and their exact chronological ages are yet to be known, they provide important clues to approach various questions regarding Javanese *Homo erectus* and will contribute to further advancement of studies on human evolution in Australasia.

### **A 3-D analysis of shape differences in the scapula between Neanderthals and modern humans using geometric morphometrics.**

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Previous studies have found numerous differences between the scapulae of Neanderthals and modern humans. Distinguishing characteristics include the dorsal position of the subglenoid axillary sulcus and a longer, narrower and less cranially oriented glenoid fossa. This study examined the shape and orientation of the glenoid fossa and the superior axillary border (including the infraglenoid tuberosity and the axillary sulcus) in Neanderthals and modern humans using 3-D geometric morphometrics.

Samples comprised pre-contact Inuit (13), recent white Americans (15), Neanderthals (3) and one Upper Paleolithic European. Eight 3-D landmarks were

digitized using a Microscribe-3DX digitizer. Specimen configurations were superimposed with GPA using Morphueus and Morphologika. The fitted coordinates were statistically analyzed (PCA, discriminant analysis) using SAS. Shape differences separating groups along principal components were explored using Morphologika.

PC1 and 2 (33.1 and 21.6 % respectively of the total variance) separated Neanderthals from modern humans. PC1 was moderately correlated with centroid size. The positioning of the axillary sulci relative to the infraglenoid tuberosity showed the expected pattern, as did glenoid fossa shape: Neanderthals showed a shallower and less cranially oriented glenoid fossa with a more superiorly located maximum antero-posterior width. However, Neanderthals also exhibited a superoinferiorly shorter infraglenoid tuberosity. PC 3 (12.7 %) separated Inuit from recent Americans. Recent Americans had a more dorso-cranially oriented glenoid fossa and a slightly supero-inferiorly shorter infraglenoid tuberosity. The Upper Paleolithic specimen showed a bisulcate pattern. It was classified as modern human by posterior probability.

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### **Morphology of Sambungmacan 4 skull and the evidence of discontinuity in Australasia.**

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Sambungmacan 4 (Sm 4), the fossil human cranial vault of an adult male individual, was found in October 2001 from the river bed of the Solo River in Sambungmacan District, Central Java. The specimen possesses a set of general morphological features seen in other *Homo erectus* skulls from Asia and Africa. The fossil shows no obvious signs of fluvial transport, and is likely to have been derived from the Kabuh Formation widely distributed upstream near the findspot.

The chronologically younger Javanese *Homo erectus* skulls from Ngandong show a number of unique features that are not observed, or rare, among the earlier *Homo erectus* from Sangiran or other archaic fossil and living humans. Such features include an extremely straight and laterally thickened supraorbital torus, absence

of the postglenoid process, presence of the strong opisthionic recess, and development of the postcondyloid tuberosity. In terms of such idiosyncratic morphologies, Sm 4, as well as Sm 1, shows an intermediate condition between the Early Pleistocene Sangiran and late Middle to Late Pleistocene Ngandong skulls.

Thus, a series of the unique features observed in the Ngandong specimens are likely to have been evolved in a regional *Homo erectus* population in the Sunda region under a substantially isolated condition. This apparent intensification of morphological distinctiveness through the Middle Pleistocene period contradicts expectation of the multiregional model of the modern human origins. It is likely that Javanese *Homo erectus* populations have made minimal contributions to the ancestry of modern humans.

### **Derived morphology in Neandertal maxillary molars: Insights from above.**

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This study investigates morphometric variation in the maxillary first molar of contemporary humans and Middle to Late Pleistocene fossil hominins. Specifically, it evaluates 1) whether perceived shape differences between Neandertals and contemporary humans is significant, and 2) whether the features that contribute to the Neandertal tooth shape are unique to Neandertals. Data on three variables (cusp area, cusp angle and occlusal polygon area) were collected to assess tooth shape and cusp orientation. The data were collected from occlusal photographs of maxillary molar crowns of *Homo erectus* (n=3), archaic *Homo sapiens* (n=2), Neandertals (n=14), early (n=2), Upper Paleolithic (n=6) and contemporary (n=64) modern humans. Univariate and multivariate tests were used to evaluate differences among groups and principal component analysis was used to summarize inter- and intra-sample variation.

Significant differences in all three variables were found. Analyses of relative cusp areas suggest that Neandertals are distinguished from contemporary and Upper Paleolithic humans by a relatively large hypocone and small metacone. Analyses of cusp angles suggest that Neandertal tooth shape is highly divergent when compared to both contemporary and fossil humans. A small, internally placed metacone contributes, at least in part, to these differences. The analysis of occlusal polygon area suggests that Neandertals

are unique in their possession of internally compressed cusps. In sum, the results indicate that Neandertal M<sup>1</sup> shape is not only distinctive, but that it appears to be derived from the more primitive shapes of *Homo erectus* and anatomically modern humans.

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#### **Using humanities to unwrap biology: The Qiang controversy.**

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Linguistic and historical data can resolve a controversy over ontogenetic affinities of the Qiang, a Chinese nationality in the mountains of northwestern Sichuan. Comparisons of prepubescent school children at four high altitude sites in Sichuan and Tibet show that Qiang children more resemble Tibetan than Han or Hui peers in physiological adaptation and shape, but are intermediate in size and weight. Interpreting these biological findings depends on one's choice of competing histories.

Between the 8th and 18th centuries, Tibetan kings controlled western Sichuan. Qiang today speak a Tibeto-Burmese dialect, share some settlements with Tibetans and intermarry. As a result, American anthropologists and historians assume this group is a remnant of early Tibetan expansion; their name is seen as a variant of "Zhang," which means Tibetan. Chinese and European colleagues, by contrast, argue for an independent origin of the Qiang from southwestern Mongolia about 3,500 BP.

New data dispute Qiang linguistic affinity with Tibetan, and suggest the two groups' propinquity is a modern artifact. Qiang fought Tibetan incursions repeatedly, culminating in the Jinchuan Campaigns of 1747-49. Tibetan and Qiang molecular sequences are geographically discordant.

If Qiang are neither remnants of Tibetan expansion nor long residents of high altitude, then our findings challenge the popular assumption that Tibetan patterns of growth adaptation required habitation since the Upper Paleolithic. Alternatively, Qiang growth may reflect convergent ontogenetic pathways, or very recent admixture. These findings suggest we can expand "biocultural" strategies to test biological hypotheses with data from the humanities and social sciences.

#### **Brucellosis at Abydos, Egypt.**

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The distribution of brucellosis and its impact on Old World populations is poorly understood. Brucellosis has rarely been documented in archaeological remains (Aufderheide and Rodriguez-Martín, 1998; Ortner, 2003), despite its common skeletal involvement in clinical studies. The presence of principal reservoirs, including domestic sheep, goats, and cattle, suggest that brucellosis would be frequent in ancient Egyptian skeletal remains. Sacroiliac lesions in two disarticulated skeletal series from the Smithsonian Institution, dating to the Middle Kingdom and later, are the only evidence for brucellosis advanced to date (Hodgkins, 2003).

More secure identification of brucellosis in ancient Egypt is provided by a well-preserved burial excavated from the Abydos North Cemetery in late 2002. The third and fourth lumbar vertebrae of this middle adult female present the pathognomonic Pedro-i-Pons sign. This lesion is characterized by osteolysis of the antero-superior margin of the vertebral body accompanied by reactive bone formation on the anterior aspect (Capasso, 1999). Additional pathology indicative of infectious disease includes severe, bilateral mastoiditis, lytic lesions on the proximal humeri, periosteal reactions on both fibulae, and nodular apposition on the visceral surfaces of ribs. While this case constitutes the first diagnostic evidence of brucellosis at Abydos, further examination of the skeletal series is required to estimate disease prevalence. The recent focus on diagnostic criteria and prevalence of brucellosis in well-preserved skeletal series from Africa, the Near East, and the Mediterranean (e.g., Aubin, n.d.; Capasso, 1999; Fan et al., 2003) contributes to evaluation of its impact on ancient populations in these regions.

#### **The creation of an anthropometric and DNA database to aid in the identification of illegal immigrant remains.**

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There were roughly 900 reported deaths between 1999 and 2000 of immigrants crossing illegally from Mexico into the United States. Forty-four percent of those individuals remain unidentified. This initiative aims to assist law enforcement,

the forensic community and families by providing a centralized depository of collected information as well as genetic analysis of remains. This effort includes the exhumation of individuals from pauper graves, anthropometric analysis of their remains and mtDNA sequence analysis. In addition, cases currently under investigation in offices along the border are being accepted for mtDNA analysis and any information shared by these agencies along with the genetic results are included in the database. Although the project is in its infancy it has assisted in the positive identification of one individual. With time the database will provide a significant increase in data to help further understand the incredible diversity within the Hispanic classification used by forensic scientists.

The Donde Esta database uses PHP middleware to enable users to access the PostgreSQL database online. The dynamic interface allows users to query the database for possible cataloged remains by using indicators such as sex, height, weight, last known location, broken bones and dental anomalies, among other categories. A specialized scoring algorithm determines the significance of a match in the database. If a match exceeds 70%, mtDNA examination of a maternal relative is performed to verify the results. Inquiries scoring below 70% are cached for re-query at a later time against a future inventory.

#### **Littoral forest primate fauna in the Tolagnaro (Fort-Dauphin) region of southeastern Madagascar.**

M. Banks. Department of Anthropology, SUNY at Stony Brook.

To expand knowledge of primate species distributions, local population levels and their relationship with existing environmental variables in an area of very high conservation priority, three littoral forest sites of unknown primate density in the southeastern Madagascar were surveyed using the line transect method and botanical survey techniques from Sept. 2000 – July 2001. Increases in the encounter rates of 3 species including at least one IUCN listed taxa (*Eulemur collaris*) emerge when a preliminary survey from 1997 is compared with the current study. Density estimates for these species were high in sites where they were discovered and may reflect decreased hunting pressure on primates in these areas since 1997. However, patterned responses to habitat fragmentation and habitat loss have been suggested in other areas in order to explain unusually high primate

abundance in remnant blocks of pristine habitat, and are also considered here. The results from botanical surveys indicate that habitat conditions vary significantly across littoral forest sites but none of these were correlated with lemur population density. Variation is likely a reflection of floristic heterogeneity within littoral forests and not necessarily the quality of habitat for lemurs. Thus, although fragmented and disturbed, littoral forest remnants in southeastern Madagascar still provide both important and unique refuges for lemur species. Efforts to understand more about this unique biological community, threats to its persistence and the role that primates play as a part of the natural ecology here would be well addressed with long-term research at these sites.

#### **Reconstructing human behavioural evolution through phylogenetic analyses of extant hominoid behaviour.**

S.J. Banks, M. Collard. Department of Anthropology, Washington State University.

One goal of palaeoanthropological research is to reconstruct the path of human behavioural evolution. There are several potential ways of tackling this, but as Di Fiore and Rendall (1994) have noted recently there is reason to think that approaches involving the explicit adoption of a phylogenetic perspective are likely to be most successful. With this in mind, we undertook a literature review to determine the states of 75 behavioural characters in the five extant hominoid genera, *Hylobates*, *Pongo*, *Gorilla*, *Pan*, and *Homo* (represented by the Ache and Hadza), as well as in two outgroup taxa, *Papio* and *Colobus*. Thereafter, we employed the cladistics-based computer program MacClade 4 to map the character states onto the widely-accepted consensus molecular phylogeny for the hominoids, and to identify behavioural changes at key points in the group's evolutionary history. Our analyses suggest that several important human behaviours have deeper roots than is commonly appreciated. For example, tool-use and male-dominated inter-group aggression are reconstructed as having developed prior to the split between the *Pongo* lineage and the lineage leading to *Homo*, *Pan* and *Gorilla*, while terrestrial locomotion, ground-based eating, and bipedal threat displays are estimated to have appeared before the separation of the *Gorilla* lineage and the lineage leading to *Homo* and *Pan*. Likewise, regular food sharing, the deliberate capture and killing

of vertebrates, and the utilization of a large home range are reconstructed as occurring in the common ancestor of *Homo* and *Pan*. These findings have implications for a number of prominent palaeoanthropological hypotheses.

#### **Where have all the hands gone? Anthropological case from biblical times.**

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Removal of the hands of captive warriors seems to be a common practice among biblical civilizations. Relief on walls of Assyrian palaces and Egyptian tombs described the victorious armies cutting the hands of their enemies and bringing them back to the king as a solid proof of their victory. In 722 B.C. the kingdom of Israel was about to collapse. The armies of the Assyrian king Sennacherib had put Samaria, its capital, under siege, which soon falls to the hands of the Assyrians. This was the end of the Kingdom of Israel. The Assyrian army, which had a reputation of being one of the cruelest armies, return victorious home, with the ultimate evidence: the hands of the Israeli soldiers. The Relief and drawings in the Assyrian and Egyptian palaces and tombs were considered, for a long time, part of the exaggeration attitude typical to the time and region. Recently, a tomb near Samaria was excavated and revealed several skeletons. Based on the archaeological findings, the grave was dated to the Assyrian time. Among the remains, there was one individual who showed evidence of extreme violent death. Among other injuries, His left hand was missing. The paper describes in details the many injuries inflicted to the skull and other bones and correlates them with the description of massacre of captives by the Assyrian army seen on the wall of Nineveh. Information of the type of weapons (mainly swords) used by the Assyrian army and supportive evidence from present forensic cases are used to further analyze this case.

#### **A population-genetic study of the Etruscans.**

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The Etruscan culture is documented in Central Italy in the first millennium BC. It is unclear whether the Etruscans can be regarded as a biological population, or rather as an assemblage of people who shared a non-Indo-European language and a religion, but not recent common ancestors. We collected bone specimens from 80 Etruscans who lived between the 7<sup>th</sup> and the 3<sup>rd</sup> century BC. Using the strictest current criteria for validation of ancient DNA sequences, and eliminating 53 specimens that did not comply with all criteria (plus a possible case of consanguinity), we determined mitochondrial sequence in multiple clones derived from 27 presumably unrelated individuals. Twenty-two different sequences were found among these individuals, who appear as genetically variable as modern populations. No heterogeneity is apparent among archaeological sites or time periods, suggesting that the Etruscans shared not only a culture, but also a mitochondrial gene pool. Observed mitochondrial haplotypes appear related with, but seldom identical to, the haplotypes of modern Europeans. Genetic affinities suggest evolutionary relationships with both Italian and Anatolian modern populations. Admixture estimates indicate that the component of the mitochondrial genome that can be attributed to ancestors similar to the current Anatolians was roughly three times as high among the Etruscans than in modern Italians. The paucity of Etruscan sequences among modern Italians of the same area is puzzling, and will be addressed trying to estimate by computer simulation the severity of a bottleneck that could justify such a high rate of allele loss.

#### **Comparative volumetric analysis of the hominoid amygdala.**

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The amygdaloid complex, a major limbic structure comprised of many distinct sub-nuclei, mediates appraisal of the social and physical environment and is extensively connected with cortical and subcortical structures. To date, amygdala volumes have been reported for only four individual apes. Using stereological techniques, we measured amygdala volumes in one human, three chimpanzees, two

bonobos, one gorilla, three orangutans, and two gibbons.

Our analysis indicates that amygdala and whole brain volumes share a negative allometric relationship ( $p < .05$ ). The absolute amygdala volumes of the gibbon are approximately 50% of the great ape values, while individual great ape volumes are 25-50% the size of the human value. However, the gibbons have the largest amygdala volumes relative to brain size and the relative volume of the human falls within the African ape range. The mean amygdala volume for the orangutans was smaller than the mean for the African apes ( $p < .05$ ).

Combined with our recent findings on hippocampal (Teffer et al., in press) and orbitofrontal cortex volumes, the amygdala data favor the idea of a reorganized limbic system in hominoids. We found a highly allometric relationship between the amygdala and hippocampus, indicating hominoids with larger brains have increased ratios of amygdala to hippocampus. Also, the orbitofrontal cortex and amygdala, highly interconnected and functionally integrated limbic structures involved in appraising the social environment, are relatively small in the orangutan when compared with the other great apes. More detailed investigation of these structures can further elucidate the evolution of the limbic system in hominoids.

**Evaluation of diagnostic criteria for coding osteoarthritic lesions: correlation between lipping, porosity, and eburnation.**

E.J. Bartelink. Dept. of Anthropology, Texas A&M University.

Despite decades of research, paleopathological diagnosis and interpretation of degenerative lesions remains elusive. To date, bioarchaeologists and clinicians have yet to reach a consensus on which criteria are most appropriate for diagnosing osteoarthritis (OA). Recent literature argues that indicators, such as joint porosity, should be deleted as signs of OA. This is problematic since bioarchaeological research relies on specific criteria for diagnosing OA, which are then interpreted as reflective of lifestyle and workload stresses. Previous research further demonstrates that use of different criteria (e.g., coding and scoring methods) produces different prevalence rates.

This study assesses relationships between three commonly used macroscopic indicators—osteophytic lipping, subchondral porosity, and eburnation—in order to test whether the coexistence of more than one indicator is the result of

chance. Joint pathology was assessed in the distal humerus from skeletal collections from prehistoric Central California ( $n=315$ ). Presence and absence for each indicator was recorded and data were analyzed using non-parametric statistics. Among individuals affected by at least one indicator, lipping alone was the most common at 66.1%. Porosity, however, was rarely found alone (1.3%), but was much more common in conjunction with lipping (29.3%). Eburnation rarely occurred in conjunction with lipping (1.9%) or with both lipping and porosity (1.5%). Age-controlled statistical comparisons tentatively support a linkage between lipping and porosity. Eburnation, generally the result of severe joint wear, could not be adequately assessed due to its low prevalence in the sample. Preliminary results suggest that further clinical and osteological research is needed for understanding diagnostic features of osteoarthritis.

**Scaling and adaptive radiation of sensory brain structures.**

R.A. Barton. Evolutionary Anthropology Research Group, University of Durham, UK.

The analysis of scaling and adaptation must be carried out within a phylogenetic framework. I show how this principle relates to the evolution of primate sensory systems, vision and olfaction in particular. The apparent non-linearity in the scaling of some brain structures is largely an artefact of ecologically related taxonomic differences in size. Neocortex size scales in an approximately linear fashion with brain size after taking into account "grade shifts" between primate taxa. In primates, large neocortex size and overall brain size are associated with expansion of the visual system, parvocellular visual projections in particular. In turn, parvocellular expansion may be related to the evolution of colour vision and stereopsis. Olfactory structures also vary in size, and different evolutionary patterns are shown by the main and accessory olfactory systems. Ecological factors associated with visual and olfactory adaptive radiation are explored.

**The slow pace of primate infancy: Lengthened lactation in long-lived learners.**

M.L. Bastian. Department of Biological Anthropology & Anatomy, Duke University.

Among mammals, primates are slow to mature to breeding age, with hominoids

representing the extreme end of the life history pace gradient. Infancy, the period of immaturity when parenting is most intense and offspring are still dependent on their mother's milk, is a critical stage in the skill and cognitive development of hominoids and other socially-biased learners. A large life history database was assembled while surveying the published primate literature. Each of the three major stages of immaturity (gestation, lactation, and juvenility plus adolescence) was analyzed as a function of life history pace, indexed by female age at first reproduction. Data from provisioned (captive or semi-free-ranging) and wild, unprovisioned conditions were analyzed separately. Analyses also controlled for phylogenetic non-independence.

Results reveal a strong pattern: as the pace of primate life history slows down, the period of infancy (lactation) lengthens disproportionately compared to the other stages of immaturity. A disproportionately lengthened infancy in species characterized by relatively slow postnatal development suggests constraints on gestation. While plausible, the extended period of infancy relative to juvenility requires further explanation. Evidence for the "Needing to Learn" hypothesis, which implicates skill learning as the primary explanatory process, is reviewed. Alternative interpretations, based on demographic life history and natural history hypotheses (e.g. Maturation Constraints, Cognitive Buffer), are also considered.

**Facial heights: Implications of postnatal ontogeny and facial orientation for skull morphology in humans and chimpanzees.**

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The upward or downward orientation of the primate face with respect to the basicranium and its consequences for the overall skull morphology is relevant in different aspects of physical anthropology and craniofacial biology. Facial orientations are ontogenetically produced by different vertical growth increments of anterior and posterior facial heights. However, their exact patterns of growth and development are unclear. Two groups of hypotheses exist regarding their ontogeny: (H1) Early facial pattern determination and minimal postnatal modification, or (H2) gradual and continuous change of facial orientation during postnatal ontogeny. We investigated the morphogenetic relevance of postnatal ontogeny for adult

facial orientation and skull variation in modern humans and chimpanzees by geometric morphometrics. Our results support aspects of both hypotheses. Dolicho- and brachyfacial patterns of facial growth and orientation are clearly present pre- or perinatally in both species. In humans, these variations belong mainly to the alveolar process. In chimpanzees, the alveolar portion, as well as the nasal floor, is involved in dolicho- and brachyfacial morphologies. Whereas no ontogenetic modification of facial orientation was found in humans, chimpanzees did show upward rotation of the face. These findings support two hypotheses: 1) homologue variation patterns at the alveolar processes and the associated mandibular morphologies in hominoids, hominids and humans and 2) different levels of integration in primate skulls. If these interpretations are correct, then the present study shows how adult morphological variation is systemically influenced by pre-, and postnatal factors, which become morphologically superposed and developmentally integrated into adult skull morphologies.

**The examination of age and sex-related changes in cortical bone mineral density and geometric properties of the radius in a 19<sup>th</sup> century archaeological population.**

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Archaeological populations provide a unique model with which to study the natural history of bone loss and fragility, offering an opportunity to examine bone maintenance in groups whose lifestyles were often very different from that of today. However, there have been few non-invasive studies of cortical bone mineral density and geometry of the radius in skeletal populations. In order to examine and compare age and sex-related changes in bone quality and quantity in an archaeological sample, a study was made of cortical bone mineral density and geometry with the use of peripheral quantitative computed tomography (pQCT). Radii from a total of 151 individuals (m=98, f=53), divided into 3 age categories (18-25, 26-45, 46+ yrs.) from a 19<sup>th</sup> century archaeological sample from the St. Thomas Anglican Church Cemetery from Belleville, Ontario, were scanned using a pQCT Research SA+

Scanner (Stratec, Pforzheim, Germany). A proximal section from the middle third of each left radius was taken with a pixel size of 0.2mm and slice thickness of 2.2mm, with a scan time of approximately 3 min./slice. While both sexes show age-related change in bone mineral density, there is no significant sex difference, in contrast with modern populations. Geometric properties of the radii (i.e. mean cortical thickness, cortical area, and polar area of moment of inertia) also show age-related change, with sexual dimorphism. The possible role of lifestyle factors in age-related bone loss in this population, and the value of comparative measures of bone density and geometry in the radius, are discussed.

**Catarrhine taxonomic diversity at Rudabánya, a late Miocene subtropical swamp forest in central Europe.**

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Rudabánya is a late Miocene fossil locality with a rich and diverse record of plant, invertebrate and vertebrate fossils. Among the taxa represented at Rudabánya are two catarrhines, *Dryopithecus brancai* and *Anapithecus hernyaki*. The samples for each these taxa are large and highly variable in size and morphology, and it is legitimate to ask if more taxa should be recognized. Standard techniques of species recognition, based largely on comparisons to ranges of variation in modern taxa, fail to falsify a single species hypothesis in each genus. However, among wet forest localities with extant primates the presence of only 2 anthropoid species is rare. In addition, the taxonomic diversity of other mammals at Rudabánya is generally higher and more in line with modern forest profiles. Consideration of the paleoecology of Rudabánya, the paleobiogeographic history of catarrhines in the Miocene of Europe, the diversity of other mammals at Rudabánya, and the variability in the Rudabánya primate samples, all compared to specific modern forest primate communities elsewhere in the Old World, suggest that more anthropoid species, if not more genera, probably lived and died around Rudabánya. Reasons for the underestimate of anthropoid taxonomic diversity at Rudabánya are both methodological and taphonomic, and as such are probably not limited to Rudabánya. This has implications for interpreting interspecific and intraspecific (e.g. sexual dimorphism) variability in many fossil taxa. A review of patterns of morphological and

size diversity in Rudabánya primates reveals indications of the probable existence of additional taxa. Funded by NSERC.

**A captive infant female gorilla with vitamin D and calcium deficiency: Preliminary description.**

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Previous descriptions of the growth of infant captive gorillas indicated that illness episodes disrupt the typical pattern of skeletal growth during the first year. We present the physical growth of Mo'ana, an infant lowland gorilla in the African Forest collection of the Columbus (Ohio) Zoo. At age 7 months Mo'ana was diagnosed with low bone density due to vitamin D and calcium deficiency. She also presented with severe congenital kyphosis due to mid-thoracic hemivertebrae. Between ages 16 and 23 months regular visits were made, standard anthropometrics were obtained, teeth were inspected, and weekly weights, collected by zoo staff, were recorded. Data were then compared to those previously obtained (by AB) of other infant gorillas raised at the Columbus Zoo. Although, to date, Mo'ana has shown no signs of mobility limitations, we have documented alterations in her growth patterns.

Relative to a small group of healthy gorilla infants raised at the Columbus Zoo Mo'ana's weight and skeletal growth is delayed. For instance, although her growth indicators have steadily increased, her weight, head circumference, leg length and arm length at age 19 months were equivalent to those of infant males ranging in age from 9 to 13 months. Relative to body size, neurocranial measures appear small, while facial measures appear normal. Results from this study provide a unique insight into the growth of an infant gorilla with a growth disruption.

Many thanks to the African Forest staff of the Columbus Zoo for valuable assistance and collaboration.

**Taphonomy, selective preservation and robusticity in human skeletal samples: The osteometrical paradox.**

S.M. Bello. Dept. of Palaeontology, The Natural History Museum.

Few studies have focused directly on the effects of taphonomical processes on os-

teometric and anthropometric analyses. However, any taphonomical process that results in the selective preservation of more robust bones can bias osteoarchaeological analyses. This paper aims to determine whether an assemblage of bones may appear to be more or less robust than the more complete (original) assemblage from which it was derived due to its state of preservation. In a poorly preserved osteological sample it is only possible to measure the better-preserved bones. In a context where the weaker bones are the more altered, only the more robust bones can be measured and included in the osteometrical profile of the sample. This means that more intense taphonomical processes may result in a greater discrepancy between the osteometrical profile of the osteological sample observed and the osteometrical profile of the original assemblage.

A sample of over five hundred adult skeletons of different osteological series was measured. The state of preservation of the samples was attested by three preservation indices considering the frequency of each bone in the sample, the quantity of osseous material present and the measurability of each bone. The results suggest that the more robust bones have a better chance of being represented, well preserved and therefore measured. Nevertheless, the comparison of osteological samples coming from geographically and temporary closed populations suggests that a poorer state of preservation of the remains does not necessarily affect the degree of robusticity observed.

**The effects of time and habitat differences on the dentition of *Victoriapithecus macinnesi* from middle Miocene deposits at Maboko.**

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In this study we compare molar size and shape in 15 mya samples of Maboko *Victoriapithecus* from 1) Bed 3, stratigraphically oldest, preserves open woodland floodplain, 2) Bed 5b (brown clay) stratigraphically intermediate, preserves a swamp forest, and 3) Bed 5w (white clay) highest level, preserves open woodland. Exact time differences between these strata are unknown. Bed 3 is separated from Bed 5 by the amount of time that it took to form the Bed 4 calcrete, an interval that could range from decades to thousands of years. Beds 5w and 5b could be contemporaneous although the superposition of 5w suggests it is more recent.

If it is assumed that Bed 3, 5b and 5w represent time successive strata, then results indicate that *Victoriapithecus* experienced a statistically significant decrease in lower molar tooth size through time. The greatest differences are observed between populations from Bed 3 and Bed 5w which are most similar in terms of paleoenvironment, but may be most different in terms of time. The least significant (although still significant) differences are found between Bed 5b and 5w which are most different in terms of habitat. For example, lower M2 length changes from a mean of 7.78 (Bed 3, N=28) to 7.52 (Bed 5b, N=62) to 7.22 (Bed 5w, N=39) with the t-test between Beds 3 and 5w yielding a  $p < .000009$ , and a  $p < .0087$  between Bed 5b and 5w. We conclude that habitat (forest vs. woodland) had less influence on *Victoriapithecus* dental size, than did time.

**Genetic diversity in an urban population in West Africa: A preliminary analysis.**

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Understanding genetic diversity in West Africa is of importance because it provides insight into African population history and overall human diversity, as well as into the history of the African Diaspora. Studies regarding genetic diversity in West African populations are comprehensive but generally reference continental population history, disease, or species origin and do not usually consider urban diversity. In this analysis, mtDNA hypervariable region I (HVI) and four Y chromosome markers are examined in 152 unrelated individuals representing nine different ethnicities from two metropolitan areas in Ghana, West Africa. This investigation highlights genetic diversity and examines the relationship between tribal affiliation and genetic markers. In addition, comparisons concerning diversity and relationships are made between these data and those published from other African and African-derived populations.

The DNA samples in this study were collected via cheek cell swabs, extracted using a standard phenol-chloroform method, and amplified by PCR. Electrophoresis and sequencing were used to determine the genotype for each locus. The heterozygosity and frequencies for each of these markers were calculated and compared with previously published data. Preliminary analysis at several of these loci indicates first, that more analysis is

needed to ascertain the relationship between genetic haplotypes and tribal affiliation, and second, that overall, the genetic diversity observed in these urban samples are higher than in other non-urban West African populations.

**The variation of body proportions over a period of 7.000 years in Denmark.**

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Skeletal material from the Mesolithic, the Neolithic, the Iron Age, the Viking Period and the Middle Ages in Denmark, has been studied in order to establish whether body proportions have changed through time in Denmark. Measurements of corpses from around 1900 AD and from the modern population are also included.

The measurements used in this study are the length of the upper and lower extremities and the length of the distal and proximal bones of the extremities of the two sides. The Bone Mineral Content/Density (BMC/BMD) has been determined for selected bones from some of the periods as well. A large number of studies have shown that body proportions are related to various factors such as evolutionary trends, temperature, sexual maturity, subsistence economy and physical activity, including mechanical stress. Furthermore, patterns of asymmetry may be related to both genetic and mechanical aspects. Other aspects related to the demonstrated changes in body proportion through time in Denmark will also be discussed.

The significance of body proportions in various populations will be demonstrated in relation to the reconstruction of stature from measurements of long bones and the use of various regression formulas by comparing the measured length of skeletons before excavation and the calculated stature from measurements of long bones.

**Cross species communication? Video analysis of human-monkey interactions.**

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While humans and monkeys have coexisted for tens of thousands of years the context and specific patterns of human-monkey interactions are poorly known. On the island of Bali, Indonesia, many tourists from around the world interact regularly with semi-free ranging long-tailed macaques (*Macaca fascicularis*). When

these interactions contain aggression they can lead to injury and have a substantial potential for disease transmission. Recent research at monkey forest sites in Bali reports potential predictive patterns in these aggressive interactions and documents the substantial problem that pathogen transmission events pose to humans and macaques. Here we present results of video analysis of 66 human-macaque interactions recorded during June-July of 2001 in an attempt to characterize eliciting factors in both human and macaque behavior surrounding aggressive interactions. Twenty of these sequences involved aggression, 18 of which involved feeding of the macaques. Six of these aggressive encounters involved bites of humans, and of these bites, 5 involved food. The actors in these interactions are mainly human adult males and females and subadult and adult male macaques. Certain human gestural and postural behaviors appear to ameliorate aggression by macaques. Other human behaviors such as sporadic or jerky movements, attempts to physically contact the macaque, or specific facial gestures appear to elicit aggression. By documenting the behavior surrounding aggression between humans and macaques we may be able to contextualize the aggression within macaque and human behavioral repertoires and thus effectively incorporate extant knowledge of primate behavior into an applied management format.

#### **A possible early case of advanced treponemal disease from Tennessee.**

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During the 1960s and 1970s, a number of Tennessee sites were excavated by the Tennessee Archaeological Society in conjunction with the University of Tennessee. While the majority of artifacts and skeletal remains recovered during these excavations are currently curated by the Frank H. McClung Museum at the University of Tennessee, a number of remains and artifacts have been retained in private collections. Recently, some of these materials have been returned to the museum, including a skull and associated mandible from the Wilhoite site (40GN10) displaying evidence of advanced treponemal disease. The Wilhoite site is located in Greene County, Tennessee and has been assessed as a habitation site dating exclusively to the Early Woodland period (2-3kya). The remains are that of an adult male and exhibit extensive active and remodeled stellate lesions on the fron-

tal, parietal, and temporal bones. The lesions extend to the endocranial surface and are consistent with caries sicca. The facial region of the cranium also displays evidence of chronic infection.

Although many of the returned remains are accompanied by archaeological records, this individual lacks any such associations. However, the site number, "40GN10" and "U.T. Pathology" were handwritten on the cranium, apparently at the time of excavation. While exact dating of this material is not yet possible, all evidence suggests the remains are from the Early Woodland period. The possible early date of these skeletal remains, together with the severity of the disease process, makes this individual a significant contribution to the history of treponematosis in the Americas.

#### **Ontogenetic influences on prehensile-tail use in *Cebus capucinus*.**

M. Bezanson. Department of Anthropology, University of Arizona.

During the course of growth and development, individuals experience ontogenetic changes in body weight, limb proportions, and motor skills. These changes are likely to exert a strong influence on foraging strategies, travel efficiency, substrate preference, and patterns of positional behavior.

In this research, I examine ontogenetic patterns of prehensile-tail use in *Cebus capucinus* inhabiting a tropical rainforest in Costa Rica. *Cebus capucinus* was observed for 361 hours during 2002 and 2003 at Estación Biológica La Suerte in Northeastern Costa Rica. Behavioral data were collected using a one-minute instantaneous sampling technique. Five age classes were recognized. When riding dorsally, infants (birth-2 mos.) and older infants (2 mos.-6mos) were observed to wrap their tails around their mother's arm, leg, tail or neck during approximately 12% of the time. When foraging independently, the older infants used their tails as mass-bearing fifth limbs 12.4 % of the observations. During feeding and foraging, young juveniles (6 mos.-1 year) and older juveniles (1 yr.-2 yrs) used their tails in suspensory postures 13.9% and 10.1 % respectively. Overall, infants and juveniles were found to use their prehensile tails significantly more often than adults during feeding and foraging.

Mass-bearing prehensile-tail use differed during social behavior. Adults were not observed in suspensory postures during social behaviors. During play, older juveniles were observed in suspensory postures 35.7% of the observations fol-

lowed by older infants (32 %) and young juveniles (28.7%). These data suggest that the prehensile tail serves different functions during infancy, juvenescence, and adulthood. Additional relationships among limb proportions, positional behavior, and substrate use are discussed.

#### **Correspondence of trabecular and cortical geometries: A natural test of Wolff's Law.**

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Wolff (1892) proposed that a bone's loading regime could be inferred from the geometry of the enclosed trabecular bone, an observation now generally extended to cortical bone and known as Wolff's Law. While the relationship between mechanical loads (or more accurately, the resulting strains) and cortical geometry has increasingly been questioned, it is more generally accepted that trabecular architecture corresponds to the direction and magnitude of mechanical loading of the whole bone. Thus, while the veracity of loading data obtained from an analysis of cortical geometry may be questioned if used as the sole source of biomechanical information, an analysis of trabecular architecture from the same cross-sectional plane can be used to test the reliability of cortical measures of bone strength and stiffness.

There are few regions that present the opportunity for such a test, since several criteria must be met to allow accurate measurement of all parameters. The bone should be one that can be modeled as a beam, and the section should be orthogonal to its longitudinal axis. Furthermore, the section should be fully filled with trabeculae, and it should possess more than a thin shell of cortical bone. The superior pubic ramus (SPR) meets these criteria.

Measures of the magnitude and orientation of bone strength were obtained from a sample of 20 high-resolution medical CT scans of SPR. Moments of inertia and their principal axes were obtained for cortical bone. The LFD algorithm was used to determine trabecular principal orientation, and Cn-BV/TV was used as a measure of overall trabecular strength. Principal trabecular orientation was found to correspond closely to the principal axis of cortical  $I_{max}$ . No relationship was found, however, between the magnitude of trabecular strength and the magnitude of cortical  $I_{max}$ .

### Examination of the paleoenvironments of two South African caves.

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Paleoenvironmental reconstructions for two South African Plio-Pleistocene cave sites, Buffalo Cave and Gondolin (GD 2) are compared to ascertain the best possible habitat reconstructions for these sites. Buffalo Cave is located in the Makapan Valley and Gondolin is near the sites of Sterkfontein and Swartkrans. The Gondolin faunal assemblage was collected by Vrba in 1978 and is designated GD 2. Habitats were reconstructed with two methods (Reed 1996; Vrba 1985). Using Reed's methodology, the fauna from both sites were assigned trophic and substrate adaptations. The GD 2 assemblage contains 4.2% aquatic species and 4.2% fresh grass grazers. However, there are no arboreal or frugivorous species in the assemblage. Based on these data, the habitat at GD 2 appears to have been open grassland with a permanent water source. Buffalo Cave also lacks arboreal species and has no aquatic fauna or fresh grass grazers. Therefore, using this method, the habitat was likely open grassland.

A second method used to compare the habitats looked at the percentages of Alcelaphini and Antilopini bovid tribes (Vrba, 1985). GD 2 has a very low representation of Alcelaphines (14.7%) and Antilopini (2.9%). This would seem to indicate that GD 2 was substantially tree and bush covered. However, considering the rocky terrain, the low numbers of these bovids may not be surprising. Buffalo Cave has slightly higher ratios of these tribes: Alcelaphines 30.76% and Antilopini 7.69%. These data place the combined ratio between the 30% and 65% cutoffs indicated by Vrba as demonstrating bush-covered and open environments respectively.

### Amazons of the Amu Darya?: A dental pathological investigation of gender and status in Bronze Age Bactria.

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Recent excavations in the middle Don Valley of Russia have yielded rich female graves that have been claimed to be those of the fabled "Amazons" of ancient literature. However, these Scythian remains clearly represent a very late (c. 7<sup>th</sup> century B.C.) intrusion from the East. Herodotus suggested that Amazonian women origi-

nated from the Sauromatae, located between the Don and the Volga rivers, where women rode horses and held positions of high social status. Others, however, noted that among the Issadones and Masagetae, found in ancient Bactria, women, despite an agricultural urban lifeway, occupied traditional male roles and held high status.

Excavations in the North Bactrian oasis of Uzbekistan led to discovery of the Bronze Age Oxus Civilization. Two urban centers (Sapalli Tepe, Djarkutan) have yielded human remains accompanied by differing amounts of burial goods.

A sample of 216 males and females from these sites were assessed for number and quality of burial goods and examined for eight dental pathologies to determine if material indicators of social status were accompanied by indications of differential diet and health. Results show that females were buried with more goods and objects of greater prestige than males. Females also experienced much higher prevalence of abscessing, antemortem tooth loss and caries, slightly elevated levels of pulp exposures, hypercementosis and resorption, but lower prevalence of hypoplasia and dental calculus. The results indicate that differences in material objects reflect differences in social status whereby Oxus Civilization females occupied social positions equal, if not superior, to that of males.

### New hypothesis of primate supra-orbital relationships and its bearing on competing models of primate origins: a test from the fossil record.

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Adaptive scenarios proposed to explain the origin of euprimates include visual predation on insects (Cartmill), grasp-leaping locomotion (Szalay and Dagosto), or exploitation of angiosperm products on terminal branches (Sussman). Only the fossil record can provide a direct test of these hypotheses. Results from cladistic analysis utilizing cranial, postcranial, and dental evidence that includes new data on the most plesiomorphic tree shrew, *Ptilocercus*, and from recently discovered, late Paleocene-early Eocene plesiadapiform skeletons, unambiguously allies plesiadapiforms with Euprimates to the exclusion of other archontan groups (Scandentia, Dermoptera, and Chiroptera).

"Plesiadapiformes" is paraphyletic, with a monophyletic Plesiadapoidea (*Chro-nolestes*, Saxonellidae, Carpolestidae, and Plesiadapidae) as the sister group to Euprimates. The earliest known euprimate skulls and skeletons differ from those of plesiadapoids in having forward facing orbits with postorbital bars and adaptations for arboreal leaping. However, anatomical features associated with specialized manual and pedal grasping (including a nail on at least the hallux), as well as a petrosal bulla, are shared by the common ancestor of plesiadapoids and Euprimates, even accounting for the morphological diversity of plesiadapiforms. Of Cartmill's "ordinally diagnostic" traits, only the postorbital bar and forward facing orbits appear to have originated at the euprimate node. The existing fossil record is not consistent with either the grasp-leaping or visual predation models of primate origins in showing that specialized grasping is adaptively dissociated from leaping and forward facing orbits, respectively. We infer that the common ancestor of plesiadapoids and Euprimates was an arboreal grasper adapted for terminal branch feeding on fruits, flowers, and nectars.

### Phyletic and locomotor affinities of the *Victoriapithecus* forelimb.

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*Victoriapithecus* from the middle Miocene of Maboko, Kenya is arguably the best-known early Old World monkey. As first noted by von Koenigswald (1969), *Victoriapithecus* predates the subfamilial division of the cercopithecoid clade, being more primitive dentally than either extant colobines or cercopithecines. This study indicates *Victoriapithecus* also retains a number of primitive forelimb features, principally straightness of the lateral humeral shaft. Principal component analyses indicate a resemblance to platyrrhines can also be discerned in measures of the distal humerus, ulna, proximal radius, carpals and the length/breadth ratios of the metacarpal bones. Manufactured phylogenies drawn from independent contrast data also support the similarity of *Victoriapithecus* to Ceboidea. All four manufactured phylogenies group *Victoriapithecus* primarily with generalized Ceboidea, and secondarily with unspecialized Cercopithecinae such as *Cercopithecus aethiops*, *Allenopithecus* and *Macaca fascicularis*.



Principal components analysis and independent contrast modeling also reveals resemblances between the forelimb of *Victoriapithecus* and extant cercopithecines, largely to the exclusion of Colobinae (Blue 2002). This evidence, in conjunction with the presence of terrestrial characters in fossil members of both cercopithecoid subfamilies, suggests that terrestriality may represent the ancestral condition of both extant Old World monkey lineages (Ciochon 1987; Pickford and Senut 1988; Strasser 1988). It follows that cercopithecines are best considered as retaining the primitive condition, while colobines are derived relative to this morphotype. The forelimb of *Victoriapithecus* is seen to exhibit characters last shared by the common ancestor of the catarrhine and platyrrhine clades, as well as ancestral cercopithecoid morphologies that it shares in common with modern cercopithecines.

**Idiosyncratic social behaviors of brown capuchins in an anthropogenic landscape are consistent with prevalent socioecological theory.**

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Ongoing research at Raleighvallen, within the Central Suriname Nature Reserve in Suriname, documents a suite of social tactics not described in brown capuchins (*Cebus apella*) elsewhere. These include frequent direct between-group food competition, male alliances critical for success in these agonistic inter-group encounters, flexibility in female residence and mate choice, and a lack of female social bonds. Males also commonly strike sticks and hard fruit against branches and break tree limbs in protracted bouts. Such *percussion* appears liberated from foraging, as used in other capuchin populations, and redirected to signal functions important in sexual selection. Percussion at Raleighvallen generates mechanical sounds that transmit farther and more reliably in this densely forested environment than social signals based on visual or vocal displays. In turn, two environmental factors appear responsible for the emergence of this idiosyncratic social structure. (1) The biota of the Guianan Plateau is characterized by low energy and nutrient flow relative to other Neotropical regions. (2) Regional edaphic characteristics are compounded by anthropogenic landscape transformations by pre-Columbian Amerindians populations in the area now encompassed by the CSNR; these sites covary with distinctive plant communities preferentially ex-

ploited by capuchins, especially dense liana forest and extensive bamboo stands.

These findings provoke a more realistic, historical perspective on primate behavioral ecology within 'natural' Neotropical habitats. The idiosyncratic capuchin behavior at Raleighvallen also provides robust support for prevalent socioecological theory predicting social responses to variations in food distribution, mating competition, predation risk, and transmission of social signals.

**Using Y-chromosome and mtDNA variation to reconstruct eastern North American population history.**

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Eastern North America contains a culturally and linguistically diverse set of indigenous peoples. Their origins and prehistory have been widely studied, but many hypotheses concerning population relationships, ancestral homelands, prehistoric migrations, and past interactions remain controversial. Studies of mitochondrial DNA (mtDNA) variation in this region have helped to address some of these issues, but inferences from mtDNA may not be congruent with what other loci would suggest due to stochastic variation, natural selection, or differences in male and female demographic histories.

In this study, I examined genetic variation on the Y-chromosome, a separate locus, to improve our understanding of the population history of eastern North America. Samples were obtained from 300 individuals, representing eight eastern North American populations. After amplifying the amelogenin locus to identify males, six biallelic polymorphisms (M19, M3, M242, M173, M45, and RPS4Y) were amplified to determine their Y-chromosome haplogroups. Six Y-chromosome microsatellites (DYS19, DYS388, DYS390, DYS391, DYS392, and DYS393) were also analyzed to define the haplotypes within each haplogroup. To estimate genetic differentiation and population relationships in eastern North America, pairwise genetic distances between populations, haplogroup and haplotype diversities, and molecular variances within and between populations were calculated, and principle coordinates analysis was performed. These Y-chromosome data were also compared with mtDNA data previously collected from the same samples to evaluate differences in male and female patterns of gene flow and migration in this region. Finally, the influence of language, culture,

and geography on patterns of variation at these two loci was also examined.

**Sex differences in growth patterns in proboscis monkeys and crested langurs.**

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Colobines represent a distinct group of Old World monkeys that feed exclusively on leaves, seeds and unripe fruits. Their protein-rich diet may explain how they reach adulthood quicker than their cercopithecine cousins. Yet relatively little is understood of colobine growth because of difficulties in captive rearing and tracking individuals in the field. In this study, growth patterns were compared between two wild-collected samples from Borneo—the large-bodied, highly sexually dimorphic proboscis monkeys (*Nasalis larvatus*, n=34) who travel via arboreal leaps; and smaller-bodied crested langurs (*Trachypithecus cristata*, n=77) who move quadrupedally on branches and swamp floors. Body mass, trunk and hindfoot lengths and reproductive state were taken at time of collection. Limb bone lengths, epiphyseal fusions, and dental eruptions were recorded. Samples were compared at dental developmental stages ranging from age class 0 (infancy) to 5 (adult). Female proboscis monkeys reached adult proportions by late juvenility (age class 4) while age class 4 males continued growth for sexually dimorphic dimensions. Crested langurs followed this general pattern, except in femur length and body mass. Age class 4 males had completed femur growth while females had not, and both females and males reached adult body mass during age class 5. Growth similarities suggest shared evolutionary patterns to achieve adulthood in colobines. Divergent maturation of hindlimbs may reflect locomotor differences, and in body mass, differences in growth rates by species. This study provides a useful comparison with cercopithecines (*Cercopithecus aethiops* and *Papio hamadryas*) that reveals how sex differences in colobine growth vary from cercopithecines.

**Individual chronology of enamel dental microdefects in the juvenile segment of the Portus Romae community.**

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Throughout growth, dental enamel records at microscopic level a variety of stress events in the form of "stress markers" (Wilson bands). Because of the regular periodicity of enamel formation, during which interpretable microstructures are continuously formed, it is possible to reconstruct the temporal scales of enamel formation and stress event chronology.

Eleven individuals with mixed dentition were selected for histomorphometric analysis from the Imperial Roman Isola Sacra (SCR) odontoskeletal collection (*Portus Romae*, II-III century AD). This sample consisted of 14 deciduous and 64 permanent crowns. Different teeth from each individual were used because, within a given dentition, the portions of tooth crowns that form at the same time are expected to show identical patterns of Wilson bands. The postnatal scale is "zeroed" at birth by the neonatal line, and extends till the end of formation of the second permanent molar crown (no third molar crowns were found).

Different classes of teeth gave different estimates of population stress prevalence through the time scale. The SCR corrected prevalence distribution shows that: (i) prevalence values are higher than modern figures; (ii) the distribution shape is asymmetric, with a steep increase until the ninth-tenth month of life followed thereafter by a steady decrease till the 50th month.

Present evidence can be tentatively interpreted as resulting from three major bio-cultural interacting factors: the progressive decrease of maternal antibody protection throughout the first months of life; weaning; and the increasing contact with pathogen agents following crouching, which occurs around the age of one year.

#### **The geometry of anthropometrics: A new typology of landmarks.**

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Classic systems of anatomical landmarks, such as Rudolf Martin's nearly a century ago, mainly comprised lists of endpoints for conventional distance or angle measurements. In 1990 Bookstein introduced a new classification of three types based on a mixture of geometric and biomathematical properties. In the years

since then, the technology of data acquisition has come to center on image analysis in three dimensions, and the statistical toolkit has grown to include information from curves and surfaces along with discrete points. The time is thus ripe for a revised typology of these fundamental geometric data sources. The new protocol we suggest here compromises among the competing demands of biological homology, thin-plate spline visualization, computerized image analysis, and multivariate statistical praxis.

The list of landmark structure types has been extended beyond points according to three types of curves: centerlines, ridge lines, and symmetry curves. The list of landmark point types per se is thereby augmented by constructions that account for curves or surfaces and for symmetry in more flexible ways than were classically available. Our presentation will explain the logic of the new classification and demonstrate (in an application to comparative allometry of the anthropoids) a tentative list of points, intended to replace Martin's, along with the associated curves and surfaces that interact both logically and statistically.

#### **Phayre's leaf monkeys - Multimale groups with female dispersal.**

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Phayre's leaf monkeys (*Trachypithecus phayrei*) are medium sized colobine primates; adult females weigh 6 to 7 kg. Like other species of their genus they are expected to live in rather small groups (ca. 15 individuals) with one adult male and several adult females and to show female dispersal. Previous studies in Northeast India do indeed report small one-male groups and emphasize seasonal restriction of reproduction but do not confirm female dispersal. Since October 2000 four neighboring groups of Phayre's leaf monkeys are being habituated in a dry evergreen forest at Phu Khieo Wildlife Sanctuary (Northeast Thailand). A census of additional groups is conducted every fourth month. Data for known individuals reveal a seasonally biased pattern of reproduction. The minimum interbirth interval is two years if the infant survives and can be as short as one year if infants die at a young age. As expected, the average group size is rather small. However, most groups have more than one adult male and these multimale groups are larger than the one-male groups encoun-

tered. Female dispersal seems common and concentrated around the time of first reproduction. Male dispersal pattern is less clear, although some solitary males as well as small all-male bands were observed. In sum, the results match the expectations for the genus and species rather well. However, it is not yet known why multimale-multifemale groups predominate in this population. Supported by NSF (BCS-0215542) and Stony Brook University.

#### **Different patterns of mandibular growth in *Papio* and *Pan* are produced by genus-specific developmental changes and rates of change in mandibular proportions.**

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Baboon and great ape mandibles are morphologically dissimilar at birth, a difference that amplifies over development via different growth trajectories. The aim of this study was to identify the ontogenetic changes in mandibular form and rates of growth that produce these different trajectories in olive baboons (*Papio anubis* n=60) and great apes (*Pan troglodytes* n=60, *Pan paniscus* n=44).

Individuals encompassing a broad range of development were radiographed and aged from their dental development using these data. Three-dimensional (3D) landmark coordinate data and two-dimensional (2D) linear measurement data were taken from the mandibles. 3D geometric morphometrics and 2D bivariate analyses of these data show marked intergenus differences in mandibular proportions and their rates of growth.

The main findings are, firstly, that corpus length posterior to the mental foramina forms a larger proportion of total mandible length in *Papio* and grows at a faster rate. However, in *Pan*, the elongation of the corpus anterior to the mental foramina, and the antero-posterior widening of the ramus contribute more to total mandible length. Secondly, bilateral mandible width increases at similar rates in both genera, but grows larger in *Pan*, particularly across the mental foramina and permanent first molars. Subtler intergenus differences in mandibular proportion and rate of change are described in detail. Intertaxon differences in adult mandible shape, and to an extent, size may be explained by factors including ontogenetic matching and functional compatibility of the mandible and maxilla,

forces exerted by developing masticatory muscles, biomechanical constraints, and size and development of the dentition.

### **Bipedality, Hox genes, hominid origins and chromosome two.**

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

Human paleontologists had thought that bipedality emerged gradually in response to the spread of grasslands. Recently both these ideas have come into question, based on discoveries of *Ardipithecus ramidus*, *Orrorin tugenensis*, and *Sahelanthropus tchadensis*. Bipedality seems to have appeared suddenly, and before the major expansion of the grasslands. In this paper I argue that the co-occurrence of the areas the development of which are under the direction of the posterior Hox D genes, and the differences between our lineage and that of the African great apes supports a new hypothesis for the origin of bipedality. The HOX D genes are on chromosome two, which was formed by the fusion of *Pan* chromosomes 12 and 13. The distal Hox genes are controlled separately from the proximal. In keeping with co-linearity, the distal Hox genes control the posterior parts of the body and the distal limb segments. These include the genitalia, the terminal gut, the lumbar and sacral spine, and the chela, areas in which humans differ from chimpanzees. Moreover, since the representation of body parts in the motor and sensory "homunculi" of the pre- and post-central gyri of the brain is a developmental phenomenon, as soon as the feet cease to be used for grasping, there would be space for some other body part to develop greater representation, perhaps the hands, allowing greater eye-hand coordination, with no increase in brain size. If the fusion of *Pan* 12 and 13 occurred in the male in a species in which the social organization was multiple female-single male, living in family groups, that mutation could spread in a few generations, producing speciation very quickly. If the fusion also altered the control of the distal Hox genes the single mutation would have epistatic effects which would account for a great many of the morphological differences between the two clades, and provide a foundation for behavioral differences with no initial alteration in brain size, as suggested by the fossils.

### **Diachronic patterns in health and dental metrics in historic African-Americans of Virginia.**

D. Boyd, C. Boyd. Sociology and Anthropology Department, Radford University.

Recent research involving the Western Hemisphere database (Steckel and Rose 2002) has shown regional variability in the health of 19<sup>th</sup> century African-Americans, particularly in relation to their temporal (early vs. late 1800s) and sociopolitical (Slave vs. Free Black) status. This study examines trends in African-American health and dental metrics from the late 17<sup>th</sup> through the early 20<sup>th</sup> centuries as represented by analyses of four historic skeletal samples from central and eastern Virginia. Two of these represent slave populations, while the other two samples reflect post-bellum Free Blacks. Comparisons of demography (mortality, fertility), non-specific stress, trauma, degenerative joint and dental disease indicators across these samples are used to assess trends in health and nutrition; dental metrics (buccolingual and mesiodistal diameters) and Markers of Occupational Stress (MOS) are also examined to evaluate dietary and behavioral change.

Results indicate a complex pattern of adaptation to slave and emancipated life in historic Virginia. Although frequencies of non-specific stress, trauma, and MOS decrease over time, dental disease is still prominent in late 19<sup>th</sup> century Virginia Free Blacks, as is high subadult mortality. These findings suggest that, unlike the generally good health of early 19<sup>th</sup> century Free Blacks in other areas (for example, the individuals from Philadelphia's First African Baptist Church), life was still difficult for the Free Blacks of later 19<sup>th</sup> century Virginia. Regional variability in skeletal responses to sociopolitical and economic inequalities facing African-Americans during this time period is supported by these results.

### **An odontometric and craniometric perspective on past and present population relationships in east and southeast Asia, Australia and the Pacific.**

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Using odontometric data and craniofacial measurements on cranial material from the eastern edge of the Old World ranging from North China south to Australia and out into the Pacific, it can be shown that there is a gradient of tooth size that has been the result of different degrees of the intensity of selection. The TS difference between the Mesolithic and

living inhabitants of Southeast Asia and Indonesia is 50% larger than the difference between Mesolithic and living Europeans. The modern Southeast Asian TS cannot have been the result of selective force change in situ. Skin color data suggest that a depigmented population came from the north and absorbed dark-skinned big-toothed indigenes.

Neighbor joining dendrograms using 21 craniofacial measurements group the peoples from the North of China down to Australia and out into Oceania into four clusters. Australia, Tasmania, New Guinea and Melanesia form one cluster; China (north, south, east and west), Japan and Taiwan form another cluster. Thailand, Burma, Borneo and Indonesia form a Southeast Asian cluster, and Jomon Japan, Ainu, and Polynesians form a Jomon-Pacific cluster. Canonical variate plots using the first two variates confirm the picture of the neighbor joining dendrogram, and allow the placement of individual specimens. Individuals from the Balinese Bronze Age are divided between the Southeast Asian cluster and the Australo-Melanesian cluster confirming the previous guess.

### **Neuroendocrine reflections of senescence in human males: Indications of decreased energy allocation ability with age?**

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The evolution of human male senescence is poorly understood. Although menopause has received much interest, male reproductive senescence has received less attention. Male aging is typified by shifts in reproductive neuroendocrine function, however the adaptive significance of these changes is unclear. Hormonal data from Ache Amerindian males ( $n = 16$ , mean age  $38.4 \pm 13.6$  SD) of Paraguay is presented to contribute to our understanding of population variation in reproductive neuroendocrine senescence. Significant increases in follicle stimulating hormone (FSH) ( $r = 0.71$ ,  $p < 0.002$ ) and luteinizing hormone (LH) ( $r = 0.65$ ,  $p < 0.013$ ) were associated with age. No significant relationship was observed between morning (AM) or evening (PM) salivary testosterone (T) and age. AM and PM salivary estradiol (E2) levels were correlated with AM T and PM T respectively (AM  $r = 0.53$ ,  $p = .05$ ; PM  $r = 0.63$ ,  $p = 0.02$ ). PM E2 was also positively associated with LH ( $r = 0.66$ ,  $p = 0.02$ ). AM E2 tended to rise with age but was not significant ( $r = 0.39$ ,  $p = 0.15$ ). Previously reported population

variation in testosterone at younger ages may be the result of chronic energetic stresses while age related changes in gonadotropin levels may be independent of energetic status, less variant, and more universal among male populations. Changes in gonadotropin function with age may reflect a decrease in the ability to regulate energetic allocation between survivorship and reproductive effort, perhaps representing an important characteristic of human male senescence.

**An investigation of the range of skeletal indicators of vitamin D deficiency in adults and juveniles.**

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Vitamin D deficiency has multiple causes related to factors such as environment, living conditions and to a lesser extent diet. A clearer understanding of this deficiency in archaeological skeletal material has the potential to contribute to interpretations of the economy and environment, and socio-economic status of individuals.

The project aims to provide clearer for the identification of vitamin D deficiency in both adults and juvenile skeletons using macroscopic, radiological and microscopic features. The material investigated came from the historic churchyard of St. Martin's, Birmingham, England. 857 human burials, from the 18<sup>th</sup> and 19<sup>th</sup> centuries were excavated. Bone preservation was good and as a result large numbers of juveniles had survived.

The juveniles displayed a range of skeletal lesions and deformities related to both active and healed rickets. A range of new diagnostic features were identified, including changes to the femoral neck and macroscopic and microscopic features of bone surfaces underlying epiphyseal cartilages, that will aid the recognition of active and healed cases of rickets. Diagnostic criteria relating to the deformities of residual rickets in adults were defined. Few cases of adult vitamin D deficiency (osteomalacia) have been identified archaeological skeletal material, but cases were diagnosed through investigation using macroscopic, radiological and microscopic and a range of diagnostic criteria for archaeological material established.

This investigation not only provides a valuable insight into socio-economic conditions during the Industrial Revolution of Britain, but more importantly has pro-

vided information to allow clearer diagnosis of these important conditions in future studies of archaeological skeletal material.

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**Sex differences in the brain likely occurred after the ape-human split.**

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As the primary commissure in the brain, the corpus callosum (CC) has been an area of intense investigation in humans. Further, studies in humans have shown that this structure is sexually dimorphic. While the extent and meaning of sexual dimorphism in the human corpus callosum has been investigated, what this structure is like in our closest relatives, the living apes, has not been approached.

In this study the midsagittal area of the corpus callosum was examined in *Pan troglodytes* (12 females, 11 males). Measurements included total CC midsagittal area and area measurements of CC regions. Two techniques were used to divide the CC into regions. For both methods, the area of the CC and each region was calculated to assess statistically significant differences in absolute area and relative CC area between males and females. In addition, CC area measurements were correlated to brain size.

Analyses show that there is no statistically significant ( $p > 0.10$ ) sexual dimorphism in the CC of the common chimpanzee. These findings differ from previous results that utilized smaller sample sizes. However, the size of the CC did correlate with brain size (0.713), supporting the argument for standardization of measurements. Nevertheless, these results suggest that sexually dimorphic CC differences in this region of the brain may not have occurred until after the ape-human split. These findings also suggest that dimorphism in certain human abilities, such as language, may only have begun with the appearance of the hominin line.

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**Male-infant interactions in wild sifaka (*Propithecus verreauxi*).**

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The prominence of human paternal behavior makes it important to understand its primate origins. This study examines male-infant interactions and their relation to reproductive competition in a social strepsirrhine. Data from wild sifaka (*Propithecus verreauxi*) are used to test the hypothesis that androgens regulate a trade-off between male aggression and infant caretaking.

Data were obtained over 3 field seasons from sifaka males residing in Beza Mahafaly Special Reserve, Madagascar. Focal observations and daily fecal samples (N=525) were collected from 84 males in 47 groups that were observed intensively for 7- day periods. Caretaking behavior was measured by the frequency and duration of proximity, grooming of mothers and infants, and infant holding and carrying. Aggression was measured by the frequency of supplants, grabs, cuffs, and bites. Androgen levels were assessed by daily and weekly fT, assayed as previously reported.

Results of our preliminary behavioral analysis show that male sifaka occasionally hold, groom, and carry infants. Moreover, in contrast to predictions, there is no evidence that T suppressed male interactions with infants. In fact, analysis of androgen-behavior interactions indicated that males involved with infant caretaking had nearly 3-fold higher weekly mean fT concentrations than those that did not, and that resident males exhibited the highest fT levels, exceeding on some days those observed in males during the breeding season. Results parallel the patterning of paternal behavior in the California mouse, and suggest that male-infant interactions in sifaka may be mediated by T or its estrogen metabolites.

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**Hunter-gatherer health at the Ernest Witte site (41AU36), southeast Texas.**

C.J. Broehm, Prewitt and Associates.

Burials from the Ernest Witte site (41AU36) in inland southeast Texas provide a case study for an understanding of changes in health, subsistence, and social structure through time within hunter-gatherer populations. Human remains from four consecutive temporal periods, Middle Archaic (MA, n=55), Late Archaic (LA, n=137), early Late Prehistoric (LP1, n=9), and later Late Prehistoric (LP2, n=9), all representing hunter-gatherer populations, were recovered from this site. Skeletons from each group were analyzed for the presence of porotic hyperostosis, cribra orbitalia, linear enamel hypoplasias (LEH) and skeletal infection. Overall,

results were equivocal. No clear evidence of porotic hyperostosis or cribra orbitalia was found in any group. Similar, low rates of LEH were found in the MA and LA groups. LEH increased in both LP groups. Infection was slightly lower in the MA than in the subsequent LA, although both rates were relatively low. None was observed in the LP1, but rates increased again in the LP2 to levels comparable to those in the LA. Severity and extent of involvement, however, peaked in the LA. Further, prevalence of both LEH and infection in the LP groups likely represents an artifact of small sample size. Intra- and intersite comparisons tentatively suggest declining health during the LA in inland southeast Texas, possibly due to increased intergroup competition and decreased resources. If health truly declines during the LP, it may be correlated with higher intergroup conflict.

**Ethnic differences in plasma lipid profiles among female school teachers in Hawaii: Japanese-Americans versus Euro-Americans.**

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Lipid profiles are an important risk factor for cardiovascular disease. Ethnic differences in lipid profiles were examined in a sample of Japanese-American (JA; N=92) and Euro-American (EA; N=59) women who were teachers at public schools in East Hawaii. Participants underwent an anthropometric battery, and submitted a fasting blood sample. JAs were significantly shorter, lighter, less massive and less fat than EA co-workers. JA women had significantly higher triglycerides (t-tests,  $p < 0.05$ ), VLDL cholesterol ( $p < 0.05$ ) and HDL cholesterol ( $p = 0.01$ ) levels, but had somewhat lower LDL cholesterol ( $p = 0.10$ ) levels than EAs. When analyses of covariance were carried out using age and body mass index (BMI) as covariates, ethnicity was a significant main effect for VLDL cholesterol ( $F=7.9$ ,  $p < 0.01$ ) and triglycerides ( $F=5.4$ ,  $p < 0.05$ ). Significant positive correlations existed between age and all lipid measures except HDL cholesterol; and these correlations were considerably higher among JAs than among EAs. BMI was significantly positively correlated with total and LDL cholesterol and negatively with HDL cholesterol. The waist-hip circumference ratio was significantly correlated with all lipid measures. Among JAs, those who reported being more Americanized in general lifestyle had higher HDL

cholesterol levels (partial correlation controlling for age,  $r=0.22$ ,  $p < 0.05$ ). The generally more favorable profiles of lipids among JAs are primarily due to their leaner body composition, but the higher triglyceride and VLDL cholesterol levels among these women persist when analyses control for age and body size.

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**Ventilatory control and exercise response in lowland born admixed Peruvians tested at 4,338 meters.**

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High altitude (HA) Andean natives have a blunted ventilatory (VE) response to hypoxia, reflected in both the acute hypoxic ventilatory response (AHVR) and the hypoxic ventilatory depression (HVD). This blunting effect is partly irreversible as de-acclimatized HA natives show ~76% and ~30% of the lowland control AHVR and HVD, respectively. The functional and genetic correlates of HVD are largely unknown. In this study, the VE response to sustained isocapnic hypoxia (20 min, end-tidal  $PO_2=50$  Torr) was measured at sea-level in 32 male and 33 female lowland born Peruvians of mixed Spanish-Quechua ancestry. Individual admixture proportion (ADMIX, %Spanish) was estimated using a panel of ancestry-informative genetic markers. After studies of VE control, subjects were transported to 4,338 m and given a graded exercise test to exhaustion. In males, HVD was negatively correlated with ADMIX ( $r=0.36$ ,  $p<0.05$ ). HVD was also negatively correlated to arterial oxygen saturation ( $SaO_2$ ) at HA, both at rest and during exercise ( $r=0.27-0.38$ ,  $p<0.05$ ). However, the  $SaO_2$ -HVD relationship depended on ADMIX, and there were notable sex differences. In males, the  $SaO_2$ -HVD relationship was significant only at rest in subjects with high ADMIX ( $r=0.743$ ,  $p<0.01$ ). In females, the  $SaO_2$ -HVD relationship was significant only during exercise in subjects with high ADMIX (repeated measures,  $p<0.05$ ). Results suggest that HVD is a determinant of  $SaO_2$  at HA. Results also suggest that population history (as measured by ADMIX) modifies the response to hypoxia in these lowland

born subjects. Supported by grants from NSF BCS-0129377 to TDB and NIH/NHGRI (HG002154) to MDS.

**Investigating cemetery diversity: grave variation, osteology and social identity late Anglo-Saxon England, c. 700-1100AD.**

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Late Anglo-Saxon burial practice has been long considered egalitarian. Thus little research has been undertaken examining the relationship between osteology, social identity and burial rites for the 8<sup>th</sup> to 11<sup>th</sup> centuries AD. However, variation in grave types including plain earthen graves, wooden and stone coffins and stone grave linings are present in most cemeteries. In addition, the use of elaborate stone sculpture and the prominence of graves located both within and close to the walls of churches indicate that social and family status may have been signalled through burial practice.

This paper compares osteological data of age, sex and health status with different forms of burial practice for a group of six late Anglo-Saxon cemeteries in Lincolnshire and Yorkshire, UK. The research shows that although all age groups could be accorded different grave types, adults were likely to have more elaborate burials than infants and young children. However different grave forms were not related to the sex of the deceased. The hypothesis that those individuals buried in more elaborate graves had better levels of health, indicative of higher social status, was tested by stress markers, revealing different prevalence rates for individuals buried in graves with coffins than individuals buried in plain graves. This research shows that comparing biological and funerary data can reveal important evidence of social differentiation in funerary practice, even from a period commonly believed to have had egalitarian burial rites.

**Developmental enamel defects of deciduous dentition from Taumako Island, Southwest Solomon Islands, Pacific Islands.**

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Evidence of prenatal and early childhood growth disturbance in dental remains is a useful measure of population health in prehistory. The frequency and types of developmental defects in the deciduous

dentition of 35 subadults aged from newborn to 11 years of age (n= 215 observable teeth) from Taumako Island, southwest Pacific, are reported in this study. The teeth were examined for evidence of disruption of enamel formation and mineralisation in the forms of hypoplasia and hypocalcification respectively. Observations were recorded following the Developmental Defects of Enamel (DDE) Index (Cuttress, 1982).

Carious lesions of the buccal and lingual surfaces of the teeth, known as 'circular caries', were also recorded. Defects of the enamel were observed in 68.8% of teeth (77.1% of individuals). Over half had hypocalcification, with hypoplasia accounting for only 5.4%. Circular caries were present in 30.4% of teeth. These data indicate high levels of prenatal and early childhood stress in the sample. Half of the hypocalcifications were diffuse defects, indicating chronic stress. There are high levels of infectious disease, particularly treponemal disease, at the site compared with other Pacific Island samples (Buckley and Tayles, 2003). The relationship of dental enamel defects with disease was examined in the 19 subadults with dental defects who had adequate skeletal preservation for observation of morbidity patterns. Over half of these individuals had periostitis and 42.1% had cranial lesions suggestive of anaemia. However, similar rates of these of these conditions in the eight individuals with no dental defects. The biocultural context of these patterns is discussed.

#### **Intra-population pattern of facial growth in humans: A geometric morphometric analysis.**

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A number of recent studies suggest an early, possibly pre-natal onset of shape differences between hominoid species and even between different human populations. The present paper expands this research and addresses individual and gender differences in facial morphology within a single human population. This study is based on a longitudinal collection of radiographs of 16 males and 16 females from the Denver Growth Study. Each individual was radiographed at the age of 1, 3, 9 months, 1 year and 9 months and then every year until generally the age of 25. Methods of geometric morphometrics, based on the analysis of landmarks and semi-landmarks have been employed to

study the morphology of the face and frontal bone on a total of 500 lateral radiographs. The results of this study demonstrate the absence of a significant correlation between the size or shape of the infant and adult face. However, such a correlation becomes significant at 3 years of age and above. It is further shown that there is a statistically significant difference in facial shape between pre-adolescent boys and girls (0-9 years old). This dimorphism is already present at birth and is different from adult sexual dimorphism that develops during pubertal spurt mainly as the result of male hypermorphosis. In summary, the present results support the hypothesis of an early determination of adult facial shape by 3 years of age. It also demonstrates that subtle shape differences between the sexes are established by birth.

#### **Molecular evolution of ASPM, a gene involved in human brain development.**

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The evolution of genus *Homo* was marked by a massive increase in gross brain size. In particular, the cerebral cortex has shown the largest increase. While the expansion of the cerebral cortex is considered a mammalian trend, the rate and magnitude of expansion seen in humans is unique. This research examines the role, if any, the gene ASPM played in the encephalization of *Homo sapiens*. In *Drosophila*, the ASPM ortholog plays a critical role in normal brain development by mediating mitotic spindle function. The murine ortholog of ASPM is expressed in the prenatal cerebral cortex during neurogenesis. In humans, mutations to ASPM are the primary cause for microcephaly, a condition whereby the brain develops normally except for the cerebral cortex which is greatly reduced. By using a comparative genomics approach, this research analyzes the coding and regulatory regions of the ASPM gene in the Order primates.

Sequences were generated from two coding regions of the ASPM gene in *Homo sapiens* (n=3), *Pan troglodytes* (n=5), *Pan paniscus* (n=1), *Gorilla gorilla* (n=2), *Pongo pygmaeus* (n=1), and *Cheirogaleus medius* (n=1). Additionally, approximately 1kb of sequence was generated upstream of the ASPM gene in all species listed above. Pairwise comparisons of exonic sequences support an elevated substitution rate in the Old World Monkey (OWM) sample relative to all other samples or a deeper ancestry for OWM.

The nonsynonymous/synonymous substitution rate ratio ( $d_N/d_S$ ) will be calculated to test for the effects of selection.

#### **Naviculo-cuneiform I coalition: Evidence of statistically significant population variation in tarsal coalition frequencies.**

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Congenital tarsal coalition is the union of two or more tarsals due to abnormal mesenchyme cavitation during development. Coalition may be osseous or non-osseous, with the latter consisting of cartilaginous or fibrous tissue, or some combination of both. Naviculo-cuneiform I coalition is one of the rarest forms. Kumai et al. (1996) have suggested that naviculo-cuneiform I coalition frequencies differ between populations. The purpose of this study is to test for significant population differences in naviculo-cuneiform I frequency between one black South African and two Caucasian samples.

Because the trait is easy to score and bilaterality is relatively high in published cases, our samples consist of individuals with one navicular or one first cuneiform observable on at least one side. Data were gathered on 603 black South African skeletons (Dart Collection, University of Witwatersrand), 403 American White skeletons (Terry Collection, Smithsonian Institution), and 619 medieval Danish skeletons (Anthropological Database Odense University). Six non-osseous cases were identified in South Africans while none were found in either Caucasian sample. Two-tailed Fishers Exact tests ( $\alpha = 0.05$ ) revealed statistically significant differences between the South African and Danish samples ( $p = 0.013$ ;  $1 - \alpha = 0.70$ ) and between the South African and combined Caucasian samples ( $p = 0.003$ ;  $1 - \alpha = 0.83$ ). These results are the first statistical evidence of population differences in tarsal coalition frequency and therefore contribute to a better understanding of population variation. Furthermore, our conclusions may be useful to clinicians since coalitions are often symptomatic.

#### **Radiocarbon dating of the extinctions in late prehistoric Madagascar.**

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Nearly 300 age determinations collected and compiled by the authors provide insights into the habitat changes and extinctions that occurred in late prehistoric Madagascar. Major climate fluctuations occurred in the late Pleistocene. Both natural and human-induced environmental transformations occurred in the Holocene. Bones of extinct animals with cut marks and the first occurrence of pollen of introduced plants in sediment cores point to the earliest human presence at ca. 2300 <sup>14</sup>C yr BP. A decline in megafauna, inferred from a drastic decrease in spores of the coprophilous fungus *Sporormiella* spp. in sediments between 1900-1700 <sup>14</sup>C yr BP, is followed within a few centuries by large increases in charcoal particles in sediment cores, beginning in the SW and spreading to the interior over the next millennium. Pollen evidence shows that, in the wake of human activity, southern and central highland dry woodlands and wooded savannas became increasingly open and less diverse. By 1130 ± 50 yr BP (779-1020 cal yr AD) a return of *Sporormiella* spores signals the probable introduction of cattle, beginning in the NW and spreading to the central highlands within two centuries. Nearly all of the extinct "subfossil" taxa were still present on the island when humans arrived, and most overlapped chronologically with humans for a millennium or more. Some probably survived well into the period of European colonization. Current efforts are focused on dating apparently late occurrences.

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#### **Mitochondrial phylogeny of southern African baboons.**

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Common baboons (*Papio*) have been much studied, but their evolutionary history remains unclear. This is partly due to the difficulty of reconstructing the relationships among closely related forms that may experience high levels of gene flow, and partly due to the difficulty of obtaining samples from across their broad geographical range. Here we present a mitochondrial phylogeny of baboons including

samples of Kinda (*Papio cynocephalus kindae*) and gray-footed (*P. ursinus griseipes*) baboons from south-central Africa, forms previously unrepresented in molecular phylogenies. The phylogeny is based on several regions of the mitochondrial genome, including portions of the D-loop, COII, ND4 and ND5. All high-quality samples were sequenced from 10 kb amplicons of the mitochondrial genome in order to reduce the possibility of accidental sequencing of numts. The phylogeny shows two clades of southern African baboons, one including Kindas, gray-footed chacmas, and northern South African chacmas (*P. u. ursinus*), the other including chacmas (*P. u. ursinus*) from southern South Africa. Yellow baboons (*P. c. cynocephalus*) from central Tanzania group with an east African clade of anubis (*P. anubis*), hamadryas (*P. hamadryas*), and ibean (*P. c. ibeanus*) baboons. Our tree supports previous mitochondrial phylogenies of east African and Arabian baboons, showing considerable paralogy among anubis, hamadryas, and yellow baboons. This considerable mismatch between outward phenotype and genotype, especially in east Africa, is possibly the result of extensive gene flow in the past. More extensive sampling, as well as Y-chromosomal and autosomal markers, is needed to clarify the evolutionary history of this important primate taxon.

#### **Dietary reconstruction of enslaved African from the New York African Burial Ground: Elemental concentrations in permanent molars.**

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We are applying a biocultural and diasporic approach to the study of lower Manhattan's 18<sup>th</sup> century African Burial Ground (NYABG). Heretofore, our main research focus has been better understanding the geographic places of birth and subsequent migration patterns of enslaved Africans. In a previous study, we used Elemental Signature Analysis (ESA) and strontium isotope ratios to better establish probable African natality of individuals with culturally modified teeth and probable New York natality of others (Goodman et. al., 2003). In this pilot study, we further use chemical studies of teeth to infer early dietary patterns of individuals from the NYABG and differences in diets of first generation/African born versus New York born enslaved Africans. Concentrations of Sr,

Ba, Zn, and Fe in first molars (calcification ~ birth to 3.5 years) were obtained via Laser Ablation-Inductively Coupled Plasma-Mass Spectrometry (LA-ICP-MS) and normalized to <sup>43</sup>Ca.

Enamel elemental concentration patterns include low Sr/Ca ratios in most African versus New York born individuals, suggesting prolonged weaning in Africa, and Ba concentrations (relative to Sr and Ca), suggesting a possible seafood contribution to the diets of children in both New York and Africa. Both results are in accord with ethnohistorical information. In addition, an inverse relationship between Sr and Zn suggests that Zn is associated with dietary quality and consistent drops in Fe and Zn at the formation of enamel hypoplasias further suggests a link between enamel Zn and nutritional status.

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#### **Vision, olfaction and brain size in *Parapithecus grangeri*.**

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Anthropoid primates have large brains, high acuity vision, and relatively small olfactory bulbs compared to other living primates. An interesting question is to what extent the evolution of these characteristics was linked. We have examined endocranial volume, olfactory bulb size, and optic foramen cross section in *Parapithecus grangeri*, an early anthropoid from the Fayum of Egypt. We scanned a nearly complete *P. grangeri* skull (DPC 18651) at the high resolution CT facility at the University of Texas, Austin. The resulting scans had an effective resolution of 0.12 mm. We find that *P. grangeri* had an endocranial volume of 11,400 mm<sup>3</sup>. Given published estimates of its body size, this is small compared to the living anthropoids. When we compare our optic foramen measurement of 3.46 mm<sup>2</sup> with the data of Kirk and Kay (2003) we find that *P. grangeri* falls in the range of the living anthropoids, suggesting that it had relatively high acuity vision. Finally, the olfactory bulb volume of 75 mm<sup>3</sup> is within the range of strepsirrhines. This may represent a retention of the ancestral primate characteristic. These results suggest that high acuity vision evolved prior to brain expansion in anthropoids. Its development did not immediately lead to brain expansion, but made possible new

behaviors, which themselves may have contributed to brain expansion. One example is increased use of vision in social communication. The later development of this might have been associated both with brain expansion and with a reduction in the olfactory bulb.

**Accelerated cell column development: A comparison between normal and Down Syndrome in four areas of cortex.**

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Cell microcolumns were examined during development in normal controls and Down Syndrome (DS) patients in three associational (21,22, 40) and one primary (17) area of the neocortex. We monitored growth rates by measuring the width of a column and the amount of peripheral neuropil space. The DS group consisted of three children with a mean age of 4 years, and six adults with a mean age of 38 years. The normal control groups were aged-matched and comprised between 3 to 6 children and seven to nine adults, depending on the cortical area. An unpaired student t-test was used to determine whether (A) the cell columns in the children were distinguishable from those of the adults in either group, and (B) to determine any differences between adult controls and those with DS. Conclusion: No statistical differences were found in regards to size and neuropil space for the two adult populations. On the other hand, cell columns in DS children attained adult configuration very early compared to those of the normal controls. Finally, cell columns in area 17 appeared to mature more rapidly in both control as well as DS children. The accelerated cell column development found in normal V1 may be related to the importance of visual information for primates, and other factors of cortical development that may require primary cortex to develop more rapidly than association cortex. These results demonstrate that cell columns do not develop at the same rate in every area.

**The mechanobiology of primate cranial sutures.**

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Mesenchymal cells residing within the extracellular matrix of the cranial suture connective tissue are osteogenically responsive to mechanical forces. Therefore, cranial sutures have been described as excellent model systems for studies in mechanotransduction. We used two experimental approaches to explore the relationship between form and function in cranial sutures. We tested the hypothesis that increased temporalis muscle mass increases sagittal suture complexity by comparing sutural fractal dimension and temporalis mass between normal mice and mice deficient in myostatin. Myostatin (GDF8) is a negative regulator of muscle growth and GDF8<sup>-/-</sup> animals demonstrate significant enlargement of skeletal muscle mass. Our results show that GDF8<sup>-/-</sup> mice have a 61% enlargement in temporalis (Student's T-test, P<0.001) and sagittal sutures with increased fractal dimension (Student's T-test P<0.026). Next, we tested the hypothesis that primates known to exploit foods of different material properties (differences in mechanical loading) will also show differences in sagittal suture complexity. To conduct this experiment two species from the genus *Cebus* were used, *C. apella* and *C. albifrons*, which reduced such confounding variables as body size differences and phylogenetic background. Results of this analysis reveal that *C. apella* has a significantly greater fractal dimension than *C. albifrons* (Student's t-test P<0.007) suggesting that increases in mechanical loading due to the tougher diet of *C. apella* elicits a sagittal suture growth response. Based upon these findings, a likely pathway for mechanotransduction in suture connective tissue is presented.

**Salivary amylase gene copy number: Have humans adapted to high starch diets?**

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The transition to agriculture in the Neolithic period brought about an increase in starch, in the human diet. This study examines whether genetic adaptation to changes in the amount of starch ingested has occurred in humans. Starch digestion begins in the mouth where it is hydrolysed into smaller polysaccharides by the enzyme salivary amylase. Three salivary amylase genes (AMY1A, B & C) and a pseudogene (AMYP1) have been described and are located in tandem on the short arm of chromosome 1. Polymorphic varia-

tion has been demonstrated in Caucasian populations in the form of the number of repeats of the AMY1 genes, as follows: (1A-1B-P1)n-1C. This variation results in differing levels salivary amylase enzyme production and, as a result, differences in the efficiency of starch digestion. We have designed a reliable high-throughput PCR based method, using ABI GeneScan technology, to quantify AMY1 gene copy number and to type 6 microsatellite markers closely linked to the AMY gene cluster. Data has been collected for 14 human populations, each with different histories of cereal agriculture and levels of starch in the diet. This data has been analysed using two approaches - a) comparing F<sub>ST</sub>, based on AMY1 repeat number allele frequencies, to a null distribution of F<sub>ST</sub> for neutral markers to gauge evidence for directional selection in different populations; b) examination of intra-allelic variability using microsatellite haplotypes associated with different AMY1 repeat number alleles, to test for differences in selective forces operating on different alleles in the same population.

**Age-related changes in body composition among Turkana males.**

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Loss of fat free mass and gain of adipose tissue are considered hallmarks of aging. However, results from the Ariaal, pastoral nomads of northern Kenya suggest that in a subsistence setting men may maintain fat free mass, but not adipose tissue, as they age.

To determine if other populations show similar age-related changes in male body composition, BMI, fat free mass, % body fat and skinfold measures were determined among Turkana pastoralists of northern Kenya. 130 nomadic, and 90 settled men, ages 20 to 90 years, were included in the analysis.

Average BMI for the entire sample was 17.7± 1.8 kg/m<sup>2</sup>. Comparison of the two sub-populations revealed significantly lower BMI, %body fat, and skinfolds among the nomads, but no difference in weight or fat free mass. Fat free mass exhibited a curvilinear age pattern, peaking in the 30's for nomads and 40's for settled males. The age-related pattern of adiposity for settled males was similar to that of fat free mass, while for the nomads both % body fat and suprailiac skinfolds declined from the 20's.

The timing of peak muscle mass among Turkana males is similar to that of west-



ern samples, but age-related changes in adiposity differ. The decline of adiposity with age presumably reflects chronic undernutrition in both sub-populations, with acute undernutrition among the nomads leading to earlier decline. These findings show that age related changes in adiposity in men can vary across populations, as function of energetic conditions.

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### **Cross-sectional geometry and locomotor behavior of habituated chimpanzees from the Tai and Mahale National Parks.**

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Studies of extant primate locomotion use cross-sectional geometry to characterize the limb structure of primates spanning broad locomotor categories. Such studies frequently are the basis for inferring locomotor profiles of extinct primates. However, any response of bone to individual differences in activity profiles is obscured when interpreting the morphology of museum specimens with the observed behavioral profiles of wild populations. Here we present an analysis of cross-sectional geometry and locomotor behavior where the same wild specimens supply morphological and behavioral data. Femora and humeri from several chimpanzees of the Tai National Park (Ivory Coast) and the Mahale National Park (Tanzania) were assessed at three diaphyseal locations using computed tomography and image analysis software. Locomotor profiles were constructed with 3387 instantaneous time-point observations (87.4 hours). Few significant correlations are found between a ratio of maximum and minimum principal moments of area, which quantify maximum and minimum structural rigidities, and locomotor activities. Furthermore, few consistent positive or negative trends are observed between structural rigidity ratios and locomotor activities. This suggests that femoral and humeral cross-sectional geometry is relatively insensitive to differences between

individual chimpanzee locomotor behavior profiles, and may be incapable of distinguishing between less than broadly defined locomotor categories (i.e., leapers, brachiators, climbers). This limits the precision with which locomotor behavior of extinct primates can be extrapolated using cross-sectional geometry of long bone diaphyses.

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### **A paleopathological assessment of the Bowser site skeletal population.**

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The Bowser skeletal population was excavated at the Fort Bend County, Texas site 41FB3. This site is one of thirteen in the western part of southeast Texas that exhibits Late Archaic mortuary traditional components. The Late Archaic time period in southeast Texas is from 1500 BC to AD 100. There are two burial groups established for this site, the upper and lower (Patterson et al., 1998).

The intent of this presentation is to summarize our paleopathological assessment for these burials. The MNI of the Bowser burials based on left tibia count is 39; with discrete burial units the number of individuals examined increases to 51. There are 11 subadults, 16 adult females, 21 adult males and 3 adults of indeterminate sex. Specifically, we are focusing on the dental health of this population. We have collected data on enamel hypoplasia, calculus, caries, abscesses, dental wear, antemortem tooth loss and alveolar resorption. We have also amassed information on general infection, osteoarthritis/degenerative joint disease and trauma found in the skeletons. Our purpose is to compare our findings to other Archaic burials in Texas, particularly the Ernest Witte Site (Taylor, 2001), the Blue Bayou Site (Commuzie, 1987) and the Crestmont Site (Vernon, 1989). We have found the Bowser population to be similar to that of other Archaic populations in terms of health assessment. Of specific interest for this population is their unusual dental wear pattern that reflects use wear and not diet.

### **Duty factors and lateral-sequence gaits in primates and chameleons.**

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Lateral-sequence (LS) gaits, in which the left hind footfall is followed by the left fore footfall, are typical of most nonprimate mammals. Primates and some marsupials commonly show a diagonal-sequence (DS) pattern, in which the left hind footfall is followed by the right fore footfall. We have argued (*Zool. J. Linn. Soc.* 136: 401) that the DS pattern allows the hind foot to be planted in a protracted position on a tested support before the next fore footfall on an untested support, and is to be expected in cautious arboreal quadrupeds with grasping hind limbs. This expectation is violated by LS gaits reported for lorises and chameleons by other authors. New data indicate that LS gaits in lorises occur only at low walking speeds, where all duty factors (ratio of stance to swing phase duration) are high and the advantages of the DS gait are irrelevant, and that gaits become more diagonal with increasing speed and decreasing duty factors. Chameleons conform to the loris distribution, but have primarily LS gaits because their speeds are always very low. A similar negative relationship between diagonality and duty factor is found in at least some other primates and arboreal marsupials (*J. Zool.* 260: 423). This relationship may be primitive for both mammalian orders.

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### **Longevity and the evolution of modernity.**

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Increased longevity, expressed as number of individuals surviving to older adulthood, represents one of the ways the human life history pattern differs from other primates and may be a critical demographic factor in the development of human culture. The evolution of longevity has been discussed through its correlation with other variables, such as body size, encephalization and growth and development patterns, but the actual pattern of change in adult survivorship critical to testing the reality of these correlations in the human lineage, the grandmother hypothesis, and other questions surrounding the evolution of human longevity, has yet to be empirically established.

We examined when changes in longevity occurred by assessing the ratio of older to younger adults (OY ratios) in four hominid dental samples (n=768) from successive time periods: later australopithecines, early/middle Pleistocene *Homo*, Neandertals and Early Upper Paleolithic Europeans. Younger and older adult status was assessed by M3 eruption and wear seriation of each sample, to indicate adulthood (M3 eruption), and the age at which individuals could first potentially become a grandmother (double the age of M3 eruption). Significance of the difference in ratios between the groups was tested using distributions generated by random resampling with replacement. While there are significant increases in OY ratios between all groups indicating a trend of increased adult survivorship over the course of human evolution, there is a far more dramatic increase in longevity in the modern humans of the Early Upper Paleolithic. We believe this increase in adult survivorship may be a root cause of the population expansions and cultural innovations associated with modernity.

**PIXE and paleodiet: Reconstructing subsistence of Florida's Middle Archaic using a new method of trace element analysis.**

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The amount of marine dietary resources consumed by the prehistoric inhabitants of Florida during the Middle Archaic is an issue of some debate. To address this issue, Particle-Induced X-ray Emission (PIXE) is used to determine elemental concentrations of human and non-human bone samples collected from Nona's Site, a Middle Archaic locality (7,000-5,000 years BP), in Sarasota County, Florida. Analysis focuses on alkaline earth elements Sr, Ca, Ba, Fe, Cu, Mg, Mn, and Zn, since they are biologically incorporated into bone and therefore may reflect elemental concentrations of diet when diagenetic factors are accounted for. Nona's Site is situated between Florida's Gulf Coast and upland interior habitats thus allowing for a wide-range of potential subsistence patterns.

This pilot study addresses the applicability of PIXE for trace element analysis of bone and determines whether elemental concentrations found within these bone samples reflect diagenesis and/or dietary intake. PIXE is a fast and accurate method of multi-elemental analysis and

has the potential to be virtually non-destructive. Nona's Site samples are also analyzed using Inductively Coupled Plasma – Mass Spectrometry (ICP-MS), a more traditional method of trace element analysis, allowing for verification of PIXE results. Comparison of PIXE and ICP-MS data indicates that PIXE is a valid method to determine trace element concentrations in archaeological bone. Human bone samples yield levels of Ba, Mg, Mn, and Zn that appear to reflect a reliance on coastal resources. However, elevated levels of Sr and Ca suggest significant bone alteration, likely the result of inundation in an aqueous environment.

**Locomotor adaptations in primates and other mammals.**

H.J. Chatterjee, W. Parr. Grant Museum of Zoology, Department of Biology, University College London.

Previous research into postcranial adaptations to arboreality have focused on robusticity and qualitative, or shape, differences, expressed in primates. There have been relatively few studies using metrical differences in postcrania to identify characteristics adaptive to different arboreal locomotor strategies. This study uses 26 two-dimensional measurements to explore relationships between postcranial morphology and locomotor strategy, across a range of both primate and non-primate arboreal taxa. The main aim of the study is to identify suites of morphological characteristics associated with varying forms of arboreal locomotion, i.e. ecomorphologies.

Size adjusted metric data were analysed using discriminant function and principal component analysis. These analyses identified suites of postcranial characteristics that can be used to predict various forms of arboreal locomotion including: true brachiation; semi-brachiation; vertical clinging and leaping and arboreal quadrupedalism.

Bivariate analyses, based on the results of the multivariate analyses, indicate that using combinations of predictor variables several other locomotor types can be identified. The identification of suites of predictive variables for varying forms of arboreal locomotion has useful implications for the classification of locomotor strategies in extinct arboreal taxa.

**Disturbing the dead: The displacement and destruction of skeletal remains in early medieval Wessex, c.600-1100AD.**

A.K. Cherryson. Department of Archaeology, University of Sheffield.

"May they rest in peace" is often said of the dead. Yet the reality is often very different. For over a millennium, the skeletal remains of those laid to rest in England's churchyards were often disturbed and destroyed by the bodies of later generations or by ecclesiastical rebuilding. This study examines the levels of post-burial disturbance seen in Wessex during the early medieval period, c. 600-1100AD, a period which saw the advent of churchyard burial in England. The evidence for post-burial disturbance of the deceased was assessed in 20 early medieval cemeteries from Wessex. This revealed a general underlying trend of increasing levels of grave disturbance during the early medieval period. This rose from the relatively low levels seen in the seventh and eighth century cemeteries, which immediately predate the advent of churchyard burial, to the high levels of intercutting burials seen in the churchyard cemeteries of the eighth to eleventh centuries. Much of skeletal disturbance when present in earlier cemeteries can best be characterised as the reuse of pre-existing graves while that in the later cemeteries was primarily the result of the intercutting by later graves. The later churchyards also saw the deposition of displaced skeletal remains in charnel pits and the use of displaced skulls as "pillow stones" for other burials. Finally, the changes in the post-burial treatment of the body are considered with respect to both the views of the church on the treatment of the deceased and the belief in the literal resurrection of the body.

**An analysis of variation in early Indonesian mandibles.**

F.Y. Chiang, R. Caspari. Paleoanthropology Laboratory, Department of Anthropology, University of Michigan, Ann Arbor.

The mandibular remains from Java have been of interest for decades because of their wide range of variation. This variation is most frequently attributed to taxonomy or to sexual dimorphism. Although it has been compellingly argued that this variation can be accommodated within a single sexually dimorphic species, controversy continues in part because previous studies have rested on traditional statistics, techniques that depend on a number of assumptions that may not be valid for fossil samples. Data resampling represents an approach that allows us to compare variation without the as-

sumptions of standard multivariate statistics.

In this paper we revisit the issue of causes of variation in the Javanese mandibles using resampling methods. Asking the question of whether the variation in the Javanese mandibles can be accounted for within a sexually dimorphic species, we assess the pattern of variation in the Indonesian mandibles and then the probability of finding that pattern in a sample of *Gorilla gorilla*. Intragroup variation was assessed using the mismatch distributions of key metric variables taken on casts of 6 Indonesian mandibles and associated dentition. We then examined the probability of finding, for each measurement, a distribution with a range equal to or smaller than that of the Indonesian sample in a distribution of 10,000 Gorilla samples of the same size ( $n=6$ ), resampled with replacement from an original sample of over 50 individuals. We find that for most measurements, the mismatch distributions lie within the Gorilla range; however, the few that do not raise interesting questions for further study about the pattern of variation in early *Homo*.

#### **Assessing the uniqueness of frontal sinus outlines using Elliptic Fourier Analysis.**

A.M Christensen. Knoxville, TN.

It was first suggested in 1921 that the frontal sinus morphology of no two individuals is alike. Since that time, the irregular shape of frontal sinuses has been fairly extensively studied, with even monozygotic twins being shown to differ in their frontal sinus morphology. The significance of such observations as well as the potential forensic applications was immediately recognized and frontal sinuses were used in identification as early as 1925. However, no empirical testing of the uniqueness of frontal sinuses has ever been performed, with many previous studies focusing on inter-group variability, and/or examining features or linear measurements, and not shape *per se*.

This study, aimed at analyzing individual variation in shape, investigated frontal sinus variability using Elliptic Fourier Analysis (EFA), a geometric morphometric approach that fits a closed curve to an ordered set of data points, generating a set of coefficients that can be treated as shape descriptors used as variables in discriminatory or other multivariate analyses, or used to reproduce the outline. By modeling 2-dimensional representations of frontal sinuses (as seen in posterior-anterior cranial radiographs) as closed contours by digitizing their outer

borders, differences in their shapes were assessed quantitatively by comparing the Euclidean distances between the EFA-generated outlines.

Results showed that there is a quantifiable and significant difference between the shapes of different individuals' frontal sinus outlines as represented by Euclidean distances, since distances between outlines of different individuals were shown to be significantly larger than those between replicates (simulated antemortem and postmortem) of the same individual.

#### **Three-dimensional mapping of the *Homo erectus* loci at Zhoukoudian, China.**

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We construct a digitized three-dimensional, stratigraphically-controlled excavation grid of Zhoukoudian Locality 1, using AutoCAD, in order to assess the spatial relationships of the excavated materials. Fifteen loci were originally established for fossil hominid discoveries. We located Loci H through O, established between 1934 and 1937, to within <1 m<sup>3</sup> vertical and horizontal provenience using an excavation grid laid out in 1934. We then mapped Loci A through G, established in the northern sector of the excavation between 1921 and 1933, onto this grid system by utilizing locations of remaining walls, stratigraphic sections, excavation reports, maps, and photographs. Many re-articulated hominid specimens were discovered as isolated fragments scattered over large areas of the cave floor, and in one case between strata, a taphonomic pattern we ascribe to extensive hyaenid breakage and dispersal of remains in the cave. Some loci were horizontally extensive, with fragments of one hominid individual widely dispersed, while other loci were less than 1 m<sup>2</sup> in extent with more than 1 individual represented.

The estimate of 51 hominid individuals from Locality 1, still based largely on Weidenreich's original identifications, requires morphological reassessment. Archaeological context should also be reassessed. Fossil vertebrate and artifactual specimen numbers from Locality 1 can be used to identify provenience to within 1 m<sup>3</sup>. We have used this approach to associate equid skull remains, putatively burned while fresh, with Locus B *Homo erectus*. The Locality 1 three-

dimensional grid data are available to researchers by request from the authors.

#### **Chimpanzees and humans: The role of spatial analysis in primate conservation.**

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The Park National du Nicolo Koba (PNNK) in Senegal is home to a number of West African chimpanzees (*Pan troglodytes verus*). However, the larger population of chimpanzees in Senegal uses the savanna mosaic surrounding the park. This has resulted in a high level of interaction between chimps and humans. The people rely on subsistence agriculture, and tension arises as the chimpanzees use gardens and fields for foraging and raid beehives. Confounding the issue, monkeys also raid the crops, seemingly at higher frequencies than chimpanzees. To clarify the question of chimpanzee behavior and how it affects and is affected by humans, Geographic Information Systems (GIS) was used to integrate a number of layers of data and determine patterns of distance, ranging behavior, and resource use by the primates. These data are based on the location and frequency of sightings of individuals and their nests, and use cost-benefit and shortest path analyses. When sightings of chimpanzees were plotted on basemaps of elevation, land cover, soils, and vegetation, some patterns emerged. Correlations exist between sightings and water sources as well as preferred foods. Based on this initial analysis of chimpanzee movements and home range calculation, a dialogue can begin, and perhaps a management plan will be developed to decrease tension between humans and primates.

#### **Group size resurgence in mantled howlers (*Alouatta palliata*).**

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The effects of deforestation and management practices on group size and composition of the howlers of La Pacifica, Costa Rica, have been previously reported. Here I report on the rebound of one group following a return to previous irrigation procedures. La Pacifica is in the dry tropical zone and little rain falls between December and May. Without irrigation, the upland forests lose their leaves and provide only new growth as food for howlers. Group 2 has been surveyed since the mid-1970's and has been regularly moni-

tored from 1984 through 2003. Group size had ranged between 20 and 27 from 1974 through 1990, at which point it decreased, and ranged between 11 and 14 group members through 2000. The low impact irrigation watering the home range ceased after 1986, and water reached the forest only occasionally. In 2000, the previous irrigation system was restored. By 2003, six new females had joined the group, three of which were secondary transfers from nearby groups. Group size increased to 26 (4 adult males, 11 adult females, 11 immatures), plus 3 peripheral females. During this complete study period, male:female ratio has varied between 1:1.5 to 1:3.0, and males left the group when the ratio dropped below 1:2.0. Adult female to immature ratio varied between 1:0.8 and 1:2.2. Thus, while the composition of the group remained stable, the size of the group decreased in association with limited irrigation, and increased after irrigation (and presumably resources) were restored.

#### **A new model for the Neanderthal vocal tract.**

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The human larynx, in contrast to those of other mammals, is in a low position in the pharynx. This low laryngeal position is regarded as essential to our ability to produce the full range of speech sounds. This change is generally presented as a gradual descent of the larynx over the course of our species' evolution.

The Neanderthals are often regarded as an exception to this process. They are often presented as having a high laryngeal position, at best having a more child-like vocal tract. Consequently, they may have had a more limited repertoire of speech sounds available to them.

Evidence is presented in this paper to suggest that the reversal proposed in the Neanderthals may be a consequence of the sex used to model the vocal tract. There has been a concentration on male vocal anatomy in the research so far undertaken. However, human males have a large secondary growth in both laryngeal size and position. This secondary growth appears to have little to do with the ability to produce speech sounds. Furthermore, we have no way of knowing when this secondary growth spurt evolved. It is plausible that this growth spurt was not found in Neanderthal males. The use of the human male as the standard model for human vocal tracts may therefore be responsible for the apparent reversal in

laryngeal position found in the Neanderthals.

#### **Genetic studies of *Mandrillus sphinx* in Gabon.**

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The mandrill (*Mandrillus sphinx*) remains an enigmatic primate species of which little is known in the wild. Mandrill societies appear to be comprised of large cohesive herds numbering up to several hundred individuals with mature, breeding males only present during seasonal cycles in females. A genetic study using microsatellite, Y-chromosome and mitochondrial markers has been undertaken, the principal aim of which is to examine intra- and inter-group relationships in order to determine levels of population substructure, effective population size, and gene flow in mandrills. All genetic data are derived from non-invasively collected fecal samples. The focal study group is from the Lopé Reserve, Gabon, which is the approximate center of the mandrill species range and from which over 600 samples have been collected over a four-year period. In addition several hundred samples from neighboring populations have been collected. Preliminary results indicate that the Lopé mandrills exhibit reduced heterozygosity, allelic and haplotypic diversity compared to a semi free ranging colony of mandrills in Gabon. These data will help clarify existing interpretations of social and mating systems in mandrills, as well as having direct implications on the current understanding of the evolutionary history of the species. This work is funded by NIH grant 5 R01 AI44596.

#### **Testosterone, parasitemia, and cytokine correlates during human malarial infection.**

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Immunoendocrine interactions have been the subject of intense interest by

evolutionary biologists due to the important life history trade-offs that are evident in the function of hormones and immune factors. Because androgens influence and regulate both immune and reproductive functions, measuring changes in hormone levels and determining how they interact with immune factors during parasitic infection may have important implications for understanding the evolution of the vertebrate life history trade-off between reproductive and immune functions. We investigate just such a trade-off utilizing a model of human malaria, *Plasmodium vivax*. To date, the effects of the human endocrine response to this infection have received little attention. In order to clarify the resultant host endocrine response to *Plasmodium vivax*, we have examined correlates of gonadal function (testosterone levels) with physiological measures of disease progression (signs and symptoms) and soluble indicators of immune function (cytokines) during *Plasmodium vivax* infection in adult Honduran residents. Four serial samples were collected from 10 males and 12 females infected with *Plasmodium vivax* (and 44 age- and sex-matched control subjects) at Tocoa Hospital, Honduras. Samples were assayed for free testosterone and cortisol levels and cytokines (IL-1beta, IL-4, IL-10, IL-12, TNF-alpha, and IFN-gamma). It was hypothesized that there would be significant correlations between testosterone levels and a) *Plasmodium vivax* parasitemia; b) cytokine profiles; c) health complaints; and d) hemoglobin levels. The results of this study are discussed, as are methodological considerations for future research.

#### **Reconstructing the peopling of Cameroon through the analysis of mitochondrial DNA.**

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Populations presently settled in Cameroon belong to the Sudanic and Bantu cultures. These two groups differ in the social structure, subsistence economy, language and religion. There is also a clear geographic distinction between them, with Sudanic populations living in the northern

part of the country and the Bantu populations living in southern Cameroon.

This work is part of a long-term anthropological survey in Cameroon aimed at reconstructing the genetic history of Cameroon's populations. In this communication we focus on the differences between the Sudanic and the Bantu components of the peopling of this area. To do this, we use mitochondrial relative to a total of 12 populations from North (Daba, Fali, Fulbe, Mandara, Ouldeme, Podokwo, Tali and Tupuri) and South (Bakaka, Bassa, Bamileke and Ewondo) Cameroon. The data were obtained by sequencing the hypervariable region-1 and analyzing 4 nucleotide positions of the mtDNA coding region (10400, 12308 and 12705, 10873). A total of 441 individuals was studied.

The preliminary results of analysis of molecular variance, haplogroup frequencies and genetic distances suggest the existence of a north-south structure, although no close correspondence between genetic and linguistic structure can be detected. Another interesting result is in the presence of mtDNA haplogroups (U5 among the Fulbe and U6 among the Podokwo and Uldeme) which did not probably originated in sub-Saharan Africa. Furthermore, sequences of probable Pygmy origin (sub-haplogroup L1c1a1) were found in the Ewondo Bantus.

#### **Diversity of paternal and maternal surnames in the Argentinean colonial period: Isonymy by ethno-social category.**

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Surnames provide a simple and useful method to study the structure of human populations, for which biological data are not available. Using the isonymic method a difficulty is the small sample size. In groups where extramarital reproduction is common, sample size is even more reduced when only paternal surnames are taken into account. Therefore, it could be of interest to retain female surnames, including the case of single mothers. This study was carried out using all birth records information from an Argentinean population in the colonial period, which was characterized by the presence of dif-

ferent ethno-social groups (Spanish, Indian and "Mestizo") and various reproductive patterns regarding legitimacy. Surname distribution supposing neutral allele model and Ri kinship matrices between geographical populations were obtained, and the results derived from sets of paternal, maternal -of legitimate and illegitimate children-, and all surnames in the registers compared by ethno-social group. The results show similar surname distribution regardless of the set of surnames and group considered, as well as a low diversity and entrance of new surnames. Ri matrices using paternal, maternal of legitimate, maternal of illegitimate, and the set of whole surnames showed the same relationships among populations, indicating a similar pattern for Spanish, Indian and Mestizo. Mantel test correlation between all pairs of matrices was significant in all different ethno-social groups. Results suggest that in populations with high illegitimacy, when the surname distributions are similar, it would be convenient to maximize the sample size, even including maternal surnames.

#### **Assessing variation within commingled hominid fossil assemblages using nonparametric density estimation.**

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When studying an assemblage of commingled hominid fossils, one of our most challenging tasks is estimating the number of taxa present. Many studies have used coefficients of variation (CVs) to compare the variation in a hominid assemblage with the variation seen in samples of closely-related, extant taxa (usually great apes and modern humans). This method has important limitations, especially when samples are very small.

We propose an alternative method for comparing fossil assemblages to extant reference samples that addresses non-independence of observations: nonparametric density estimation (NDE). Using all possible combinations of fossil elements, we quantify the size of the multivariate space containing the entire sample. We compare the size of this space to similarly-constructed spaces for the extant taxa, using Monte Carlo simulation when samples are large. With NDE, we construct confidence envelopes analogous to parametric confidence regions. If the size of the fossil multivariate space size exceeds the confidence envelopes for the extant taxa, we interpret this as evidence for the presence of multiple fossil taxa.

We also examine the fossil distribution for multimodality, which may be suggestive of sexual dimorphism.

To demonstrate our methods, we revisit the problem of dental metric variation in the combined Hadar/Laetoli hominid samples. We compare fossil canine and M2 sizes with reference samples of *Gorilla*, *Pongo*, and *Pan* and find that variation in the fossil sample does not exceed the amount seen in the apes. However, the multimodal fossil distribution suggests the presence of a single, highly dimorphic taxon.

#### **Diversity in primate auditory structure and its influence on hearing performance.**

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The auditory region contains numerous structures that have proven useful for phylogenetic classification at various taxonomic levels. However, little work has been done in primates relating differences in morphology to variations in hearing performance. This study documents three anatomical and physiological distinctions within primates and begins to address the functional and evolutionary consequences of these and other auditory features. The dimensions of the outer ear (pinna) were measured in cadaveric specimens representing nearly every primate family and used to calculate a shape ratio (height/width). It was found that prosimians have a significantly higher ratio than anthropoids although the actual height was not found to differ. This indicates that most prosimians have ears that are tall and narrow whereas monkeys and apes are characterized by ears with a more subquadrate shape. The eardrum area, stapedial footplate area and ossicular lever arm lengths were measured in dried specimens to calculate an impedance transformer ratio. Again, a distinction was found between prosimians and anthropoids, with the former group having a transformer ratio indicative of a higher percentage of acoustic energy transmission through the middle ear. Audiogram data was gathered from the literature to analyze hearing sensitivity. Although there were no significant differences in high frequency sensitivity, platyrrhines illustrated more low frequency sensitivity than like-sized lorisooids. The effects of intra-specific variation on the audiogram results were also examined. These findings are discussed with respect to how these and other sensory adaptations may

be related to the current radiation of primates.

### **Sexual selection, homoplasy and fossil primate phylogenetics.**

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Homoplasies are resemblances between taxa that are due to processes other than descent from a common ancestor and that imply phylogenetic relationships that conflict with the best estimate of phylogeny for the taxa. It has become increasingly apparent in recent years that homoplasies are common in the datasets used to reconstruct fossil primate phylogenetic relationships, and that their prevalence is a major reason why robust phylogenies for the main fossil primates have been difficult to obtain. Accordingly, developing a better understanding of the distribution and causes of homoplasy among primates represents a challenge for physical anthropology. This paper reports a study that investigated the possibility that sexual selection is an important cause of primate homoplasy. First, large (>50 measurements) sex-specific craniometric datasets were constructed for the four extant large-bodied hominoids, and for the six extant papionin species. Next, the datasets were size corrected, coded, and subjected to several cladistics-based analyses. Lastly, the results were compared with the groups' well-supported molecular phylogenies in order to assess homoplasy levels in the morphological datasets. The analyses of the hominoid datasets suggested that males and females of this group are equally prone to homoplasy. In contrast, the analyses of the papionin datasets indicated that female papionins exhibit markedly less homoplasy than male papionins. Thus, the study suggests that sexual selection may indeed be responsible for some of the homoplasy encountered in fossil primate phylogenetic studies. However, the study also suggests that sexual selection-induced homoplasy cannot be assumed to affect all fossil primate groups.

### **The Nizwa Family Study: Mapping genes for complex metabolic diseases in the Arab Bedouins of Oman.**

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The Arab Bedouin population of the interior province of Oman is the focus of a collaborative study between Omani and U.S. scientist to identify and map genes influencing a number of complex metabolic diseases. For hundreds of years the traditional agriculture practices of this region have included cultivation of date palms and subsistence farming, as well as, animal breeding. The current population of Arab Bedouins is approximately 75,000, with these individuals distributed between the provincial capital of Nizwa (15,000) and several small villages (1000 – 5000). The inhabitants of each village are all related to each other with 1st cousin marriage approaching 50% of all marriages. As a result of the economic impact of the petroleum industry over the past 30 years dramatic changes in lifestyle have been witnessed. In an effort to delineate the genetic contribution for the risk of developing these diseases we have begun the Nizwa family study. We are currently collecting extensive phenotypic data, along with DNA, from 5 large extended families (approximately 200 – 300 individuals per family) of Arab Bedouins living in Nizwa and the surrounding villages. Given the unique marital practices of this community (e.g., 1<sup>st</sup> cousin marriages and males taking multiple wives) the resulting pedigrees offer tremendous power to map genes contributing to the development of common complex metabolic diseases.

### **Species richness in early hominins: A reply to Conroy.**

G.C. Conroy. Depts. of Anatomy & Anthropology, Washington University Medical School, St. Louis.

Conroy (*J. Hum. Evol.* 2002; 43:607-614) recently suggested that interesting insights may be gained about early hominin speciosity by considering the relationship between body mass and speciosity in extant mammals. Although the relative sizes of organisms are not traditionally used in most taxonomic analyses, he suggested that comparative body size might be an important factor in discussions of early hominin taxonomic diversity and called into question some "bushy-tree" models of excessive speciosity in early *Homo*.

Evolutionary biologists have long commented on a seemingly universal "rule" of nature – that in large taxonomic assemblages from groups as diverse as bacteria, plants, insects, marine invertebrates, fish, reptiles, amphibians, birds, and mammals, a strong inverse relationship is often noted between mean body size of taxa

and the number of species they contain – i.e., small body size is often associated with high species diversity. In this study I address the following questions of (paleo)anthropological interest: (1) How speciose is the Order Primates? (2) Does this biological "rule" characterize the Order Primates (at any taxonomic level) in any meaningful way? (3) Does the association between speciosity and body mass within the Order Primates provide any useful models for interpreting and/or predicting speciosity in the fossil primate record? Using phylogenetically independent contrasts methods, I conclude that the answers to those three questions are: (1) not very; (2) no; and (3) not particularly (with the possible exception of larger-bodied taxa). I predict that no early hominin genus will prove to be very speciose even when they are more fully known from the fossil record.

### ***Paranthropus* paleobiology: A review.**

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It has been more than 15 years since the publication of Grine's edited volume *Evolutionary History of the "Robust" Australopithecines* (Grine, 1988) and even longer since the last paper-length synopsis of *Paranthropus* taxa (Wood and Chamberlain, 1987) was published. However, new fossil discoveries and new interpretations of the existing fossil evidence have increased our knowledge and understanding of this taxon. We present a review of the genus *Paranthropus* focusing on the contribution of research conducted in the past 15 years, and the results of our own research that addresses the taxonomic significance of an up-to-date dental metrical description of the taxon.

*Paranthropus* fossils from four new sites include the youngest specimens, the first skull, the largest cranial capacity, and the most complete cranium known for this genus. In addition to tantalizing evidence for tool-use and an omnivorous diet, habitat reconstructions indicate that *Paranthropus* was one of the first hominin taxa to regularly visit open grassland sites. Several studies have supported the validity of *P. aethiopicus* as a distinct taxon, but there has been less evidence for the continued recognition of *P. crassidens* in southern Africa. The question of *Paranthropus* monophyly remains unresolved. Our analysis of *Paranthropus* dental metrics supports the recognition of *P. boisei sensu stricto* and *P. robustus sensu lato*

despite suggestions that these may be invalid taxa. (PC is supported by NSF IGERT Grant No. 9987590. BW is supported by the Henry R Luce Foundation).

### **A taphonomic analysis of crowned hawk-eagle nests from Tai National Forest, Ivory Coast.**

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Predation likely plays a significant role in primate mortality yet actual predation events are rarely observed. The study of prey remains can provide clues to a species' vulnerability to predation and help generate profiles of damage characteristics that can be used in taphonomic analyses. To better understand the role of predator activities in the accumulation of fossil fauna, we conducted a taphonomic analysis of primate remains from twelve crowned-hawk eagle (*Stephanoaetus coronatus*) nests collected over a period of two years in the Ivory Coast's Tai Forest. We determined the relative abundance of each primate species preyed upon by eagles as well as bone survivability, bone fragmentation, and damage patterns for each of the nests.

Results indicate that the most abundant remains are from two primate species that differ dramatically in body size and behavior: *Cercopithecus diana* and *Cercocebus atys*. Hindlimb bones (40%) were most abundant followed by those of the forelimb (24%) and crania (18%). The majority of recovered long bones and cranial bones remained intact. Damage to long bones typically consisted of broken proximal and/or distal ends with minimal harm to the shaft. Many of the cranial bones displayed puncture marks behind the orbits and along suture lines. The scapulae were shattered and exhibited raked breakage and V-shaped puncture marks.

Bone abundance and damage patterns described from Tai nests are similar to those reported for other crowned-hawk eagle nests such as those at Kibale. Our results have implications for interpreting the taphonomy of hominid sites such as Taung.

### **Synergistic musculoskeletal attachment sites in the upper extremity and activity patterns at Tell Abraq, United Arab Emirates, 2300 BC.**

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Skeletal pathology and morphological variations are frequently used to support theories of activity patterns in prehistoric populations. It is thought that the people of the Arabian Gulf in 2300 BC were fisherman, herders and agriculturists. In this study, adult forearm pathologies and morphologies were assessed using individuals from the Tell Abraq Neolithic tomb, United Arab Emirates. Previous work on this skeletal population demonstrated a high level of osteoarthritis (OA) at the trapeziometacarpal (TMC) joints, suggesting repeated stressful activity involving the thumbs.

The forearm bones from the same tomb show minimal pathology. However, morphological variations and eleven musculoskeletal attachment sites (MAS) on both the radius and ulna, including the sites for attachment of the volar radiocarpal ligament, flexor pollicis longus, abductor pollicis longus, brachioradialis and biceps brachii, were evaluated and shown to be hypertrophied. Several MAS on metacarpals II, III and V were also hypertrophied. Synergistic movement patterns were developed using the hypertrophied MAS to determine the probable frequent positioning of the forearm, wrist and digits in these individuals. Elbow flexion in combination with rotation of the forearm and wrist extension, with digits flexed forcefully and the thumb used extensively in flexion/extension and abduction was the most commonly observed synergistic movement pattern in this sample. In combination with the high levels of OA observed at the TMC joint, these data support the theory that the individuals in this sample were engaged in regular heavy and repetitive activities with their upper extremities, especially their thumbs.

### **The Monte Circeo Neandertal brain endocast.**

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Through the kindness of Dr. Roberto Bondioli, an endocast of the Monte Circeo cranium was received by the author. The endocast was undistorted, and required but minimal reconstruction to determine its endocranial volume, which was 1360 ml. In addition to having the "classic" Neandertal shape, the endocast shows

very strong cerebral asymmetry, with a prominent left occipital petalia in both length and width, and a right frontal petalia in the lateral aspect, thus representing the classic "torque" petalial pattern associated with right-handedness that is found in modern humans. The Broca's cap regions are unfortunately not present on either side, and the surface of the endocast is lacking sulcal details despite the excellent preservation of internal table of bone. There is considerable pre-lambdoidal flattening, and the occipital lobes are subsequently thrust quite posteriorly relative to the cerebellar lobes. Is it possible that this pattern might tell us more about postnatal growth and development with further study? Aside from the overall shape of the endocast, the features are indistinguishable from the brain endocasts of modern humans.

### **The Italian populations during the Copper Age (III millennium BC): Analysis of the genetic barriers.**

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The Italian Copper Age human populations (III millennium BC), have been sorted into 14 different groups (Buccino, Eboli, Laterza Puglia, Laterza Campania, Marche, North East, North West, Remedello, Rinaldone Gaudio, Rinaldone, Santa Caterina, Sicilia, Soleminis, Sardegna Sassari) and analyzed in order to assess the phenotypic affinities based on the dental morphological traits. The study has been carried out using the ASUDAS system to calculate the relative frequencies of 68 dental traits (39 maxillary and 29 mandibular), from which the Mean Measure of Divergence (MMD) and the genetic barriers (resting upon Delaunay's triangulation and Monmonier's algorithm) have been calculated. A major barrier separates the Laterza-culture groups from all the others, while a second one sorts the northern groups and Rinaldone. The Gaudio-culture groups, Marche and Rinaldone-Gaudio are instead distinguished by a third barrier, while the fourth and fifth ones sort out the remaining groups from Sardinia. This is consistent with the results of traditional multivariate analyses. The first two barriers instead isolate the northern groups from the southern ones, which may be indicative of population flows into these areas respectively from central Europe and the Eastern Mediterranean.

This study has been granted by the CNR's "Progetto Finalizzato Beni Culturali" and MURST COFIN01.

**Skeletal analyses of Umm El-Jimal, Jordan (300-400AD).**

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In 1996 and 1997 excavations of a cemetery and a monumental tomb were conducted at Umm El-Jimal, which is located in a semi-arid region of northern Jordan. Uncovered were a series of isolated burials (MNI=100+) containing from 1-4 individuals ranging in ages from neonates to the elderly. All of the interments were dated, using grave goods, and found to be from the second period of Umm El-Jimal's occupation, (4<sup>th</sup> and 5<sup>th</sup> century AD). While some burials were disturbed as a result of looting, most were found intact.

Data collected from the human remains excavated at Umm El-Jimal will be presented here. Demographic and pathological assessments will be used to determine the relative health of this community. In addition markers of occupational stress will be evaluated to discuss the labor intensive activities conducted by these people. This is one of the first reporting of this material and as such represents new information on the livelihoods and health of 4<sup>th</sup> and 5<sup>th</sup> century AD Jordanian populations.

**Fossil excavations of the Makapansgat Member 2 and adjacent breccias.**

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The Makapansgat Limeworks is well known for having produced extensive Plio-Pleistocene faunal and hominin fossil material. The vast majority of the Makapansgat fossil assemblage has been recovered from limestone dumps and thus lacks provenience information. The dearth of stratigraphic data has resulted in disparate paleoenvironmental, paleoecological, and lithological reconstructions, further confusing discussions regarding the context of early hominin evolution in South Africa. Excavations of *in situ* Member 2 deposits may help resolve the Pliocene

sequences of the valley and have the potential to reveal earlier hominin fossils.

The excavation focuses on an *in situ* surface exposure considered roughly contemporaneous with a dense fossil concentration representing a probable hyena den in the Entrance Quarry. These deposits are older than those from which all australopithecine material from Makapansgat has been attributed previously and spans a time period broadly contemporaneous with early East African hominin-bearing localities.

Recent excavations of the Member 2 *in situ* breccia was enabled by traditional methods utilizing large drills, wedges, and pry bars and novel methods adopted from the geological sciences utilizing explosive cap technology. With these techniques, 66 blocks of breccia were excavated, 179 bags of fossil material were accessioned, and over 200 fossils were recovered during 2003. In addition, the first fossil material from deposits not accounted for by the member system were retrieved from an adjacent exposure. While the Member 2 fossil materials are fragmentary and relatively sparse, they provide valuable provenanced information contributing to Plio-Pleistocene reconstructions of the valley.

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**Provenance of African origin individuals from the colonial cemetery of Campeche (Mexico) by means of LA-ICP-MS.**

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The colonial cemetery of Campeche, Mexico, was excavated by the local INAH center during 2000. About 120 individuals came to light from a large set of burial conditions. Among them, three individuals presented particular patterns of dental mutilation that did not pertain to the "local" prehispanic array. Their dental morphological pattern suggested a possible African ethnicity. Twelve additional individuals were subsequently identified as "African" on the ground of non-metric dental traits. The presence of the non-native dental decorative techniques triggered the question of provenance of the individuals bearing them, along with the cultural implications related to the importing and persistence of specific cultural mutilations. The present study aims at inferring the place of origin of the "African" individuals interred in the cemetery by analyzing the trace elements spectrum in their dental enamel and comparing it to

those of infant individuals buried in the same cemetery and supposedly native of the area. The analysis is performed by means of LA-ICP-MS. It laser spots the hidden enamel of the first permanent molar, based on the assumption that the elemental spectrum in this tooth is closely related to the environment the individual was born and grew up in. Comparisons were also made with the spectra from individuals from other areas in the Yucatan peninsula. Principal component analyses and cluster analyses mainly indicate a local provenance of the African individuals who do not bear any kind of mutilations, while the three individuals with "extraneous" dental modifications do not clearly fall within the range of variability of the native individuals.

**Postcranial sexual dimorphism at the A.L. 333 site.**

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The degree and pattern of postcranial sexual dimorphism in *Australopithecus afarensis* remains an unresolved issue. Interpretations of the fossil material have yielded widely varying estimates of dimorphism in this taxon, from relative monomorphism to levels exceeding those present in gorillas and orangutans. Because of links between sexual dimorphism and mating systems, interpretations of dimorphism patterns can impact reconstructions of social behavior.

We test the hypothesis that postcranial dimorphism in A.L.333 hominids is similar to that of modern humans. Since geographic and temporal factors can influence levels of variation present in a fossil taxon, restricting analyses to a single geographic and temporally constrained assemblage is appropriate. In the case of *A. afarensis*, the fossils from the A.L. 333 site meet these criteria. In order to fully exploit the varied fossil assemblage from this site, we combine the isolated postcranial elements into all possible (N=1536) "composite" individuals. We then compare variation in the fossil composites to similar "composites" constructed from extant African ape and human samples using Monte Carlo simulation. We measure differences in variation patterns and visualize them using nonparametric density estimation. The multivariate distribution of the human sample is unimodal, indicating a low degree of skeletal sexual dimorphism. In contrast, the apes have multimodal distributions, indicating higher levels of dimorphism. The distribution of



the A.L. 333 sample is also multimodal, suggesting an "ape-like" pattern of sexual dimorphism in *A. afarensis*.

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**Dental variation and dental health in a wild population of ring-tailed lemurs (*Lemur catta*) from Beza Mahafaly Special Reserve, Madagascar.**

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As part of a comprehensive study of the population of ring-tailed lemurs at Beza Mahafaly Special Reserve, Madagascar, we collected data (n = 71) on dental variation and dental health, including for the first time, information on individuals inhabiting a highly degraded habitat, those exploiting human habitation sites, and reserve groups. Here we present these data, compare them with those previously published for this population, and address the role of different habitats on the patterns revealed. The patterns of metric and morphologic variability in the current sample (e.g., m1 length CV = 4.15; variably present p4 metaconids) compare favorably with previous studies of this population (Sauther et al., 2001, 2002), as do the general patterns of dental health (e.g., 64% of damaged teeth occurring in the toothcomb). Examples of individual variation not seen in previous studies include one individual with a supernumerary upper premolar, and two individuals that lack the ledge-like M1-2 cingulum characteristic of ring-tailed lemurs. In terms of habitat differences, both cases of dental abscesses occur in the troop that spends extensive time in and around areas of human habitation surrounding the reserve headquarters. Also, while the frequency of broken (including cracked or chipped) teeth is similar between the group within degraded habitat and remaining individuals (36%, n = 11 vs. 33%, n = 60, respectively), the percentage of missing teeth does differ (36% vs. 23%, respectively). These data indicate that dental health is directly affected by habitat characteristics, which can be measured in living primate populations.

**Variation in the microscopic appearance of the frontal bone in a cadaveric population.**

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of Indianapolis, <sup>2</sup>Physiology Department, Indiana University.

This study examines the variation due to age, sex, hyperostosis frontalis interna, side, orientation, and sample source on the microscopic appearance of the external table of the frontal bone. Cores were extracted from European-American cadavers (N = 92). One section per bone core was examined microscopically and measurements were taken for the total area of the external table. Measurements included external table thickness, osteon density, osteon size, and Haversian canal size. Age significantly affected osteon size, osteon density, and external table thickness. Side affected osteon size while sex affected osteon density and external table thickness. The other independent variables had no significant effect on the sub-variables.

Age-prediction equations were then developed using least-squares linear regression. External table thickness and osteon population density produced a regression line with the lowest amount of prediction error for the entire sample. Sex-specific age equations were also developed. The equation developed for females performed better than the sex-pooled equation while the equation developed for males performed worse than the sex-pooled equation.

The degree to which the histological structure of the frontal bone is affected by age is much less than that of other skeletal elements. As a result, the ability to predict age from the external table of the frontal bone is not as good compared to other skeletal elements. However, in cases where the only bone available for analysis is a fragmented frontal bone, this histological method would be useful.

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**JC Virus genotype distribution in Papua New Guinea.**

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In an attempt to clarify the events leading to the peopling of Oceania, JCV genotype distribution data from Papua New Guinea (PNG) was generated and JCV sequence data was used to phylogenetically compare PNG to worldwide strains. Samples were collected from coastal and highland provinces representing 33 differ-

ent villages and both Austronesian and non-Austronesian speakers. 229 JCV positive samples were partially sequenced for genotyping and 11 samples were sequenced in their entirety for phylogenetic analysis. The results show JCV Type 8B to be prevalent on the coast in both Austronesian and Papuan speaking populations. In the highlands, Types 8A and 8B are nearly equally represented. Type 2E is in low frequency in both regions. The Southeast Asian genotype (Type 7A) was absent in these samples. The Type 8 group is phylogenetically the oldest in Asia. Type 8A, apparently restricted to New Guinea, likely entered with the earliest settlers, possibly along a south Asian route. While closely related phylogenetically, Type 8B appears to represent a second ancient migration into New Guinea after Type 8A, which then spread into Western Melanesia. Although it has not yet been resolved whether Type 2E or Type 7A represents the Austronesian expansion occurring approximately 3,500 years ago, the distribution data does imply that Polynesian populations reflect both an indigenous Melanesian and Asian contribution. Supported by the Wenner-Gren Foundation for Anthropological Research and the National Institutes of Health.

**QTL mapping in biological anthropology: Bone density.**

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Despite increasing knowledge of the genetics of bone mineral density (BMD) and osteoporosis risk, identifying the specific genes underlying normal variation in BMD has remained an elusive task. Compared to other health disorders, there are relatively few whole genome linkage scans investigating bone mineral density and osteoporosis risk in human populations. In order to identify genes influencing susceptibility to osteoporosis, we performed quantitative trait linkage analysis on total body BMD in a sample of healthy adults participating in the Fels Longitudinal Study. There were a total 684 participants ranging in age from 18-90 years with at least one total body BMD measurement. Additionally, a subset of study subjects was genotyped for 377 autosomal markers spaced approximately every 10 cM along the genome. Using a variance-components based maximum likelihood method (SOLAR) for pedigree data we calculated initial heritability estimates and identified quantitative trait loci (QTL)

influencing variation in total body BMD. Total body BMD was highly heritable ( $h^2=0.60 \pm 0.07$ ,  $p<0.01$ ) after adjusting for the effects of age, sex, age\*sex, age<sup>2</sup>, and age<sup>2</sup>\*sex. Preliminary results of the initial quantitative trait linkage screen revealed two regions of suggestive linkage (i.e., LOD scores  $>2.0$ ). These suggestive QTL were located on chromosomes 6 (marker D6S289) and 20 (D20S119).

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### Effects of load orientation and constraints on finite element analyses of a primate mandible.

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Finite element modeling offers unprecedented precision in describing the stress environment in skeletal structures. Currently, however, the potential of finite element models to inform studies of bone biomechanics is compromised by our ignorance of how well such models accurately portray states of stress and strain. Among the obstacles that hinder development of reliable models is uncertainty over boundary conditions that are chosen to represent the mechanical environment *in vivo*. This problem can only be ignored if it can be shown that alteration of these conditions has inconsequential effects on model output.

Using a finite element model of a *Macaca fascicularis* mandible (13,616 quadratic tetrahedral elements), we present the effects of changing boundary conditions (force orientation and nodal constraints) on model output based on a simplified loading regime under various conditions of isotropy/anisotropy and homogeneity/heterogeneity. Nodes are constrained bilaterally below the condyles and at gonion, with a reduction of nodal constraints at each location in subsequent iterations ( $n = 25, 12, 6, 3, 1$ ). Load orientation effects are evaluated by altering a point load on the left central incisor in 5° increments within a parasagittal plane. Constraint reductions from 25 to a single node at each location resulted in an over 50% increase in maximum principal strain. Our model suggests that a 5° error in occlusal force direction can be expected to alter maximum principal strains up to 15%. We thank the Southwest Regional Primate Research Center for providing the specimen used in this study.

### Estimation of living body mass from multiple skeletal elements.

S. Daneshvari, O.M. Pearson, Dept. of Anthropology, University of New Mexico.

Body mass can be important in forensic identification and it is an essential variable in biomechanical investigations of the bones of ancient peoples. Skeletal evidence of activity can give us insight into a person's life style, which can also be important in forensic work, and touches upon many questions in bioarchaeology.

This study investigates the potential of multiple skeletal measurements to provide better estimates of body mass. Measurements of long bone lengths, articular dimensions, bi-iliac breadth and lumbar dimensions were gathered from skeletons at the Maxwell Museum, University of New Mexico ( $n=50$  males, 20 females) and from the Hamman-Todd Collection ( $n=111$  males, 76 females). The study included only individuals of known height and weight who had died from non-wasting diseases or accidents. The measurements were chosen due to their importance in previous studies regarding body mass. Stepwise regression is used to determine the most effective equation to predict body mass.

Results from the Maxwell collection showed that different combinations of variables provided the best estimates of mass for males and females. However, there were high amount of error in predicted body mass, with  $R^2 = 0.37$  for males and a standard error of the estimate of 42.5 kg; for females,  $R^2 = 0.35$  and SEE = 35.0 kg. Results from the Hamman-Todd Collection are compared to these findings to determine if body mass can be estimated from skeletal remains with any certainty.

Supported by the University of New Mexico.

### The dynamics of vertical jumping in bonobos.

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Bonobos (*Pan paniscus*) display a wide range of arboreal and terrestrial locomotor modes, with vertical squat jumping as one extreme form. Jumping is often employed and ecologically relevant for bonobos. Yet, based on the wide variation of functional demands and corresponding "generalist" anatomy (with relatively light leg muscles

and poorly developed in-series tendons), good jumping performance is not expected.

We video-taped bonobos (250 fps) while squat jumping from a forceplate (sample frequency, 1000 Hz) in the Wild Animal Park of Planckendael, Belgium. Analysis included linear and angular kinematics in the sagittal plane, kinetics of the center of mass (COM) and an inverse dynamic analysis of selected sequences.

The maximal observed jumping height (vertical displacement of the COM while airborne) was surprisingly high at 0.71m, for an adult male, and jumping heights over 0.5m are typical. The subjects started from a deeply crouched position and accelerated their COM throughout the pushoff phase by a proximo-distal extension sequence of the leg joints. The legs never fully extended during push-off. The highest joint moments and powers, by far, are calculated for the hip, with the knee having a very low net contribution.

Overall, we conclude that a "generalist" anatomy can allow for surprisingly good performance in "specialized" locomotor modes, and that this should be kept in mind when inferring locomotor function from gross anatomy.

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### Incisor variation in Miocene protohominoids: A comparative study across 12 fossil genera.

C.A. Davis. Southern Illinois University.

A morphological study of incisor variation in Early and Middle Miocene protohominoids was carried out at the Kenya National Museum following up a previous study (Davis 2002) to determine which traits vary most. 246 incisors of 12 fossil genera were sampled from four different clades: Dendropithecidae, Proconsulidae, Afropithecinae, and Mabokopithecinae.

Preliminary results demonstrate that maxillary incisor morphology varies intraspecifically more than mandibular incisor morphology across all Miocene taxa. Traits varying most are margin shape, spiraling, and mesial flange. Margin shape can vary from symmetrical to highly asymmetrical. It is least variable in dendropithecids and most variable in mabokopithecines. As in extant hominoids, incisor spiraling is common in Miocene taxa, though less so in early protohominoids. Furthermore, the mesial flange characterizing the KNM-FT 49 (*K. wickeri*) UI-1 is not unique. Smaller flanges are present on KNM-MB 24768,

20728, and 32330 (*K. africanus*). Mesial flanges are also present on *Afropithecus* (KNM-WK 16999) and *Proconsul* (RU 2040, 1968). Therefore, this trait is also present within early clades as well as later ones (e.g., TH 28860, KNM-ZP 365, and KNM-WK 16999).

It is important for understanding phylogenetic relationships in the Miocene proto-hominoids to know which incisor traits are variable and which exhibit clear polarities. Avoiding splitting taxa by using traits that exhibit clear polarity instead of broadly variable traits will enhance our knowledge about relatedness between these once-diverse clades of dental apes.

#### **Faunal composition and bone accumulating agents in the Plio-Pleistocene cave infills of South Africa.**

D.J. de Ruiter. Dept. of Anthropology, Texas A&M University.

The probable impact of carnivorous agents on the accumulation of faunal materials in the fossil caves of South Africa has been a focal point for researchers ever since the pioneering work of Brain in the late 1960's. This study compares the assemblage structure of several Plio-Pleistocene fossil localities in South Africa to determine a) whether significant similarities or differences in faunal composition are evident between the localities, and b) whether patterns evident across faunal assemblages can be used to establish a predominant mode of accumulation for each of the individual deposits. Faunal assemblages from select members of the sites of Swartkrans, Kromdraai, Sterkfontein, Makapansgat, Coopers and Gladysvale are investigated, with corresponding data from a number of modern carnivore lairs incorporated for comparative purposes.

Variables examined include relative abundance of macromammals, bone surface modification and skeletal part representation. Relative abundance is quantified by calculating the comprehensive minimum number of individuals (cMNI) per fossil-bearing member. Spearman's rank order coefficient of correlation ( $r_s$ ) is computed to test whether relative abundance is significantly influenced by sample size. Correspondence analysis is employed to compare the various faunal assemblages. The results indicate that in only a small subset of the fossil assemblages can a predominant accumulating agent be hypothesized, while for the remainder the evidence is equivocal. It is likely that more than one type of bone

collecting carnivore impacted on the faunal assemblages at different times during the cave's infilling. Such "time-averaged" and/or "collector-averaged" assemblages appear to minimize the impact of episodic or idiosyncratic factors.

#### **Pulling teeth: The value of cementum annulation for the ageing of human remains.**

B. Dean. The School of Conservation Sciences, Bournemouth University.

The aim of this investigation was to assess the accuracy of cementum annulation counts as a means of determining age at death in adult skeletal remains. In 1982 the use of cementum annulation was proposed for the first time for use with humans. This method has been used historically amongst mammalian species but its value in terms of human age determination is still debated.

How accurate is cementum annulation as a method of age determination? As a component of wider research investigating the use of the dentition in age estimation, it was necessary to evaluate a number of proposed methods. It became clear, during this evaluation, that this method was less consistent than is often claimed. This paper intends to evidence the reliability of cementum annulation counts in the determination of younger adults (i.e. those under thirty) whilst illustrating the weakness of the method in terms of older adults (individuals of thirty and above). Employing previously published data, the reliability of cementum annulation will be assessed in terms of its correlation, inaccuracy and bias.

It will be shown that cementum annulation counts have a higher correlation with the younger age group ( $r = 0.766 - 0.887$ ) than with the older group ( $r = 0.01 - 0.747$ ). In addition it will show that the mean inaccuracy increases with age. This increase in inaccuracy is concomitant with an increased trend towards underestimation of age. It is concluded that cementum annulation is more reliable for use with younger adults.

#### **Quantifying curvature in fragmentary fossil hominoid phalanges using the anatomical curve fitting (ACF) method.**

A.S. Deane<sup>1</sup>, D.R. Begun<sup>1</sup>, E.P. Kremer<sup>2</sup>, <sup>1</sup>Department of Anthropology, University of Toronto, <sup>2</sup>Department of Chemical Engineering and Applied Chemistry, University of Toronto.

Phalangeal curvature has long been recognized as a suitable proxy indicator for hominoid positional behaviour. Several techniques have been developed to quantify phalangeal curvature (e.g. included angle, normalized curvature moment arm), although these require complete elements and are poorly suited to a fragmentary fossil record. A new method, anatomical curve fitting (ACF), uses 2<sup>nd</sup> order polynomials to reconstruct fragmentary phalanges and is independent of size and the assumption that all curvatures represent arc-lengths on the perimeter of a circle.

To test the accuracy of ACF, 3 complete and 3 fragmentary manual phalanges representing *Dryopithecus*, *Sivapithecus*, and *Lufengpithecus* were analysed for comparison with a representative sample (N=87) of extant cercopithecoids, hominoids and hominids. The results were identical to results from similar analyses of extant taxa using included angle and NCMA (Stern *et al.*, 1995) and identify the descending order of curvature as *Dryopithecus*, *H. syndactylus*, *Pongo*, *H. lar*, *Lufengpithecus*, *P. troglodytes*, *Sivapithecus*, *Nasalis*, *P. paniscus*, *Australopithecus*, *Papio*, *Macaca*, *Homo*. This is consistent with interpretations of positional behaviour based on additional post-crania and palaeoecological data that describe *Dryopithecus* as a highly arboreal below-branch suspensory ape and *Sivapithecus* as a predominantly terrestrial quadruped with powerful grasping capabilities consistent with vertical climbing and clambering (Begun, 1992; Andrews *et al.* 1997; Rose, 1986; Madar *et al.*, 2002). *Lufengpithecus*, although intermediate to both taxa, is still considerably curved and most likely suspensory in keeping with interpretations of modern ape-like scapular and clavicular specimens known for that taxon. Neither phalangeal preservation nor size were factors in determining the degree of curvature.

#### **State regulation across the generations: Children's autonomic arousal and their parents' daily schedules.**

J.A. DeCaro, C.M. Worthman. Department of Anthropology, Emory University.

Anthropologists have identified psychological, ecological, political-economic, and cultural factors important to the relationship between working arrangements and stress. Such research generally focuses upon individual adults, and rarely considers the impact of daily schedules on overall household ecology. Nonetheless, parental schedules structure everyday house-

hold experience, thereby shaping the ecology of child development.

To investigate whether children's cardiovascular response during a mild social challenge predicts the density of their parents' schedules, we asked parents in 33 families with 4 or 5 year-old children to track moods, contexts, and experiences throughout 7 days. We derived an index of weekday schedule complexity (frequency of venue changes, e.g., home to work) for parents, and computed mean and standard deviation of children's heart rate across 6 minutes of a structured, puppet-based psychobehavioral interview.

Increased HR standard deviation in children predicted greater schedule complexity for mothers (median split on SD, *t*-test; *n*=33, *t*=2.216, *p*<0.05), but lesser complexity for fathers (*n*=23, *t*=2.770, *p*<0.05). By contrast, increased mean HR in children predicted lesser schedule complexity for mothers (median split on HR, *t*-test; *t*=2.644, *p*<0.05), with a non-significant trend toward greater schedule complexity for fathers. Higher and less variable heart rates characterize the classic "reactive" response pattern; therefore, the more reactive children appear to have mothers who move around less, and fathers who move around more. This presentation evaluates explanations rooted in the contrasting impact of mothers' and fathers' types of "busyness" on household ecology, and on children's responses to experience. Support: Wenner-Gren, Sloan Foundation, NIH MH65019.

#### **Morphometric analysis of craniofacial traits used in ancestral identification.**

S.J. Decker, J.L. Thompson, B.T. Arriaza. Dept. of Anthropology & Ethnic Studies, University of Nevada, Las Vegas.

The determination of ancestry is a critical component in forensic identification, and/or repatriation, of human skeletal remains. Ancestry is commonly assessed using a suite of metric and non-metric traits whose grouping tendencies have been extensively researched. However, many non-metric traits cannot be measured with traditional osteological tools. For example, the zygomatic's angle, in relation to the entire craniofacial region, can vary from retreating to vertical to projecting. The distinction between populations is made by placing a pencil across the nasal aperture and attempting to insert a finger beneath it. While these traditional methods are useful, they do not take individual variation into account. This paper uses geometric morphometric coordinate data to 'metricize' non-metric

traits used in ancestral identification and to evaluate their accuracy of correctly assigning unknown individuals to statistically defined groups.

A 3-D digitizer was used to collect coordinate data from 38 craniofacial landmarks to capture the form of several ancestral morphologies. The sample consisted of individuals of known origin representing ancestral populations traditionally used in forensic analysis. Principle components analysis confirmed that ancestral shape groupings could be identified while Generalized Procrustes Analysis and Thin-Plate Splines were used to assess the nature of form variation within and between groups. Discriminant function analysis calculated the probability of accurately assigning new individuals to their correct ancestral group. The results indicate that ancestral morphologies, while variable, can be distinguished and used successfully to predict group membership. This work therefore augments traditional osteological methods and lends accuracy to ancestral identification.

#### **Quantitative trait linkage mapping studies in Samoa .**

R. Deka, D.E. Weeks, S.T. McGarvey, University of Cincinnati, University of Pittsburgh, Brown University.

The high levels of obesity and type 2 diabetes among modernizing Samoans has led to questions about the genetic influence on these phenotypes. This talk describes the rationale and early results of a genome-wide scan for obesity and type 2 diabetes susceptibility loci among Samoans. Human settlement in Samoa and establishment of communities occurred about 3,000 years ago and de-population after European contact in the 18<sup>th</sup> and 19<sup>th</sup> century. Although the current population size is over 100,000 individuals, the Samoan population appears to show signatures of genetic isolation and reduced genetic diversity which may be an advantage in searching for genes associated with complex diseases. The data collection in 2002-03 has focused on sampling large pedigrees and preliminary data suggest we have very large mutigeneration families for this study. For example, in 2002 in American Samoa we recruited 1,213 individuals from 200 households which yielded 21 families, including three very large families, one of which had 704 individuals. In 2003 in Samoa we ascertained members of these 'American Samoa' as well as recruiting new families, especially from very rural neo-traditional villages. We collected several obesity phenotypes, including fat mass and % body fat, body

mass index (BMI), fat distribution from circumferences and skinfolds using anthropometry, and fasting serum glucose, insulin and leptin data, as well as dietary, physical activity, health and socio-demographic data from adults and youth. The genome-wide scan will be conducted using a panel of highly polymorphic genetic markers with average spacing of 10 cM between markers.

#### **Fluctuating asymmetry and stress in a medieval Nubian population.**

V.B. DeLeon, Johns Hopkins University School of Medicine.

Fluctuating asymmetry is commonly used as a bioindicator of developmental stress. This study addresses asymmetry under nutritional/systemic stress in the human craniofacial skeleton and its utility as an indicator of developmental instability.

Crania from the diachronic Christian cemeteries at Kulubnarti (Sudanese Nubia) were chosen as a model for nutrition/systemic stress. Significant literature demonstrates that individuals from the Early Christian cemetery were subjected to greater developmental stress than individuals from the Late Christian cemetery. I expected the crania from the Early Christian cemetery to display a greater magnitude of fluctuating asymmetry than crania from the Late Christian cemetery. Thirty crania of comparable age and sex were selected from each population. Landmark coordinates were digitized in two separate trials and averaged to minimize error. Euclidean Distance Matrix Analysis (EDMA) was used to measure and compare the magnitude of fluctuating asymmetry in each sample.

Results indicated that crania from the Early Christian cemetery displayed a significantly greater magnitude of fluctuating asymmetry than those from the Late Christian cemetery, as predicted. The degree of fluctuating asymmetry for each linear distance was highly correlated between the cemeteries, suggesting that all humans may share common patterns of fluctuating asymmetry in the skull. In contrast, there was little correlation between magnitude of fluctuating asymmetry and length of linear distance or measurement error. These results support the hypothesis that poor nutrition/systemic stress increases developmental instability in the human skull and that increased fluctuating asymmetry constitutes morphological evidence of this stress.

***Paradolichopithecus*: A large-bodied terrestrial papionin (Cercopithecidae) from the Pliocene of western Eurasia.**

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*Paradolichopithecus arvernensis* is known by crania and postcrania from Senèze (France), Graunceanu (Romania), and Vatera (Lesvos, Greece), all of late Pliocene age. Partial crania from Kuruk (Tajikistan) have been named *P. sushkini*, while fragmentary (often juvenile) remains occur in earlier sites across southern Europe. It is generally thought that this genus is a sister taxon to *Macaca* which was strongly adapted to terrestriality (see abstract by Ting et al.). However, Mashchenko reviewed the Kuruk fossils and suggested that they were best placed within genus *Papio*, which would imply an out-of-Africa dispersal. Here we seek to determine the phylogenetic affinities of *Paradolichopithecus*, based on analyses of the entire craniodental sample.

Proportions of crania and dentitions were studied using traditional morphometric methods, while geometric morphometrics were applied to craniofacial morphology. Although *Paradolichopithecus* superficially resembles *Papio* in cranial proportions, its morphology is in fact more like that of *Macaca* when allometric factors are considered. For example, the small anterior dentition, rounded muzzle dorsum and perhaps the lack of a clear anteorbital drop in the midline profile all distinguish *Paradolichopithecus* from African *Papio*, and most link it to Eurasian *Macaca*, suggesting in-situ divergence. The dental size of the earlier Pliocene sample is intermediate between that of the late Pliocene populations and large macaques and may imply a size trend. The relatively large size of the Senèze female cranium (ca. 2 Ma) compared to males from Graunceanu (ca. 2.3 Ma) may also reflect this temporal size increase or indicate a low level of sexual dimorphism.

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**Quantitative trait linkage mapping in the Fels Longitudinal Study.**

E.W. Demerath, S.A. Czerwinski, R.M. Siervogel, B. Towne. Lifespan Health Research Center, Wright State University School of Medicine.

The Fels Longitudinal Study began in 1929. It was one of several longitudinal studies of child growth and development initiated in the US during the 1920s, and is the only one that survived to today. Familial data began to be collected soon after the study began. Today, the Fels Longitudinal Study has more than 1,000 active participants with serial data from infancy, and cross-sectional data have been collected from more than 1,000 of their relatives. These individuals are from some 200 nuclear and extended families. As the participants in the study have aged, the scientific focus of the study shifted from an exclusive interest in growth and development toward an emphasis on genetic and environmental influences on chronic disease risk factors. Complex traits being studied include blood pressure, serum lipids, inflammatory markers, osteoporosis risk factors, osteoarthritis, visceral adiposity, and skeletal development, among others. Recent advances in molecular and statistical genetics have led to several modern genetic epidemiologic projects utilizing Fels Longitudinal Study data. At present, over 800 participants have been genotyped for approximately 400 highly polymorphic markers distributed across the genome. Using quantitative trait linkage analysis, these data are being used to identify genes influencing a wide array of traits, including measures of infant growth, skeletal maturation, body composition, and bone mineral density. The Fels Longitudinal Study has entered the 21st century as a unique resource in the search for genes influencing changes in health-related traits across the lifespan. Supported by NIH grants R01HD12252, R01HD36342, R01DK064391.

**External forces on the limbs of jumping lemurs.**

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Many quadrupedal primates incorporate jumps into their locomotor repertoires, and this activity is likely to be associated with high ground reaction forces. We tested in two species of strepsirrhine primates how these forces compare to those associated with quadrupedal gaits. We also analyzed the distribution of forces on

fore- and hindlimbs in these species that are closer to the basal primate condition than anthropoids, for which hindlimb forces tend to be higher than forelimb forces. Three individuals each of *Lemur catta* and *Eulemur fulvus* performed long jumps to and from a force plate and walked and ran over the plate integrated into a wooden runway. Vertical take-off and landing forces and impulses were higher than the highest forces for fast quadrupedal gaits. Fore/aft forces differed less between leaping and quadrupedal locomotion as animals made use of a run-up to gain horizontal speed and also carried some horizontal speed into a run-out after landing. The major propulsive thrust in the jumps and in quadrupedal progression came from the hindlimbs, confirming previous findings of "rear-drive" for primate and nonprimate mammals. In general, the high magnitude vertical force peaks and impulses are higher for the hindlimbs than for the forelimbs for both jumps and overground quadrupedalism. Whereas *L. catta* landed with hindlimbs first, *E. fulvus* frequently made first contact with the forelimbs. In these cases, the forelimb forces and impulses were higher. Our data therefore only partially support the notion that the forelimb of primates is spared high forces. Supported by NSF BCS0109331

**Comparative immunohistochemistry of the primate vomeronasal organ.**

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The sensory epithelium of the mammalian vomeronasal organ (VNO) detects compounds that identify the social and reproductive status of conspecifics. A VNO is present in adult prosimians and New World primates but is either absent or vestigial in adult Old World anthropoid primates. We used immunohistochemistry to detect the expression and distribution of four neuronal markers and two signal transduction proteins in paraffin embedded VNO sections from *Eulemur macaco*, *Otolemur garnetti*, *O. crassicaudatus*, *Leontopithecus rosalia*, *Saguinus geoffroyi*, *S. oedipus*, and *Callithrix jacchus*. Immunoreactivity patterns showed that bushbaby and lemur VNO has a denser population of neurons compared to marmosets and tamarins, with the possible exception *Callithrix jacchus*. Among

callitrichids, *Saguinus* spp. had fewer immunoreactive VNO epithelium cells than either *L. rosalia* or *C. jacchus*. The distribution of growth associated protein 43 (GAP43) and the alpha subunits of the signal transduction proteins Gi and Go were compared in adult *C. jacchus* and *O. crassicaudatus*. GAP43(+) cells, indicating that neurogenesis continues in adults, were present in both species. *O. crassicaudatus* contained more Go(+) than Gi(+) cells per section. The marmoset VNO contained more Go(+) cells compared with the bushbaby VNO. Our results indicate that: 1) the VNOs of at least some prosimians and callitrichid primates contain a neurogenic population of chemosensory neurons; and 2) the population size of mature neurons varies among adult primates.

#### **Possible intergeneric differences in finding objects among lemurs.**

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Assessing cognitive abilities of prosimian primates can assist the understanding of the evolution of complex problem solving skills. This study investigates cognitive abilities of four species from three genera of captive diurnal lemurs by administering standardized object permanence tests. These tests are used to measure the ability of an animal to find a hidden object. Seven tests with increasing difficulty required the subjects to retrieve a food reward that was hidden in one of three hiding locations. The results reveal differences among the lemur genera tested. *Eulemur fulvus rufus* and *E. mongoz* located fruit hidden within the view of the lemur in successive places (Stage 5b ability), and *Lemur catta* achieved finding food in single sites (Stage 5a). *Hapalemur griseus* overall did not locate hidden foods, and therefore did not even reach Stage 4. Differences in the number of correct responses, response levels and general approach towards the tests suggest a more consistent response to the manipulations by the *Eulemur* subjects compared to the other two genera. *Eulemur* response was very similar to the response of most monkeys tested in other studies.

The Lemur Conservation Foundation is greatly acknowledged for its assistance.

#### **The earliest stages of human colonization of the Central Asian arid zone: New discoveries in Mongolia and Kazakhstan.**

A.P. Derevianko, A.N. Zenin. Institute of Archaeology and Ethnography, Siberian Branch, Russian Academy of Sciences.

Central Asia is dominated by an arid zone in which erosional processes typically exceed those of sediment accumulation and most Paleolithic localities consist of surface finds. Since 1995, extensive research on the Paleolithic of arid zones has been carried out by the Russian-Mongolian Historical-Cultural Expedition, the Joint Russian-Mongolian-American Expedition, and the Russian-Kazakh Archaeological Expedition. As a result, a large collection of new data has accumulated concerning hominid adaptations to this type of environment, especially during the earliest stages of colonization.

We summarize current perspectives on the geology, paleoenvironment, and lithic technology of Lower Paleolithic archaeological sites in the arid zone and establish a preliminary chronological scale for the occupation of Central Asia. Data from recent investigations in Mongolia (e.g., Flint Valley, Tsagaan Agui Cave sites) and in the Cis-Balkhash (Semizbugu site), Mugodjari, and Karatau (e.g., Koshkurgan, Shoktas, Kyzyltau, Shakhbagta, Tanirkazgan sites) regions of Kazakhstan are utilized. Sites have been classified as workshops, temporary occupation sites, and long-term camps. It is possible to temporally locate sites with shared industrial traditions using absolute and paleomagnetic ages, geomorphological settings, and degrees of surface abrasion on exposed artifacts. During the Early and Middle Pleistocene (1 million – 200,000 years ago), distinct pebble tool, microindustrial, notch-denticulate, and bifacial Levallois lithic complexes appeared in this area, reflecting influences from both the East and the West. We discuss the origins and spread of these complexes with reference to better-known localities in Eastern Europe, the Near East and East Asia (e.g., Ubeidiya, Dmanisi, Nihewan sites).

#### **The analysis of variation of mtDNA hypervariable region-1 suggests that Eastern and Western Pygmies diverged before the Bantu expansion.**

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The Eastern Pygmies from Zaire and Western Pygmies from Cameroon, Congo and the Central African Republic represent the two principal groups of African Pygmies. Cavalli-Sforza (1986) proposed a "Recent Divergence" hypothesis in which Western Pygmies are thought to be the result of hybridization between the ancestors of Eastern Pygmies and Bantu farmers who penetrated the equatorial belt and came into contact with Pygmies around 2-3 kiloyears ago. On the basis of recent archeological research in the tropical rainforest, we propose a "pre-Bantu Divergence" hypothesis which posits the separation between the ancestors of Eastern and Western Pygmies earlier than 18 kiloyears ago.

In order to test the two hypotheses, we analyzed the variation of the hypervariable region-1 of the mitochondrial DNA in the Mbenzele Pygmies of the Central African Republic and in the Bakola and Baka Pygmies of Cameroon and compared our results with those of previous mtDNA and Y-chromosome studies. Distribution, sequence variation and age of haplogroups along with genetic distances among populations, estimates of divergence times and simulations based on the coalescent approach were found to be congruent with the "pre-Bantu Divergence" but failed to support the "Recent Divergence" hypothesis.

#### **Variation in estradiol level affects diaphyseal bone growth in response to mechanical loading.**

M.J. Devlin, Department of Anthropology, Harvard University.

The extent to which mechanical loading stimulates diaphyseal growth in humans is a subject of debate, in part because the mechanisms of mechanotransduction in growing bone remain poorly understood. This project tests a mechanism of mechanotransduction in bone that is directly relevant to the biology of human skeletal robusticity. Recent *in vitro* studies demonstrate the importance of estrogen (E<sub>2</sub>) in mechanotransduction in bone, raising the possibility that variation in E<sub>2</sub> levels may affect osteogenic responses to loading.

The hypothesis is that variation in estrogen (E<sub>2</sub>) level affects periosteal osteoblast response to strain. The 45-day experiment used sixteen lambs (*Ovis aries*), divided into low and high E<sub>2</sub> treatment groups. Low-E<sub>2</sub> animals were vaccinated against GnRH; high-E<sub>2</sub> animals were implanted with E<sub>2</sub>-releasing capsules. Half of each group was sedentary, and half exercised daily for 40 min. Fluorochrome dyes labeled bone growth.

Results indicate that in the femur, mean daily apposition rate (DAR) in exercised animals is 44% higher in high-E<sub>2</sub> than in low-E<sub>2</sub> animals ( $p < .05$ ), and 26% higher than in sedentary, high-E<sub>2</sub> animals ( $p < .05$ ). In the tibia, mean DAR in exercised animals is 42% higher in high-E<sub>2</sub> than in low-E<sub>2</sub> animals ( $p < .09$ ), and 66% higher than in sedentary, high-E<sub>2</sub> animals ( $p < .05$ ). In the metatarsal, mean DAR in exercised animals is 75% higher in high-E<sub>2</sub> than in low-E<sub>2</sub> animals ( $p < .03$ ), and 75% higher than in the sedentary, high-E<sub>2</sub> animals ( $p < .03$ ). These results support the hypothesis that variation in E<sub>2</sub> level affects diaphyseal bone growth, and may affect patterns of skeletal robusticity in humans.

**RNase 9, a unique new member of the primate RNase A superfamily: Evidence of diversifying selection and its role in host-defense innate immunity.**

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The RNase A superfamily is a cluster of rapidly evolving genes on human chromosome 14q11.2 with diverse functions. Several of these loci; RNase 2, RNase 3, RNase 5, and RNase 7 have been shown to be involved in host defense innate immunity. Each of these genes shares a pattern of diversifying selection presumably driven by response to viral, microbial, and parasitic challenges. We have identified a new member of this superfamily that we have named RNase 9.

RNase 9 shares a number of features in common with the other superfamily members. All of the RNases A contain an amino-terminal signal peptide consistent with a secreted protein. All members of the superfamily contain a set of eight conserved cysteines that serve to maintain a fixed tertiary structure through four disulfide bridges. All members for which sufficient data have been obtained are seen to be under diversifying selection in the primates. Diversifying selection in these proteins consists of a pattern of radical non-synonymous substitution in surface domains coupled with conserved interior regions. RNase 9 is also unique in several respects. First, it is the only member of the RNases A that has an amino-terminal pre-protein domain. This domain lies between the signal peptide and the first amino acid of the mature protein. Second, it is the only member of the superfamily that has lost its RNase function through substitutions that have elimi-

nated the catalytic amino acids. Third, as we have identified an RNase 9 homolog in several rodent species, it appears to be older than most of the primate or rodent RNases A as these have been shown to have evolved since the primate-rodent divergence.

In addition to presenting the evolutionary history of this gene, we will argue that it, along with other members of the superfamily, has played a role in primate evolution through adaptive host defense innate immunity.

**A preliminary study of social behavior and pair-bonding in wild titi monkeys (*Callicebus discolor*) in Amazonian Ecuador.**

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Titi monkeys are one of three genera of platyrrhine primates that typically live in 'monogamous' social groups. The adult male and female in a group are considered to be 'pair-bonded', displaying behaviors such as tail-twining and vocal duetting that are presumed to reinforce the special relationship between them and to advertise their paired status to other animals in the population. As part of a collaborative project on the comparative socioecology of 'monogamous' platyrrhines, we collected data on the social behavior of adults in radiocollared groups of titi monkeys in Amazonian Ecuador. Specifically, we examined grooming relationships; patterns of initiation, maintenance, and termination of proximity between group members; parent-offspring interactions; coordination of group movement; and territorial behavior. Titis in our study population invariably lived in groups comprising a single adult pair plus dependent offspring. Preliminary data indicate that grooming is the most common type of social interaction, with bouts between pair-mates often lasting >1 hour. Pair-mates also spend more time involved in grooming each other than either does with dependent offspring, and the adult male is the most common recipient of grooming. While an entire group is generally spatially cohesive, the adult male appears to spend more time in close proximity to dependent offspring than the female. Adult males also appear to more commonly share food with dependents. Inter-group interactions and territorial displays are far less common in this population of titis than has been reported elsewhere.

Together, these patterns of behavior have implications for the evolution of 'monogamous' social systems.

**QTL mapping in biological anthropology: Genotype  $\times$  age interaction in the growth hormone axis.**

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Growth hormone (GH) and insulin growth factor I (IGF-I) are the major players in an endocrine network that regulates development, growth and metabolism. For practical reasons, we will focus on IGF-I and its effectors. A suite of binding proteins controls circulating levels of IGF-I and chief among these are the IGF binding proteins (IGFBP) IGFBP1 and IGFBP3. Recent findings indicate that leptin is a positive regulator of GH secretion by way of its effects on hypothalamic secretion of GH release hormone (GHRH) and somatostatin (SS), which are the two main effectors of GH release. This implies that leptin may also affect IGF-I, as it is known that GH release down-regulates IGF-I secretion. Under a simplified genetic model, the GH axis is controlled by a gene regulatory network (GRN), where the genes of the GRN may exhibit pleiotropy and age-specific variation with respect to IGF-I, IGFBP1, IGFBP3 and leptin. Minimally, this model consists of two hypotheses: 1) the GH axis is pleiotropic. 2) The components of the GH axis exhibit age-specific effects. To address these hypotheses, we employ variance components models for detecting genotype  $\times$  age interaction and pleiotropy. Our study samples include a large pedigree of captive baboons (*Papio hamadryas* subspp.) and Mexican Americans of the San Antonio Family Heart Study. Using multiple phenotypes from the GH axis, our results show how QTL mapping of such endocrine traits can be efficiently performed. This approach can provide important new biological insights when genotype  $\times$  age interaction is explicitly incorporated.

**Dermatoglyphic ridge counts compared to short tandem repeats as measures of population distance.**

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Ridge count data from fifteen different populations worldwide, with a total of 2814 individuals, were used to generate Fst, a measure of population divergence. These ridge count Fst values were compared statistically to Eller's (1999) Rst values for short tandem repeats for similar populations to determine which method yields a higher estimation of population distance. Statistical analyses tested both within regions (e.g. Africa, Europe, Asia) and then Eurasia and the World as a whole. Principal coordinates were additionally generated to view the data graphically. The test for significance revealed that ridge counts were significantly less differentiated than short tandem repeats for the world, but not by regions. The pattern of relationships is similar for Eller's (1999) Rst values and for the Fst values generated by this study, indicating that dermatoglyphic traits accurately reflect genetic relationships among populations.

**A comparison of female dominance in blue-eyed black lemurs (*Eulemur macaco flavifrons*) and gray gentle lemurs (*Hapalemur griseus griseus*).**

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As we learn more about the nature of female dominance in Malagasy lemurs, it becomes clear that there is a great deal of variation in the expression and maintenance of dominance across species. We can use this variation to better understand the influences of ecology and social organization on dominance relationships. Here, we compare the nature and extent of female dominance in two lemur species: the frugivorous blue-eyed black lemurs (*Eulemur macaco flavifrons*; n= 6 groups) and the bamboo specialist the gray gentle (or bamboo) lemur (*Hapalemur griseus griseus*, n = 5 groups). All dominant-submissive interactions were recorded over 450 hours of observation. Both species showed a clear pattern of female dominance. However, the blue-eyed black lemurs used aggressive dominance (defined as aggression + submission) in a larger portion of their interactions (66%) than did the gentle lemurs (40%). Gentle lemurs appear to rely primarily on social dominance (submission in the absence of aggression) in the majority of their interactions. In both species, rates of aggressive dominance interactions were higher during feeding periods (blue-eyed black lemurs: 9.8 vs. 0.61 acts/hr; gray bamboo lemurs: 0.72 vs. 0.34 acts/hr). Small cage size and recent changes in group composi-

tion also increased rates of dominance interactions. Nevertheless, the females were clearly dominant in all contexts. Overall blue-eyed black lemurs exhibit a stronger and more aggressive form of female dominance compared to the gray gentle lemur.

**Thinking small: A comparative study of dental microstructure in *Cantius*, *Otolemur*, *Perodicticus*, and *Saimiri*.**

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Studies of dental microstructure have contributed to insights into developmental processes in extant primates, as well as fossil hominins, Miocene hominoids, and subfossil lemurs. Until recently, the primate fossil record of North America has been neglected in these analyses. In this study, we examine molar microstructure in *Cantius abditus*, a Notharctine from the early Eocene of North America, and compare it to two small extant strepsirhines, *Otolemur crassicaudatus* and *Perodicticus potto*, as well as a small anthropoid, *Saimiri sciureus*. We ask how a small molar is formed, whether strepsirhines differ from a small anthropoid in details of molar development and microstructure, and whether *Cantius* molar microstructure shows similarities with these extant taxa, or whether its microstructure differs.

Standard histological sections of *C. abditus* mandibular molars (n=7) from the Great Divide Basin of Wyoming were compared to molars of *S. sciureus* (n=9), *O. crassicaudatus* (n=2) and *P. potto* (n=2). There do not appear to be significant differences between the extant strepsirhines, *Saimiri*, and *Cantius* in the timing of molar development. The periodicity of long period growth increments is 2 or 3 in each specimen in each taxon. Daily enamel secretion averages 3.1µm daily in *Cantius* molars and 3.5µm in *Otolemur*. Daily enamel secretion rates appear to be slightly lower in *Perodicticus* and higher in *Saimiri*. Crown formation times are similar in *Otolemur* and *Cantius*, with a mean of 0.38yrs and 0.46yrs respectively.

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**Tooth modification in late Iron Age in Cambodia.**

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Recent excavations (2000-2003) in Cambodia have revealed one of the first collections of prehistoric skeletal remains available for research. Phum Snay, Northwest Cambodia, has revealed 21 excavated individuals plus a large amount of unprovenanced bone. The evidence for dental modification, a common feature among this sample, is reported here and discussed in relation to that from prehistoric Thailand. The methodology used incorporated recording not only antemortem tooth loss but also features that may differentiate between pathological, congenital and intentional tooth loss such as the symmetry of tooth loss. There was evidence for dental ablation in 50% of the sample of 32 adult individuals including males and females of all adult age groups. Tooth loss was limited to the involvement of the anterior dentition: upper lateral incisors, upper canines and all lower incisors and the left lower canine. Ablation was more common in the maxilla (15/23, 65%) than in the mandible (5/17, 29%) although this difference was not highly significant (FET P-value = 0.054). In the maxilla, 80% (12/15) of those with tooth loss showed symmetrical patterns of loss. This was the same for the mandible (4/5). In those individuals that had both the maxilla and mandible present, 83% (5/6) showed symmetrical patterns of loss. The skeletal sample from the Neolithic Southeast Thai site of Khok Phanom Di also had high rates of ablation (Tayles, 1996, *Int. J. Osteoarchaeology* 6:333-345) showing similar patterns as at Phum Snay, hinting that this practice had a long history. Evidence from this and other samples reported from Thailand will be discussed in order to place the Cambodian evidence in the context of the Southeast Asian cultural record.

**Sensory perception of food: A study of fruits, fingers, and fermentation.**

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Sensation and perception are central subjects in primate evolution. However, few studies have considered how edible targets are discerned. Because food nutritional parameters vary with respect to odor, color, texture, and taste, the perception of such cues is relevant to primate survival and reproductive success. In



fruits, for example, color and sugar concentrations may change during development. Sugars, in turn, are decomposed by yeast to produce ethanol, a volatile compound to which primate olfaction is acutely sensitive. Accordingly, for highly frugivorous primates, odor and color may be important cues because they operate at greater distances than other sensory modalities.

Here we report on the sensory properties of 238 fruits (N = 193 species) from Singapore, Kibale Forest, Uganda, and Pasoh Forest, Malaysia. Results show that fruits evince a variety of spectral changes during development. Collectively, color was a poor predictor of sucrose, fructose, glucose or sweet amino acids. However, the elastic modulus of fruits was a strong predictor of both sugar content and ethanol, which ranged from 0.005 – 0.50 % of fruit flesh. Furthermore, some fruits provoked palpation by chimpanzees. The deliberation of this behavior implies a cognitive link between texture and food quality. Accordingly, the olfactory and haptic senses appear to be well tuned for discriminating edible fruits. The importance of trichromatic color vision is less clear.

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### **Sternebrae morphology in extant primates and *Proconsul*.**

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In this study we compare sternebrae of the Miocene hominoid *Proconsul* with those of living primates. The sternum has dual functions. It receives forces transmitted through the pectoral girdle and forelimb during posture and locomotion. It is also an important structure within the pulmonary respiratory complex. Previous studies on extant taxa have demonstrated that the primate sternum is long, narrow, and composed of unfused elements in many quadrupedal Old World monkeys and prosimians, and short, broad, and fused in erect or semi-erect apes. In an expanded database consisting of extant platyrrhines and catarrhines, we quantify a variety of dimensions, including length, width, and thickness of the manubrium and individual sternebrae. We use this database to reconstruct the functional significance of *Proconsul* sternebrae from the Kaswanga Primate

Site, Rusinga Island, Kenya. The extant primates exhibit different sternal morphologies, including narrow, rod-like sternebrae, characteristic of many Old World monkeys, and broad, flat sternebrae, characteristic of apes and some New World monkeys. Our morphometric analyses indicate that *Proconsul* has relatively broad, flat sternebrae and most closely resembles hylobatids and some New World monkeys. These anatomical relationships suggest that *Proconsul* may have engaged in some antipronograde locomotor and postural activity. This fossil hominoid has previously been reconstructed, based upon various other skeletal regions, as a generalized arboreal quadruped with some climbing capacity. Non-pronograde activities suggested by our analyses broaden the reconstructed positional behavior repertoire of *Proconsul*.

### **Demography and kinship responses to livestock reduction amongst historic Navajo pastoralists.**

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The Navajo remained largely unacculturated by other reservation standards well into the 20<sup>th</sup> century. It wasn't until the Bureau of Indian Affairs (BIA) enforced a mandatory *Livestock Reduction Program* in the 1930's that the Navajo truly experienced "a social upheaval of unbelievable proportions" (Witherspoon 1973:1444). Little population and social structure data has been generated from studies of this event, and the exact nature and magnitude of the program's impact on the Navajo remains speculative. Through the use of regional BIA censuses and parochial records spanning the livestock reduction period, combined with ethnographic interviews, a more detailed understanding of how this event altered Navajo demography, kinship, and social structure is achieved. The singulate mean age at marriage (SMAM) is observed to increase dramatically for both sexes and there is a significant decline in the 0 to 5 year age category. Distal determinates and proximal causes will be discussed. In addition, a shift occurred from more complex predominantly matrilineal households to more independent families, coupled with a rise in virilocal residence in this matrilineal society. These were not *de novo* shifts in Navajo culture, nor were all of them long lasting as comparisons to more modern data show a return to pre-stock reduction levels for some variables. These results illustrate the flexible nature and buffering capacity of pastoralist socie-

ties to severe resource stresses. Research supported by a Social Sciences and Humanities Research Council of Canada (SSHRC) Post Doctoral Fellowship, and The Navajo Nation Historic Preservation Dept. permit # C0002-E.

### **QTL mapping in biological anthropology: Obesity.**

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Genetic dissection of quantitative traits such as body mass index (BMI) is a part of biological anthropological investigations, and such traits are influenced by genetic and environmental factors and their interactions. Given that the global incidence of obesity has been increasing alarmingly in both developed and developing countries, there have been intensive efforts to map quantitative trait loci (QTLs) for obesity.

Numerous studies have been scanning the genome to map QTLs that underlie the phenotypic expression of various obesity measures such as BMI using advanced molecular and statistical genetic approaches. The hitherto findings of such investigations appear to signify oligogenic architecture for human obesity. Thus far, about ten QTLs across the genome have been identified with sizable influences on obesity using data from various human populations, although specific functional variants that correspond to these QTLs are yet to be identified.

As part of the obesity QTL mapping, we have used obesity-related phenotypic data obtained from the San Antonio Family Diabetes Study to identify QTLs for various obesity measures (e.g., BMI and adiponectin) in Mexican Americans using complex pedigree data and a genome scan linkage approach. We have found several chromosomal regions that harbor QTLs for obesity, and a few of these regions have been pursued further by evaluating polymorphisms at the positional candidate genes. Here, we will review the ongoing activities of obesity QTL mapping, and will present the findings from our ongoing efforts of characterizing genes for obesity as well as birth weight in the Mexican American population.

**Biological distance analysis of Postclassic skull rows and pairs, El Petén, Guatemala.**

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Ethnohistoric sources suggest that at least two ethnic groups lived around the Petén lakes in northern Guatemala during the 17<sup>th</sup> century, the Kowoj and Itzá. Recent excavations at the site of Ixlu produced three pairs of skulls, and 13 skulls in two rows placed in and around a small Postclassic (AD 950-1524) Itzá temple. The skull rows were placed under the temple, as a dedicatory cache, while the skull pairs were placed around the temple at some point after construction. Previous analysis of the skull burials focused on mortuary data and suggested that the interments may reflect an attempt to ensoul or animate the temple itself. It remains unclear who is buried in these deposits. This paper presents the results of a biodistance analysis between individuals in the skull rows and pairs to identify patterns of relationships between the deceased. Variables from the Arizona State University system were used, including supernumerary teeth, interruption groove, enamel extensions, and molar cusp size. Five of the six paired skulls, and 12 of the skulls in rows were considered in a principle components analysis. The dental data suggest that all of the individuals came from one population. Further, the presence of bilateral mandibular supernumerary teeth in three of the 17 individuals (one individual from the skull pairs and two individuals from the skull rows) suggests that the individuals were closely related to one another.

**Throwing ability in fossil hominids.**

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Throwing has been linked to the evolution of bipedalism, limb proportions, cephalization and lateralization, language, intelligence, and the tendency for humans to coexist in large groups of unrelated people. However, little is known about its origins and evolution. Here we assume that throwing evolved sometime between the emergence of bipedalism and the arrival of Neanderthals and anatomically modern humans. We entered published estimates of hominid stature and upper limb proportions into our simple computer model of throwing. The poten-

tial throwing abilities of "Lucy" (*Australopithecus afarensis*), the Bouri remains (possibly *A. garhi*), *Homo erectus*, *Homo neanderthalensis*, and modern humans were simulated and compared at different target distances. We searched for release windows that maximized both accuracy and velocity of a throw. Results show that early hominids could not throw far, but could throw accurately and fast with the help of a relatively large release window. On the other hand, modern humans can throw much further, faster and more accurately, but have a narrow window of release. Thus, throwing seems to have evolved from a relatively simple to a relatively complex task in hominids. We used these results to assess four interrelated hypotheses for the selection of throwing ability: 1) hunting, 2) self-defense, 3) scavenging, and 4) punishing. Each of these activities requires certain levels of distance and accuracy that are largely determined by stature and limb proportions. Based on these parameters, we can limit the different models of throwing origins to particular phases of the hominid fossil record.

**Age related changes in arachnoid foveae: Test of a new quantitative method.**

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Age related changes of arachnoid foveae have been described by several researchers, but objective, quantitative analyses have been lacking. A new quantitative method is presented, for estimation of change in total volume of arachnoid foveae with age.

The pilot sample consisted of 9 skulls from the Palmer Anatomy lab. Arachnoid foveae were filled with sand until level with the intracranial surface. The sand was then extracted using a vacuum pump, weighed with an analytical balance, and converted to volume. Volume was totaled for each skull. A reliability analysis was performed using intraclass correlation coefficients. The method was found to be highly reliable (Intraobserver ICC=0.9935, Interobserver ICC=0.9878). The relationship between total volume and age was then examined in a sample of 63 males of accurately known age from the Hamann-Todd collection. The relationship between fovea frequency and age was also examined. Linear regression analysis revealed no statistically significant relationship between total volume and age, or fovea frequency and age ( $\alpha=.05$ ).

One possible explanation for these results is that development of arachnoid foveae is in part influenced by health related factors. Any condition which alters CSF pressure, including vitamin A deficiency, may potentially affect the size of arachnoid granulations, and their associated foveae. In addition, several recent studies have suggested a role for arachnoid granulations in immune response. Use of specimens from the Hamann-Todd collection, representing individuals of low socioeconomic status, and dating to the pre-antibiotic era, may have accentuated health related variability, when compared to modern samples.

**A test of the multiregional hypothesis of modern human origins using the basicranial evidence from Southeast Asia and Australia.**

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Proponents of the Multiregional Hypothesis of modern human origins have consistently stated that the material from Australasia provides one of the most compelling examples of regional continuity in the human fossil record. According to these workers, features found in the earliest *Homo erectus* fossils from Java can be traced through more advanced hominids from Ngandong and are found in both fossil and recent Australian Aborigines.

For this study, non-metric observations will be used to determine the degree of similarity between earlier *Homo erectus* from Sangiran, the Ngandong fossils (including Ngawi and the Sambungmacan hominids), and fossil/modern Australian Aborigines in the cranial base. This analysis will examine the null hypothesis that a number of non-metric features will show an overall similarity between these samples, and will be rejected if it can be shown that significant dissimilarity exists between these groups.

The results of this project highlight a suite of features on the cranial base in the Ngandong sample that appear to be unique not only within the region, but in the human fossil sample as a whole. These morphologies include a dual foramen ovale, the location of the squamotympanic fissure, and the marked expression of the postcondyloid tuberosities. The presence of these characters in the Ngandong population, and their apparent absence outside of this group, provides strong evidence of discontinuity between *Homo erectus* and *Homo sapiens* in the Australasian fossil record.

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versity Anthropology Foundation, The University of Tennessee, and The American Museum of Natural History.

**The rhesus macaque (*Macaca mulatta*) corticotropin-releasing hormone gene: Sequence analysis and variation.**

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Primates exhibit stable, heritable differences in temperament and stress reactivity. Selection on stress physiology may be a proximate mechanism in the evolution of social behavior and life history. In rhesus macaques (*Macaca mulatta*), correlations have been demonstrated among temperament, baseline cortisol levels, and cerebrospinal fluid concentrations of corticotropin-releasing hormone (CRH), a fundamental mediator of the behavioral and endocrine stress response. We wanted to determine whether there was sequence variation in the rhesus CRH gene, a good candidate for studying the genetic bases of temperament.

Ten animals that were outliers on the basis of hypothalamic-pituitary-adrenal (stress axis) activity were selected for sequence analysis and for preliminary screening for nucleotide variants. Sequence was determined using PCR and direct sequencing from genomic DNA. Genotyping was done using a primer mismatch assay.

We sequenced the preproCRH gene and 3 kb of 5'-flanking region. We found single nucleotide polymorphisms in the coding region, intron, 3'-untranslated region, and 5'-flanking region. The rhesus preproCRH gene shows 97% sequence identity to its human homologue. The predicted 41-amino acid CRH peptide is identical to that in the human, implying strong selection acting on this gene product. A nucleotide substitution located in a putative glucocorticoid-responsive element half-site within the promoter region had a frequency of 14% in a subset of our population (n=268).

Functional assays will determine whether the identified gene variants alter CRH expression. Allele-based association studies in the NIH rhesus colony may help identify genetic contributions to individual differences in primate behavioral and neuroendocrine responses to stress.

**Size and power required for locomotion in early hominids: Paleobiology meets OH62 (again).**

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In an exercise designed to carry data on the fossil record of early hominids from static dimensions into more dynamic paleobiomechanical explorations of relationships among size, power required for motion (PRM), and cycle-time (temporal difference between neighboring peaks in each foot's trajectory), Wang and Crompton (2003) used such basic morphological parameters as  $d$  (any characteristic dimension such as chest width),  $L$  (any characteristic length such as stature) and mass derived from the paleoanthropological literature (for 11 fossil hominids selected from Tables 14.9 and 14.11 in Aiello and Dean, 1990). In many graphs of derived values such as the coefficient of robusticity ( $R_p = \text{radius/Length}$ ) and  $P_d$  (dimensionless power) vs. stature or  $P_d$  vs. mass, the single specimen OH62 (Johanson et al., 1987) was a notable outlier. For example, in the plot of  $R_p$  against time (MA), fully 50% of the error comes from this one specimen.

The problem described here arises chiefly because many paleoanthropologists (Richmond et al., 2002) continue to represent the limb bone dimensions of OH62 by single values (humerus length = 264 mm, femur length = 280 mm) despite the fact that these bones are so badly damaged that their lengths are not directly measurable, and the error term associated with the humerofemoral index is so substantial that it is possible only to situate it between the distributions for *Homo* and *Gorilla*. Our new analyses show that after allowing for empirical uncertainty, OH62 exhibited morphological and biomechanical properties consistent with its temporal placement in the fossil record.

**Growing old on Black Mesa: A new look at aging in the past.**

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When looking at aspects of aging in the past, it is sometimes difficult to answer questions concerning the type of care given to and received by the elderly. Human skeletal remains can give us some clue as to the biological processes of aging, but may also reveal more vividly the so-

cial aspect regarding the kind of care that elders received, who it is that cared for them, and how they were buffered (or not buffered) from death at an earlier age.

The skeletal population (N=172) studied here was excavated from Black Mesa (A.D. 850-1120). It includes a rather large number (N=32, or 18.6%) of individuals in the 50+ age category. Even more surprising is the male/female ratio of this elderly group (12 to 20). Using a combination of non-invasive measures, such as bone density analysis and a detailed quantitative analysis of osteoarthritis, a clearer picture emerges of the lives of these people and the cultural system surrounding and buffering them. Adult bone densities were taken using the distal radius and ulna and/or the calcaneus. As well, osteoarthritis was observed and quantitatively recorded in all joints of the adults. Using this data set, a more comprehensive picture of growing old - not only in a geographic area but in a temporal one - emerges. They, especially the women, managed to live long lives even though their bones tell us that life was hard for these people. The patterns of biological aging seen in this study help to shed light on the cultural systems involving aging in this population.

**Phylogenetic implication on humeral and calcaneal morphologies of Amphipithecidae.**

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This study focuses on postcranial morphologies of an amphipithecoid from the Eocene Southeast Asia and asks whether or not the postcranial characteristics could contribute to solving the phylogenetic position of the family. Twenty-six humeral and eight calcaneal features of an amphipithecoid specimen (NMMP 20) were compared with those of lemuriforms, notharctine and adapine adpiforms, omyoids, *Tarsius*, *Eosimias*, *Apidium*, *Aegyptopithecus*, and platyrrhines. Using the MacClade program, the phylogenetic nature of each morphology was determined in three different phylogenetic placements of NMMP 20: in primitive anthropoids, in notharctine adpiforms, and in stem adpiforms.

Almost all of the features are subject to homoplasies; no character state completely uniquely connects NMMP 20 to anthropoids, notharctines, or adapiforms, and there are always some characters of which homoplasies are increased regard-

less of the placement of NMMP 20. Many features in NMMP 20 are primitive euprimate traits. On the contrary to the previous suggestions that the morphology of NMMP 20 enhances its adapiform status, we found a greater number of characteristics in the humerus and the calcaneum of NMMP 20 that favors its primitive anthropoid status (e.g., the lesser tuberosity subequal to the greater tuberosity in width, the robust and straight humeral shaft, the round deltopectoral crest edge, the posterior position of the deltopectoral crest on the shaft, the medially flared humeral trochlea, and the round calcaneocuboid facet) than those that supports its adapiform status (e.g., the humeral head projecting above the tuberosities, the large lateral epicondyle, and the presence of the trochlear gutter).

**Adult male relations with juveniles among brown capuchins (*Cebus apella*) in Suriname: affiliation, antagonism or benign neglect?**

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Brown capuchins (*Cebus apella*) are unusual among primates for high rates of social interaction between adult males and immatures. Even within *Cebus*, the frequent grooming of immatures by adult males is not found in congeners. In our effort to interpret field data on adult male and immature brown capuchins, we were surprised that the preponderance of reports of adult male-immature social relationships among primates concentrate on male interactions with infants (i.e. paternity and infanticide). Nonetheless, adult male-juvenile interactions are arguably of comparable importance. This is particularly true for *C. apella*. Adult male tenure in brown capuchin troops can last a decade and, plausibly, significantly shape juvenile social success as an adult.

Our long-term study of multi-male troops of wild brown capuchins in Suriname found that juveniles are responsible for initiating contact with adult males, and that the alpha male attracts them most strongly. We considered four functional benefits for these juvenile preferences: enhanced opportunities for observational learning of foraging skills; social buffering; access to preferred foods; and the nurturing of adult male acceptance of juveniles to facilitate long-term troop residency and status acquisition. Our field data indicate that juveniles maintain relations with the alpha male as a mechanism to increase social acceptance, obser-

vational learning, and access to foraging sites. Juveniles interact with natal subordinate males primarily to scrounge for food, despite considerable risk of agonism from these males. In contrast, juvenile interactions with non-natal males are characterized by low levels of agonism and are associated with contexts of social buffering.

**Muzzle morphology and size in *Mandrillus leucophaeus*.**

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The drill (*Mandrillus leucophaeus*), a forest living Old World monkey, exhibits high levels of sexual dimorphism, with a limited number of males in each group (those that are 'fatted') developing extreme secondary sexual characteristics, including muzzle growth. In this study, the degree of secondary bone growth on the muzzles of wild-caught drills was assessed in relation to overall body size. Bone growth on different parts of the muzzle was also investigated. In female drills, muzzle breadth was positively correlated with an indicator of overall body size, skull length. However, there was no significant correlation between muzzle breadth and skull length in males. Paranasal swellings and other secondary bone growth on the muzzle in males also appeared to be independent of body size. This suggests that secondary muzzle growth in male drills is independent of overall body size. Furthermore, male secondary muzzle bone growth appeared not to follow a defined trajectory, with no correlation in the sizes of different areas of the muzzle. Further work is therefore required to investigate the relationship between body size and the development of secondary sexual features in drills. Attention should also be paid to the mechanisms and trajectories of muzzle bone growth and development in these animals.

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**Changes in social structure in *Eulemur fulvus rufus* in southeastern Madagascar from 1988-2003.**

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Based on a 10-year study (1988-1998) of the social structure of *Eulemur fulvus rufus* at the Vatoharanana study site (RNP), Overdorff and colleagues (1999)

described this subspecies as having stable multi-male/multi-female groups with an average of 9.5 group members, a male-biased sex ratio, and female philopatry. These results are consistent with reports from other eastern and western populations of *E. f. rufus*. Continued study of these groups from 1998 until August 2003 at the study site, however, suggests that the social structure of this subspecies may be more flexible than originally reported. Although the birth-rate, male:female sex ratio, and number of male emigrations remained similar between the two studies, we found a decrease in average group size (9.5 to 6.3) and an increase in the frequency of group membership changes (2.1 to 4.2 times/year) in the latter study. These differences seem to be linked to an increase in female transfers between the study periods (zero to 7 instances). Finally, groups traveled outside of their home range areas more often in the second period than they had previously, migrating up to 8 km away from the study site once or twice a year. These changes in *E. f. rufus* social structure coincide with increased densities of their main food competitors: *Varecia variegata* and *Eulemur rubriventer*.

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**Late Pleistocene human evolution in China: East Asian pathways to modernity.**

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The replacement model for modern human origins continues to garner widespread support based on accumulating genetic and fossil evidence indicating demic diffusion of moderns into various regions of the old and new worlds commencing approximately 100,000 or more years ago. Much of the discussion surrounding modern human origins has, however, focused on the relationship between Neandertals and expanding modern populations. While still debatable, both genetic and fossil evidence can be marshaled to build a persuasive case for the near total replacement of Neandertals by moderns by approximately 28,000 years ago. It can be argued, however, that the Neandertals are a special case and the criteria used to demonstrate replacement in Europe and the Near East are not applicable to East Asia.

Transitional fossils exist in East Asia that display heritage features shared with predecessor populations of *Homo erectus* as well as derived features shared with

anatomically modern humans. These transitional fossils are the best evidence for anatomical continuity in East Asia throughout the Pleistocene. Genetic evidence, however, supports the spread of certain aspects of the modern human genome into East Asia within the last 60,000 years. A model of continuity with hybridization can best explain the discrepancy between physical and genetic evidence for modern human evolution in East Asia.

**The roles of infant crying and motherese during prelinguistic evolution in early hominins.**

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As human infants develop, a special form of infant-directed speech known as baby talk or motherese universally provides a scaffold for their eventual acquisition of language. This paper explores when and how motherese first evolved in hominins, and suggests that it formed a prelinguistic substrate for the emergence of protolanguage. Although infant chimpanzees older than two months are able to cling unaided to their mothers' bodies, human infants never develop the ability to do so because they are born at extremely undeveloped stages, i.e., when their heads are still small enough to negotiate bipedally-adapted birth canals. According to the "putting the baby down" hypothesis, before the invention of baby slings, early bipedal mothers would have carried their helpless infants in their arms and routinely freed their hands to forage for food by putting their babies down nearby where they could be kept under close surveillance. Unlike chimpanzees, human babies cry excessively as an honest signal of need for reestablishing physical contact with caregivers, and human mothers engage in motherese that functions to sooth, calm, and reassure infants. These special vocalizations are in marked contrast to the relatively silent mother/infant interactions that characterize living chimpanzees (and presumably their ancestors), and probably evolved in the wake of selection for bipedalism to compensate for the loss of sustained direct physical contact that was previously achieved by grasping extremities. Motherese is therefore hypothesized to have evolved in early hominin mother/infant pairs, and to have formed an important prelinguistic substrate from which protolanguage eventually emerged.

**Differential subsistence adaptations of agriculturalists and herders of the**

**early intermediate period in the Lurin Valley, Peru: New data from stable isotope analysis.**

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The coastal site of Villa El Salvador is a burial ground for two populations of seemingly different origins and subsistence practices. Dating to the Early Intermediate Period (200 B.C.E. – 600 C.E.), the two populations are physically marked by stature and cranial deformation. Those thought to have been agriculturalists are taller and exhibit cranial deformation while those thought to have been highland herders are shorter and do not have cranial deformations. We have selected stable isotope analysis, a well-established method for studying ancient diet, to test whether these physical differences may be directly correlated with different dietary patterns, and likely residence locations.

Carbon and nitrogen isotope ratios in bone collagen, and carbon isotope ratios in bone apatite and tooth enamel were determined for a significant sample of the Villa El Salvador remains to determine the amount terrestrial C3 and C4 plant and animal foods as well as freshwater and maritime resources contributed to the diets of the two morphological groups. While bone collagen primarily indicates the source of protein in the diet, bone apatite and tooth enamel are produced from all dietary components. Furthermore, since bone is constantly reabsorbed and replenished, the isotopic composition of bone collagen and apatite indicate the diet over the last several years of life, while tooth enamel reflects diet at the age of crown formation, thus allowing a comparison within individuals to assess immigration or other mobility patterns. Our results provide important insight into pre-Inca subsistence adaptations and organization, as well as social and mortuary practices.

**Faunal remains from La Nuestra Señora de Atocha and Santa Margarita.**

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We analyzed the faunal remains from two 17<sup>th</sup> century Spanish galleons, to document diet, and perhaps lifestyles, aboard these vessels as they returned to Spain from the Americas. We hypothe-

sized that the assemblage would be primarily New World fauna since the ships were returning to Europe. Analysis of the 311 bones yielded the following inventory: cattle (*Bos taurus*, N=134), hogs (*Sus scrofa*, N=82), horses (*Equus caballus*, N=28), fowl (*Gallus gallus*, N=10; *Meleagris gallopavo*, N=6), sea turtle (*Chelonia mydas*, N=4), buffalo (*Bison bison*, N=8), sheep/goats (*Ovis/Capra*, N=33), rats (*Rattus rattus*, N=4), and deer (*Odocoileus virginianus*, N=2). No human remains were recovered. The faunal remains are largely butchered and preserved meaty parts of cattle and hogs. The horses, buffalo, and deer were live cargo because there were no butchering marks, with rats likely being uninvited stowaways. It is likely that the lone buffalo was intended for presentation rather than a food source during the voyage. Our data did not support the hypothesis that only New World fauna were part of ships' stores. Old World fauna constituted the bulk of the remains. Processing marks on the faunal remains suggest that each item was used to the fullest extent possible.

**Dental caries distribution in the Anglo-Saxon population of Sedgford, England.**

M.T. Fashing. Dept. of Anthropology, College of William & Mary, Sedgford Historical and Archaeological Research Project (SHARP).

During the Anglo-Saxon period, caries rates were typically lower than in most other periods in British history. Previous researchers have concluded that decay commonly occurs on the approximal surface of the tooth, particularly at the CEJ, in all but the youngest age groups, where it occurs on the occlusal surface. In this study, the dentition of 100 adult skeletons from the Anglo-Saxon cemetery at Sedgford was examined for the presence and location of dental caries using a dental probe and magnification. Carious lesions were recorded as approximal, occlusal, buccal, non-approximal root surface, or gross caries if the area of decay was too large for the initial location to be determined. Preliminary results indicate that, without division into age groups, the incidence of approximal and occlusal surface caries is approximately equal. When separated into age groups, the youngest age group, 15 – 24 years, has almost exclusively occlusal caries. Approximal caries is prevalent in the 25 – 34 and 35 – 44 age groups, though there are still several cases of occlusal caries. In the 45 – 54 age group, approximal and gross caries are equally dominant. In the 55+ age

group, only approximal caries was found. The decrease in occlusal caries after ~25 years of age might be attributable to the heavy degree of tooth wear resulting from the gritty Anglo-Saxon diet, which abrades the enamel until fissures are no longer present to trap food in the occlusal surface.

**Influence of availability on food transfer patterns in a captive Angolan colobus monkey group.**

P.J. Fashing. Science and Conservation, Pittsburgh Zoo and PPG Aquarium.

Food sharing is a relatively uncommon behavior among primates, most often consisting of food transfers from mother to infant. Most primate food sharing can best be described as occurring via tolerated theft or as a response to begging. I studied food transfer patterns in a 9-member group of Angolan colobus (*Colobus angolensis*) housed at the Pittsburgh Zoo. At the beginning of each observation, the group was provisioned with one of four quantities of browse (large, medium, small, none) that acted as a supplement to their breakfast food already available. Data were then collected on all occurrences of food transfer (both successful and unsuccessful) over the next 30 minutes. More than 1,000 food transfers were observed during the 52-day study. I found no evidence of begging and most instances of successful food transfer could be categorized as some form of tolerated theft. All individuals were observed participating in food transfers, though rates of participation varied markedly among individuals. The likelihood of study subjects resisting food theft by others was inversely related to the amount of browse available on a given day. Furthermore, rates of resistance to food theft tended to increase over the course of individual observation periods as browse supply became depleted. Determining whether or not the food transfer behavior exhibited by Angolan colobus at Pittsburgh Zoo is a species-typical behavior or merely a by-product of captivity will require further investigation of this species in the wild where its social behavior remains poorly known.

**Patterns of variation in enamel microdefect appearance in the first permanent molar and canine.**

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Accentuated striae (AS) are defects in enamel microstructure that form during tooth development when physiological stress events affect ameloblast activity. Any tooth developing during a stress event is affected to some extent. However, defects resulting from the event will vary in appearance by tooth type and location on the tooth crown. Therefore, if the same criteria for identifying AS are used across tooth types, a stress event may be reflected as an AS on one tooth type but not on another. Variation in defect formation across tooth types complicates comparisons of stress across different developmental ages.

We select first permanent molar-canine (M1-C) pairs from twenty medieval Danish skeletons to investigate how defects differ across tooth types. Using overlapping defect patterns, each AS is matched to its corresponding defect on the other tooth, regardless of whether the latter is scored as an AS. For cuspal-M1/cuspal-C defect pairs (n=26), an AS occurred in just the M1 in 65% of cases, in both teeth (27%), and in just C (8%); for cuspal-C/lateral-M1 pairs (n=11, both:55%, M1:36%, C:9%); and for lateral-M1/lateral-C pairs (n=47, both:43%, C:36%, M1:21%). These data suggest that M1 is more sensitive to stress than C cusally, C is more sensitive than M1 laterally, and lateral enamel is more sensitive than cuspal enamel. AS counts in M1 underestimate stress relative to C. Objective measures of AS appearance are needed to correct for this bias because M1 contains important stress information for the earliest year of life that is not reflected in C.

**Effect of human cohabitation on activity budgets in white-fronted capuchin monkeys (*Cebus albifrons*) in Ecuador: A pilot study.**

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With the expansion of human populations into nonhuman primate habitats, the number of cases of nonhuman primates living in close contact with humans is increasing. Few studies have been completed on long-term close cohabitation of humans and nonhuman primates and those that do exist have focused on Old World monkeys. Despite reports of urban human-nonhuman primate coexistence in South America, no socioecological studies exist for these situations and the effects that they have on the nonhuman primates involved.

Data on the group of white-fronted capuchin monkeys living within the town of Misahuallí, Ecuador were collected during

March and April 2003. Fifteen-minute scan samples were taken hourly from 700 to 1700 h each day. During the scan, each individual's activity was recorded.

The data support the hypothesis that the capuchins of Misahuallí utilize their time differently than do wild living *C. albifrons*. For example, in comparison to activity budgets reported for their wild living counterparts (Terborgh 1983), the Misahuallí monkeys spend less time resting (9 vs. 18%), and feeding/foraging (28 vs. 61%), and more time locomoting (31 vs. 21%) and performing social behaviors (32 vs. <2%). The results are discussed in relation to the activity budgets reported for other species of nonhuman primates living in conjunction with human populations and the effects that such behavioral differences pose for the health of nonhuman primates living in urban environments.

**Effects of habitat on fluctuating asymmetry in a population of wild ring-tailed lemurs (*Lemur catta*).**

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Although the conservation of primates has become an increasingly important topic, primatologists possess few tools to assess the long-term viability of primate populations. A promising approach that has been applied to other taxa of animals, but has seldom been applied to primates is the examination of fluctuating asymmetry (FA) within a population (Clarke, 1995; Moller, 1995; Weishampel, 1995). Under optimal conditions, the development of an organism should proceed along a genetically determined pathway and result in bilateral symmetry. However, under conditions of stress, an organism's mechanisms for stability are less efficient so that development cannot occur along its original pathway and the individual may differ from the expected perfect bilateral symmetry (Clarke, 1995). This deviation in development from the original genetic pathway is known as fluctuating asymmetry.

Seventy-one ring-tailed lemurs were captured as part of a long-term project investigating the biology of a population of wild ring-tailed lemurs (*Lemur catta*) living in and around Beza Mahafaly Special Reserve. Fluctuating asymmetry measurements were taken for 7 dental features, 9 skeletal features, and 2 soft tissue features. The results revealed that ring-tailed lemur females living in ranges that include the human-impacted re-

search camp and village had higher levels of FA when compared to female lemurs whose ranges are confined to the reserve. The implications of these results for understanding the stresses faced by lemurs during growth and development as well as the implications for ring-tailed lemur life history and conservation are discussed.

### **Testing hypotheses for dental reduction in Late Pleistocene and Early Holocene hominids.**

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Tooth reduction, a trend broadly seen in the genus *Homo*, is widely accepted to have been particularly marked in Neandertals and so-called anatomically modern *Homo sapiens* in the period from about 120,000 BP to 5000 BP. However, until now, such claims have been difficult to validate because of the confusing effect of tooth wear, particularly heavy in these groups, on conventional dental measurements. This study uses cervical measures, taken at the base of the crown, so that worn dentitions can be measured, making it possible to include a larger number of specimens and to consider the question of variability in crown size. A large and robust dataset collected over three years and consisting of measurements and other observations for 6631 teeth from 728 individuals has allowed us to confirm that reduction over this period has indeed occurred, although it is not marked in all teeth and the range of variation overlaps between different groups.

A number of hypotheses have been proposed to account for this reduction, and in this paper, using results from our study, we examine the argument that the dental-facial complex acts as one unit for selection, and that decreasing requirements for heavy forces in chewing (with greater food preparation) favoured a smaller, more energy efficient jaw musculature and supporting skeleton, along with an appropriately smaller dentition. We conclude that, although only weakly supported by the evidence, this is a more likely explanation for the reduction than others that have been proposed.

### **An alternative model for Clovis colonization that retains Amerind genetic diversity.**

A.G. Fix, University of California, Riverside.

The classic "Blitzkrieg" model for the peopling of the Americas involved an initial small group of Clovis hunters entering

via the ice-free corridor and expanding rapidly throughout the hemisphere. However, this mode of colonization leads to an extreme reduction in genetic diversity, a pattern inconsistent with observed Amerind variation. An alternative colonization route along the coastal margins of both North and South America allows rapid deployment of the migrant population while preserving genetic variation and dispersing ancestral genes widely.

Archaeological evidence for early coastal settlement, however, remains slim. The oldest well-dated and widely accepted occupation of North America is the Clovis "culture" represented by many sites across the interior of the continent. Despite the salience of the western plains sites associated with mammoth remains, some archaeologists have argued that Paleoindian occupation in the east was localized along major river systems. Anderson (Research in Economic Anthropology, Supp. 5: 187) has characterized these river systems as "staging areas" from which settlement of the interior of the continent was carried out.

This paper presents a computer simulation model evaluating the effects of colonization from such staging areas on genetic variation in founding Clovis populations in North America. In contrast to the "Blitzkrieg" model of Clovis spread, this model preserves Amerind genetic diversity.

### **Preliminary taphonomic analysis of microfaunal assemblage from Coopers D deposit, Gauteng Province, South Africa.**

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Coopers site is located between two well-known sites of Sterkfontein and Kromdraai in the Cradle of Humankind, Gauteng Province, South Africa. The deposit is divided into multiple localities yielding hominin fossils as well as a large and diverse mammal assemblage. The large mammal fauna excavated from the Coopers D deposit suggests a date of 1.6 to 1.9 Ma. The Coopers D deposit also contains an extensive small mammal fauna. Current research on this small mammal fauna focuses on the depositional environment, accumulating agent, and taphonomy of the specimens. Analysis has thus far been limited to microscopic examination of mandibles and post-cranial element representation. Preliminary results suggest that owls are primarily re-

sponsible for the microfaunal bone assemblage at Coopers D. The light digestion pattern of the specimens and well-preserved post-crania indicate that the species *Tyto alba*, *T. capensis*, or *Asio capensis* are the most likely accumulating agents. These species have been implicated in microfaunal deposits at neighboring sites of similar age. Root etching has also been identified on several specimens. While signs of water transport and exposure to the elements are suggested in many specimens, the results are not conclusive and require a more detailed examination currently underway. Post-fossilization fracturing observed on the majority of mandibles as well as the paucity of cranial elements are indicative of collection damage.

### **Are there critical periods in the ontogeny of stress response and immune function?**

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Early trauma can have long-term effects on hypothalamic-pituitary-adrenal (HPA) stress response. Because the HPA system has important immuno-modulatory functions, children that have endured difficult conditions during development may be at higher risk for immune dysfunction. Here we examine whether there are critical periods in the ontogeny of HPA and immune function.

Sample and methods: a sixteen-year study (1988-2004) of child health in a rural community on the island of Dominica provides sequential, biyearly data on salivary cortisol, morbidity, and social environment (N= 282 children, 32,432 saliva samples). A more limited sample of immune measures (IgA, IL-8, neopterin) were assayed from saliva collected several times per day for up to a week for sixteen children experiencing naturally occurring common colds and a matched period without apparent morbidity. Patterns of cortisol response, morbidity, and immune response are examined for associations with trauma at different periods during development.

Results: Early trauma is associated with cortisol profiles in complex ways. Early traumatic experience is associated with high cortisol levels throughout child development. Apparent HPA dysregulation, however, may reflect higher incidence of continuing stressors, and incompetent models of the social world. Longitudinal profiles of immune measures indi-

cate delayed IgA response to common colds.

**Age at death determination using the skeletal histomorphometry of the third metacarpal and third metatarsal from autopsy and cadaver samples.**

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The goal of this presentation is to contribute to the growing body of methodologies used by physical anthropologists for determining age at death via histology. Our hypothesis is that secondary osteon numbers per cortical area of the left third metacarpal and left third metatarsal bones yield statistically significant correlations with known age.

Autopsy samples were obtained from the Lubbock County Medical Examiner's Office. Samples were also acquired from cadavers provided by the Department of Anatomical Services of TTUHSC. Information on the individual's age, sex, height, weight, health conditions prior to death, and cause of death were collected. The documented ages for our fifty samples range from 19 to 93 years of age at death. The histomorphometric analysis involves preparing thin sections of the mid-shaft of the left third metacarpal and left third metatarsal as complete cross-sections. A number of factors were examined at the microscopic level; specifically, we focused on intact and fragmentary secondary osteon counts per mm<sup>2</sup> for the entire cortical cross-section of each bone. The data are then used to produce age-predicting regression formulas. This procedure follows closely to suggestions made by Stout & Paine (1992).

With fragmentary remains, histological examination of skeletal material may be the best means of age approximation. Based on our results, age-predicting equations developed for the metacarpal, metatarsal, and for a combination of both bones can be used in conjunction with, or in lieu of, other aging methods. These equations can be applied to prehistoric, historic, or modern skeletal remains.

**A geometric morphometric study of cranial sexual dimorphism in selected indigenous populations of South Africa.**

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It is widely accepted that the pattern and magnitude of sexual dimorphism varies between different populations, necessitating specific population standards for optimal sex determination. What is often not considered is the degree to which sexual dimorphism varies within those population sub-groups. We report here on new morphometric data examining regional variation of sexual dimorphism in the crania of five modern human populations from South Africa. A total of 332 (182 male and 150 female) crania of Zulu, Swazi, Xhosa, Sotho, and Tswana individuals drawn from the *Dart Collection* were studied. An extended series of 96 3-D landmarks was designed and then acquired using a Microscribe 3DX digitizer. The shape analysis software *Morphologika* was used to analyse the data of each sub-group, male and females separately.

In all five populations sexual dimorphism was highly significant. Certain features characterise the sexes across the populations examined. Males, for example, typically presented relatively flatter, forward sloping frontal bones, and greater craniofacial width associated primarily with larger and broader zygomatic arches and cheekbones. There are also, however, sexually dimorphic cranial features unique to the specific indigenous South African populations. One more marked example of these features is the Swazi males who have a significantly broader palate and larger inferior nasal spine. Given the extent of inter-population variation in cranial sexual dimorphism in the five indigenous South African populations examined, this data suggests that population specific dimorphic features must be considered, whether it be through metric or non-metric assessment, in order to achieve optimal sex discrimination in that population.

**The significance of the capitate/metacarpal II articulation for grasping in early hominids.**

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The articulation of the capitate and second metacarpal (CM2) is considered by some to indicate a specialized form of power and precision grasping in humans

and in early hominids. The distinction of the CM2 articulation in humans is said to lie in the relative size of the articular surfaces and in the orientation of these surfaces to inferred load vectors. In humans, the orientation of this joint forms an angle with the shaft of the metacarpal, so that the joint lies between sagittal and transverse planes, whereas in non-human hominoid primates the joint lies in a plane parallel to the shaft of the metacarpal. Some suggest that the uniqueness of the human form facilitates power grasping and precision grasping by allowing pronation of the metacarpal.

We studied the form of the CM2 articulation in a series of anthropoid primates. Second metacarpals from seventeen genera were photographed and digitized in order to measure the angle of orientation and the area of articulation of CM2. While our data confirm previous notions that the ape CM2 form is different from humans, our data also indicate that the form of the joint in humans is not significantly different from several monkey species. *Theropithecus*, *Macaca*, and *Colobus* are among Old World monkey genera sharing similar CM2 morphology as humans. Our findings suggest that the CM2 articulation is not a unique hominid trait. Consequently, this trait reveals little about human-like precision grasping in early hominids.

**Bio-cultural components of the co-existence of under-nutrition and obesity in Latin America.**

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Obesity has become a major epidemiological problem in Latin America in both the upper and lower socio-economic classes. Previous studies indicate that short leg length index ((leg length/stature)\*100) is a good marker of growth delay and childhood undernutrition of adults. It is postulated that exposure to undernutrition during the developmental period is an important component of the increased risk of obesity of adults in developing nations.

To test the hypothesis that the risk of overweight and obesity in Latin America is related to childhood exposure to undernutrition the anthropometric markers of excess weight of Latin American samples will be evaluated with reference to relative leg length leg length and socio-economic factors. First, the anthropometric data sets of the third National Health and Nutrition Examination Survey (NHANES III) of the USA will be evaluated to set reference of leg length index.



Second, the markers of excess weight such as skinfold thickness, weight by height, and body mass index of Latin American samples will be evaluated with reference to relative leg length and socio-economic factors.

**Cranial allometry, phylogeography and systematics of baboons inferred from geometric morphometric analysis of landmark data.**

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Cranial morphology of the African Old World monkeys *Mandrillus*, *Papio*, and *Theropithecus* (i.e., the baboons) has been the subject of numerous studies investigating their systematic relationships, patterns of scaling, and growth. In this study, we use landmark-based geometric morphometrics and multivariate analysis to assess the effects of size, sex, taxonomy, and geographic location on cranial shape. Forty-five landmarks were digitized in three dimensions on 452 baboon crania and subjected to generalized Procrustes analysis. The resulting shape coordinates were submitted to regression analysis, principal components analysis, partial least squares analysis, and various clustering techniques, with findings visualized by 3D thin-plate spline.

Scaling was the largest single factor explaining cranial shape variation. For instance, most (but not all) of the shape difference between the sexes was explained by size dimorphism. Yet central tendencies of shape clearly varied by taxon, both specific and subspecific, even after variation in size and sex was adjusted for. Within *Papio*, about 60% of the size- and sex-adjusted shape variation was explained by the coordinates of the specimen's geographic provenance, revealing a stepped cline in cranial morphology with the greatest separation between northern and southern populations. Combined with evidence from genetic studies and the presence of at least two major hybrid/interbreeding zones, we interpret the phylogeographic pattern of cranial variation as implying that these popula-

tions are best ranked as subspecies of a single species, rather than as two or more distinct biological species.

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**Food and the state: Bioarchaeological investigations of diet in the Moche Valley of Perú.**

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The Moche of north coastal Perú were among the earliest New World societies to develop state socio-political organization. The Moche State (AD 200-800) was a centralized hierarchical society that controlled the Moche Valley as well as valleys to the north and south. Prior to the establishment of the state, a series of less hierarchical organizations were present in the valley. Irrigation agriculture, particularly of maize, has often been cited as central to development of the Moche State. To test this assertion I examined 750 individuals recovered from the largest cemetery at the site of Cerro Oreja. Although the most important occupation of Cerro Oreja was during the Gallinazo period (AD 1-200), many individuals were interred here during the earlier Salinar period (400 -1 BC). Consequently, the Cerro Oreja collection holds a key to understanding the development of one of the earliest and most extensive states in the Americas.

Of the 750 individuals examined 424 (56.5%) had preserved teeth and/or alveoli that could be examined for the presence of dental caries, periodontal disease, abscesses, and antemortem tooth loss. This sample consists of 59 Salinar, 144 Early Gallinazo, 107 Middle Gallinazo and 70 Late Gallinazo individuals. Population caries rates show a general decreasing trend, 14.2%, 13.2%, 8.9%, and 11.8% respectively. These rates are lower than the 15 to 45% carious teeth that characterize many Eastern North American agriculturalists (Larsen et al. 1991, Gagnon 1999). These preliminary findings call into question the assertion that the Moche State was built upon intensive agricultural production.

**Describing shapes from the dawn: Internal femoral neck architecture of Bar 1002'00.**

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Computerized tomography (CT) was used to quantify superior and inferior cortical bone thicknesses and areas in the femoral neck of BAR 1002'00 from the Lukeino Formation in the Tugen Hills of the Baringo District of Kenya, dated to 6 MA. Cortical bone thicknesses and areas were gauged for each CT slice by the standard approach of using two Hounsfield Unit thresholds, the first at the air-bone interface and the second at the cortical-endosteal bone interface. Biomechanically the femoral neck resembles a cantilevered beam, with bone thicknesses reflecting structural loading history (ontogenetic and/or phylogenetic). Along its length, hominids exhibit cortical bone that is thinner superiorly than inferiorly, particularly toward the neck-shaft junction. At that more distal location, in extant humans the ratio of superior to inferior (SI) thickness approximates 1:4 or less and the ratio of SI cortical areas is about 1:3, while in African apes the SI ratios for thickness and area vary around 1:1 (Ohman et al., 1997). In BAR 1002'00 the ratio of SI cortical bone thickness is approximately 1:3 around mid-neck and 1:2 to 1:3 at the femoral neck-shaft junction, while SI cortical bone area ratios in the region from around mid-neck to the neck-shaft junction range from about 4:5 to 2:3, depending on the threshold used to demarcate the boundary between cortical and endosteal regions complicated by some mineralization. The BAR 1002'00 femur exhibits a total morphological pattern consistent with bipedal locomotion and entirely appropriate for a population living at the dawn of the human lineage.

**Functional morphology and evolution of the Neandertal pelvis.**

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While the debate concerning hypotheses accounting for the functional significance of the unique pelvic morphology of Eurasian Neandertals has been lively, evolutionary perspectives have been hindered by insufficiently preserved Lower and Middle Pleistocene comparative material. The remarkably complete pelvis of a putative Neandertal ancestor from the Sima de los Huesos (Atapuerca), furnishes crucial evidence to the emergence of Neandertal

pelvic form and patterns of morphological evolution in the locomotor system of Plio-Pleistocene hominids.

Comparative analysis reveals that the proportions of the ilium, sacrum and acetabulum in early *Homo*, *H. heidelbergensis* and Eurasian Neandertals do not differ discernibly from those of *Homo sapiens*. Superior pubic ramus length and bi-acetabular breadth (IAD) are relatively greater in Neandertals than in other hominids, and this does not apparently reflect an increase in the A-P pelvic plane. The Atapuerca specimen contrasts with the Kebara Neandertal with respect to relative IAD and superior pubic ramus proportions, which are not elongate. Contrary to expectations, A-P pelvic diameter, acetabulum and relative femoral head size in the Atapuerca specimen are unusually small for a hominid of its reputed body size. Furthermore, increasing functional load-arm to lever-arm proportions ( $Dw/Dm$ ) in recent humans coincides with a decrease, not an increase, in absolute femoral head size. These findings have profound implications for contemporary models of locomotor evolution in Pleistocene hominids.

#### **An infant skull of *Lufengpithecus* from Yuanmou, Yunnan Province, China.**

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The late Miocene hominoid *Lufengpithecus* is generally regarded as belonging within the orangutan clade. However, interpreting the relationships of *Lufengpithecus* is complicated by the severe crushing affecting all the cranial specimens from the principal site of Lufeng. Among the hominoid remains from the nearby and nearly contemporaneous site of Yuanmou is a minimally distorted partial skull of an infant, YV0999, with the first molars just coming into occlusion. The Yuanmou sample has been assigned to a separate species of *Lufengpithecus*, *L. huidienensis*.

YV0999 preserves virtually the entire facial skeleton, much of the frontal to the coronal suture, the anterior cranial fossa, the entire palate, and portions of the sphenoid body and pterygoids. To assess the relationships of YV0999, data were collected for a number of metric and non-

metric features on it and at least 10 specimens each of *Pan*, *Gorilla* and *Pongo* of approximately the same developmental stage.

There are few similarities between YV0999 and the crania of either *Gorilla* or *Pongo*, but there are a number of similarities with the crania of *Pan*. Notably, these do not include features generally considered to be derived for *Pan* specifically, or for both African apes more broadly, such as a supraorbital torus and sulcus. We conclude, therefore, that the Yuanmou cranium expresses a morphology that is generally primitive with respect to the extant great ape and human clade. This conclusion could change, though, if certain features of *Pan* or both African apes that we are interpreting to be primitive are instead derived.

#### **Kinematic analysis of trunk-to-trunk leaping in Goeldi's monkey (*Callimico goeldii*).**

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Leaping to and from vertical trunks is a pattern of locomotor behavior that characterizes the positional repertoire of several species of prosimians and New World monkeys. Trunk-to-trunk leaping requires mechanical adjustments of the limbs, tail, and body mass associated with in-air body rotation, and in prosimians, a posterior displacement of the center of mass such that the hindlimbs strike the landing platform well in advance of the forelimbs. In this study, we examined the kinematics of leaping in a group of 6 Goeldi's monkeys housed at the Anthropologisches Institut der Universitaet in Zuerich, Switzerland. In the wild, trunk-to-trunk leaping is reported to account for 45-55% of *Callimico* leaping behavior. We introduced a set of two wooden, fixed, non-compliant vertical supports into a large outdoor enclosure and used two video cameras set at right angles to document leaping behavior. The supports had diameters measuring 2.5 cm, 6 cm, or 15 cm and were placed at distances of 1 m, 1.5 m, 1.7 m and 2 m. Frame by frame analyses of 122 leaps were conducted.

Results indicate that *Callimico*'s forelimbs always contacted the landing substrate in advance of the hindlimbs. This probably reflects the primarily quadrupedal nature of travel in callitrichine primates. Based on kinematic equations provided by Warren and Crompton (1998), the energy required for *Callimico* to leap a

distance of one meter (2.8 KJ) was comparable to that reported for similar sized prosimian vertical clingers and leapers. Even when leaping a horizontal distance of 2 meters, *Callimico* experienced a downward vertical displacement of only 0.17 m. Additional relationships between the kinematics of leaping, travel speed, and *Callimico* locomotor anatomy are discussed.

#### **An analysis of Neandertal trauma patterns.**

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This study analyzes trauma, which has been identified as an important factor in Neandertal lifeways. Results from a previous study suggested that Neandertals and rodeo performers have similar patterns of trauma due to shared behavior patterns. Specifically, both groups engage in activities that place them in close contact with large ungulates. The present analysis utilizes a similar methodology to the earlier study; however, a different occupation-specific group of modern humans was selected as a comparison population. Agricultural workers were chosen for this purpose as they come into close contact with large animals when engaging in the day-to-day routines of farm operation and animal management. This type of animal-human interaction more closely approximates the hunting activities that would place Neandertals in close proximity to large mammals. Based on the assumption that both groups frequently came into contact with large ungulates, the null hypothesis for this study was that Neandertals and agricultural workers would exhibit similar patterns of trauma. However, this null hypothesis was tested and rejected based on the statistically significant differences in trauma patterns between Neandertals and a sample population with traumatic injuries that were specifically caused by livestock. Consequently, alternative explanations were developed to account for the patterns of trauma observed in Neandertals. These explanations include interpersonal violence, natural events (rock falls) and other accidents resulting in injury, particularly falls.

#### **Posterior facial height and mandibular tooth crowding in chimpanzees with reference to anterior tooth crowding in robust *Australopithecus*.**

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cer University School of Medicine, <sup>3</sup>Matthew Ferrini Institute for Human Evolutionary Research, Kent State University.

Recent discussions of robust australopithecine facial development have emphasized the significance of growth rotations of the jaws in the establishment of numerous features that distinguish these taxa. As revealed through longitudinal implant studies of humans and macaques, rotation of the jaws during ontogeny is a normal feature of anthropoid facial growth. In robust *Australopithecus*, the development of an unusually tall posterior face would likely have been associated with an extreme form of forward jaw rotation.

In modern humans extreme forward rotation of the jaws is expressed in the dentition as both a mesial placement of the mandibular molars and a crowding of the anterior dentition. The frequent occurrence of the latter feature in robust australopithecines suggests that it may be a developmental byproduct of forward jaw rotation. We explored this possibility by examining the relationship between cranial size-corrected values of posterior facial height and the length of the mandibular dentition relative to that of the maxillary dentition in a small, mix-sexed sample ( $n = 32$ ) of adult chimpanzee crania from the Cleveland Museum of Natural History. In this study cranial size was represented as the geometric mean of palatal length, bitympanic breadth and basicranial length.

Results of correlation found no significant association between posterior facial height and the relative length of the mandibular dentition in our chimpanzee sample. Whether these negative results can be applied to the interpretation of the robust australopithecine condition is uncertain as differences in upper jaw ontogeny and anterior tooth function may confound the chimpanzee results.

#### **Minding the P's and Q's: New mtDNA haplogroup data from Melanesia.**

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Evidence for the occurrence of a separate south Asian migration route into Australia and Melanesia has primarily depended on the emergence within the mitochon-

drial DNA M and N clades of the regionally restricted haplogroups P and Q. Studies of P and Q have defined these haplogroups by a small set of unique control region mutations: Forster (2001) defined P by 15607A→G, with a subset (p94) with 212T→C; he defined Q by 16144T→C, which also occurs with the 16265A→C transversion (Sykes 1995). This study incorporates new results from over 1,000 control region sequences from Island Melanesia which clarify and enlarge the definitions of haplogroups P and Q. Applied to the Melanesian/Australian origins question, the data suggest a very remote common origin for Melanesia and Australia based on an enlarged definition of haplogroup P. Haplogroup Q remains undetected in Aboriginal Australian samples while showing phylogenetic relations with three other distinctive Melanesian haplogroups, which should be regarded as proto-Q. The ultimate articulations of both of these enlarged haplogroups remain unresolved, pending more extensive coding region sequencing. However, an ancient south Asian migration hypothesis for Australia/Melanesia is substantiated, at least in part.

#### **The impact of a labor-saving technology on birth spacing in southern Ethiopia.**

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Across the developing world labor-saving technologies introduce considerable savings in time and energy that women allocate to work. Clinical hormonal studies on natural fertility populations predict that such a reduction in energetic expenditure can lead to improved energy balance and higher reproductive function. This biodemographic study investigates whether these physiological changes affect fertility at a population level, specifically through variation in birth interval lengths. The focus is a water development scheme in an agro-pastoralist community Southern Ethiopia where a reduction in women's workload has occurred following the installation of village-level water points.

Using life tables and multivariate hazard modeling techniques, correlates of the length of first and later birth intervals are identified. Co-variates including age, season, village ecology, and access to the improved water supply influence the timing of births in this population. There is a positive effect of improved access to the water on women's monthly risk of birth.

The analyses indicate that fertility may be increasing in response to a new development technology, despite infrastruc-

tural and social developments which are driving the secular trend towards increasing age at marriage. This may have a number of deleterious health consequences for both women and children.

#### **Loss of olfactory receptor genes is coupled to the acquisition of full trichromatic color vision.**

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Olfactory receptor (OR) genes constitute the basis of the sense of smell. They are encoded by the largest mammalian gene superfamily of more than 1,000 genes, of which >60% are pseudogenes in humans. In contrast, the mouse OR repertoire of roughly equal size contains only ~20% pseudogenes. To assess whether the high fraction of OR pseudogenes is specific to humans or a common feature of all primates, we surveyed a random subset of the OR gene repertoire of 19 primates species from all sub-orders (using a combination of a specific orthologous gene approach and OR degenerate primers). We found that humans have accumulated mutations that disrupt OR coding regions at least four-fold faster any other primate, while apes and Old World monkeys (OWM) have a significantly higher proportion of OR pseudogenes than New World Monkeys (NWM) or prosimian primates. Strikingly, the Howler monkey, the only NWM with full trichromatic vision, carries a similar fraction of OR pseudogene to that of the OWM. Since all OWM and apes also possess full trichromatic vision, these findings suggest that, in primates, the acquisition of full trichromatic color vision is coupled to the loss of OR genes.

#### **Dentine shape as a taxonomic indicator and the origins of bilophodont molars.**

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The external shape and thickness of the enamel component of primate molars have been employed extensively in studies of primate phylogenetic relationships. The dentine component of the molar crown has also been suggested to be indicative of phylogenetic relationships, but few stud-

ies have quantified enamel-dentine junction (EDJ) morphology in order to evaluate this possibility. To explore the utility of dentine shape as an indicator of phylogenetic affinity, a two-dimensional geometric morphometric analysis (EDMA-II) was performed using nine homologous landmarks on a sample of sectioned maxillary molars of extant ceboid, cercopithecoïd, and hominoid primates. Results indicate that dentine shape (the configuration of the EDJ) can distinguish taxa at every taxonomic level examined, including superfamilies, subfamilies, and closely related genera and species. Dentine morphology appears, then, to be useful for phylogenetic studies. It is further suggested that the morphology of the EDJ may be more conservative than enamel morphology, making this character perhaps even better suited than enamel for determining phylogenetic relationships. The cercopithecoïd primates, in particular, have a unique dentine shape. This particular configuration may be related to the development of the distinctive bilophodont molars that characterize this group. One possible scenario for this evolutionary event is given; however, the exact process by which dentine shape affects (and can therefore predict) enamel shape remains unknown. Further investigation into this promising line of research may greatly increase our understanding of primate dental evolution.

#### **A cellular aging pattern unique to humans and common chimpanzees.**

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Lipofuscin pigment accumulation is the most prominent marker of cellular aging in postmitotic cells. The formation of lipofuscin is related to oxidative enzymatic activity. Causal factors also involve free radical-induced lipid peroxidation. In rat, dog, and macaque as well as in cheirogaleid primates, most of the large neurons, such as cerebellar Purkinje cells and neocortical pyramidal cells, show heavy lipofuscin accumulation. In contrast, a well-known yet poorly studied feature of the aging human brain is that although lipofuscin accumulation is most marked in large neurons of the cerebral cortex, the large neurons of the cerebellar cortex - the

Purkinje cells - appear to remain free of lipofuscin accumulation. It is however not known whether this characteristic of human Purkinje cells is shared by other primates.

This study reports results from histological observation of Purkinje cells in humans and non-human primates. The material includes *Homo sapiens* (N=10), *Pan troglodytes* (N=6), *Gorilla gorilla* (N=2), *Pongo pygmaeus* (N=1), *Erythrocebus patas* (N=4), *Macaca fascicularis* (N=2), *Felis catus* (N=1), *Canis familiaris* (N=1). Human specimens are all above 50 years old. The age range of common chimpanzee specimens is 4 - 45 years old. Staining reactions include Schmorl and PAS reactions. We also used fluorescence microscopy.

Lipofuscin deposition is observed in Purkinje cells of all the above-mentioned species except *Homo sapiens* and *Pan troglodytes*. When compared to other primates, Purkinje cells of common chimpanzees and humans share a common aging pattern that could involve mechanisms for neuroprotection. This observation is important when considering animal models of aging.

#### **The Early Paleolithic of Kazakhstan: Eastern boundary of the Acheulian culture?**

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Since the Movius line entered the vernacular of paleoanthropological studies, its objective reality as well as the pattern of its footprint across Middle Asia has been debated. In addition, the relationship between the Movius line and the timing of hominid migrations across the Eurasian super-continent and the possible cultural differences between hominid groups synchronously occupying Asia has been discussed. The "hand-axes" province to the west and "choppers and chopping tools" province to the east are buffered by a "transition zone" comprising the territories of Central Asia, particularly Kazakhstan. Here, recent research at Early Paleolithic localities by joint Russian-Kazakh expeditions has documented a significant eastern spread of Acheulian bifacial technology within the arid zone of Central Asia.

Surface collections made in the Mugodjari Mountains, northwestern Kazakhstan, comprise predominantly radial Levallois flake cores, sidescrapers, notched tools, and a large number of bifaces. Most specimens are heavily to moderately abraded, allowing some age

differentiation. Analogous bifacial industries have been recovered in Kazakhstan from the northern Balkhash region to the east (Semizbugu), in the southeast (Shakhabagata, Tanirkazgan), and in the southwest (North Aral Sea, Mangyshlak Peninsula, Krasnovodsk Plateau), as well as from the Caucasus. It is proposed that the industry dispersed into Kazakhstan along northern routes from the Caucasus, where most comparable sites have been dated between 500,000 and 300,000 BP. This industrial tradition existed alongside pebble tool, microindustrial, and notched tools complexes in the "transition" region, testifying to the complex origins of the Central Asian Paleolithic populations during the Early and Middle Pleistocene.

#### **A reanalysis of the Neandertal status of the Teshik-Tash child.**

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Debates concerning the relationship between Neandertals and modern humans hinge partly on how their respective geographical ranges are defined. Central Asia is considered the eastern periphery of the Neandertal range based on the discovery of the Teshik-Tash child from a Mousterian cave in Uzbekistan. Consequently, conceptualizing the appearance of modern humans in the area requires reliance on the competing models of replacement or continuity. Yet, some have considered Teshik-Tash a modern human with Asian affinities while others have interpreted it as possessing a combination of Neandertal and modern features. The present study expands on this research by comparing Teshik-Tash to a more appropriate comparative sample from Central Asia in order to evaluate its phylogenetic status.

Over 25 metric variables taken from Teshik-Tash are compared to those of 28 modern human crania from historic Central Asian populations. In addition, published data from over 50 European modern human crania and 20 Upper Pleistocene specimens from Europe and the Near East are used. A discriminant function analysis using size adjusted linear variables is performed, leaving Teshik-Tash unclassified. Different components of the cranium are analyzed separately and the fossil and modern comparative samples are plotted according to principal components. Results indicate that Teshik-Tash shares greater affinities with modern human populations from Central Asia in some aspects of the cranium and with the Upper Pleistocene group in others. These results have ramifications for our under-

standing of the Neandertal geographic range as well as the patterning of morphological variation during the Upper Pleistocene.

#### **Can low-magnification stereomicroscopy reveal diet?**

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A new method of scoring dental microscopic use wear, initially developed for and applied to extant and extinct ungulates, is here applied to primates, and the efficacy of the method as a tool for diagnosing diet in both ungulates and primates is established. The method employs standard refractive light microscopy instead of scanning electron microscopy (SEM), and all use-wear features are counted or scored under low magnification (35X). We use measurement systems analysis (variance components analysis of sources of measurement error) to evaluate the consistency and reproducibility of measurements using this method. The method is shown to have astonishingly low intra- and inter-observer measurement error, and to effectively distinguish among graminivores, folivores, and frugivores. It can be used to identify seed predators and to diagnose hard-object feeding. The method is also shown to be robust to the selection of measurement site; it works equally well when applied to upper or to lower molars. Finally, we use analysis of variance to examine the consistency of the signals across mammalian orders, and discriminant function analysis to develop dietary diagnostic tools for a set of "classified" primates with known diets. We test the success of these tools not merely by examining their *a posteriori* classification "success," but by using them to construct predicted dietary profiles for a sample of unclassified extant primate species, again with known diets.

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#### **mtDNA variation in Kazakhs of the Southern Altai Republic, and their relationship to Turkic-speaking populations.**

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The Altaian Kazakhs inhabit remote mountain districts of the Altai Republic of Russia next to its southern border with Mongolia. However, the history of this Kazakh population, and its genetic relationships with neighboring Turkic-speaking groups, are unclear. It appears that Altaian Kazakhs began migrating from an area near northwestern Mongolia and China around the end of the 19<sup>th</sup> century, when some local populations were expelled from their homelands. They then resettled in the Altai Mountain region, where they remained relatively isolated from other indigenous groups. To clarify the genetic prehistory of Altaian Kazakhs, we analyzed mtDNA variation in ~277 persons from three villages (Chanual, Kosh-Agach, Turata) in the southern Altai Republic. Our results suggested a complex population history for Altaian Kazakhs. Their mtDNA gene pool contained significant frequencies of both East Eurasian (A-G) and West Eurasian (H, HV, I-K, T, X) haplogroups. The latter constituted a greater proportion of their mtDNAs [55-60%], although they lacked haplogroup U mtDNAs, which commonly occur in South Asian and west-central Siberian populations. In addition, there were differences in the overall genetic composition of these villages, particularly in the frequencies of haplogroups C, D, F and J, suggesting possible lineal effects within each settlement. The implications of these patterns of variation for constructing the history of this Kazakh population, and its links to other Turkic-speaking people, will be explored.

#### **Complete mitochondrial genome sequencing of Tanzanians implies an east African origin of modern humans.**

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The time and origin of the speciation of modern humans within Africa remains an enigma. Mitochondrial (mt)DNA studies have indicated that Khoisan speakers of southern Africa carry the most ancient mtDNA lineages. The Hadza and Sandawe of Tanzania are hunter-gatherers who also speak languages classified as Khoisan. The origin of these populations and their relationships with southern African Khoisan speakers remains a genetic and linguistic "puzzle". Previously, we have proposed that 1) Tanzanians carry mtDNA lineages that are more an-

cient than the Khoisan speakers of southern Africa and 2) the Sandawe appear to share a close relationship with southern African Khoisan speakers. However, our analyses were confined to the mtDNA control region, which makes up about 7% of the mtDNA genome. The control region is complicated further by homoplasmy and variation in substitution rates between sites, particularly in basal tree branches containing ancient mtDNA lineages.

We present several complete 16.5kb mtDNA genome sequences from Tanzanians and southern African Khoisan speakers (n>40). These sequences were examined along with 150 mtDNA genome sequences obtained from Genbank. Several of the Tanzanian genomes, cluster together with southern African Khoisan speakers in the most basal branches of the mtDNA genome phylogenetic tree. These Tanzanian lineages represent the most ancient mtDNA haplotypes of all human populations. Our results indicate that the oldest mtDNA lineages in humans are present in Tanzania and support archaeological and fossil evidence indicating an east African origin of modern humans. Funded by BWF, Packard, Leakey, Wenner Gren, and NSF grant BCS-0196183 (ST).

#### **Morpho-geometric functional analysis of New World cranial samples and the distribution of the Paleoamerican morphological pattern.**

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The debate about the settlement of the America usually focuses on the lack of morphological affinities between early Holocene human remains (Palaeoamericans) and modern Amerindian groups, as well as the degree of contribution of the formers to the gene pool of the latter. It is suggested that the pattern of craniofacial affinities in the Americas is the result of a double migratory event: a first migration of Palaeoamericans which were originated in an ancestral population inhabiting southern Asia in pre-glacial times, and a second migration of the so-called Mongoloids, from which derived much of the

modern Amerindians. Under this hypothetical scenario, detection of relict groups deriving from the former Palaeoamerican population is expectable somewhere in the New World. Cranial samples consisting of digitized images in lateral view were analyzed for twelve groups of modern Amerindians, Asiatics, and Australians, and Late Pleistocene and Early Holocene remains from Africa, Asia, Australia and the Americas. Statistical analysis was focused on the observation of within and between-group variability of specific functional components of the skull by means of geometric-morphometric techniques. Results showed that some modern Amerindian groups, like those from Baja California peninsula in Mexico, shows clear affinities with Palaeoamericans and Late Pleistocene Asian and African skulls, rather than with modern Amerindians. Climatic changes during the middle Holocene probably generated the isolation conditions which restricted the gene flow between Baja California inhabitants and Northern populations, which resulted in the temporal continuity of the Palaeoamerican traits to the present.

#### **Comparison of Y-chromosome and mitochondrial genetic diversity in Panamanian Amerinds.**

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Differential modes of inheritance between the Y chromosome and the mitochondrial genome enable one to test for sex-based differences in evolutionary history. Different marriage practices may leave a distinct genetic signature that is independent of other cultural traditions, shared ancestry or linguistic affiliation. Specifically, matrilineal marriage practices (husband moves to wife's house) may result in increased Y variation and decreased mitochondrial variation while patrilineal practices may result in the opposite pattern of variation. In this study, we compare Y-chromosome and mitochondrial variation in four groups of Panamanian Amerinds: Chibcha-speaking Ngöbé (n=32) and Kuna (n=26) and Chocopeaking Emberá (n=22) and Wounan (n=19). The Ngöbé, Emberá and Wounan practice patrilineal marriage customs, while the Kuna group is matrilineal. Seven Y-chromosome STRs (DYS19, DYS388, DYS389-I and II, DYS390, DYS391, DYS392, DYS393) were amplified in two multiplex reactions. Mitochondrial D-loop sequence data were collected on larger sample sizes in a previous study.

Y-chromosome haplotype diversity was lowest in the Kuna (0.8615) and slightly higher in the patrilineal groups, Ngöbé (0.9012), Emberá (0.9177) and Wounan (0.9649), although the differences were not significant. Mitochondrial diversity was lowest in the Kuna (0.59), intermediate in the Ngöbé (0.76) and highest in the Emberá (0.94) and Wounan (0.91). The distribution of mitochondrial variation is consistent with differences in marriage practices among these groups. The lack of significant difference in Y variation, despite high levels of diversity in the assayed STRs, suggests that other processes may be influencing Y-chromosome variation in these groups.

#### **Social network structure and human/HIV coevolution.**

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The microevolution of sexually transmitted pathogens results from both the evolutionary mechanisms of the pathogen and the social behavior of the host. Nevertheless, attempts to understand patterns of HIV-1 genetic variation among human hosts have generally assumed that the host population mixes randomly. Here I simulate eight types of dynamic sexual networks whose general features are derived from insights of sexual network studies: one panmictic population, four assortative mixing populations, two core-periphery populations and one bridge (commercial sex worker / client / client's wife) population. Network simulation is accomplished using exponential random graph modeling (ERGM), a general framework adopted from social network analysis that allows for statistical inference and simulation of arbitrarily complex dependence patterns among social relationships. HIV transmission and evolution are then simulated within these networks using a model for HIV evolution that incorporates elements of the virus's complex intrahost dynamics. Resulting phylogenetic trees are analyzed using 'skyline plot' methods (Pybus 2000), which allows for a coalescent-based maximum likelihood estimate of effective population size at all points in the past. Existing parametric models for population growth are found to fare well when applied to viral sequences from a randomly mixing human population, but rather poorly from populations with more realistic patterns of sexual partnering, often overestimating current host populations by one or more orders of magnitude. Implications for HIV epidemiology are discussed, along with a

discussion of ERGM as a potential tool for better integrating human social dynamics and pathogen phylogenetics in the study of human pathogen co-evolution.

#### **Selective forces and size change in the evolution of sexual size dimorphism in primates.**

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Presented here is a new synthetic quantitative genetics model based on 1) Lande's (1980, 1981) model for the response of continuous characters to selection and 2) Bulmer's (1971) model for the reduction of additive variability due to directional or stabilizing selection. This iterative selection model describes the effects of selection on dimorphism and sex-specific relative variation of size over multiple generations. It also detects whether populations have recently undergone selection for size increase or decrease. The model was used to investigate the evolution and maintenance sexual size dimorphism (SSD) in 103 populations of 67 species representing the major radiations within the Order Primates. Cross-specific analyses of indices of 1) sexual size dimorphism and 2) sex differences in relative variability of body mass used phylogenetically independent contrasts to evaluate relationships within primate radiations.

Some radiations demonstrate violations of Cope's Rule (increase in size through an evolutionary lineage) and Rensch's Rule (positive allometry of size dimorphism). For example, the *fascicularis* group of macaques is shown to have undergone dwarfing since its divergence from other macaques, and dimorphism is negatively correlated with size in these populations. Consideration of patterns of size decrease across primates suggests that natural selection may play a larger role in generating differences in sex-specific selection pressures than previously thought. These findings suggest that reconstructed behavior of fossil primates inferred from dimorphism data alone may be missing an important component affecting size dimorphism: the relative contributions of sexual and natural selection pressures. Supported by NSF Dissertation Improvement Grant BCS-0137344.

#### **Genome-wide linkage analyses of human stature in pedigree samples from different ethnicities.**

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gero<sup>1</sup>. <sup>1</sup>Southwest Foundation for Biomedical Research, <sup>2</sup>Medical College of Wisconsin, <sup>3</sup>University of Texas Health Science Center San Antonio, <sup>4</sup>Wright State University School of Medicine.

Height is enormously variable in our species, ranging from less than 50 cm in some dwarfs to five times that height in some NBA basketball players. Our stature is undoubtedly determined by the interplay of environmental and genetic factors. A dramatic reminder of the importance of nutrition and other aspects of our surroundings is provided by the shortness of medieval bed frames or the low height of doors in many old buildings. However, if one accounts for change in height over generational time and for sexual dimorphism in height, then the importance of our genetic make-up becomes readily apparent: Heritability estimates in many ethnic groups suggest that most of the remaining phenotypic variance is due to genetic variation among us. Little is known about the individual genetic components, however. Multiple genes are certainly involved, but it is unclear whether the number of genes is large, with each gene having a negligible effect by itself, or whether a few genes have a substantial influence individually. Modern technology finally allows us to attempt to distinguish between these two hypotheses by conducting genome scan experiments. We will present the results from linkage scans in multiple samples, comprising over 8,000 phenotyped and genotyped individuals combined. While it appears that individual loci influencing height can be identified, the importance of these loci may vary by ethnicity. It is also apparent that variation in a single gene does not by itself account for a large proportion of our genetic variance in height.

**Tuberculosis in Inuits from Pt. Hope, Alaska: A possible maritime resource connection.**

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Of all infectious diseases in the world today, tuberculosis (TB) remains the number one killer. Investigating the types of human groups infected by TB provides a greater understanding of this disease. Information is especially limited for prehistoric human foragers who occupied remote and harsh environments, such as Alaskan Inuits. This paper reports on recent analyses documenting TB in pre-contact Inuit skeletons from Pt. Hope, Alaska, and presents a new hy-

pothesis for its introduction into this population.

The Pt. Hope Inuit collection comprises a large skeletal sample (n >500) divided into Ipiutak and Tigara components. Of the two groups, only the Tigara display lesions associated with tuberculosis. Larger numbers of Pt. Hope Inuits most likely had TB, as skeletal manifestations generally occur in only severe cases.

While researchers recognize that TB was present in the pre-Columbian Americas, it is thought that TB was introduced to Inuits through European contact. We propose that Pt. Hope Tigara contracted TB after they shifted their subsistence behavior towards hunting marine mammals. Recently, it has been established that Arctic marine mammals carry TB. Close contact with these animals may have provided a transmission vector. Meat eaters are also more susceptible, especially if the meat from an infected animal is eaten raw or undercooked, a situation ethnographically documented for Inuits. Given the maritime hunting lifestyle of the Tigara and the presence of TB in Arctic mammals, it is reasonable to think that pre-contact Inuits contracted TB from contact with animal hosts rather than Europeans.

**Fracture patterns in drivers and front passengers of automobile collisions.**

H. Gray. Dept. of Anthropology, University of New Mexico.

Distinguishing drivers from passengers is of forensic significance in terms of reconstructing the sequence of events in automobile accidents. However, this can be difficult if there has been a relatively long postmortem interval. Perimortem fracture patterning is a potentially useful way to distinguish drivers from front-seat passengers. The presence of a steering column has implications for chest injuries. The greater permanency of bone fractures facilitates more systematic data collection, compared to soft tissue characteristics. Skeletal elements also are affected less by post-accident taphonomic changes. It was predicted that, due to differences in vehicle structure, there would be many differences in fracture patterning between drivers and passengers.

Included in this study were human remains at the Maxwell Museum of Anthropology, as well as autopsy reports from the Office of the Medical Investigator (Albuquerque, NM). The data included adults who died as a result of vehicular accidents involving cars, SUVs, and pickup trucks. Burned human remains

and back-seat passengers were excluded. Presence/absence data were collected from approximately 300 deaths, divided equally between drivers and front-seat passengers, from the last 3 decades. Bones were grouped for analysis by anatomical region (head, trunk, left and right upper limbs, left and right lower limbs). Patterns were recognized from the distribution of fractures. Statistical analyses, including chi-square and T tests, were used to detect differences between frequency of injury to each anatomical region of drivers and passengers. Results indicate that there are fewer statistically significant differences in fracture patterning between drivers and front passengers than expected. There is little difference in patterning in the head and trunk regions between drivers and front-seat passengers.

**Human male testosterone variation viewed within a framework of mating and parenting effort.**

P.B. Gray. Division of Endocrinology, Metabolism and Molecular Medicine, Charles Drew University of Medicine and Science.

Energetic factors affecting human male gonadal function have consequences for long-term growth, maintenance of skeletal muscle and other outcomes. However, because the ultimate constraint on male reproductive success tends to be access to females, we should expect human male gonadal function to be highly sensitive to social cues. We should expect elevated male testosterone (T) levels associated with male-male competition and reproductively available females but lower T associated with affiliative pair bonding and direct paternal care. In these ways, variation in male T levels may reflect differential allocation to mating and parenting effort. I discuss human male T data, some of which colleagues and I have collected, that variation in T levels supports these expectations. I highlight the recent findings from Kenyan Swahili men in which monogamously married men had comparable T levels as unmarried men, polygamously married men had higher T levels than other men, and there was a trend toward fathers of younger children having lower evening T levels.

**The dynamic actions of the human fibula.**

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The fibula is known to provide stability to the lateral boarder of the talocrural

joint. Yet, the fibula extends beyond this joint in its articulations with the tibia. The proximal fibula has a synovial joint, which implies that some movement occurs. The distal fibula articulates with the tibia via a syndesmosis, which implies a restricted range of motion. These joint morphologies seem contradictory for the fibula should not be able to move at one joint without also moving at the other. This presentation will describe the movements that occur at these joints.

Data collection is based on a series of *in vitro* experiments. Muscles were removed from a leg of 24 human cadavers, so that only ligaments would restrict movement. An optical tracking system (Optotrak, Northern Digital Inc.) was used to monitor the position of the fibula relative to the tibia during manipulations of the foot and ankle (Plantarflexion/Dorsiflexion, Inversion/Eversion and Medial/Lateral Rotation). Our results show that the fibula does not accommodate ankle motions in the way that is described in most textbooks. For example, the fibula responds to maximum dorsiflexion almost exactly the same way it moves in response to maximum plantarflexion. Our investigation also shows that the ends of the fibula move independently. Consequently, the fibular shaft experiences torsional and compressive stresses during ankle movements. The fibula effectively acts as a shock absorbing spring. The synovial proximal tibiofibular joint appears to serve as a release mechanism by moving in response to stress on the fibula rather than as a direct response to muscular action.

#### **Mitochondrial sequence variation in the Canadian Mohawk.**

K.S. Grennan, D.A. Merriwether. Department of Anthropology, Binghamton University.

We compare control region variation between mitochondrial sequences from the Mohawk of east-central Canada and published contemporary and ancient North American sequences. The sample consists of 170 individuals, collected during the 1970s. Mitochondrial DNA was extracted from plasma and sequenced. Results from this sample so far indicate it contains a high percentage of haplogroup A, with a correspondingly low percentage of haplogroup D. This sample is particularly valuable because there are few such large samples of Native North Americans. We put the population into phylogenetic context using Bandelt Median Joining networks for each observed haplogroup.

#### **Cross-sectional geometry of the human forefoot.**

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Many aspects of human foot morphology have been related to function during bipedal postures and locomotion. However, little is known about the cross-sectional geometry of the foot, despite its potential for investigating loading regimes in extant and fossil taxa. This study examines variation in, and scaling of, cross-sectional properties across the human forefoot, especially in relation to plantar pressure data.

We CT-scanned the midshaft and collected external metrics of metatarsals 1-5 and hallux proximal phalanges from a sample (n=40) of African American and Caucasian males and females (Terry Collection, Smithsonian Institution). We estimated body mass using bi-iliac breadth and femoral length. Cross-sectional properties were obtained using a Scion Image macro (Ruff and DeLeon, pers. comm.).

Cross-sectional area is negatively allometric relative to body mass ( $r^2=0.385$ ,  $p=0.004$ ), whereas dorsoplantar bending rigidity (Ix) scales isometrically with body mass ( $r^2=0.63$ ,  $p=0.0$ ) and metatarsal length ( $r^2=0.589$ ,  $p=0.0$ ). Metatarsal distal articular area correlates with body mass ( $r^2=0.124$ ,  $p=0.013$ ), but not cross-sectional area ( $r^2=0.0$ ,  $p>0.5$ ). Cross-sectional area, and area/metatarsal length, vary significantly (" $>>$ ") across metatarsals, in the following order:  $1>>5>>4\sim 2\sim 3$ . This contrasts with published magnitudes of plantar peak pressures at the metatarsal heads ( $2>3>1>4>5$ ) during walking. The lack of correspondence between external pressure data and cross-sectional strength presents a caveat for interpreting the functional significance of these cross-sectional properties, thus indicating a need for further research in the area of human forefoot mechanics.

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#### **Asymmetry of three deciduous teeth and their replacements in the Gullah.**

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In this study, deciduous teeth and their permanent successors were used to test

two related hypotheses about dental asymmetry. First, because deciduous teeth form more quickly than permanent teeth, it was predicted that the former would exhibit less asymmetry than the latter. Second, and based on similar reasoning, it was expected that because of their relatively shorter crown formation spans, the teeth of females would be less asymmetric than those of males.

To test these hypotheses, dental casts from a single Gullah population were used and bucco-lingual measurements taken. For deciduous teeth, the total number of antimeric pairs ranged from 63 for the maxillary M2 to 69 for the maxillary M1; for permanent teeth, the number of antimeric pairs ranged from 69 (males, lower P2s) to 82 (females upper Cs). A two-way mixed model ANOVA was used with repeated measurements. Three kinds of asymmetry were evaluated: antisymmetry, fluctuating asymmetry, and directional asymmetry. Repeatability was also calculated, to determine the degree of accuracy gained by repeated measurements.

The sample as a whole shows no antisymmetry but for some teeth, exhibits significant directional as well as fluctuating asymmetry. The deciduous teeth do not uniformly exhibit less asymmetry than their permanent successors; likewise the permanent teeth of females do not uniformly exhibit less asymmetry than those of males. While our results overall reject the stated hypotheses, they must be viewed cautiously, because they are based on a single population that exhibits relatively high asymmetry.

#### **Changes in human brain-and skull during growth.**

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Changes in brain morphology during growth can indicate some aspects of brain evolution in hominids, in particular if changes on brain morphology are related to modifications of skull. The aim of our work is to characterize brain and related skull changes from the postnatal period to adulthood.

MRI examination of 72 girls and 127 boys whose age range from 2 postnatal months to 21 years were analyzed. Measurements of distances and surfaces were performed on the midsagittal sec-



tion. To fit data, a non-parametric flexible model, the cubic spline method, was employed. In this method, successive third-degree polynomials are sliced together such that the resulting curve is continuous and smooth. A smoothing parameter ( $\lambda$ ) allows to choose the degree of flexibility of the resulting curve. Spline fits were computed separately for boys and girls.

Results suggest an evident slowing down of the growth rates between 2 and 3 years in all variables. A slight time lag is observed between boys and girls, boys having their peak of growth earlier than girls.

Previous studies on brain growth have reported a steady low growth rates in humans. However, they did not include children less than two years old. The high growth rate in the postnatal period and the slowing down of the growth rates between 2 and 3 years would suggest that main characteristics of human brain are established early after birth.

#### **Comparing ontogenetic trajectories of *Homo*, *Pan* and *Australopithecus africanus*.**

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Evolutionary change of ontogenetic trajectories can involve size, shape, or the relation between shape and size. We study differences of growth trajectory among *Homo*, *Pan*, and *A. africanus* by a method accommodating all three of these components. Three-dimensional coordinates of 191 anatomical landmarks and semi-landmarks on ridge curves and the neurocranial surface were measured on a cross-sectional sample of dried skulls of both sexes varying in age: 52 *H. sapiens*, 48 *P. paniscus*, and 49 *P. troglodytes*.

In order to reconstruct the outer neurocranial surface of Taung (which is missing almost completely, while parts of the endocranium are preserved) by thin plate spline warping, we also located several hundred endo- and ectocranial landmarks and semilandmarks on CT scans of four carefully selected specimens: the Taung I cranium, an infant *H. sapiens*, an infant *P. troglodytes* (all with erupted upper M1) and STS 5. The resulting three reconstructions were sufficiently similar that the choice of the reference specimen does not alter conclusions from the following analysis.

A principal component analysis of Procrustes coordinates demonstrates that in shape space the Australopithecine ontogenetic trajectory (based on Taung and

STS 5) lies roughly parallel and intermediate between the trajectories of *H. sapiens* and the two chimpanzee species. In size-shape space, however, the Taung cranium lies very close to the chimpanzee specimens, indicating an evolutionary dissociation of size and shape. We detail these findings in separate analyses of the face and braincase and discuss the implications for evolution of human ontogeny and for elucidating the familiar adult cranial shape differences among these species.

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#### **Maternal energy status during pregnancy and birth outcomes in Tanzania.**

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The energetic demands of pregnancy can be very high and often force pregnant women to adopt physiological and behavioral strategies to minimize adverse outcomes for themselves, the developing fetus, and their current children. In this paper, we argue that when the increased demands of pregnancy overlap with low food availability and increased workloads the result is low pregnancy weight gain and elevated risk of producing low birth weight infants. This scenario is common across many subsistence economies, particularly those with highly seasonal environments. We then use cross sectional anthropometric data collected from two Tanzanian ethnic groups to test for associations between period of the year born and current nutritional status. In support of the hypothesis, children who spent their third trimester during periods of the year typically characterized by low food availability and increased maternal workloads were more likely to be nutritionally stunted ( $n=739$ ) and, after controlling for several factors, underweight ( $n=937$ ). Moreover, the evidence suggests that little catch-up growth occurs, and growth deficits are evident even in the oldest group of children. These results are consistent with the hypothesis that the fetus is developing under poor nutritional conditions, and that this can have lasting effects on children's health and well being.

#### **A multivariate analysis of the postcranium of KNM-ER 3735 (*Homo habilis*).**

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Upper-to-lower limb proportions of *Homo habilis* are said to be more ape-like than in its reputed ancestor, *Australopithecus afarensis*. Comparisons are, however, complicated by the fragmentarity and small body size of the OH 62 specimen from Olduvai as body proportions of small-sized modern humans and chimpanzees overlap. A second partial skeleton, KNM-ER 3735 from East Turkana, Kenya, represents a larger individual, but is also fragmentary. Nevertheless, Leakey *et al.* (1989) found body proportions that differed significantly from modern humans, based on a single human and chimpanzee skeleton. In the present study, however, a multivariate analysis places both KNM-ER 3735 and AL 288-1 at the periphery of modern humans and away from great apes, yet at different positions. Compared to femur and tibia midshaft, the sacrum basis is smaller than in modern humans but close to the mean of African great apes, the spina scapulae is more robust than that of most humans, whereas the humerus fragment as well as radius head and shaft dimensions are average-sized for modern humans. The distances of the foramen nutricium and tuberositas radii suggest a distinctly longer forearm than in humans, corroborating earlier findings based on OH 62 of human-like humero-femoral but chimpanzee-like brachial proportions. The two proximal hand phalanges are not relatively more robust than those of modern humans if they are rays III and IV/II. This mosaic of human- and pongid-like characteristics might indicate that *Homo habilis* still relied partially on trees.

#### **Megadontia and bipedalism: Did habitual bipedalism evolve in early hominids to reduce the energetic costs of increasing head weight?**

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Early australopithecines are distinguished from apes by large postcanine dentitions, robust mandibular corpora, reduced canines, and habitual bipedality. With chimp-sized brains, the large chewing apparatus of *anamensis* and *afarensis*—including a likely increase in chewing muscle mass—suggests a larger head to body weight ratio among early australopithecines relative to their ape ancestors. In a quadruped, increasing head weight would have increased energy expenditure

in neck muscles, and would likely have necessitated larger neck muscles. Habitual bipedalism reduces these costs by balancing the heavier head over the spine, and by permitting the evolution of smaller, 'cheaper' neck muscles, compensating for the larger, more 'expensive' chewing muscles. Although larger chewing muscles would have increased canine puncturing ability, weak neck muscles may have made fighting with canines impractical because the weakly supported neck would have been vulnerable to injury when large forces were applied to the head during a fight. The evolution of reduced canines should then follow the evolution of smaller neck muscles.

A strategy of reducing the costs of transporting a heavy head by balancing it atop the spine may have been open to apes but few other mammalian clades because (1) apes were facultatively bipedal, and thus pre-adapted for habitual bipedality, (2) apes had grasping forelimbs, allowing an habitual biped to bring food to its mouth, and (3) the rich social intelligence of apes may have allowed the evolution of mutual care to buffer the costs of foot and leg injuries which are particularly devastating to an habitual biped.

**The spindle neurons of fronto-insular cortex (area FI) are unique to humans and African apes.**

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Von Economo described a class of elongated bipolar cells, the spindle neurons, in layer 5 of area FI, which is located in the posterior part of orbitofrontal cortex. After close examination of the orbitofrontal and insular cortex in 25 primate species, we have found that the spindle neurons are present only in humans and African apes. We found area FI containing spindle neurons in humans, gorillas, chimpanzees and bonobos. We were not able to detect spindle neurons in the Asian apes (orangutans and gibbons), nor were we able to find them in Old and New World monkeys or in prosimians. Since humans and African apes comprise a monophyletic group, the spindle neurons in FI are likely to be a derived specialization within this group which originated about 10 million years ago. We have used stereological sampling to determine the number of spindle neurons in FI in humans and African apes. The FI spindle neurons are 5 to 40 times more abundant in the adult human than in the apes. The FI spindle

neurons are about 24% more numerous in the right hemisphere of both humans and apes. Functional imaging studies indicate that area FI is activated by situations involving uncertainty, incongruity, infant cries, embarrassment, guilt, resentment, and deception. We suggest that the spindle neurons may relay to other parts of the brain a signal related to the commission or recognition of error, particularly in social behavior, and may participate in the mounting of adaptive responses to errors.

**Therapeutic effects of Bach Flower Essences: A double-blind analysis.**

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Bach Flower Essences®, the distilled and diluted products of 38 flower species, have been orally and topically administered since 1930 for biomedical and psychological disorders ranging from insomnia to diabetes, hypertension, depression and back pain. Few scientific studies have been conducted on the effectiveness of these nontoxic, over-the-counter homeopathic preparations, however. In the present investigation the Bach "Rescue Remedy"®, a frequently prescribed combination of the derivatives of five plants, was tested over a 3-hour period against a placebo in a double-blind analysis of stress reduction in a sample of 111 Individuals aged 18-49. No statistically significant differences were observed in a comparison of treatment versus control groups with respect to pre- and post-test results of a standardized instrument that evaluates stress level. Since both sub-samples exhibited a downward trend in scores of stress indicators, the placebo effect was likely operating in each set of subjects. Demographic characteristics—gender, age, body weight, population affiliation, etc.—were not correlated with test results.

**Subadult growth in prehistoric Southeast Asia.**

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Infant and child growth are sensitive barometers of a population's health. The study of subadult growth is assessed in archaeological samples using linear and more recently appositional bone growth. Recent research in prehistoric Southeast Asia indicates that patterns of health changes do not adhere to the general bioarchaeological model that posits a de-

cline in health with the origins and intensification of agriculture. This paper, a part of a more comprehensive synthesis of subadult health and disease aiming to address this issue, presents the results of a comparative study of subadult linear and appositional bone growth from five Thai samples. These samples are from two different geographical locations and span from the early agricultural period to the late Iron Age. The aim of this study is to assess what effects, if any, environmental differences and cultural changes, including the intensification of agricultural practices, had on growth. Previous research has found morphological differences among the inhabitants from the early agricultural site in central Thailand and later Northeast sites. This study offers the opportunity to investigate these findings further.

Results show no differences in linear growth among the samples. There is a pattern of reduced appositional bone growth in the later sites compared to the early agricultural site. However this could be affected by small sample sizes. A cortical thickness increase with age in all samples indicates the absence of severe nutritional deficiencies. Implications of these results for the bioarchaeological model of health change are discussed in the context of the prehistoric Southeast Asian natural and cultural environment.

**What does the human biological perspective suggest concerning migration routes into the Americas?**

R. Hall. Dept. of Anthropology, Oregon State University.

Recent research on climate following the Last Glacial Maximum at 20,000 yr B.P. provides a framework for developing realistic models of routes for human migration into the Americas from Northeast Asia and the optimum timing of their use. Both the interior route through central Beringia and the coastal route along southern Beringia require physiological adaptation to cold, but the coastal route was less arid and temperatures were not as severe. Palynological studies in the Queen Charlotte Islands indicate the presence of coastal refugia from at least 16,000 B.P. on, with steadily increasing moisture levels. Published data on limb length and femur/tibia proportions suggest the lack of cold-adaptation in the earliest American populations. Nasal morphology is another key complex that indicates whether a population has achieved genetic adaptation to cold, arid conditions. I measured crania in skeletal samples from contemporary cold-adapted and heat-adapted

American native populations for comparison with published measurements on prehistoric Asian skeletal material and the earliest skeletal remains from the Americas. These comparisons suggest that optimal nasal adaptations to cold, possessed by contemporary Arctic and sub-Arctic populations, did not characterize the North Asian populations of 16,000-11,000 years ago who made the migrations. From an adaptational perspective, the coastal route appears more amenable than the interior route.

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#### **Metastatic carcinoma: Skeletal pattern and diagnosis.**

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The modern skeleton of a 62 year-old White female diagnosed with metastatic carcinoma (primary site – breast) never receiving chemical, hormonal or radiation therapy is examined. Confirmed clinical diagnosis, lack of medicinal intervention and quality of skeletal preservation make this specimen a possible pathognomonic standard for metastatic carcinoma and differential diagnosis of idiopathic dry bone in paleopathology. We detail gross and radiographic bone response to this disease and differentially diagnose the skeleton against Langerhans cell histiocytosis and multiple myeloma, neoplastic conditions capable of modifying bone in characteristic patterns that may mimic metastatic carcinoma.

#### **Patterns of genomic variation in the Baining of New Britain in relation to other world populations.**

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The Baining are a Papuan-speaking population that inhabits the Gazelle Peninsula of New Britain, a volcanic region that has been repeatedly depopulated as a result of a number of recent and prehistoric eruptions. To explore the demo-

graphic history of the Baining population we have undertaken a DNA sequencing survey of mitochondrial COIII,  $\beta$ -globin and two X-linked loci (APXL and DMD44) in a sample of 50 Baining males. Patterns of variation at these four loci were compared with those from the same four loci sequenced in a similar sample from five other world populations, as well as a panel of 41 globally sampled males. The average level of nucleotide diversity across loci in the Baining was the lowest ( $p = 0.082$  for the three nuclear genes) of all five populations (global  $p = 0.119$ ). Interestingly, there was an excess of common polymorphisms in the Baining for mtDNA (Tajima's  $D = 0.65$ ,  $P > 0.10$ ) and Dmd44 (Tajima's  $D = 1.76$ ,  $0.05 < P < 0.10$ ). All other populations had a negative Tajima's  $D$  for mtDNA and the Dmd44, and the Baining had the only statistically significantly positive  $TD$  value in this study. These patterns of variation are consistent with the hypothesis that that Baining have experienced a series of reductions in population size during their evolutionary history.

#### **Muscle-bone interactions in a mouse gene knockout model: implications for functional analysis of the primate postcranial skeleton.**

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Comparative approaches have frequently been utilized to identify form-function relationships in the primate limb skeleton. Here we describe an experimental approach for investigating the factors influencing skeletal form and function in small (<100 g) mammals such as small-bodied primates. We have analyzed skeletal morphology and osteogenesis in mice with targeted disruptions in genes encoding proteins affecting muscle size and strength. Mice lacking myostatin (GDF8) were used to investigate the effects of increased muscle mass on bone morphology. Myostatin is a negative regulator of muscle growth and mice lacking myostatin function show a 50-100% increase in skeletal muscle mass. We used microarray technology to monitor gene expression in mouse femora and results indicate that genes involved in osteogenesis (e.g., osteocalcin) are up-regulated over 3-fold in the knockout mice. pQCT densitometry was used to measure bone mineral content (BMC) and density (BMD) at the midshaft and the distal metaphysis of mouse femora. Femora of myostatin-deficient mice show significantly increased BMC and BMD at the midshaft

due to increased endosteal bone formation, and this increase is similar to that observed in normal mice after 20 days of exercise. BMC does, however, show a much greater (15-25%) increase at the distal femoral metaphysis than at the midshaft in both normal and exercised mice. These findings indicate that the bones of small mammals are quite responsive to alterations in physical activity and muscle mass, and that comparative functional analyses of bone architecture in metaphyseal regions may be more informative than studies of mid-diaphyseal bone geometry.

#### **A phylogenetic comparison of oxidative damage to DNA across European mitochondrial haplogroup clades.**

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Reactive oxygen species (ROS) produced as byproducts of energy production in mitochondria are associated with aging, and heritable differences in the proteins encoded by the mitochondrial genome might influence the amount of ROS produced. Transversions at the nucleotide guanine are associated with oxidative damage to DNA in vitro.

We analyzed published mtDNA sequences from 561 individuals of European descent to test the null hypothesis that all the haplogroup clades (H, J, K, T, U, V, and WIXZ) have experienced equal proportions of ROS-associated nucleotide substitutions during their evolutionary histories. We used Bayesian analysis with Markov chain Monte Carlo to estimate 991 phylogenetic trees for each haplogroup clade; then we estimated the occurrence of each type of character state change for each tree using maximum parsimony character state reconstruction. We compared mean ratios of ROS-associated character state changes to total changes across haplogroup clades using a Kruskal-Wallis test, and found that mean ratios differed across haplogroups, (Chi Square=6310,  $p < 0.001$ ,  $df=6$ ). The mean estimated ratio was lowest for haplogroup H (mean rank=496) and highest for the haplogroup clade WIXZ (mean rank=6372). Haplogroups J and U, previously associated with longevity, had estimated proportions of transversions at guanine more than twice as high as those for haplogroup H. These results suggest that transversions at guanine have occurred at the lowest rate in haplogroup H, and at the highest rate in haplogroup

clade WIXZ. These differences might result from selection for mitochondrial genetic variants that influence the rate of release of ROS across haplogroups.

**Craniofacial variation of prehistoric and recent populations from Far East, Oceania, and New World: Model-free and model-bound approach.**

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Metric and nonmetric craniofacial variation of the prehistoric and recent populations from eastern Asian and circum Pacific regions was analyzed. In both metric and nonmetric analyses, two major clusters are indicated, one containing all the East/Southeast Asian and Oceanian cranial series, and a second that includes the series from Northeast Asia, Arctic and New World. One of the differences between the results of metric and nonmetric analyses is the affinities of the prehistoric Jomon people and recent Ainu. In metric analyses, they are plotted at an intermediate position between East and Southeast Asians. In nonmetric analyses, on the other hand, Jomon and to a lesser degree Ainu occupy a distinct and separate branch. It is a matter of interest, moreover, that Ainu shows some association with the Native American groups. Model-free biological distances presented here can be interpreted as reflecting genetic drift, gene flow, natural selection, and/or common ancestry. For determining which combination of these factors is responsible for a given set of such distances, we applied model-bound analyses. The results obtained suggest that the Jomon and Ainu may have retained the late Upper Paleolithic features in eastern Asian region to a greater degree than others.

**Vertical climbing kinematics in specialized and generalized prosimians: Implications for morphology and performance.**

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Although all primates climb vertically, only some possess morphological specializations that may be related to vertical climbing mechanics and energetic efficiency. Previous work on anthropoids suggests that climbing mechanics differ both among specialized climbers (Isler, 2003) and between specialized climbers and generalized quadrupeds (Hirisaki *et al.*, 1993, 1996, 2000).

The present study expands our knowledge of climbing mechanics by providing the first quantitative kinematic data on three prosimians during vertical climbing: two specialized climbers, *Loris tardigradus* ( $n=3$ ) and *Nycticebus coucang* ( $n=3$ ), and one generalized quadruped, *Cheirogaleus medius* ( $n=3$ ). Subjects were videotaped while climbing up a 3-cm wooden pole. Hindlimb step length, limb excursions, and shoulder and hip distances from the contact point were determined by digitizing each locomotor bout.

Results show that both lorises use limb kinematics that are more similar to one another than they are to *C. medius*. Lorises exhibit significantly ( $p<0.05$ ) greater hip excursions, thigh protraction angles, and overall forelimb and hindlimb angular excursions than *C. medius*. Additionally, horizontal shoulder and hip distances from the contact point (scaled to limb length) are significantly ( $p<0.05$ ) greater in *C. medius* than either lorise. Finally, *Nycticebus* has significantly ( $p<0.05$ ) larger hindlimb protraction and forelimb angular excursion than *Loris*. Maintaining relatively close proximity to the support and using large limb excursions may decrease limb stresses and improve energetic efficiency in specialized climbers.

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**Are early hominin hypodigms equally biased samples?**

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Analyses of the hominin fossil record rarely, if ever, consider whether samples of different hominin taxa are influenced by taphonomic processes relating to depositional environment or body and element size. The assumption is that the fossil evidence represents a random sample from the population. However, taphonomic research shows that fossil samples are influenced by factors such as overall body or skeletal part size and durability, predator choice, and depositional environment.

If these factors bias all early hominin fossil hypodigms in the same way, estimates of variables such as brain volume and tooth size will be inaccurate but will not necessarily affect the rank order of parameter estimates. However, if differences in body mass, tooth size, and molar size order mean that early hominin taxa are not equally affected by taphonomic influences, then the rank order of param-

eter estimates may be misleading. This is important because hominin taxonomy is influenced by estimates of these variables, and because the same estimates are used to make inferences about hominin behavior and life history.

This contribution reports the results of a preliminary investigation of taphonomic influences on Plio-Pleistocene fossil hominins from the Turkana Basin using previously published data captured in the Turkana Basin Database (Kenya National Museum and Smithsonian Institution). We focus on determining whether a) depositional environment, and b) element size have introduced significant bias into the hypodigms of hominins recovered from the region. We also address the extent to which any bias may result in misleading estimates of critical population parameters. Supported by a NSF Graduate Research Fellowship and NSF IGERT Grant No. 9987590.

**Estimating hominoid reciprocal joint congruence: A comparison of two morphometric techniques.**

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One of the central issues surrounding the analysis of hominin fossil assemblages is the allocation of skeletal elements to the correct taxon, and, in some cases, to the correct individual. One little studied approach to this issue is the statistical estimation of congruence between reciprocal joint surfaces – that is, the closeness of fit between articulating elements of a joint complex. Aiello *et al.* conducted a preliminary analysis of talo-crural joint congruence in extant hominoids, but limited statistical techniques and computing power made it difficult to address the complex 3D relationships between the joint surfaces. In this study we compare and contrast two recently developed techniques of estimating joint congruence and test the effectiveness of each technique in correctly assigning reciprocal elements at the individual and species levels.

Both techniques use three dimensional landmark and semi-landmark data collected from high resolution Laser Surface Scans of the reciprocal surfaces of the humero-ulnar component of the elbow joint. The sample consists of adult speci-

mens representing *H. sapiens*, *P. troglodytes*, *G. gorilla* and *P. pygmaeus*. The first technique is indirect, and uses Partial Least Squares (Bookstein, 2003) and matching by discriminant analysis to assess to what degree two surfaces covary. The second technique is a direct measure of congruence, and is based on the overlap ratio between the two surfaces throughout the range of the joint's motion.

Results show that both techniques confidently assign reciprocal elements at the taxonomic level, and that further refinement will provide a useful tool in matching unassociated skeletal elements. Funding: NSF ACI 9982351.

### **Comparing hominoid proximal femur morphology using geometric morphometrics.**

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Using geometric morphometrics, this study compares and contrasts proximal femur shape among hominoids. As part of the hip joint, the proximal femur is an important component in locomotion. When quantified in previous work, the complex morphology of the proximal femur has been partitioned into discrete features (e.g., head, neck, greater trochanter) to facilitate conventional linear measurement. Here the proximal femur is examined three-dimensionally as an integrated whole. Seventeen landmarks are used to capture the superior, medial, lateral and posterior surfaces of over 200 adult femora of *Homo*, *Pan*, *Gorilla*, *Pongo* and *Hylobates*. Generalized Procrustes Analysis (GPA) is used to register the landmark data and adjust for the isometric effects of size.

Principal components analysis of residuals from the GPA shows that the majority of variation is between humans and apes, and in particular between humans and African apes. Humans, compared to apes, have large femoral heads that are positioned superiorly relative to short, squared-shaped greater trochanters. Another analysis that excludes *Homo* highlights the differences between African and Asian apes. African apes, compared to Asian apes, have a supero-inferiorly extensive greater trochanter. Among Asian apes, as with *Homo*, the femoral head is positioned above the superior point of the greater trochanter. *Pan* and *Gorilla* share a common proximal femur shape, whereas *Hylobates* and *Pongo* are distinct from one another. The variation among hominoid proximal femora is broadly coincident with variation in locomotor pattern. Or-

thograde posture may explain the similarity between Asian apes and *Homo*, although a non-functional explanation is possible.

### **Interregional gene flow in the eastern Mediterranean: A Cypriot melting pot?**

N.K. Harper, Department of Anthropology and Ethnic Studies, University of Nevada-Las Vegas.

Classical archaeological interpretations of population change in Cyprus cite the wholesale migration of Mycenaean Greeks into the eastern Mediterranean fleeing Doric invasions. Previous research into the relative biological relationships of Cypriot populations has shown evidence of sharp change in craniofacial morphology toward the end of the Bronze Age (circa. 1050 BC) exhibiting strong regionalism within the island (Harper and Moore-Jansen 2003, Harper 2003). For this study the cranial measurements of 384 individuals from 14 sites from Cyprus, Greece, Crete, Anatolia, the Levant and Egypt are used to address the question of admixture within Cyprus during and after the Bronze Age. RMET 5.0 (Relethford and Blangero, 1990) is used to test minimum genetic differentiation and relative biological distance and MANTEL 3.1 is used to test the effect of geographic and temporal distances in relation to the estimated biological distance. Preliminary results show regional variation within Cyprus during the Bronze Age ( $F_{ST} = 0.022$ ) and suggest that specific populations (Enkomi, Melia) remain relatively isolated while other populations within Cyprus (Kourion-Bamboula, Lapithos) share close affinity with western Anatolian and Greek mainland populations, with possible gene flow from Egypt. These results contradict the assumption that Enkomi was a cosmopolitan center harboring multiple populations and raises intriguing questions concerning the importance of Egyptian groups within Cyprus. The post-Bronze period exhibits a lower overall  $F_{ST}$  (.003) suggesting higher admixture specifically with Levantine and Greek groups. The results for the post-Bronze period are consistent with the advent of large-scale trade and colonization by Greek and Phoenician groups.

### **Effects of chorionicity on tooth size in monozygotic twins.**

E.F. Harris. Orthodontics, University of Tennessee, Memphis.

Analysis of twins—monozygotic compared to dizygotic—has provided heritability estimates for many kinds of data. The conventional perspective is that twins are of two sorts, MZ or DZ. In fact, MZ twins are heterogeneous, consisting of those that divide early—with individual chorions and amnions—and those dividing later, sharing these membranes. These later-forming MZ twins are prone to fetofetal transfusion syndrome. This study used mesiodistal and buccolingual tooth dimensions to test three assumptions of the twin model, (1) that mean crown size is the same across twin types, (2) that total variances are equivalent, and (3) that mean intrapair variances are homogeneous. Zygosity and chorionicity were known for 51 monozygotic and 40 dichorionic MZ pairs plus 65 same-sex DZ pairs. MD and BL crown dimensions were measured from the twins' dental casts. Significant differences in mean trait size were infrequent across the 28 variables, but total variances commonly were unequal between zygosities and chorion types, with greater variances in the DZ sample. So too, intrapair variances commonly were unequal. Invariably, the DZ sample was more variable. Between chorion types, the MC sample was more variable, as expected given their greater risk of greater prenatal competition. Critically, this study between mono- and dichorionic MZ twins shows that assumptions of the twin model often are violated in the battery of dental traits tested, presumably because of differences in intrauterine competition. The fundamental issue may be that twins are not representative of the bulk of the population that consists of singletons.

### **Allo-mothering in black and white colobus monkeys (*Colobus guereza*).**

T. Harris. Dept. of Anthropology, Yale University.

I studied allo-mothering, or infant handling, in black and white colobus monkeys in Kibale National Park from November 2002-October 2003. Focal sampling was conducted on two infants in the main study group and ad lib data were collected for four infants in three other groups. Over 300 bouts of infant handling were recorded. Mean handling time/bout was 0:10:10 (max 1:38:16). Adult females handled infants most frequently, followed by juvenile females. All three adult males and a subadult male in the main study group occasionally handled infants. In one case, an infant from the main study group was handled by a juvenile female from another group. Allo-mothers most

commonly rested while handling infants, followed by moving with and grooming the infant. Allo-mothers sometimes mistreated infants (19.3% of bouts in the main study group). Allo-mothers dropped infants on 5 occasions, most likely contributing to the death of one infant. Some mothers usually fed while their infants were being handled (74% of bouts for one female) while others usually rested (65% of bouts for one female) or followed allo-mothers. One mother almost never allowed her infant to be handled. The behaviors of mothers and allo-mothers varied widely between individuals and groups, making it difficult to apply a single hypothesis for the function of infant handling to black and white colobus monkeys in general.

**Neanderthal taxonomy reconsidered: Implications from multivariate models of intra- and inter-specific differences.**

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Neanderthal taxonomic status is one of the most contentious issues in paleoanthropology, with direct implications for modern human origins. Palaeontologists agree that fossil species should be equivalent to extant ones in their morphological variation. An approach using models of variation within and between living taxa is recommended to help recognize species in fossil samples. Recent studies have supported specific status for Neanderthals based on analogy to chimpanzees and bonobos (Harvati 2001) and hybridizing Sulawesi macaques (Schillachi & Froelich 2001). These taxa may not be the most relevant models. Although chimpanzees are probably the closest living taxon to modern humans, they differ greatly in their geographic distribution and ecology from Pleistocene humans. *Macaca* may be a better ecological model, but the Sulawesi species are not representative of the full geographic and ecological range of the genus.

This study used twelve extant catarrhine species (1089 specimens) as models of craniofacial variation. Fifteen 3D landmarks were collected on all specimens. Samples included: five Neanderthals; five Upper Paleolithic Europeans; seven modern human populations; all three species of African apes; the seven subspecies of *Papio hamadryas*; the two species of *Mandrillus*; and five species of *Macaca*,

including two Sulawesi taxa. A randomization procedure (10,000 iterations) was used to test whether Mahalanobis distances between Neanderthals and modern humans were greater than distances between species and subspecies pairs of model taxa. In this procedure, distance between modern humans and Neanderthals is greater than those among all nearly all modern subspecies pairs, supporting specific distinction for Neanderthals.

**The effect of parity on spinal and forearm BMD in the baboon (*Papio hamadryas*).**

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Of the 10.1 million people in the U.S. with osteoporosis (OP), more than 77% are women. Pregnancy-associated hormonal changes, calcium demands, and their effects on bone mineral density (BMD, currently the most accurate predictor of OP fracture risk) are potential contributors to this dramatic sex difference. Current knowledge of the effects of pregnancy on BMD involves ambiguous and conflicting study results. Pregnancy clearly affects BMD, but variability in study methodology and individual variation across females in apparent ability to compensate for demands on the maternal skeleton due to mineralization of the fetal skeleton contribute to inconsistent study results. Some studies indicate that higher parity (number of pregnancies) positively affects BMD in postmenopausal women, while others do not.

Baboons share physiological characteristics with humans making them particularly well-suited for studying the effects of reproductive history on BMD. In our sample of 676 olive baboons (*Papio hamadryas anubis*), yellow baboons (*P. h. cynocephalus*) and their hybrids (5.5 to 30.0 years of age) BMD (g/cm<sup>2</sup>) was assessed in the lumbar spine and the forearm via DEXA. We estimated the heritability of BMD in these baboons and examined the effect of parity on BMD. Heritability ranges from 0.18 in the ulna to 0.45 in the radius. In maximum likelihood models that simultaneously account for the mean effects of age, sex, weight, and parity, parity has a significant effect on BMD at all sites (p=0.01 to p<0.0001). The effect of parity is to lower BMD 0.0045 to 0.0068 g/cm<sup>2</sup> (0.5% to 0.8%) per pregnancy.

**Paleodemographic genetic diversity: Pitfalls and prospects.**

J. Hawks. Department of Anthropology, University of Wisconsin—Madison.

Small, fragmentary samples of fossil humans are poorly suited to any assessment of the genetic relationships of ancient populations. Here, I review the application of multivariate statistical methods to derive information about Pleistocene human population structure from phenotypic fossil data. Resampling on large sets of data from extant hominoids shows that with such methods even the best plausible datasets, with tens of characters and specimens, produce wide confidence limits that cannot distinguish whether intercontinental  $F_{ST}$  was as low as zero, or as great as the intersubspecies differences in living chimpanzees. Such a wide range of estimates does little to constrain hypotheses about ancient human taxonomic or genetic divergences.

I propose a new avenue for testing hypotheses about ancient population structure. I employ pairwise and samplewise comparisons of univariate traits to determine the minimal and maximal amounts of genetic differentiation consistent with each observed trait, in the specimens that preserve it. By comparing these fossil observations with larger samples of living hominoids across many traits, the distribution of minima and maxima allow a maximum likelihood estimate and confidence interval for  $F_{ST}$ .

Empirically, the results tend to justify the method, as the confidence limits on fossil human samples contract and uncertainty decreases compared to traditional multivariate approaches. In other words, it seems to work. But the technique lacks a strong theoretical justification, and requires problematic assumptions about the nature of variation in time-extended samples and trait covariance. These problems are extensively discussed, and will require additional work to resolve.

**Musculoskeletal stress markers (MSM) as indicators of kneeling behavior in a Byzantine Jerusalem monastery.**

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The study of musculoskeletal stress markers (MSM) as indicators of activity patterns has at times been hindered by the lack of simple, standardized scoring methods. In the current study, we have developed such a method, and applied it to markers on the innominate (n=298) and proximal femora (n=215) of an urban monastic community from 5th century St. Stephen's in Jerusalem.

We chose sixteen muscle markings, each a part of a muscle group performing one of the four major motions of the hip: extension, flexion, adduction, or abduction. Only adult males were used in this study. We selected texture and elevation as variables to measure robusticity, producing a composite score used to grade robusticity as minimal, moderate, or maximal. These data were then compared to a non-monastic rural Byzantine collection from Umm el-Jimjal, Jordan.

Fifteen of the sites examined for the St. Stephen's collection demonstrated greater robusticity than expected, indicating a group utilizing the lower limb extensively. The muscles of both the extensor and adductor groups showed significantly more ( $p < 0.05$ ) robusticity than the others. This indicates possible activity patterns including repetitive stair- or hill-climbing, horseback riding, and deep flexion of the knee. When combined with non-metric postcranial data and analysis of osteoarthritic response from the femur, tibia, talus, and calcaneus as well as the liturgical records for the site and period, a strong circumstantial case can be made for postural gestures associated with worship such as kneeling for prayer and genuflection.

#### **Mandibular and craniofacial shape in the hominid lineage: A comparative analysis using 3D-morphometrics.**

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The evolution of the hominoid face has been an anthropological puzzle for decades. Traditional morphometric methods and an incomplete fossil record have made it difficult to describe changes in absolute facial shape through time and across species. This research uses 3D-geometric morphometrics to study phenetic similarities and differences in the hominoid mandible and craniofacial skeleton. Two questions are asked of the data. Firstly, how does Miocene fossil ape and early hominid facial morphology differ from the patterns observed in the modern comparators (*Pan troglodytes* (n=20), *Gorilla gorilla* (n=20), *Pongo pygmaeus* (n=20), *Hylobates lar* (n=20), *H. hoolock*(n=10) and *H. syndactylus*

(n=15)? Secondly, how do patterns of inter-taxonomic variability differ between the craniofacial skeleton and the mandible? Results suggest that the craniofacial skeleton, particularly the upper- and mid-facial region, has high inter-taxonomic variability, while the mandible is comparatively invariant. All fossil hominoids are similar to the modern comparators in aspects of their mandibular morphology including gracility of the corpus and ramus height. Yet hominids display unique morphological variation in symphysis shape and a decrease in ramus robusticity. In the craniofacial skeleton, *Proconsul* and *Afropithecus* are most similar to *Hylobates* and not to the large-bodied African apes in their lower maxillary morphologies. Meanwhile, *Sivapithecus* demonstrates a closer affinity to gorillas than to orang-utans in both lower maxillary and mandibular morphologies. Among the hominids and as expected *Australopithecus* exhibits the most affinity with the great apes while *Paranthropus* and *Homo erectus* are the most variant from any of the modern comparators.

#### **Co-evolution of brain size and orbit orientation in primates and other mammals.**

C.P. Heesy. IDPAS/Department of Anatomical Sciences, Stony Brook University.

Primates are characterized both by similarly facing, or convergent, orbits and relatively large brain sizes. Comparative analyses of mammalian orbit orientation suggest that primate orbit convergence first evolved in a context of nocturnal visual predation. Similar analyses of the relative sizes of brain components in mammals and birds suggest that areas responsible for sensory processing are correlated with aspects of ecology, including foraging habits and diet. However, it is unknown whether mammalian orbit convergence is correlated with either the overall size of the brain or with individual brain components, such as the visual cortex and subcortical structures.

This study examines the relationship between orbit convergence, binocular field overlap, and brain size in primates and other mammals. Data on orbit orientation are combined with those on overall brain size in primates, carnivorans, chiropterans, insectivorans, artiodactyls, marsupials, and rodents taken from the literature. In addition, data on brain component volumes were collated for a subset of these taxa. Primates differ from other mammals in that orbit convergence is correlated with brain size in anthropoids, and less strongly in strepsirrhines. In other taxa

with relatively high orbit convergence, such as carnivorans and megachiropterans, orbit orientation is not correlated with overall brain size. These results suggest that there is a relationship between visual cortex size and orbit convergence that is unique to primates.

#### **Is primate hearing special?**

R.S. Heffner, H.E. Heffner. Department of Psychology, University of Toledo.

The most basic functions of audition are to detect and locate other animals, the sources of sound in the natural environment. In addition, hearing often permits identification of the source and its intentions. Because the selective pressures to carry out these functions apply to the hearing of virtually all mammals, including primates, primate hearing is consistent with the mammalian pattern.

The overriding selective pressure appears to be the localization of sound sources, which is achieved by comparing the time of arrival and spectrum of sound at the two ears. For mammals with small heads, time differences become so small that the nervous system is forced to rely on spectral differences. Spectral differences are only effective if an animal can hear frequencies high enough to be shadowed by its head and pinnae. Thus small Primates hear relatively high frequencies whereas humans do not. Nearly all vertebrates hear low frequencies (below 125 Hz), and the extent of low-frequency hearing in mammals is correlated with high-frequency hearing.

Sound localization, in turn, appears to be under selective pressure from vision to direct the gaze to unseen sound sources. Mammals with narrow fields of best vision, like most primates, appear to be under selective pressure for precise auditory localization, presumably to direct the fovea with precision. Conversely, species with broader fields of vision and visual streaks have poorer sound-localization acuity. Here, too, Primates fit the mammalian pattern.

#### **East of Eden, west of Cathay: An investigation of Bronze Age interactions along the Great Silk Road.**

B.E. Hemphill. Dept. of Sociology & Anthropology, California State University, Bakersfield.

The Great Silk Road has long been known as a conduit for contacts between East and West. Until recently, these interactions were believed to date no earlier than the second century B.C. However, recent discoveries in the Tarim Basin of

Xinjiang (western China) suggest that initial contact may have occurred during the first half of the second millennium B.C. The site of Yanbulaq has been offered as empirical evidence for direct physical contact between Eastern and Western populations, due to architectural, agricultural, and metallurgical practices like those from the West, ceramic vessels like those from the East, and human remains identified as encompassing both "Europoid" and "Mongoloid physical types."

Eight cranial measurements from 30 Aeneolithic, Bronze Age, Iron Age and modern samples, encompassing 1505 adults from the Russian steppe, China, Central Asia, Iran, Tibet, Nepal and the Indus Valley were compared to test whether those inhabitants of Yanbulaq identified as "Europoid" and "Mongoloid" exhibit closest phenetic affinities to Russian steppe and Chinese samples, respectively. Differences between samples were compared with Mahalanobis generalized distance ( $d^2$ ), and patterns of phenetic affinity were assessed with cluster analysis, multidimensional scaling, and principal coordinates analysis.

Results indicate that, despite identification as "Europoid" and "Mongoloid," inhabitants of Yanbulaq exhibit closest affinities to one another. No one recovered from Yanbulaq exhibits affinity to Russian steppe samples. Rather, the people of Yanbulaq possess closest affinities to other Bronze Age Tarim Basin dwellers, intermediate affinities to residents of the Indus Valley, and only distant affinities to Chinese and Tibetan samples.

**Breast-feeding variability in the French Modern Period: A comparison of the effects of differential social-economic status.**

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This study concerns the history of infant diet with the estimation of the duration of breastfeeding and the modalities of weaning (when and how) in the French Modern Period. Based on an intra-individual sampling strategy, stable nitrogen isotopic data were recorded from 30 children aged between birth to 5 years old. Osteological series are well-defined both temporally and spatially and were excavated from the Saint-Laurent de Grenoble Cemetery (17<sup>th</sup>-18<sup>th</sup> AD, Isère) and from the Saint-Martin-des-Champs Church (17<sup>th</sup>-18<sup>th</sup> AD,

Paris). The objective was to gain insight into the historical dietary practices of mothers related to their infants as well as to evaluate the link between breastfeeding and economic status (urban/rural context) prior to the industrialization of the 19<sup>th</sup> century AD. The analysis of the relative differences between the isotopic signals from bone samples compared to tooth samples show variability in the age of cessation of breastfeeding during Modern Period. Some children may have still been consuming breast milk into their second year, while others may have been weaned by this age. The variability in feeding practices during the Modern Period also allows us to consider the role of wet-nurses in interpreting stable isotope data.

This research was supported by Fyssen Foundation.

**Sacroiliac joint ankylosing: From evolution to paleopathology.**

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The sacroiliac joint's structure, movement and load handling are unique in relation to other joints in the body. Ankylosing of the sacroiliac joints (SIA) has been observed and reported in both the medical and anthropological literature. Nevertheless, contradictory results as to the true nature of the phenomenon exist. As the area has significant implication to both the field of paleopathology (spondyloarthropathy, DISH etc.) paleodemography (mainly aging technique) and evolution (bipedal locomotion), we set a project to define the phenomenon demographically and morphologically and shed light on its etiology. The study was conducted on 2845 skeletons from the Hamann-Todd collection CMNH. 10.5% of all individuals examined showed evidence of SIA. The phenomenon is either bi or unilateral (no side preference) and occurs mainly on the superior aspect of the joint surface. The bony bridge always develops from the ilium towards the sacrum. It is sex (12.3% in males and 1.8% in females) and age ( $r=0.985$ ) dependent and race and size independent. SIA is usually accompanied by other changes in the skeleton, although no direct relationship with DISH or spondyloarthropathy was found. Only slight changes were noticed in the cartilage of the joints with ankylosing (and therefore cannot be the trigger in the process). The study discusses the implication of the findings to paleopathology, evolution of bipedal locomotion (and erect posture) and aging methods.

**Trace element analysis of dentin: A test of the application of PIXE and Laser Ablation methods to the assessment of childhood diet from archaeologically-derived adult human teeth.**

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A feasibility study of the applicability of proton-induced X-ray emission (PIXE) and Laser Ablation analyses as a means of assessing nutritional status was undertaken as part of a larger study, which included the remains of 65 individuals. These techniques, commonly used in the material sciences, allow researchers to examine the major and trace element composition of a target sample.

While bone is remodeled over time, dental material is relatively stable once formed and can theoretically be used to assess changes in childhood health, nutritional status or dietary patterns. Given the fact that dentin should be relatively protected from diagenetic and taphonomic factors by the rather impervious nature of its enamel coating, the elemental composition of dentin ought to reflect the elements present in the local environment *intra vitam*.

Differences in the applicability of each method to the interpretation of childhood dietary patterns, difficulties encountered, and suggestions for future research are discussed.

**Dental reduction and diet in the prehistoric Ohio River Valley.**

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Post-Pleistocene dental reduction has been documented around the globe. Dietary change is a common factor in many of the selectionist models explaining dental reduction. The current study examines tooth size in the prehistoric Ohio River Valley of Indiana and Kentucky to determine if a dental reduction occurred from the Late Archaic to the Mississippian periods and, if so, to see if dietary shifts are associated with dental reduction. Data from 282 individuals are compiled from 21 sites that span from 5000 BC to AD 1400. These sites represent Late Archaic foragers, Early/Middle Woodland early horticulturalists, Late Woodland mixed-economy horticulturalists, and Mississippian agriculturalists. Previous studies have indicated that the diet became less abrasive through time in this region and also became harder from the Late Archaic to the Early/Middle Wood-



land but became much softer thereafter. Mesiodistal and buccolingual diameters were taken for all suitable permanent teeth. Occlusal area was determined using the Robustness Index correction formulae developed by Schmidt and Hill. Standard descriptive statistics, ANOVA, percent differences, and rate of change were calculated for each dental measurement to determine the degree of change between the various temporal groups.

It was found that a dental reduction occurred in the Ohio River Valley that was more pronounced in females and the maxillary molars. Dental reduction seems to parallel the transition to a less abrasive and softer diet. This study presents some evidence for an association between dietary abrasiveness and dental reduction.

#### **Neandertal lumbar lordosis and pelvic orientation.**

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The functional morphology of Neandertal pelvis has been a topic of considerable speculation and debate due to a number of unusual pelvic traits. Research has intensified with the discovery and subsequent reconstruction of the well-preserved pelvis of Kebara 2, the only Neandertal with a complete inlet. Rak (1993) has suggested that Neandertal pelvic orientation may have been different relative to anatomically modern humans, specifically that the position of the sacro-iliac joint was more posterior in Neandertals. Given the importance of the pelvis in locomotor behavior and obstetrics, this pelvic orientation would have affected locomotor biomechanics and parturition.

Pelvic orientation in modern humans is influenced also by the vertebral column curvatures created with anterior and posterior vertebral body wedging (kyphosis and lordosis, respectively). Vertebral curvatures, specifically lumbar lordosis, provide efficient balance of the torso during locomotion by allowing the torso body weight vector to pass through the biacetabular axis. Given the difficulty in assessing pelvic orientation in isolation, analysis of Neandertal vertebral curvatures can help determine the degree of lumbar lordosis and thoracic kyphosis and, therefore, Neandertal pelvic orientation.

The degree of vertebral body wedging is assessed in the two Neandertals, i.e., Shanidar 3 and Kebara 2, preserving relatively complete vertebral remains. Comparative analyses are made to pre-contact

Inuits (n = 123) from Pt. Hope, Alaska. Results show that these two Neandertals do not exhibit the degree of lumbar lordosis seen in the Pt. Hope Inuits, suggesting that Neandertal pelvic orientation may have had subtle differences relative to recent modern humans.

#### **An exploratory study of the nutrition transition in rural Costa Rica.**

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Increased consumption of high fat and carbohydrate dense foods along with decreased physical activity are leading to rising rates of overweight and obesity worldwide. This is particularly so in Latin America, where between 35% and 68% of the population is considered obese or pre-obese, depending on the country and region. Beginning in the 1970s, there was a health transition in Costa Rica which resulted in significant declines in infant mortality, under-nutrition, and infectious disease. The shift away from infectious disease to chronic disease and the notable nutrition transition in Costa Rica has resulted in a growing concern over the development of obesity-related diseases. For example, recent studies have documented a high prevalence of overweight and obesity among elementary school children and coronary disease risk factors among Costa Rican adolescents (Nunez-Rivas et al. 2003, Monge and Beita 2000).

Here we present the preliminary findings from an exploratory study on the food consumption patterns and nutritional status among women and children (7-12 y) living in two communities in the Monteverde Zone of Costa Rica. This mountainous area is characterized by a growing economy which is based on tourism. Two communities will be compared, one is centered in main tourism area and the other is located in an area in which the economy is more dependent upon agriculture. Previous research conducted as part of the Monteverde Institute summer field school in community health show a high prevalence of risk for obesity and obesity for children and adults, respectively. Moreover, very preliminary findings from this study suggest that the high cost of food (e.g., fruits and vegetables) may have an influence on food consumption patterns and nutritional status. The findings from this study will be used to better understand the impact of globalization on health in a rural area.

This project is funded by a grant from the Globalization Research Center and a Presidential Young Faculty Award from the University of South Florida.

#### **Head kinematics during locomotion in a gibbon and Japanese macaques.**

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This study examined head rotation and translation during locomotion in Japanese macaques (*Macaca fuscata*) and a gibbon (*Hylobates lar*). Subjects walked on a level surface at their preferred walking velocities bipedally (both species) and quadrupedally (only Japanese macaques). Head movements in the sagittal and transverse planes during locomotion were determined using a video-based motion analysis system.

The results showed that the head of the Japanese macaques oscillated vertically and laterally at frequencies corresponding to step and stride frequencies, respectively, during bipedal walking. Head rotations were essentially compensatory for head translations; the head pitched down when its position was high, and rotated right when it translated left. These well-coordinated head movements were likely to maintain the stability of the gaze. The frequencies and magnitudes of linear acceleration of the head were well above the threshold for activating the linear vestibulocollic reflex, suggesting that this reflex could induce the head rotations. No significant difference between bipedal and quadrupedal walking in the macaques was found except for the averaged head angular position, which showed that the head forward-tilted more during quadrupedal walking. The gibbon also showed coordinated head motions during bipedal walking, although their amplitudes were slightly larger than those of the Japanese macaques. The fact that the coordinated head rotation and translation were observed both in the two species and both during bipedal and quadrupedal walking suggests that the head movements during locomotion be well regulated in the manner of "top-down" control over the species, despite the different limb motions.

#### **Y chromosome genetic variation in Tanzanian populations: Implications for modern human origins.**

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Evidence from genetic, paleobiological, and archaeological studies suggest that East Africa was the likely site of origin of early humans and the source of migration of modern humans across the globe. Tanzania is a region of tremendous genetic, linguistic, and cultural diversity, containing populations speaking languages belonging to the four major language families spoken in Africa – Afroasiatic, Nilosaharan, Niger Kordofanian, and Khoisan. Populations speaking Cushitic and Nilotic languages are thought to have migrated into Tanzania from the Sudan, Ethiopia, and Kenya within the past 5,000 years. Thus, Tanzania contains much of the genetic diversity likely to be present in East Africa. Preliminary studies of mtDNA diversity of Tanzanian populations by our group, and comparison with data from other globally diverse populations, indicates that they have very high levels of genetic diversity and the deepest mtDNA lineages. Here, we present a study of Y chromosome genetic variation among 460 male individuals belonging to Khoisan speaking Hadza and Sandawe, Cushitic speaking Iraqw and Burunge, Nilotic speaking Maasai and Datog, Bantu speaking Mbugwe, Rangi and Pare, and the Mbugu who speak a mixed Bantu/Cushitic language. We compare patterns of male mediated gene flow and admixture with results from the maternally inherited mtDNA. As with the mtDNA data, we find the most ancient Y chromosome haplotype lineages in Tanzanian populations, supporting the hypothesis of an East African origin of modern humans. Funded by BWF and Packard Career awards, Leakey Foundation Fund, Wenner Gren, and NSF grant BCS-0196183 to ST.

#### **Identifying pleiotropy in hominid dental evolution: Results from a baboon model.**

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Many of the paleontological approaches to phylogeny reconstruction assume genetic, functional, and evolutionary independence among characters. However, given recent advances in developmental and quantitative genetics that highlight extensive pleiotropy within the skeletal and dental systems, these assumptions may not be tenable for many traits. In order to refine the characters used in, and improve the resolution of such analyses, the hypothesis of genetic

independence needs to be tested. Modern quantitative genetics provides such an opportunity.

We summarize the results of ongoing statistical genetic studies of dental variation in which we detect and estimate the magnitude of pleiotropy on pairs of dental traits in a captive pedigreed colony of baboons from the Southwest National Primate Research Center. Using bivariate maximum likelihood-based variance decomposition methods, we estimated genetic and environmental correlations between pairs of dental traits assessed on the molars of c. 500 individuals. The traits studied include crown metrics, cusp position, cingular remnant expression, and enamel thickness. We find, for example, extensive pleiotropy between crown width and cusp positioning ( $RM_2$  distal loph  $r_G = 0.70$ ,  $P < 0.10$ ), but not between crown size and enamel thickness ( $P < 0.10$ ). Given the often highly conserved nature of many developmental mechanisms across diverse taxa, this genetic analysis of baboon dental variation is highly relevant to our studies of human dental variation and evolution. The identification of shared genetic effects in baboons helps to refine the traits used in hominid phylogenetic analyses and in reconstructing adaptive scenarios. These results also have implications for understanding trait evolvability.

#### **Molar shear crests as dietary indicators: Evidence from primate ecological analogs.**

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Based on theoretical arguments outlined by Kay and colleagues, species with diets high in structural carbohydrates (in foliage and insect cuticles) are predicted to have relatively longer molar shear crests than all other species. Although studies on primates support this contention, corroboration in a distantly related, ecologically analogous clade would powerfully affirm the underlying functional model. Given the limited range of diets displayed by extant primates, consideration of this prediction in a clade possessing a wider array of diets would also greatly inform efforts to reconstruct the potentially disparate feeding habits of extinct primates.

This study addressed these issues by testing this prediction in a dietarily diverse sample of 65 extant marsupial species.  $M_3$  shear crest length,  $M_3$  size (mesiodistal length and crown area), and the percentage of structural carbohydrates in the diet were analyzed using phylogenetic

autocorrelation and independent contrasts. As predicted, species with diets composed of at least 50% structural carbohydrates have longer autocorrelation-adjusted (ACA) shear crests (relative to molar size) than all other species ( $p < 0.001$ ). Furthermore, relative ACA shear crest length is significantly positively correlated with ACA percentage of structural carbohydrates in the diet (0.550-0.791,  $p < 0.001$ ). Finally, independent contrasts of relative shear crest length are significantly positively correlated with contrasts of dietary percentages (0.319-0.551,  $p < 0.01-0.001$ ) and exhibit significantly positive regression slopes (0.002-0.003,  $p < 0.001$ ).

These results show that taxa with diets higher in structural carbohydrates consistently have relatively longer molar shear crests than other taxa, reaffirming the value of this character for dietary reconstruction in fossils.

#### **Microscopic openings of dentinal tubules on naturally heavily worn occlusal surfaces of specimens from a Japanese archaeological site using SEM.**

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Microscopic openings of dentinal tubules on a heavily worn occlusal surface of the mandibular first molar of early modern western Japanese from an archaeological site were analyzed using scanning electron microscopy (SEM), and compared with those of previous works (Hojo, 1989, 1990). The high resolution casts of specimens were sputter-coated, and were analyzed at the magnification ranging from 7X to 3,000X using SEM. The number and the diameters of the openings of dentinal tubules were measured using Microwear Image Analyzing Software Version 2.2B (Ungar, 1996), and varieties in the shape were analyzed. The openings of dentinal tubules of these early modern specimens were arranged in rows, and closing patterns of openings of dentinal tubules tended to increase with age advance on the occlusal surface of the hypoconid as those of modern Japanese (Hojo, 1990). The number of dentinal openings of a specimen was 32 on the area of 600 square microns, and the mean area of openings was 0.88 square microns. This mean area of openings was almost the same as that of the 40-59-year age group of modern Japanese. These people lived in a region close to sea coast, and their heavily worn mandibular first molars might be related with their food with small bits, such as

sweet potatoes full of mud grains, hard bones of sardines, and hard dried shell fishes.

### **Zygapophyseal facet distances of the lumbar vertebrae: A predictor for spondylolisthesis?**

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Spondylolisthesis involves one vertebral body slipping out of alignment with adjacent vertebrae, often accompanied by lysis of the laminar pars interarticularis. Despite its prevalence in human lumbar vertebral columns, the etiology of this disorder remains incompletely understood. Latimer and Ward (1993) hypothesized that the pyramidal increase in the distance between lumbar zygapophyseal facets that occurs towards the caudal end of the lumbar column represents a uniquely human adaptation to protecting the laminae when vertebrae are configured in a lordotic posture. Without this increase, adjacent zygapophyses could impinge on the intervening lamina, contributing to lysis of the bone, and thus to development of spondylolisthesis.

We tested this hypothesis by examining the extent of lumbar interfacet distance increase and incidence of spondylolisthesis using standard anteroposterior radiographs of 20 affected and 20 normal modern human lumbar spines. Data for each level were constructed as ratios of the distance at L1, and compared between the groups, with significance assessed using a two-tailed t-test.

A significant interfacet distance increase is associated with decreased incidence of spondylolisthesis at fourth and fifth lumbar vertebrae, where most cases occur. This widening is not due to size increase throughout the column, as measures of vertebral size are not correlated with incidence of spondylolisthesis.

These results support the hypothesis that the uniquely human increase in zygapophyseal facet distances represents an adaptation to habitually lordotic posture of the lumbar spine. Our results may also be clinically significant; if predisposition for developing spondylolisthesis can be identified early, preventive measures can be employed.

### **Another look at the brain volume and reorganization in the Stw505 *A. africanus* from Sterkfontein, S. Africa.**

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The original volume determined for this specimen was 515 ml, making it one of the largest of the S. African gracile australopithecines. Subsequent analyses, using computer scanning (Conroy *et al.*, 1998, 2000), regression analysis (Hawks and Wolpoff 1998) as well as a previous attempt by this author, have suggested a significantly larger size. The endocast shows that a minimum of 6 regions are either distorted or displaced relative to each other and the midsagittal plane. The correct alignment of these elements is essential for determining an accurate volume and for measuring the distance of a rarely seen lunette sulcus to a midsagittal plane. Two new reconstructions, done by dissecting the elements, and repositioning them, yield volumes between 540 and 580 ml, thus making this specimen the largest male *A. africanus* yet found. A volume of 550 ml appears most accurate.

It is fortunate that evidence for the midsagittal plane is secure, although the cerebellar region and posterior base are particularly difficult to reconstruct. Nevertheless, the inferior portion of the lunette sulcus which delimits the anterior extent of primary visual cortex is clearly discernible, and is located some 20-25 mm lateral to the midsagittal plane. This distance is some 10 mm less than found on chimpanzee brains fewer than 400 ml in volume, and provides strong support for Dart's original claim that *A. africanus* had a reorganized brain.

### **Predicting the location of well-preserved Palaeolithic archaeological sites in Africa and Asia based on the likelihood of bone preservation.**

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In recent years several models estimating the likelihood of bone preservation under known conditions have been proposed. This project represents the first instance in which these developments have been exploited by archaeologists through an investigation into how a predictive model, based on models of bone preservation, may be combined with geographical information to predict the location of potentially fossiliferous deposits.

Collagen is the dominant protein in bone and heating experiments have shown that the rate of collagen loss is highly temperature dependent. Therefore, differences in

burial temperature have a significant impact on the survival of collagen, which directly affects the probability of fossilisation. Thus, by estimating the temperature experienced by bones in different burial environments, we are able to predict the likely survival of fossil remains.

A close relationship is shown to exist between the distribution of known fossil remains, dating to between 6 and 0.01 million years, and the survival of collagen across the African continent. A more complex relationship has been identified for the Asian continent. These results will have a significant impact on the disciplines of Palaeolithic archaeology and palaeoanthropology, since we have developed a method for assessing the completeness of the known hominin fossil record across time and space.

### **The Wolff's law debate: Throwing out the water, but keeping the baby.**

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The hypothesis that mechanical loads influence cross-sectional quantity and distribution of diaphyseal bone is commonly referred to as Wolff's law. In a paper often cited as a good example of Wolff's law, Jones *et al.* (1977) presented data on humeral asymmetry in tennis players. Ohman and Lovejoy (AAPA 2003) questioned the notion that asymmetry in upper limb bone strength results from higher stresses placed on the dominant arm of the players. They argue that the fact that cortical bone increases both periosteally and endosteally fails to confirm predictions from Wolff's law that increased diaphyseal rigidity should result primarily from periosteal apposition.

Establishing a firm link between mechanical loads and bone remodeling is of primary importance. This link underlies all studies that aim to reconstruct behavior based on skeletal morphology. A review of the controversy regarding the Wolff's law concept is, therefore, timely. Our purpose is three fold. First, we point out that Ohman and Lovejoy fail to consider the effect of age as an important factor for the results obtained by Jones *et al.* Second, we review several critical studies of upper limb asymmetry that lend strong support to the hypothesis that bone remodels in response to increased mechanical load (in particular through periosteal modeling). Third, we argue that,

while the term "Wolff's law" should be abandoned, in particular with respect to its orthodox meaning of "trajectorial architecture" (Cowin 2001), the concept of bone functional adaptation remains a valid hypothesis, supported by numerous experimental, clinical, exercise, developmental and comparative studies.

### **Causal modeling of nasal breadth and intercanine distance in fossil and recent *Homo*.**

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Neandertal nasal breadths (NLB) are not unusually wide relative to Pleistocene *Homo* in general. However, NLB is wider than expected in Neandertals that lived during colder phases when compared to clinal patterns in NLB among recent humans. A possible explanation is that cold climate selection for narrower Neandertal NLB was constrained by the plesiomorphic retention of large intercanine distances (ICB) associated with large anterior dentitions. This explanation leads to two specific hypotheses: 1) a strong correlation between NLB and ICB, and 2) a causal relationship such that NLB is determined by ICB rather than the reciprocal. A complicating factor is that both NLB and ICB are correlated with basion-prosthion length (BPL), a measure of lower facial projection that is likely a primary determinant of both NLB and ICB. This study tests the above hypotheses using path analysis where BPL is the exogenous (independent) variable, and NLB and ICB are each mediated through the other as the endogenous (dependent) variables in recent humans (n=523) and fossil hominids (maximum n= 43, including all available Neandertals). Our results reject both hypotheses: NLB and ICB are weakly correlated (range of  $r^2 = 0.10-0.49$ ); and the relationship between BPL and ICB is more strongly mediated by NLB than is the relationship between BPL and NLB mediated by ICB. The unexplained variance components in our path models, however, are large indicating that other independent variables in concert with BPL (e.g., other facial breadth measurements) contribute to variation in both NLB and ICB in more complex causal paths.

### **Behavioral correlates of neuro-anatomical asymmetries in great apes.**

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The link between behavioral and neuro-anatomical asymmetries in nonhuman primates is poorly understood. In this paper, we present data on the association between three neuroanatomical regions in the great ape brain including the frontal orbital sulcus, planum temporale and motor-hand area. Asymmetries in three regions were assessed from MRI scans and correlated with two measures of hand use, one measuring coordinated bimanual actions (referred to as the TUBE task) and one measuring handedness for gestural communication. To evaluate the predictive significance of each brain region on handedness, two multiple regression analyses were performed with the TUBE and gestural communication handedness measures serving as dependent measures. For each analysis, the asymmetry coefficients for the PT, FO, CS and KNOB served as the predictor variables. For the TUBE task, the multiple  $R$  was .619  $F(3,36)=7.76$ ,  $p < .002$  and subsequent partial correlation coefficients revealed that the KNOB ( $r = -.461$ ,  $p < .005$ ) and PT ( $r = .440$ ,  $p < .007$ ) both significantly predicted hand preference for this task but in opposite directions. For gestural communication, the multiple  $R$  was .44  $F(3,25)=2.00$ ,  $p < .10$  and the partial correlation coefficients indicated that the FO ( $r = -.497$ ,  $p < .03$ ) was the sole brain region significantly predicting variation in hand use for this measure. The overall results suggest that asymmetries in three separate brain regions correlate with different behavioral manifestations of hand use.

### **Estimating inter-individual variation in human cortisol levels: Mixed models applied to data from Nepal, Mongolia and the U.S.**

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Cortisol levels are commonly used to examine human variation in the activity of the hypothalamo-pituitary axes, but high degrees of intra-individual variability have posed problems when using cortisol levels in individual difference models. A common practice in such cases is to clarify the signal of inter-individual difference by collecting multiple samples on each individual and then analyzing within-individual averages. This remedy leads to the loss of important information,

including the degree to which variation in the final average reflects inter-individual differences versus remaining intra-individual differences or measurement error. In this paper, we describe statistical models for estimating the degree of inter-individual variation in cortisol levels. We further apply these models to cortisol data collected from children in Nepal (n=30, 15 observations per child), Mongolia (n=47, 9-12 observations per child) and the U.S. (n= 546, 6 observations per child) with varying collection protocols. After accounting for time of day (generally the largest systematic source of intra-individual variation), 20% to 75% of variation in cortisol levels is attributable to individual differences and this estimate depends on the time intervals at which measurements are taken. These findings have implications for the number and timing of cortisol measurements in future studies. Furthermore, the models used in this analysis are readily available in standard statistical packages (SAS, STATA, SPSS, S, R) and avoid the information-costly practice of analyzing cortisol levels averaged at the individual level.

### **Bipedalism in orangutans (*Pongo pygmaeus*).**

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The topic of the locomotor precursors to the development of hominid bipedality continues to be debated. On the assumption that bipedalism evolved in an arboreal context, analyses of locomotion in arboreally adapted hominoids may yield additional insights into the nature of the ancestral locomotion. Currently, the data support the notion of the biomechanical similarity between vertical climbing in orangutans and human bipedalism; however, the quantification of bipedal locomotion in *Pongo* has not been thoroughly explored.

In this study, we present the data on kinematics of bipedal locomotion in orangutans. The analysis was based on 15 instances of terrestrial bipedalism in three female orangutans. The data revealed that bipedalism in orangutans, unlike that observed in chimpanzees and bonobos, is characterized by a more orthograde trunk throughout the duration of a bipedal bout and a greater hip angle at the initial foot contact during the stance phase. The trunk and hip angles in bipedal orangutans, therefore, approach the human pattern more closely than the other two referential species. On the other hand, orangutan knee angles changed minimally throughout the phases of a

bipedal stride, thus being more similar to characteristic "bent-hip, bent-knee" bipedal walking in other great apes.

#### **Investigation of age at weaning using Sr/Ca ratios in human tooth enamel.**

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Infant feeding practices and age of weaning have a significant impact on the health and survival of children in a population. The types of supplementary foods given and the age and rate at which these are introduced are influenced by cultural beliefs and access to resources, and vary within and between populations. Strontium calcium ratios (Sr/Ca) are an effective means of examining dietary change during this period since human milk has a very low Sr/Ca compared to most solid foods. Four discrete phases of nutritional intake can be distinguished in early life: prenatal, exclusive breastfeeding, breastfeeding with supplementation, and fully weaned. A new model is presented that predicts changes in Sr/Ca within each of the four nutritional phases and at the transitions between phases, taking account the different dietary and physiological parameters that contribute to the Sr/Ca of tissues forming during each phase.

Systematic micro sampling of tooth enamel offers the possibility of reconstructing individual profiles of dietary change in the first few years of life. Incremental growth structures present in tooth enamel are used to define a sampling strategy that is sensitive to the time transgressive nature of enamel matrix formation and subsequent maturation. Laser ablation inductively coupled plasma mass spectrometry (LA-ICP-MS) is used to determine Sr/Ca in tooth enamel from the deciduous canines and permanent premolars of two individuals of known dietary history. Results are consistent with the model and clearly distinguish the two different infant diets.

#### **Does Greenberg's linguistic classification predict patterns of New World genetic diversity?**

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Greenberg and colleagues (1986) identified three major linguistic divisions of New World languages and argued that

each corresponded with an independent wave of migration into the Americas. Subsequent studies identified genetic differences between these linguistic groups, but, to date, no one has systematically evaluated the correspondence of each portion of the proposed linguistic hierarchy with patterns of New World genetic variation. In this paper, we test the fit of the Greenberg linguistic classification to the pairwise nucleotide differences between mtDNA sequences (N= 1343) within and between 26 Native American populations. Using a linear statistical method, we evaluated the fit of this classification by sequentially adding and removing portions of the linguistic hierarchy and testing the change in fit at each step. We found that the Amerind and Eskimo-Aleut divisions of the Greenberg hierarchy were consistent with patterns of within and between population genetic diversity, but that the Na-Dene division was not. We found support for the Athabaskan grouping within Na-Dene, and for four language families within the Amerind division. However, in all but two cases, the supported linguistic pattern was confounded by geography. In addition, we identified hierarchical structure in the genetic data that was not captured by the linguistic model, much of which was consistent with geographic proximity. These results indicate that, in the New World, geography is a better predictor of patterns of genetic diversity than is language.

#### **A test of developmental causality of morphological integration.**

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Morphological integration, a general pattern of morphological character correlation, indicates one or more developmental, functional and genetic causal mechanisms. Modules of integration are overlapping and embedded, challenging the discernment of causality. Many analyses of integration causality are limited to adults of a single taxon. However, patterns of morphological integration vary significantly through ontogeny. A proper test of developmental influences on morphological integration ought to utilize observed changes in the patterns of trait correlation through ontogeny.

Developmental influences on morphology include the shared or unshared nature of skeletal element tissue origin and the interactions between skeletal elements during ontogeny. Different organ systems develop at different rates, causing bony morphology to respond in a correspondingly timed fashion. This study tests the

specific predictions of two general developmental hypotheses. First, the correlation patterns of cranial features should be influenced by the development of associated soft tissue at each ontogenetic stage. Second, correlation patterns of adjacent bony elements should be more similar than those of elements that are not adjacent.

The predictions are tested in four ontogenetic stages in four different species of primate. On over 550 crania of four species, *Macaca mulatta*, *Hyllobates lar*, *Pan troglodytes* and *Homo sapiens*, 80 homologous landmarks were captured using a 3D digitizer from infant to adult. Characters were identified as Euclidean distances between osteometric points. Observed character correlations are compared to those prescribed by the developmental hypotheses to evaluate how well causal developmental models can predict observed morphological integration.

#### **Fluctuating asymmetry and immune status: Implications for intrauterine growth in a population of South American natives.**

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Much of modern epidemiology attempts to explain why health inequalities are as rooted in biological causes as they are in ecological, economic and social causes. In their search for answers, epidemiologists have relied on statistical approaches that model the relationship between short-term social and economic exposures and the health status of adults. But it is now clear that many exposures can make their mark on the health-related biology of individuals in utero, long before the illness occurs, and that the long-term impact is modulated by genetic inheritance. Thus, an interest in health as a phenotype with complex developmental reaction norms is now of particular interest. In this paper we present the results of a pilot study of Ache trekkers of Eastern Paraguay. The Northern Aché, like most other South American natives, were left with less than one percent of their original territory within a few years of contact with outsiders in the late 1970s. They now live in extreme poverty and are chronically exposed to infectious pathogens. We explore the possibility that research on the relationship between fluctuating asymmetry (FA), or the absolute asymmetry in bilateral traits due to random errors in the development of the two sides of the body, immune status later in life, and heterozygosity provides insights into the intrauterine experiences of individuals in this

population, the immunological and long-term health consequences of those experiences, and the interaction between in utero exposures and genetic inheritance on long-term health status. The findings suggest that in order to reduce health inequalities between the Aché and their nonindigenous neighbors, public health interventions should target the specific ecological, economic and social factors that together shape the developmental reaction norms of this, and other native populations who share similar living conditions.

#### **Adaptation and change in Gulf Coast Florida.**

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There is substantial evidence that maritime habitats provided a stable set of subsistence resources for prehistoric and proto historic human populations. In Gulf coast Florida, chiefdoms developed largely outside of the sphere of Mississippian influence. Six populations (n=909 individuals) from the central Florida Gulf coast were examined for pathological lesions indicating dental, cranial, and postcranial infections, cranial and postcranial trauma, and lesions and behavioral modifications indicative of lifestyle (osteoarthritis and external auditory exostoses). The populations lived between A.D. 500 and A.D. 1600, and are used to address the hypothesis that disease and nutrition experiences were relatively similar throughout time. Comparisons are made with interior Florida populations and coastal and interior populations in other regions of the Southeast to test the hypothesis that there was far more change through time in disease and nutrition in those other regions. The data indicate that for most pathological lesions and behavioral modifications little change occurred through time for populations living on the Florida Gulf coast while in other regions there is considerable change. Supported by grants from East Carolina University and the National Science Foundation (SBR 9707921).

#### **The cohesive nature of gestural communication among *Pan paniscus* in the wild.**

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With its large party sizes and frequent group interactions, the population structure of *Pan paniscus* appears to have selected for mechanisms that promote group

cohesion, increase bonding between individuals, and limit aggression. At Wamba, *Pan paniscus* use a variety of behaviors to produce complex forms of communication. The often described sexual behavior between females, genital-genital rubbing, is just one example, reducing tension and competition among the dominant females of a group. Gestural communication also plays an important role in assuring general group cohesion. Gestures such as rocking and arm movements are used to solicit close contact between individuals, with different combinations of gestures indicating different types of contact. Objects are also incorporated into communication. Adult males branch-drag, providing specific information concerning the timing and direction of group movements; young individuals use sticks and small branches to initiate and enhance social play. All of these behaviors function to coordinate social activities, serving to decrease inter-individual distance. When *Pan troglodytes* use similar gestures or objects for communication, it is often during aggression, which increases the distance between individuals. The ability to accurately communicate intentions and coordinate social activities is crucial to the functioning of bonobo society, and may be key to understanding species differences.

This research was supported by grants from the Wenner-Gren Foundation, NSF, and the Japan Society for the Promotion of Science.

#### **Purposeful manipulation of teeth in Final Neolithic burials from Upper Egypt.**

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During excavation of a Neolithic cemetery near Gebel Ramlah, Egypt, three unusual examples of deliberate tooth manipulation were revealed. All affected skeletons were disturbed by later burials - at which time several teeth were inadvertently loosened from their jaws. When these remains were reburied, an attempt was made by the Neolithic people to collect the teeth and include them with the other original elements. In the first case, a young female's maxilla was found to contain mandibular and misplaced maxillary teeth. Second, another young female's jaws contained two incorrectly placed teeth. And third, two adult male crania from a common pit also had teeth loosened from their jaws; however, instead of reinserting them, the Neolithic people placed these teeth into the right orbit of one cranium and the nasal aperture of the other. In the first two cases, replacement

may have represented an attention to detail while reinterring the remains in as complete of a state as possible. Only the gravediggers' limited anatomical knowledge prevented the act from going unnoticed. This assumption may hold true for the third case, although there are other interpretations. An additional example of the inhabitants' interest in teeth, involves a carved ivory incisor. Although its function is unknown, the anatomically accurate tooth would fit perfectly into a maxillary alveolus. Whatever the case, these and other examples provide valuable insight into the mortuary and other biocultural practices of these little known desert peoples.

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#### **Lemur latrines: Do "latrines" of wild primates function in inter-group olfactory communication?**

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"Latrine behavior" (the preferential and repeated use of one or more specific defecation sites) is well known among mammals, and has been documented in seven non-primate mammal orders. In many circumstances, behavioral evidence shows that latrines function in olfactory communication among individuals or groups. Study of primate social systems has historically focused on visual and auditory communication systems; primate evolution in general is known for reduction in olfactory communication in favor of more developed visual systems. However, several prosimian primates and some platyrrhines regularly use olfactory communication for transmission of social signals, the most well known examples being the use of scent gland secretions and urine.

Latrine behaviors have been described only rarely and anecdotally in primates, and have traditionally not been included in reviews of primate olfactory communication. Here we review previous evidence for latrine use in primates and report new and more extensive observations of latrine use in the wild from two lemuriform primates (*Lepilemur* sp. and *Hapalemur griseus*). In all, we found evidence for

latrine behavior in 9 species within 4 phylogenetically and ecologically diverse lemur genera (*Cheirogaleus*, *Lepilemur*, *Hapalemur*, and *Lemur*).

Based on these new observations, we present and evaluate 4 available hypotheses for the function of latrines (advertisement of sexual cycling, predation avoidance, intra-group spacing, and inter-group resource defense) in 3 lemur taxa for which the behavioral context of latrine use has been observed. In all cases, inter-group resource defense is the function most consistent with available observations.

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### **Extraordinary demography and life history in patas monkeys (*Erythrocebus patas*).**

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Among iteroparous organisms, it is the norm that juvenile mortality greatly exceeds adult mortality. In mammals in particular, infant mortality is often several times higher than adult mortality, even in relatively short-lived animals. We report here ten years of demographic data from two populations of sympatric vervet monkeys (*Cercopithecus aethiops*) and patas monkeys (*Erythrocebus patas*). Adult female mortality was higher and infant mortality was lower in patas monkeys than in vervets. In fact, newborn patas infants were as likely to be alive a year later as their own mothers. Mortality patterns are thought to be strong selective forces on life history traits, with high adult mortality (and low immature mortality) favoring early and rapid reproduction. Analysis of fertility schedules reveals that patas monkeys have the highest intrinsic rates of increase for their body size of any haplorhine primate, because they reproduce both earlier and more often than other primates after controlling for body size. Variation in demographic parameters also more strongly affected population size in patas monkeys than in vervets.

### **Variation in Neanderthal early ontogeny: Craniometric evidence from Dederiyeh children.**

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Two Dederiyeh Neanderthal children of about two years old from Syria were compared with other Neanderthal (N=10), Skhul-Qafzeh (N=4) and modern children (N=89) through univariate statistical analysis of cranial measurements to evaluate the ontogenetic, phylogenetic patterns and variations in early stages of development. We calculated the Z-scores and associated probabilities for each fossil specimen using the standard deviation of modern residuals.

Several conspicuous features of Neanderthals, including high orbits, low nasiofrontal angle, wide bi-oc breadth, large maximum occipital breadth and wide nasal bone, are recognized in the Dederiyeh children even from the early developmental stage of two years old. The developmental patterns observed here are comparable to those based on geometric morphometric analyses showing early manifestation of a taxonomic difference in cranial morphology between Neanderthals and modern humans.

However, close inspection of the growth profile demonstrates two different patterns in the measurement items. The first one is the almost parallel course of development showing an early indication of the taxonomic difference by at least two years of age. The second is indistinguishable between Neanderthals and modern humans showing the absence of a clear difference during ontogeny. The second includes a diverging pattern indicating a possible rapid development in Neanderthals during early childhood between about 2 to 4 years of age. The last subdivision is attributable to the masticatory complex.

### **Age changes in the adult skulls of Old World monkeys (Primates: Cercopithecidae).**

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The mammalian skull is a dynamic structure, which undergoes changes in shape throughout life. From attainment of full adulthood through senility, the skull undergoes subtle changes of shape and bony surface texture. These involve bone deposition and resorption, and are related to the attachments of the muscles of mastication and to the mechanical stresses generated by chewing. Age-

related changes in the adult skull of primates have been documented primarily for humans in clinical contexts; such changes have not been documented for nonhuman primates.

In this study, cross-sectional samples of adult male skulls of five cercopithecine and two colobine species, drawn from homogeneous, wild-shot skeletal populations, were examined. In all species, the most noticeable shape changes through adulthood were observed in the circumorbital region, temporal lines, zygomatic arch, palate and piriform aperture of the cranium, and the gonial and symphyseal regions of the mandible. In mangabeys, anubis baboons and geladas, significant changes were also observed in the depth of the maxillary fossa and fossa of the mandibular corpus, and in the conformation of the maxillary and mental ridges. In all species, a predictable sequence of age-related changes could be defined.

Age-related changes in the adult skull involve areas considered highly diagnostic for taxonomic purposes. Documentation of these changes in a variety of living primate taxa may help researchers avoid the creation of new fossil species on the basis of a feature or set of features related only to the chronological age of the individual.

### **Resident male replacement in *Cebus capucinus* groups.**

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In male dispersed primate species adult males may enter groups peacefully and join resident males at low ranks, or aggressively and assume the top dominance positions within groups. In our long-term study of white-faced capuchins, *Cebus capucinus*, in Santa Rosa, Costa Rica, we have never observed an adult male (>10 years) to enter a group peacefully at a low rank and join higher ranking resident males. Instead, we see complete replacements of group males at an average of every 2.3 - 4.6 years. In our study population, these replacements of resident males occur in two ways: extragroup males enter a group aggressively and evict resident males (*takeover*) or they opportunistically enter a group that is without resident males (*waltz-in*). Here we detail 15 male replacements that have occurred within our study groups between 1985 and 2002. In particular, we discuss *how* male replacements occur, *when* they occur, and *why* they occur.

**“Funked up and Yowza!”: A study of descriptive terms used in the evaluation of infectious lesions.**

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Patterns of interobserver error in scoring pathologies have become of increasing importance as repatriation occurs. Informal standards exist for the evaluation of infection lesions (e.g., Buikstra and Ubelaker 1994), but many researchers have generally found them complicated to apply. To contribute toward development of a more user-friendly scoring standard, a project was undertaken to determine how researchers typically recorded lesions in their work.

Fifteen participants, comprised of both graduate students and PhDs experienced in paleopathology, were given 11 bone samples to evaluate, with lesion expression (as judged by the authors) ranging from complete absence to severe osteomyelitis. Each was asked to record in writing any infection process observed as when conducting their own research. No further instructions were given to prevent bias.

Results of the study show that scorers seldom use the same descriptive words in their observations of the same lesion. A wide gamut of terminology is used from the vernacular (“like caked on dirt”, “major activity”) to highly technical (“sclerotic periosteal apposition”). Some 73% of descriptions included the location of the infection, but less consistent was notation of whether the bone was from an adult or child. One-third of the descriptions recorded the lesions as active or healed; it was found that those who provided very detailed specific descriptions of the lesion and rated themselves high in experience were less likely to provide this observation. Overall, these findings suggest that among the commonly recorded osteological lesions, those associated with infection will likely be the most difficult to standardize.

**Are overnight norepinephrine and epinephrine excretion rates reproducible baseline measurements for diurnal stress studies?**

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In anthropological field studies, overnight or “sleep” rates of norepinephrine and epinephrine excretion (ng/min) are often used as baseline measurements from which the stressfulness of other daily environments (such as work) are determined. If overnight excretion rates are reasonable baseline measures, then they should be reproducible over time. However, the consistency of overnight rates is largely unknown, as the reproducibility of overnight catecholamine excretion has rarely been tested. The purpose of this study was to assess the reproducibility of the overnight rates of norepinephrine and epinephrine excretion in 71 premenopausal women (age=34.9±7.7 years; 43.7% Euro-American; 33.8% African-American; 4.2% Asian-American; 18.3% Hispanic-American; 21.1 % taking oral contraceptives) who collected timed overnight urine specimens two weeks apart over their menstrual cycle. Norepinephrine and epinephrine were measured in these samples using HPLC. The results of the analysis showed that the average rates of both norepinephrine and epinephrine were not significantly different between the two time frames, with the average differences being .5 ng/min for norepinephrine and .1 ng/min for epinephrine. Bland-Altman plots revealed that the distributions of the test-retest differences were consistent with expectation, meaning that 95% of the measures were within 2 standard deviations of a mean difference of 0. These data suggest that overnight catecholamine rates are reproducible, and therefore may be reasonable baseline measurements for diurnal stress studies.

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**Energy status, energy balance and energy expenditure in relation to ovarian function in rural and urban women from Poland.**

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The availability of metabolic energy has a major influence on reproductive function in women. Relationships between energetic factors and ovarian function were studied in samples of 102 urban and 50 rural women from Poland, aged 24-37. Urban and rural populations differed in energetic status of women (as assessed by body weight, BMI, and fat %) and levels of energy expenditure. Ovarian function was assessed by analyzing levels of estradiol (E2) and progesterone (P) from saliva

samples collected daily by each woman during the entire menstrual cycle. Urban and rural women had the same mean age and did not differ in energy balance, as assessed by changes in BMI during the period of sample collection. Despite their superior energy status (higher body weight, BMI, and fat %), rural women had suppressed ovarian activity, as indicated by significantly lower means (in pmol/L) of: luteal phase P (103.0 rural, 136.6 urban), mid-luteal phase P (132.5 rural, 173.7 urban), mid-cycle E2 (5 day average; 19.3 rural, 22.8 urban) and day of E2 peak (29.0 rural, 35.8 urban). Lower levels of ovarian function in rural women corresponded to higher levels of energy expenditure, resulting from spending more time per day in moderate and heavy physical activities.

Results of this study indicate that energy status per se has no relationship to ovarian function. However, high energy expenditure resulting from physical activity may have a suppressing influence on ovarian steroids even in well-nourished women.

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**Femoral neck activity and kneeling at a Byzantine monastery.**

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Various scholars suggest a biomechanical control on the presence or absence of non-metric traits of the femoral neck, including Allen's fossa, plaque, Poirier's facet, and the posterior cervical imprint. The present study examines 217 proximal femora from the Byzantine St. Stephen's monastic collection (Jerusalem), and numerous individuals from two non-monastic regional counterparts (Emmaus and Umm el-Jimjal), also dating to the 5<sup>th</sup> thru 7<sup>th</sup> centuries CE. Over 90% of the St. Stephen's collection is male, and all the femora studied are adult. The presence/absence of the four femoral neck traits are compared by side, angle of the neck, and femoral head diameter.

In the St. Stephen's collection, plaque is found to be bilaterally asymmetrical ( $\chi^2=5.13$ ,  $df = 1$ ;  $p < 0.05$ ). This suggests differential use by side, which agrees with the historical and liturgical accounts of



repeated kneeling and genuflexion among monks of this large monastery. The frequencies of Poirier's facet, Allen's fossa, and the posterior facet were not bilaterally asymmetrical however ( $\chi^2=0.052$ , 0.011, 1.275 respectively;  $df=1$ ;  $p<0.05$ ). The traits were also compared by femoral neck angle and femoral head diameter. Only the presence of plaque yielded a significant difference in frequency by head diameter ( $\chi^2=4.26$ ,  $df=1$ ;  $p<0.05$ ). These findings are incorporated into a larger biocultural model of kneeling and genuflexion at Byzantine St. Stephen's, and contribute to an overall biomechanical model of lower limb activity for this monastic collection.

**Linked autosomal genetic marker systems and pre-Out of Africa subdivision.**

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SNPSTR's are tightly linked autosomal genetic systems consisting of one Short Tandem Repeat and at least one Single Nucleotide Polymorphism. These systems are informative in tracing the origins of our species and elucidating the paths via which our species spread across the globe. SNPSTR systems provide a unique and complementary perspective on human origins to mtDNA and Y chromosome data, broadening our understanding markedly. We analyze the CEPH sample set at two SNPSTR loci, providing a large global survey of variation. We compare these data to coalescent models of emigration from Africa, focusing on the issue of subdivision on that continent before the Out of Africa migration event(s). Specifically, we ask to what extent, if at all, was the human population of Africa subdivided at the time of the initial movement of anatomically modern humans out of Africa. In this analysis we consider only those descendents of a possible subdivided population which survive to the present. Using custom-designed analysis program and a modified version of the coalescent simulation software SIMCOAL, we evaluate the empirically-derived data by comparing summary statistics to those generated under a set of relevant models of population history.

**Perimenstrual behavior in captive female chimpanzees (*Pan troglodytes*).**

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This study was designed to investigate whether chimpanzees exhibit behavioral patterns around menstruation that are analogous to reports of human premenstrual syndrome (PMS). At the Primate Foundation of Arizona, ten captive female chimpanzees, ranging in age from 13 to 37 years in age at the start of the study, were observed for behavioral changes over portions of three menstrual cycles each. All chimpanzees lived in social groups though not all groups contained adult males. Behaviors were recorded during 20-minute focal samples. For analysis, the observed portion of the cycle was divided into three time blocks based on the day of menstrual onset: pre-perimenstrual phase (first day of detumescence to 3 days prior to observed menstruation, 133 observations), perimenstrual phase (two days before to two days after day of menstrual onset, 109 observations), and post-perimenstrual phase (third through seventh day after menstrual onset, 99 observations).

While females did not show perimenstrual changes in social behaviors (affiliative, submissive, aggressive, sexual) that would be indicative of social withdrawal, they did show significant variations in behaviors relating to energy expenditure ( $p < 0.05$ ). The proportion of time in all active behaviors (manipulate environment, locomotion, forage, self-groom) and high-energy postures (stand, move, move fast, hang) occurred less often during the pre-perimenstrual and perimenstrual phases than during the post-perimenstrual phase. This tendency towards less energy expenditure before and during menstruation is consistent with reports of fatigue associated with human PMS.

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**Culturally modified human remains from the Hopewell Mound Group.**

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Culturally modified human remains (CMHR) from Hopewell contexts include skulls, crania, jaws and other skeletal elements that have been drilled, ground, incised, or shaped and deposited as funerary objects. Researchers seeking an understanding of the role of these remains in Hopewell ideology focused on the ages and

sexes of individuals from whom the modified bones were derived under the assumption that the use of bones from young adult males supports the hypothesis that CMHR represent trophies of war. All available skeletons and CMHR recovered from the Hopewell Mound Group (33RO27) were examined and described. Eleven methods were used to produce age estimates from which a best estimate was calculated using principal components analysis. Sex estimates were based on seven pelvic and three cranial indicators of sex as well as seriation of cranial robusticity, diameters of humeral and femoral heads, and discriminant functions calculated using dental metrics. Three hypotheses regarding the role of CMHR in Hopewell culture were tested using age and sex data: trophies of war, revered ancestors, and memento mori/objects for ritual use. Two hypotheses were tentatively rejected (trophies of war and memento mori/objects for ritual use). The results indicate that adults of either sex were used as donors of raw material or as posthumous recipients of CMHR.

**Modeling the effects of social and economic change on health and nutritional status: Historical microenvironments.**

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Studies of the effects of economic modernization on nutritional status and health in populations undergoing 'modernization' have most often utilized either ecological/evolutionary models in anthropology or transition models in demography and epidemiology. In spite of their robustness, each of these models lacks some focus that would enhance understanding of this process in specific populations and communities. It is argued here that an alliance of these models, incorporating a concept of lifestyle change within an ecological framework that includes both micro-environmental factors and the larger political-economic context of change, provides an opportunity to gain additional insights. Use of birth cohorts is one way to operationalize such a perspective, as each group can be considered to have been affected by specific environmental influences acting at different points in time (historical microenvironments). Anthropometric data reflecting nutritional status, gathered from a probability sample of 150 Blackfeet Indian women and analyzed using four age cohorts, illustrate this approach.

Blackfeet women demonstrate a significant effect of cohort on height, BMI, skin-

folds, and circumferences. There is a consistent, non-linear pattern to these cohort differences for most measures. Women 70+ and 30-49 years are relatively smaller, lighter, and leaner than women 50-69 or 18-29 years. The latter two groups are similar. This non-linear pattern suggests differing cohort experiences with energy balance during such significant life history periods as childhood or the reproductive years; these can be mapped to the larger social and economic changes affecting the reservation during the 20th century.

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**Neighbours or sisters? Testing models of cultural transmission in the Pacific using phylogenetic methods.**

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Increasingly, phylogenetic methodologies from biology are being employed to explore adaptive hypotheses of human biocultural and cultural evolution. Accurate estimation of the mode of bio/cultural trait transmission is necessary for the proper application of the comparative method. Many explanations for cultural evolution assume vertical (phylogenetic) trait transmission, while others indicate a horizontal or reticulate mode of transmission. Few reports quantitatively investigate which models best characterise particular aspects of culture. Here we present the results of a series of investigations into mode of cultural transmission in the Pacific, using ethnographic data and linguistic phylogenies developed using formal phylogenetic methods. Individual traits are tested for associations with phylogenetic versus geographical nearest neighbour. Correspondence analysis and mantel tests are used to further identify appropriate models for groups of cultural traits, and the results are discussed in the context of Pacific prehistory, ethnography and environment.

**Humeral torsion in anthropoids and its relationship to upper thoracic and/or pectoral girdle shape.**

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This study investigates the relationship between humeral torsion in anthropoids and its relevance to upper thoracic and pectoral girdle shape. These two factors have been presumed to reflect degrees of torsion, which is defined as the angle made by the axis of the head of the hume-

rus with the mediolateral axis of the elbow joint. Traditionally, a dorsal-ventrally compressed thorax has thought to facilitate a more dorsally placed scapula, by redirecting the glenoid fossa laterally. The pectoral girdles of primates with this thorax shape are assumed to have a short scapular spine and a long clavicle to assist the dorsal position of the scapula. The opposite has been assumed of primates with a less dorsal-ventrally compressed thorax. These specific positions position the glenoid fossa either laterally or anteriorly, facilitating certain locomotions, and presumably different degrees of torsion. This is important because torsion and/or thoracic shape have been used to infer the locomotion of some fossil Miocene apes, based on this association only. The hypotheses of this study are that torsion reflects pectoral girdle shape, that torsion reflects upper thoracic shape, and that torsion reflects neither.

Measurements include scapular spine and clavicular lengths, torsion and thoracic shape. The latter two provided by Dr. Larson (NSF BCS-0109331) and Dr. Chan (1997). Species used include New World monkeys (N=3), Old World monkeys (N=3), apes (N=4) and humans. Results show a significant correlation between torsion to both thoracic and pectoral girdle shape, specifically clavicular length. Therefore both factors can be used to infer torsion.

**The evaluation of the somatosensory system in primates.**

J.H. Kaas. Dept. of Psychology, Vanderbilt University.

Inferences about how the complex somatosensory systems of anthropoid primates evolved are based on comparative studies of such systems in extant mammals. Experimental studies of members of the major clods of extant mammals suggest that somatosensory cortex consisted of only a few areas, including a primary area, S1, bordered by strip-like rostral caudal somatosensory fields, SR and SC. In addition, the second somatosensory area, S2, and the parietal ventral area, PV, were probably present. S1, S2 and PV were activated independently via parallel projections from the ventroposterior nucleus, VP. Little posterior parietal cortex existed, and the presence of a separate primary motor area, M1, was uncertain. Early primates retained this basic organization, but they also had a larger posterior parietal region that emerged to mediate sensorimotor functions in conjunction with motor and premotor area. The frontal cortex included M1, dorsal and ventral

premotor areas, a supplementary motor area, and cingulate motor fields. In early anthropoid primates, area S1, Sr, and SC differentiated into its fields now recognized as areas 3b, 3a, 1 and 2. Serial processing became more dormant, and posterior parietal cortex expanded into more areas. Less is known about changes that might have occurred with the emergences of Apes and humans, but the brains were larger and they would have posed scaling problems.

**A quantitative analysis of the ecological niche space of savanna baboon populations, and its taxonomic implications.**

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Savanna baboon taxonomy is one of the most contentious issues in primatology. The two major taxonomic hypotheses, a single or multi-species classification, are each supported by various types of morphological and/or molecular data. Ecological data from many baboon populations are available, and may provide additional evidence to corroborate one of these hypotheses. These data can provide an important picture of a population's niche characteristics, and consequently, may help to distinguish evolutionary relationships among taxa since ecological divergence is often thought of as a characteristic of true biological species. Consequently, populations of a single species are expected to display very similar niches, whereas populations from separate species should display distinctive ecological roles. To investigate this idea, previously published long-term data were accumulated from over fifteen savanna baboon populations. Variables from four categories were evaluated: 1) environmental, 2) dietary composition, 3) activity budget, and 4) social organization. A discriminant function analysis was conducted for each dataset, with each population being placed into an *a priori* category according to its subspecies designation. The results of the discriminant analyses suggest that the subspecies inhabit significantly distinct environmental conditions, yet display a moderate degree of niche overlap with regards to their diet, activity budget, and social organization. The evolutionary implications of these preliminary findings will be discussed in the context of existing morphological and molecular data.

**Insight into demographic events and population history of Siberian populations: A comparison of Y-chromosome, X-chromosome and mitochondrial data.**

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We compare Y-chromosomal, X-chromosomal and mitochondrial DNA data from the same samples to test hypotheses concerning the origins, migrations, and expansions of modern human populations in Siberia. Thirty paternally and maternally unrelated males from two Western Siberian Samoyed-speaking populations: the Forest Nentsi and Selkups, are studied. These two populations have retained a traditional subsistence economy, lifeways, and a patrilocal residence system until very recently. Previous studies show that Forest Nentsi and Selkups have different pattern of paternal genetic diversity. In addition, 35 samples were chosen from 13 Siberian populations to represent Siberian genetic, linguistic, and geographic diversity. Variation in three compartments of the human genome is assessed by use 3-kb of the X-chromosomal Duchenne Muscular Dystrophy (*DMD*) gene, mtDNA HVSI, 792-bp of mtDNA *COIII* gene, 7.5-kb of non-coding Y-chromosome sequence, 20 Y chromosome microsatellites and 70 binary Y chromosome polymorphisms.

The Y chromosome data reveal lower number of haplogroups and haplotypes in Forest Nentsi when compared to the Selkups. mtDNA sequence variation shows opposing results. *DMD* demonstrates greater nucleotide diversity in the Forest Nentsi than in the Selkups. The differences that are seen can be explained by different marriage structure in these populations and relatively recent northern migration of Selkups.

**Increased male-male cooperation among brown capuchin monkeys (*Cebus apella*) in Suriname.**

L. Kauffman, E. Ehmke, S. Boinski. Department of Anthropology, University of Florida.

Copulations, unlike food, cannot be shared readily. Therefore prevalent theory predicts that males in the same group will be intolerant of each other's mating attempts. Male tolerance of mating attempts is more likely, however, if subordi-

nate males provide necessary services such as defense against extra-troop males and food competitors. Using long-term data collected on brown capuchins (*Cebus apella*) at Raleighvallen in the Central Suriname Nature Reserve, we found that co-resident adult males exhibit stronger male-male affiliation and tolerance than reported elsewhere. More specifically, males in Raleighvallen exhibit higher rates of male-male grooming and lower rates of aggression than suggested by studies in Peru and Argentina. These novel observations of male brown capuchin behavior are most likely a consequence of distinctive forest structure at Raleighvallen, particularly dense, defensible and highly preferred patches of understory habitat. These tolerated co-resident males appear to provide the alpha male with critical support essential for a troop's monopoly of these preferred food patches.

**Pattern and scaling of baseline brain activity: A comparative analysis of regional cerebral glucose metabolism.**

J.A. Kaufman. Dept. of Anthropology, Washington University in St. Louis.

As more anthropologists begin to focus their attentions on the energy demands of the brain in relation to aspects of human development, nutrition, and encephalization, it has become necessary to gain a better understanding of variation in brain metabolism among different regions of the brain, both intra- and inter-specifically. While measurements of regional brain metabolism have been performed in laboratory animals for more than twenty years, newer, non-invasive methods of functional neuroimaging now allow these measurements to be performed in humans, as well.

In this study, positron emission tomography (PET) was used to calculate steady-state baseline regional glucose metabolic rate in humans and baboons. These data were combined with published values of baseline regional glucose metabolism in seven other mammalian species measured either with PET or with 2-deoxyglucose autoradiography. Since metabolic data are calculated in mass-specific units, regional brain volume measurements were also performed, either from MRI scans or from stereotaxic brain atlases. The regions examined in this study include the neocortex, cerebral white matter, hippocampus, thalamus, basal ganglia, and cerebellum.

Results indicate that regional brain metabolism scales negatively with region size, and that brain regions show differing

degrees of negative allometry. Neocortex, for example, displays a relatively steep negative allometry, while white matter exhibits the smallest decrease in metabolic rate over a range of volumes. Although there is a great deal of intraspecific variation, undoubtedly influenced by differences in measurement and sampling technique, there remains a consistent pattern of energy utilization among brain regions of these mammals.

**Observations on the olfactory system of *Tremacebus harringtoni* (Platyrrhini, early Miocene, Sacanana, Argentina) based on high resolution X-ray CT scans.**

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CT-imaging was undertaken on the skull of ~20 Myr-old *Tremacebus*. Here we report our observations on the olfactory bulb endocast.

Platyrrhines vary in the relative size of the olfactory bulbs and the differences appear to relate to the importance of olfaction. *Aotus*, with relatively the largest olfactory bulb, when foraging relies more on olfactory cues than *Callicebus* or *Saguinus* (Bicca-Marques & Garber, 2002) with relatively smaller bulbs. Perhaps the difference is related to nocturnality in *Aotus*, as in nocturnal vs. diurnal strepsirrhines (Barton et al., 1995), although communication and other behaviors must also select for olfactory variation in diurnal anthropoids.

The endocranium of *Tremacebus* is incomplete making precise estimate of brain- and olfactory bulb-size imprecise. We estimated 1) olfactory bulb breadth from the endocranial surface of the frontal that preserves the lateral outlines of the olfactory bulbs, and 2) maximum endocranial breadth. These dimensions give a reliable estimate of relative olfactory bulb size. We compiled data on these same dimensions from CT images of *Miopithecus* and eight extant platyrrhines for which volumes of the olfactory bulb and brain are known. In the extant sample, 1-s residuals for bulb volume (vs. brain volume) and bulb breadth (vs. maximum endocranial breadth) are significantly correlated ( $p < 0.04$ ). *Aotus* has the largest residual olfactory bulb volume among anthropoids. *Tremacebus* had a much smaller volume comparable to that of diurnal platyrrhines. Olfaction of this Miocene monkey probably was not as

acute as in *Aotus*. This finding accords well with previous observations that the orbits of *Tremacebus* are not as large as nocturnal *Aotus* (Kay & Kirk, 2001).

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**Prehistoric subsistence adaptations in west-central Florida as determined by stable isotope analysis.**

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Stable carbon and nitrogen isotope analyses of prehistoric human remains from archaeological sites along the Florida Gulf Coast and inland sites were performed to reconstruct indigenous subsistence adaptations prior to European contact, and to compare the results with other studies associated with Mississippian and related cultural groups in the southeastern United States. Over 400 bone collagen, bone apatite, and tooth enamel samples have been analyzed in order to answer questions regarding the discrete subsistence practices of inland vs. coastal vs. estuarine populations from 1,000 BC to AD 1400. Scientific results from this study are used in combination with archaeological evidence and ethno-historical documentation so that an accurate model of prehistoric lifeways may be constructed.

Previous studies on sites in northern Florida and along the Atlantic coast, almost entirely on bone collagen, suggest that maize became significant very late in Florida's prehistory, or perhaps only in the protohistorical period. This would indicate that complex societies like the Calusa in southwest Florida achieved chiefdom-level sociopolitical organization based on intensive exploitation of marine resources, not agriculture. While bone collagen is produced primarily from dietary protein, bone apatite and tooth enamel reflect whole diet, and thus are more likely to reveal lower-scale consumption of maize. The results from this study also shed light on the relative contributions of freshwater fish and/or marine foods, how subsistence adaptations varied geographically within Florida, and how they may have changed over time.

**Mitochondrial DNA variation in Uto-Aztecan speaking populations.**

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Uto-Aztecan is cited as one of the major world-wide prehistoric language family spreads. Some scholars hold that Uto-Aztecan originated in central Mexico and spread northward into Southwest region of the United States as a result of population expansion due to the innovation of maize agriculture. This hypothesis suggests that Uto-Aztecan speaking populations of the two regions should be biologically akin. Further support for close relations comes from a wealth of archaeological and cultural connections between Mesoamerica and the Southwestern United States. However, the available molecular data have provided only equivocal clues to the nature of this relationship. As genetic evidence is the only way to test for biological relationships, this study further investigates the question with data generated from newly sampled Native American populations of Mexico.

Samples collected from Cora, Huichol, Nahua, and Tarahumara populations were categorized as belonging to one of five New World Mitochondrial DNA (mtDNA) haplogroups: A, B, C, D or X. Haplogroup frequencies were used to assess the relatedness of these populations with previously studied populations from central Mexico and the American Southwest. In addition, the control region of the mtDNA was sequenced in order to generate specific mtDNA lineages (haplotypes). These data were used to determine relationships between individuals of the populations. The data generated in this study bring into question the sharp genetic contrast that has been previously detected between Native American population from Mexico and the American Southwest.

**Obesity in East-Indian and African derived groups in Costa Rica.**

E. Kenney, L. Madrigal. Department of Anthropology, University of South Florida.

Obesity, hypertension, and NIDDM in populations of recent urbanization have been a subject of great interest to physical anthropologists since the proposal of a thrifty-genotype by J. Neel in 1962. It has been hypothesized that the risks of salt depleting dehydration suffered during the slave trade favored those individuals who were better able to retain sodium, which in a nutrient rich environment elevates the risk of hypertension, a condition that is strongly correlated with obesity. These risks were probably endured as well by the East Indian indentured workers brought to the New World by the British.

In this paper we present the findings of a study with two Costa Rican groups, one

of which descends from East-Indian indentured workers (the Culis from Westfalia or C), and one of which descends from Afro-Jamaican workers (Afro-Limonenses or AL). For all anthropometric measures, the Culis are consistently heavier or have higher means than do the Afro-Limonenses: BMI (mean AL = 25.62, mean C = 27.23,  $p > 0.05$ ), sub-scapular skinfolds (mean AL = 18.24, mean C = 26.81,  $p = 0.001$ ), triceps skin folds (mean AL = 19.26, mean C = 25.89,  $p = 0.06$ ), and mid-upper arm circumference (mean AL = 32.62, mean C = 33.5,  $p > 0.05$ ). Our data indicate that in this, rather homogeneous setting, the population that descends from the East Indian indentured workers has a greater propensity to obesity. We compare our results with those found in other, similar populations.

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**A tale of two morphs? A craniometric analysis of the Near Eastern hominids.**

J.H. Kidder, A.C. Durband. University of Tennessee, Knoxville.

The human fossil remains from the Near East have caused consternation among paleoanthropologists since their discovery in the early 1930's. Alternately used to support replacement and continuity models of modern human origins, these crania are extremely diverse in morphology. This problem is compounded by the apparent asynchronous nature of the remains, with the more modern remains appearing in the middle of the Neandertal range of occupation.

For this study, Mahalanobis distances are generated to test the null hypothesis that two separate species exist within this fossil sample. The Howells modern sample is used to calculate a stable covariance matrix. Mahalanobis distances are computed for the fossil samples after Jantz and Owsley (2001). Once these distances are calculated, the fossil crania are compared to one another by the use of random expectation statistics.

The Near Eastern sample used consists of Amud 1, Skhul 4, 5 and 9, Qafzeh 6 and 9 and Tabun C1. These fossils are compared to 27 archaic and early modern crania from Europe and Africa. Two analyses are performed using ten and twelve cranio-facial variables. These results strongly suggest that the specific nature of the Near Eastern hominids is unclear and that specimens routinely classified as Neandertal and early modern human fall within the same expected

population. Furthermore, the pattern of these results indicates that the Skhul, Amud and Tabun remains are morphometrically dissimilar to the European archaic sample. This indicates a homogeneous nature for these hominids and possible long-term coexistence of these populations.

**Growth, stress and deprivation in the Old Frankfort Cemetery: An evaluation of stature, hypoplasias and Harris lines in a nineteenth century population.**

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Physical anthropologists and bioarchaeologists advocate the study of stress as central to our understanding of the health of current and past populations. The Old Frankfort Cemetery provides a certain perspective of the pathological impact of stress, as it represents a pre-antibiotic, poor to working-class burial population. Assessment of multiple measures of stress sequelae in this sample of an early Frankfort community reveals it to have been nutritionally impoverished and disease-stricken. The cemetery population is 273 individuals ranging in age from birth to sixty years. Of 189 dental inventories, 158 have some form of enamel defect. The degree of these defects varies between individuals, but presents an overall pattern consistent with recurring stress. A similar induction is made based on the high prevalence of Harris lines. Finally age-adjusted stature calculations confirm the deleterious impact of chronic stress. To summarize, pathological consequences of stress are repeatedly observed, providing a glimpse of the hardships that were part of the agricultural economy of 19<sup>th</sup> century Frankfort, Kentucky.

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**Estimating individual age-at-death parameters through multi-trait Bayesian analysis.**

E.H. Kimmerle, L.W. Kongisberg. Department of Anthropology, University of Tennessee, Knoxville.

Due to the nature of skeletal biology and individual variation it is imperative that multivariate trait analysis be used to establish the biological age-at-death of

skeletons. Yet, the estimation of an age-at-death interval based on numerous criteria from a variety of skeletal traits is often problematic because of the suite of possible trait combinations at each age, the strong association between age-progressive skeletal features, and the lack of standardization among skeletal biologists in determining age parameters. Often, osteologists rely on experience to "average" the aging information for each individual and establish the age interval. Several methods have been offered to overcome these problems; however, these methods are rarely applied in practice and pose their own statistical challenges.

The purpose of this study is to investigate the use of a multiple trait model for the estimation of age-at-death intervals to aid in the construction of the demographic profile of genocide victims in the former Yugoslavia. A Bayesian approach to calculating the probability of death at each age is employed utilizing an informative prior for the age-at-death profile derived from a large Balkan reference sample (n=876), and combining this with likelihoods derived from identified Balkan skeletal remains with known ages-at-death. A mixed-model combining both continuous and discontinuous traits is used to obtain the likelihoods from skeletal and dental age "indicators." The advantage of this method is that it provides the complete posterior density for age-at-death for practical applications on both complete and incomplete cases.

**A test of the Fully anatomical method of stature estimation.**

K.A. King. Dept. of Anthropology, University of Tennessee.

The anatomical method of stature estimation devised by Georges Fully estimates stature by summing the superior-inferior heights of the skeletal elements that contribute to stature and adding to that value a correction factor to account for the soft tissue that would be present in a living individual. Fully's original sample is potentially biased due to sex, ancestry, and secular factors which bring into question the applicability of this method to skeletal remains of individuals from demographically dissimilar groups.

Thirty six individuals of known living stature or cadaver length from the William M. Bass donated collection at the University of Tennessee were measured following the methods outlined by Fully. Soft tissue contributions to stature were calculated for each individual using the summed contributions of the osseous elements and the recorded statures and com-

pared to the soft tissue estimates described by Fully. The Fully method underestimated the statures of all groups (females, all males, African-American males, and Caucasian males). The differences between the calculated and estimated soft tissue contributions were statistically significant for the total sample, all males, and Caucasian males. The results of this study suggest that there is a potential bias in the soft tissue correction factors devised by Fully, possibly making this method less broadly applicable than previously thought.

**Losing the edge: Tooth wear and life history in rainforest sifakas of Madagascar.**

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*Propithecus diadema edwardsi* is a rainforest folivore and seed predator whose dental morphology includes relatively long shearing crests, typically found in highly folivorous primates. This study used mixed longitudinal and cross-sectional data from Ranomafana National Park. Tooth-wear data from known-aged individuals were complemented with 17 years' field-collected behavioral, life history, and phenological information. The goal of the study was to examine the correspondence between ontogenetic changes in dental morphology and life history parameters.

Dental molds of the right mandibular tooth row were taken from the same captured and sedated individuals on several occasions throughout the period of the study. High quality plaster casts were digitized using a high resolution piezo scanner. GIS techniques were used to quantify ontogenetic changes in occlusal relief, slope, angularity, and 3D shearing crest length of the second molar.

We found a systematic ontogenetic decrease in occlusal relief, slope, and angularity. On the other hand, shearing crest length remains nearly constant during the adult years, and even increases at about 15 years of age. The increase in crest length is due to the late appearance of additional enamel cutting edges in the center of the tooth that supplement the original buccal and lingual crests. Thus, molar attrition in *Propithecus* produces a near-selenodont morphology, which is best developed in mammals with fibrous diets. The crest length, reproductive value, and life expectancy all plummet to minimum values after 20 years of age. This project

was supported in part by the Leakey Foundation.

### **Effects of activity pattern on eye and orbit morphology in primates.**

E.C. Kirk. Dept. of Anthropology, University of Texas at Austin.

Relative orbit diameter is widely used as a means of reconstructing activity pattern in fossil primates. This methodology is based on the observation that living nocturnal primates have relatively larger orbit diameters than living diurnal primates. It is generally assumed that this pattern is the result of differences in relative eye size between nocturnal and diurnal species, but this assumption has not previously been tested.

In order to study the effects of activity pattern on eye and orbital morphology, morphometric data on eye size and orbital aperture size were collected for 147 specimens of 55 primate species. Eyes were extracted from cadavers, and eye diameter, cornea diameter, and orbital aperture diameter were measured using digital calipers. These data indicate that although nocturnal and diurnal primates differ in relative orbital aperture size, they do not necessarily differ in relative eye size. Most nocturnal species with relative eye sizes greater than those of diurnal species either lack a tapetum lucidum (e.g., *Tarsius*, *Aotus*) or are highly faunivorous (e.g., *Loris*). By contrast, nocturnal frugivores (e.g., *Cheirogaleus* and *Perodicticus*) tend to have eye diameters comparable to those of similar-sized diurnal species. Within suborders, nocturnal species always have larger corneas relative to eye size than diurnal species. A number of factors appear to influence orbit size in primates, including cornea size, eye size, orbit orientation, and differential eye/orbit allometry. Nonetheless, relative orbit diameter remains a good indicator of activity pattern because cornea size and eye size are both influenced by activity pattern.

### **New evidence of human sacrifice in the north coast of Peru: Middle Sicán ritual killing in the Lambayeque Valley.**

H. Klaus<sup>1</sup>, J. Centurión<sup>2</sup>, M. Curo<sup>2</sup>. <sup>1</sup>The Ohio State University/Museo Nacional Sicán; <sup>2</sup>Museo Arqueológico Nacional Brüning de Lambayeque.

Until recently, human sacrifice in the Central Andes has only been known from Moche art and secondhand Inka ethnohistorical accounts. This presentation pre-

sents our analysis of the third well-documented sample of Andean sacrificial victims, at Cerro Cerrillos in the Lambayeque Valley, North Coast of Peru. Thirty-two juveniles and young adult males were documented, dating to the multi-ethnic, pre-Hispanic Middle Sicán culture (AD 900-1100).

Most skeletons bear physical evidence of sacrifice. We discern at least seven permutations of ritual killing at Cerro Cerrillos, involving combinations of slitting the throat, semi-decapitation, and cutting open of the chest. We also identify newly observed sacrificial practices, including the ritual focus on killing children, accession of the thoracic cavity, and careful burial of the victims after they were curated through decay/desiccation stages. The identity of victims can also be assessed – mortuary patterning and bioarchaeological data indicate the victims were ethnically Mochica Middle Sicán commoners. Finally, archaeological and taphonomic data is used to reconstruct the sacrificial process in detail, from victim selection, killing, interment, and post-burial visitation.

In sum, this study (1) empirically contributes to the study of ritual killing in the late pre-Hispanic times, where sacrifice has been overlooked due to a lack of representational art styles; (2) adds to the emerging bioarchaeological reconstruction of the Middle Sicán culture as a whole, and; (3) underscores an integrated burial methodology to interpret ancient behavior and social organization.

This research was supported by Nextel Perú and the Ohio State University.

### **Time since death: The problem of determining PMI in skeletal remains.**

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The forensic anthropologist is frequently asked to examine human skeletal remains in order to provide information about the identity of an individual. Therefore estimating time since death is of highest interest to the investigating authorities. Since many studies have been failed to establish a reliable method of determining PMI this investigation was conducted to evaluate the time dependent protein loss of interred human bones and the relevant taphonomic parameters. Femurs were collected from 112 skeletons and submitted to chemical analysis. Total nitrogen levels were obtained by the Dumas

method and subjected to statistical analysis. Although there was an observable decrease for protein content with deposition time, statistical calculations proved that there was no significant correlation between the times elapsed since death and the bone nitrogen content. Microscopic investigations were performed, showing extensive plaques known as growth vestiges of fungi and bacteria. The post mortem invasion of soil microorganisms seems to cause contaminations sufficient enough to disturb the data derived from the bone protein. Considering the influence of the burial environment it must be concluded that nitrogen analysis provides inaccurate data and is therefore not appropriate to determine PMI in forensically relevant cases.

Analyses were supported by the Institute of Forensic Medicine, University of Vienna.

### **The energetic cost of arboreal motherhood in orangutans: Effects on the inter-birth interval.**

C.D. Knott. Department of Anthropology, Harvard University.

Orangutans have the longest inter-birth interval of any primate, and probably of any mammal (Galdikas and Wood 1990; Knott 2001). Among the great apes, orangutan inter-birth intervals are on average 8 years, compared to 5-6 years in chimpanzees, and 4 years in gorillas. These long inter-birth intervals in orangutans seem largely due to the extremely variable food supply and its effect on female ovarian function. Orangutans experience long periods when nutritional intake is inadequate and their hormonal profiles are suppressed.

In this talk I test the hypothesis that arboreal locomotion places an added energetic constraint on inter-birth intervals in orangutans compared to other great apes. Influenced by the availability and distribution of preferred fruits, orangutans are almost entirely arboreal. This may place an added constraint on juvenile development that in turn affects maternal energetics. I examine the following questions to test this hypothesis: (1) Do orangutan mothers carry their infants longer than do other apes? (2) Do orangutan mothers travel significantly slower than do non-mothers? (3) Do orangutan mothers help their infants locomote more than do other apes? I then explore how these behaviors in orangutans affect foraging and ranging and ultimately how they translate into differences in total daily caloric intake and energetic expenditure. Data presented are from a long term study of wild

orangutans in Gunung Palung National Park in West Kalimantan, Indonesia, on the island of Borneo.

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### The primates of Phu Khieo Wildlife Sanctuary.

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Assessing diversity and density of primate communities is important, because it helps to understand the evolution of primate communities and to set conservation priorities. Asian primate communities have been considered odd, because of unusual relationships of primate diversity to mammalian diversity, rainfall, and latitude. Here we report the group and population densities of a primate community in a dry evergreen forest at Phu Khieo Wildlife Sanctuary (Northeast Thailand) and compare it to available data of other Asian communities. A 4-km transect was walked on four consecutive days in the middle of each month resulting in more than 400 km of transect walks (09/2000-08/2003). We encountered 6 diurnal species. Phayre's leaf monkeys (*Trachypithecus phayrei*) were most abundant, white-handed gibbons (*Hylobates lar*) and Assamese macaques (*Macaca assamensis*) were the second most common species. Other macaques (*M. mulatta*, *M. nemestrina*, *M. arctoides*) occur at low densities. Circumstantial evidence indicates the presence of nocturnal slow loris (*Nycticebus coucang*). We did not encounter silvered langurs (*T. cristatus*) reported for other parts of the sanctuary. Cumulative density calculations indicate robust values for Phayre's leaf monkeys, gibbons, and Assamese macaques. Densities are moderate to low compared to most other sites. The overall primate species richness is considerably higher than expected based on latitude and rainfall. This high biodiversity supports the idea of Pleistocene refugia during glacial aridity. Future analyses of Asian primate communities should include additional Indochinese mainland communities. Supported by NSF (BCS-0215542), National Geographic (7246-02), L.S.B. Leakey Foundation, and Stony Brook University.

### Marital migration rates, malaria epidemiology, and biological diversity within Island Melanesia.

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The differences in physical appearance among the peoples of New Guinea and Island Melanesia can be quite dramatic, reflecting the effects of long term settlement (ca. 40,000 years), very small population sizes, restricted marital migration patterns in the interiors of the larger islands, as well as a series of migrational influences from different external sources. Differential natural selection is thought to have affected genetic heterogeneity in the region primarily via malaria related mortality. We present contemporary data relating to a number of these factors. Marital migration data collected over the past 50 years compare shore vs. inland rates, and male vs. female rates of movement. While there is no apparent male/female distinction in marital migration rates (with median rates less than 5 km. for both), there is a distinction between inland and shore rates, which may well reflect pre-contact conditions. Differential genetic susceptibility to malaria infection among groups in New Guinea and Island Melanesia is caused not only by ecological differences in malaria frequency, but differential migrational influence from Southeast Asia. Frequency patterns in Hereditary Ovalocytosis, Gerbich blood group negativity, a-thalassemia, and Glucose-6-phosphate dehydrogenase deficiency will be reviewed from this perspective.

### Postcranial robusticity and limb-length proportion in Neandertal children.

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Postcranial morphology in late Pleistocene hominids, especially in Neandertals, has been often regarded as 'robust', and their high levels of robusticity have been interpreted in context of behavioral/cultural differences or of adaptation to different (circumpolar/tropical) climates. Assessment of the postcranial robustness for young Neandertals and its relationship to their limb-length proportion may contribute to this discussion, because it is generally considered that the long bone length is more genetically determined, while the shaft circumference

(one of the robustness measurement) is subject to the individual loading history.

We collected linear measurements of several postcranial bones from young Neandertals (N=9), Skhul-Qafzeh children (N=4), and European Upper Paleolithic children (N=11) as well as three geographically different modern samples of modern Japanese, historic to recent British and modern South African children. To offset the growth changes in each parameter, all measurements are log-transformed, and expressed as residuals from reduced major axis on the long bone lengths.

Young Neandertals generally occupy upper positions in the modern variation in postcranial robustness, while lower positions in the crural/brachial limb-length proportion. Considering weak but significant association of greater robusticity with smaller crural/brachial indices as well as moderately clear geographical patterns in the modern child samples, the detected high robusticity in young Neandertals might be a byproduct in the course of growth toward accomplishment of a genetically determined bodily proportion.

### Non-metric traits of the femur and tibia related to Byzantine monastic prayer.

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This study is part of a larger consideration of habitual squatting in a skeletal collection from Byzantine Saint Stephen's (Jerusalem). Historical and liturgical texts from the site and the region indicate kneeling for prayer and repetitive genuflection (numbering the hundreds) as part of the daily worship cycle.

The distal femur (n=128) and proximal tibia (n=142) were analyzed for the presence of several non-metric traits associated with deep flexion of the knee. These included Charles facets, plaque, Martin's facets, tibial imprints, supratrochlear facets, osteochondritic imprints, and tibial retroversion. Ninety-seven percent of the right femora and 91% of the left demonstrated at least one of these traits. Both medial and lateral features were found in higher numbers on the right femurs. Right femora demonstrated significantly more plaque formation (n=51) and Martin's facets (n=16) than the left femora (p<0.01). Medial tibial imprints (n=77)

were likewise significantly greater on the right side ( $p < 0.05$ ). To test the frequencies of these traits, data was likewise collected for two non-monastic communities in the region (Umm el-Jimnal and Emmaus).

The St. Stephen's collection demonstrated significantly higher numbers of all of these non-metric features. Osteoarthritic lipping of the femoral condyles and patella was likewise far more severe in the St. Stephen's collection. When combined with non-metric traits of the proximal femur, distal tibia, talus, calcaneus and hallux, as well as musculoskeletal markers of the hip, these data further support a biocultural reconstruction of prayer practice in this Byzantine monastery.

#### **Development of foraging skills in the aye-aye (*Daubentonia madagascariensis*).**

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Among mammals, humans and other primates are distinguished by slow life history. The "needing-to-learn" hypothesis attributes this feature to the long period needed to learn adult skills, especially foraging skills acquired during immaturity. Alternatively, the development of foraging efficiency may be constrained by maturational (size/strength, neuromuscular) constraints. My objective is to evaluate the predictions of the "needing-to-learn" hypothesis in aye-ayes, which are ideal subjects due to their complex extractive diet and relatively slow life history. Specifically, my goal is to determine the age at which immature aye-ayes begin tap-foraging independently, the constraints that limit the development of efficient skills, and how much time/experience is required to reach adult-level efficiency.

Experimental data on immature ( $n=4$ ) and adult ( $n=4$ ) aye-ayes were collected between 2002-2003 at the Duke University Primate Center, Durham, NC, on the developmental trajectory of aspects of tap-foraging (locating larvae, gnawing depth, extraction time, errors made). Results show that aye-ayes are initially incapable of independent tap-foraging, but begin to forage successfully soon after reaching 1 year of age. Immature aye-ayes forage less efficiently than adults, due to both inexperience and size constraints, but rapidly improve in efficiency such that three out of four aye-ayes were capable of foraging like adults by age two. In general, aye-ayes are able to forage efficiently quite early, relative to age at first repro-

duction (~5 years). Therefore, although "needing-to-learn" seems to correlate with the duration of infancy, it does not appear to select for the slow life history of this species.

#### **Taxonomic affinities and geochronological age of RH1, the first fossil hominid from West Java, Indonesia.**

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During our 1999 excavations at Cisanca, near the village of Rancah, West Java, Indonesia, a lower, lateral incisor (designated RH1 = "Rancah Hominid 1") was recovered *in situ* 353 cm below the surface. This is the first fossil hominid to be discovered from this region and is one of the few fossil hominid specimens to be produced as a result of controlled excavations on Java. In comparisons to samples of *Pongo*, *Homo erectus* and *H. sapiens*, RH1 is most similar in size to modern humans, shares shape similarities with *H. erectus* and is most unlike orangutan lower, lateral incisors. To determine the maximum geochronological age of RH1, bovid teeth that were recovered 190 cm beneath the hominid tooth were subjected to electron paramagnetic resonance (EPR) dating analyses. These EPR dates range from 516 to 606 ka. Primarily because of RH1's great depth within the section, and secondarily because the sediments grade continuously between RH1 and the bovid, we suggest that RH1 (although deposited later) was broadly geologically contemporaneous with the bovid from whose teeth the EPR ages were determined. The EPR dates from Cisanca indicate that hominids had arrived in western Java at least half a million years ago, and possibly earlier. The expansion of the known range of Pleistocene hominids into this portion of the current archipelago is relevant for an improved understanding of the timing of hominid dispersal into Southeast Asia, as well as questions concerning insularity and endemism in the region.

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#### **Do body proportions matter when predicting the energy required to walk?**

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Conventional empirical analysis indicates that the metabolic energy used by modern humans to walk varies with velocity and body mass, but not with body proportions (like leg length), while mechanical analyses indicate that changing body proportions should change energy use. To attempt to rectify this apparent anomaly, we obtained energetic data from 11 adults walking at self-selected slow, normal and fast velocities. Using least-squares regression and repeated measures techniques, we found that when individual variation in resting metabolic rate was accounted, a model which uses absolute velocity, total body mass, height and leg length as independent variables can predict approximately 85% of the variation in energy expenditure. Correction for velocity using Froude number did not improve the fit of the model. As expected, velocity remains the strongest and most significant predictor of energy expenditure, accounting for 70% of the variation. The relationship between height, leg length and body mass is, however, more complex than often appreciated. This complexity points to the need to include the upper body in mechanical modeling schemes.

#### **A prospective study of maternal prenatal dietary intakes and the formation of enamel growth disruptions.**

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In bioarchaeological and contemporary population studies, enamel growth disruptions such as linear enamel hypoplasias (LEH) and histologically observed Wilson Bands (WBs) are assumed to be indicative of poor diets and increased disease loads during enamel formation. However, few studies have been able to longitudinally study these relationships, and this is especially true for WBs. In this paper, we prospectively evaluate the relationship between maternal prenatal diets and the formation of WBs in prenatal deciduous enamel of their infants.

This study is based upon thirty-one mothers and their newborns from Kalamia, Egypt who were previously part of the Collaborative Research Support Pro-



gram (CRSP). From 1984-6 data were collected on maternal factors such as monthly dietary intakes throughout their pregnancies. Subsequently, we collected, sectioned, and scored exfoliated deciduous incisors from infants for the presence, severity, and location of WBs.

Eight of thirty-one teeth (26%) had one or more prenatal WBs. Mothers of infants with WBs consumed significantly fewer kilocalories (1816 vs. 2049; difference = 233;  $p = .013$ ), significantly less total protein ( $p = .001$ ) and micronutrients such as iron ( $p = .005$ ), zinc ( $p = .025$ ) and riboflavin ( $p = .001$ ). In showing that maternal prenatal dietary quantity and possibly quality are related to the development of a WB *in utero*, these data lend support to a prior study of infants from Mexico (Acosta, et al. 2002). These results lend unique support to the assumed relationship between poor diets and prenatal enamel growth disruptions.

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#### **Niah Cave paleoanthropology in late Pleistocene regional context.**

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The paucity of physical evidence for early modern humans in Mainland and Island Southeast Asia has restricted paleoanthropological research, although important contributions have been and continue to be made towards clarifying its rich human biological history. Remains from Tabon Cave (Palawan, Philippines), Wajak (Java, Indonesia), Liujiang (Guangxi, China), and Niah Cave (Sarawak, Malaysia) are routinely considered in such discussions. This study places early human remains from Niah Cave's West Mouth in late Pleistocene regional context. Purported dates, stratigraphy, and context of these remains recovered from "Hell" deposits have been re-established by the Niah Cave Project. The ~40 ka "Deep Skull" and associated post-crania, including a newly reconstructed left femur, are described vis à vis other early human remains from the region.

In 1960, Brothwell published an outstanding reconstruction and analysis of the gracile cranium, suggesting it to be an adolescent based on unerupted M3s, with "Tasmanian" affinities. At these meetings twenty-five years ago (1979), Birdsell presented a reassessment (never published) concluding that the cranium was that of a female young adult (20-30 years) based on dental wear, basilar suture fusion (partial), and varied rates of M3 formation/eruption. Birdsell concurred with Brothwell on affinity, but claimed "a

heightened Negritoid component" as well. The implications of Birdsell's reassessment, coupled with on-going research of these remains, are considered in light of interpretative models for the modern peopling of Southeast Asia during the late Pleistocene.

#### **New hominid remains from the Obi-Rakhmat rock shelter, northwestern Uzbekistan: Insights into the makers of the Initial Upper Paleolithic of Central Asia.**

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During the 2003 field season, new hominid remains were discovered in a Middle to Upper Paleolithic transitional context from Obi-Rakhmat rockshelter, Uzbekistan, marking the first hominid discovery in this region since the late 1930s. The remains consist of six teeth and over 150 cranial fragments. The site contains a 10 m. thick succession of deposits with an industry that is transitional in character between the Levallois-Mousterian blade-based Middle Paleolithic and the Upper Paleolithic. Radiocarbon dates from the upper part of the sequence indicate an age of at least 48,000 BP for the hominid bearing level (level 16). After a preliminary investigation, our working hypothesis is that the remains are from a single juvenile (<12 years old) individual. The dental remains are noteworthy because of their extremely large size and the presence of an upper molar cuspal variation previously undocumented in the fossil record. In addition, the single lateral incisor is strongly shovel-shaped and expresses a pit at the cingulum. The cranial fragments are generally gracile and are comprised of vault bones, two petrous portions, and some of the sphenoid. Taxonomic affinity is assessed using a discriminate function analysis and descriptive statistics of the Obi-Rakhmat finds are presented in a comparative context with other age-appropriate Upper Pleistocene specimens. Results indicate that the Obi-Rakhmat remains express a mosaic of archaic and more modern features. This discovery will contribute to a more refined understanding of the morphological land-

scape across Central Asia during the Upper Pleistocene.

#### **Ontogeny of mandibular shape in Neandertals and modern humans.**

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Many descriptive mandibular features figure prominently in comparisons between Neandertals and modern humans, including mental foramen position, and the presence/absence of a chin or retromolar space. Ontogenetic studies of the mandible usually discuss the development of such features qualitatively, or focus on the description and comparison of an individual non-adult fossil specimen. This study analyzed mandibular shape and growth patterns in Neandertals ( $N_{non-adult}=7$ ;  $N_{adult}=12$ ) and seven geographically diverse recent modern human samples ( $N_{non-adult}=212$ ;  $N_{adult}=119$ ). These samples were divided into five developmental age groups based on patterns of dental eruption. Three-dimensional landmark coordinate data were collected from 13 midline and unilateral landmarks on the mandible and analyzed using Euclidean Distance Matrix Analysis (EDMA) and principal coordinates analysis.

The morphology of the anterior mandible and symphysis differs significantly between Neandertals and modern humans in both non-adult and adult samples. These significant differences are localized to the chin and inferior symphysis in modern humans, while Neandertals show more developed genial tubercles and more posteriorly positioned mental foramina. Results also demonstrate that modern humans have significantly taller mandibular rami, and Neandertals have longer mandibles and wider mandibular rami. However, there is also a high degree of variability in mandibular shape in both modern humans and Neandertals. Ontogenetic comparisons show that Neandertals experience increased growth in most mandibular distances, reflecting their larger mandibular size; modern humans grow more than Neandertals only in localized distances in the inferior symphysis, reflecting development of the chin.

#### **A three-dimensional approach to intra-regional variation among Archaic populations of the Mid-South.**

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The Mid-South has yielded numerous Archaic sites, many of which contain assessable human skeletal remains. In-

cluded in this study are crania from seven sites located along the Tennessee, Harpeth, and Green River drainages, dating from the Middle to Late Archaic phases (3-8 kya). Examination of morphology at these sites is important as these samples represent some of the earliest sizeable populations to inhabit the Southeast. Although a few of the sites assessed here have previously been subjected to morphological examination for intra-site purposes, and for comparison to Paleoindian and/or more recent American Indian populations, very little attention has been given to understanding spatial and temporal differences within the region itself. It is essential that such variation is accounted for and understood before comparisons of these populations to other regions and time-periods can be adequately addressed.

Geometric morphometric techniques have proven useful for assessing morphological variation and biological distance among populations. This study utilizes the generalized least-squares Procrustes superimposition method to examine three-dimensional coordinate data extracted from all fully or partially articulated adult crania. The resulting superimposed coordinates are then subjected to various multivariate statistical procedures to aid in analysis of biological distance and existing trends in the data. Preliminary results suggest that despite their close geographical proximity, these Archaic groups are morphologically distinct, and subgroups in the data reflect regional divisions in subsistence strategies and settlement patterns.

**Occlusal Fingerprint Analysis (OFA) – Quantifying individual wear pattern of tooth crowns using optical 3-D topometry.**

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Occlusal fingerprint analysis (OFA) is used to interpret the relief and functional aspects of primate teeth. Information about food ingestion and mastication behaviour during the life span of an individual is encoded in the wear pattern. In order to decode this information we measure structural parameters, like strike and dip of cusp slopes and wear facets. The dental occlusal compass, which indicates the pathways of interaction on antagonistic cusps and basins, can also facilitate the interpretation of growth, fusion and position of wear facets.

The current OFA studies show that modern apes and humans develop a very similar overall wear pattern, referred to as background pattern. This background pattern is formed due to crown shape and relative position of cusps and basins in the lower and upper jaws during occlusion. The foreground pattern is an individual feature, reflecting the pressure distribution due to a distinctive behaviour of the masticatory system. Since the complex wear produced through background and foreground pattern is unique for each individual, it is termed occlusal fingerprint (OF).

The data acquisition is based on high resolution surface models of jaws and teeth generated by an optical sensor system (optoTop). The strike of a region of interest is measured, according to the longitudinal axis of the tooth, and the dip with reference to cervical plane orientation. The average orientation of defined surfaces in three dimensions is presented in stereonet diagrams. Each molar is characterized by its specific stereoplot pattern.

**Population-pathogen histories, MHC efficiency, and vaccine efficacy.**

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Lack of exposure-acquired immunity to novel pathogens is understood to underlie the devastating effects of population contact on indigenous peoples. But the enduring population genetic effect of disease history on contemporary health and efficacy of contemporary public health measures, particularly vaccination, remains obscure. Adaptive immune response relies on products of the Major Histocompatibility Complex (MHC) that bind protein fragments from pathogens, present them to T lymphocytes, and initiate a cascade of events resulting in the proliferation of immune cells specific for the protein fragment from that pathogen. The six MHC loci are among the most polymorphic in the genome: polymorphisms represent different binding capabilities, thus determining the repertoire and efficacy of antigen "recognition" that comprise immunocompetence against a pathogen.

Pathogen exposure therefore determines selective pressures on MHC polymorphism, whereby population history of exposure predictably shapes MHC allele frequencies for those most effective for prevalent pathogens. Thus, history of pathogen exposure influences immune responses to classes of pathogens and can become a covert but powerful factor in vaccine failure. Understanding relation-

ships of MHC:peptide binding efficiency to vaccine effectiveness may not only help to explain differential impact of emerging diseases and resolve unexplained poor vaccine efficacy, but also prove useful in selecting the best vaccine for a particular region. Discussion will be illustrated from examples from Old and New World populations, and with regard to specific pathogens such as tuberculosis and mumps.

**Maternal and prenatal influences on male life history.**

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Puberty has key evolutionary significance, as it is the developmental stage when excess energetic resources (productivity) are shifted away from body growth and into reproductive effort. Recent research reveals relationships between size at birth and maturational timing among females, while prenatal nutritional interventions in animal models permanently alter the growth trajectory, maturational timing, and endocrine function of adult offspring. Such findings suggest that important features of an organism's life history may be influenced by early life nutrition. However, little is known about such relationships in human males. In this paper, we investigate the hypothesis that size at birth and maternal energy intake and nutritional status during pregnancy predict maturational status among 994 adolescent male Filipinos participating in a longitudinal birth cohort study (CLHNS) begun in 1983. In multivariate models, birth length, weight, and 3<sup>rd</sup> trimester maternal energy intake and energy status were used to predict age-adjusted maturational status, with household income used to control for the quality of the postnatal environment. There were significant interactions between prenatal variables and income in models predicting maturational status. Individuals who were born large, whose mothers were better-nourished than average, or both, mature at a rate that is highly sensitive to the income level of their household. In contrast, the maturational status of individuals who were small at birth or born to poorly-nourished mothers is independent of postnatal income. These interactions are graded and highly consistent, and suggest that the male maturational response to the postnatal environment is conditioned by fetal nutrition.

### Balancing the immunological demands of pregnancy and infection.

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Immunologically, pregnancy is characterized by a shift toward an anti-inflammatory Th2 profile, which is thought to protect the fetus from maternal rejection. Elevations in Th1 cytokines in early pregnancy are associated with recurrent miscarriage and later help initiate both term and preterm labor. Researchers contend that preterm delivery (PTD) is fetally initiated when the third trimester uterine environment becomes inhospitable to the developing fetus. Pregnant women with malaria have a Th1 cytokine profile, characterized by TNF- $\alpha$  elevations, but it is not clear whether malaria-related pro-inflammatory cytokine elevations actually trigger PTD.

To assess the effects of malaria on PTD, women who delivered preterm (n=42) and at term (n=99) at the Queen Elizabeth Central Hospital in Blantyre, Malawi, were matched for HIV status, parity and approximate date of enrollment. Chorioamnionitis (infection of the placental membranes) and anemia were assessed, and maternal, placental and cord cytokines were measured. By multivariate conditional logistic regression, chorioamnionitis (OR=2.6; 95% CI:1.1-6.4) and lower maternal hemoglobin levels (OR=1.3, 95% CI:1.0-1.6) significantly increased the odds of PTD. Malaria did not itself increase the odds of PTD, but was associated with significantly lower maternal hemoglobin levels (t=3.38, p=0.001). Malaria and chorioamnionitis were associated with elevations in different proinflammatory cytokines. However, only the cytokine alterations associated with chorioamnionitis were associated with PTD. In conclusion, we found that although anemia and chorioamnionitis increase odds of PTD, only chorioamnionitis appears to act through an inflammatory immune mechanism. This suggests that malaria, despite its induction of a Th1 profile, is a relatively weak risk factor for PTD.

### A contribution to the nutritional history of prehistoric Sardinia (Italy): Preliminary results of isotopic analyses of bone collagen, bone apatite and tooth enamel.

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Knowledge of subsistence strategies is invaluable for our understanding of prehistoric societies. With this study we investigated isotopically the nutritional patterns of prehistoric populations of Sardinia to reveal the economic basis of important social transformations between the Neolithic and Bronze Age. This provides us with a means of testing hypotheses, strongly rooted in the literature, which assume a substantial shift from agriculture towards pastoralism between the two periods. However, the data currently available come mostly from a few faunal studies, and this interpretation has already been put into question. Our research was designed to make a contribution with a different, more quantitative approach.

As part of a project including radiocarbon dating, study of mobility patterns with strontium isotopes, and DNA analyses, we present the results of carbon and nitrogen isotope analyses on bone collagen, apatite, and tooth enamel; the bone and tooth samples were chemically processed to separate the organic (collagen) and mineral (apatite and enamel) components, which were analyzed at USF with high precision on mass spectrometers dedicated to analyzing carbon and nitrogen in organic samples (using an in-line CHN analyzer), and carbon and oxygen in carbonate samples (using a Kiel individual acid bath system).

Significant new data are provided from approximately one hundred individuals, regarding the relative importance through time of farming, herding and fishing at both coastal and inland sites of central-southern Sardinia spanning from the Ozieri phase (Late Neolithic, 4th millennium BC) until the advanced Nuragic (Middle-Late Bronze Age, second half of 2nd millennium BC).

### How primates eat: An analysis of food handling and processing in a community of African cercopithecoids.

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Researchers interested in the biological roles of morphological features in extinct species must necessarily use data collected on extant taxa. Early research on inferring diet in fossil primates used relative anterior to posterior tooth size as indicators of reliance on either fruit or leaves. Subsequent generalizations that frugivores have relatively large incisors,

and folivores relatively small, have informed our interpretation of paleospecies diet. However, as cautioned by Ungar (2002), research on distantly related primates indicates variation beyond that which would be predicted by relative tooth size alone. Unfortunately, evaluating whether these generalizations are more robust for predicting diet in more closely related taxa is precluded by a paucity of information on food processing in most species.

Here, I present data on food processing by three cercopithecines (*Lophocebus albigena*, *Cercopithecus ascanius*, *C. mitis*) and two colobines (*Procolobus badius*, *Colobus guereza*). Data were collected in Kibale National Park, Uganda (1993-2002), on anterior/posterior dental use, feeding rate, cheek pouching, and hand use whilst feeding. I evaluate the influence of plant species/part, phenophase, fruit/seed/leaf size and hardness, nearest neighbor, and food availability on ingestive behavior. Preliminary results indicate that incisal preparation was not more common in cercopithecines. Hand use was frequent in leaf and large fruit processing which influenced incisor reliance. Social context, too, was important in determining food handling; e.g., #indvs/tree influenced cheek pouching which impacted anterior fruit processing by cercopithecines. These results provide a means to refine generalizations regarding diet and dentition and to identify probable feeding ecology as signaled by morphology.

### Presence of *Mycobacterium* infection at the Crystal River archaeological site: Preliminary findings.

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The Crystal River Archaeological site spanned the Deptford (200 B.C.-A.D. 300) and Weeden Island (A.D. 300-A.D. 900) periods of Florida's prehistory. The occurrence of *Mycobacterium*, *spp.* infection is rare in North America and no cases have been documented at an archaeological site in Florida.

A young female (aged 16-30) excavated from the circular embankment of the main burial mound displayed gross cranial lesions indicative of *Mycobacterium*, *spp.* infection. Other morphological features indicative of tubercular pathology included circumferential pitting on a vertebral body and surface lesions on the sacro-

auricular surface of the right ilium. No pathological alterations were observed on the long bones or ribs. X-rays were made of the cranium and postcranial remains. Cranial X-rays indicated lesions that were not visible at the gross level. X-rays of the ilium and vertebral body showed similarities to other tubercular radiographs.

For confirmation of *Mycobacterium, spp.* infection, samples drilled from the cranium, vertebral body, clavicle, ribs, ilium, and tibia were analyzed for mycobacterium DNA using the polymerase chain reaction (PCR). Preliminary results indicate that the ilium and tibia were positive for mycobacterium infection. A control rib sample excavated from the same burial mound also tested positive for mycobacterium DNA, although the negative PCR and extraction controls analyzed with the rib sample tested negative, suggesting the possibility of other infected remains. Repeated analyses in a separate laboratory will be done in order to confirm our initial results as well as provide data on the strain of *Mycobacterium, spp.* through spoligotyping.

**Muscle recruitment in primates: Preliminary results on the question of neuromuscular conservation in primates.**

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On the basis of observations of similar electromyographic (EMG) activity in homologous limb muscles of morphologically different animals, Goslow and coworkers have proposed a *neuromuscular conservation hypothesis*, that is, patterns of muscle recruitment are maintained during the evolution of tetrapods, despite changes in morphology. However, studies on shoulder muscle recruitment in several anthropoid primate species reveal differences from this common pattern. In addition, the muscle activity patterns for each species are similar despite their morphological differences, suggesting that primates may display a common motor program that distinguishes them from other tetrapods. Since EMG data currently exists only for anthropoid primate species, we have undertaken a study of muscle recruitment patterns in prosimians, and here we report on preliminary results for *Lemur catta* and *Eulemur fulvus*.

Telemetered electromyography was used to examine the recruitment patterns of the supraspinatus, infraspinatus, deltoid, pectoralis major and latissimus dorsi in three subjects of each species during quadrupedal locomotion. Samples of

walking steps were collected for each individual and average profiles of muscle activity through a step cycle were derived.

Although the activity profiles of these muscles did not exactly match either the tetrapod pattern or that of anthropoid primates, in certain important respects, such as the absence of support phase activity in pectoralis or latissimus, the results for these two lemur species support a distinctive primate pattern of neural control.

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**Bilateral erosive arthropathy of the upper limbs: An Inuit case from Point Hope, Alaska.**

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Analyses of pathological lesions in ancient human skeletons provide biological anthropologists opportunities to assess the manifestations of certain disease processes and the level of health care in traditional peoples. However, assessing health and morbidity in pre-historic hunter-gatherers is difficult due in part to small group size, high mobility, and the limited excavation of skeletons from non-cemetery locations. Hunter-gatherer groups who have occupied extreme environments, such as Inuits of Alaska, are of particular interest due to their remote living conditions.

Recent examination of a large collection of pre-contact Inuit skeletons excavated from Pt. Hope, Alaska, has identified a 35-39 year old female with bilateral erosive lesions of the metacarpophalangeal, carpal, radiocarpal, and radioulnar joints. While the distribution pattern of these lesions is suggestive of a classic diagnosis of rheumatoid arthritis (RA), it is necessary to consider other diseases including hemochromatosis and psoriatic arthritis as both diseases can mimic the classic RA skeletal lesion distribution.

Hemochromatosis, a genetic disorder characterized by abnormal iron absorption, is compatible with the pattern of lesion distribution in this individual. The presence of reactive bone growth in conjunction with erosive lesions also supports a diagnosis of psoriatic arthritis. This paper discusses our differential diagnosis and the consequences of such lesions for an individual living within a hunting-gathering lifestyle of the harsh Arctic environment. This is particularly relevant given that Inuit women are known to have underwritten the costs of male hunting by engaging in extensive upper limb

activities such as hide preparation, clothing manufacture, and food preparation.

**Trace element, strontium isotopic ratio, and X-Ray Fluorescence (XRF) analysis of Pleistocene human teeth from the Altai.**

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In 1984, human remains (7 teeth and postcranial fragments) dated to the late period of the Middle Pleistocene were discovered in two caves of the north-western Altai, Siberia. According to their absolute dimensions and morphological features, the Altai findings resemble Mousterian samples from the western Central Asia. Although detailed anthropological investigations have been carried out, the number of present individuals still remained open.

In this study we apply a Laser Ablation ICP-MS technique to perform a Multi-element analysis containing 50 elements (5 shots each on the enamel as well as 5 shots on the dentine in all 7 specimens) and compared the signals to a Ca signal. Different blocks of elements could be established, some of them, e.g., reflect site specific environmental conditions and post mortem effects. Statistical analysis (e.g., cross correlation, Principal Component Analysis) was performed and results of the Pleistocene specimens were compared to those obtained in modern samples.

The Multi-element analysis support the conclusions drawn from morphological criteria: thus, it is most likely that two teeth (the deciduous molar and the lower left permanent first molar) from Okladnikova cave belong to one single individual, whereas the others represent different individuals.

Moreover, Strontium isotope ratio analysis and X-ray Fluorescence (XRF) Analysis has been performed and the possibilities and limits of these techniques were discussed.

**Sifaka positional behavior: Ontogenetic and quantitative genetic approaches.**

R.R. Lawler. Department of Anthropology, Yale University, Biology Department, Woods Hole Oceanographic Institution.

In many primate species, hands and feet are large relative to neonatal body weight and they subsequently exhibit negative allometric growth during ontogeny. Here, I present data that indicate that this pattern holds for a wild population of lemur, the white sifaka (*Propithecus verreauxi verreauxi*). Using morphometric data collected on this population, I show that younger animals (= 2yrs) have larger than expected hands and feet relative to body size. This ontogenetic pattern suggests a simple behavioral test: do juvenile animals, with their larger, almost adult-sized hands and feet, locomote on similarly-sized substrates as adult animals? Using locomotor bout sampling, I tested this question by collecting positional behavior data on this population. Results from this test find no differences in locomotor behaviors or substrate use between juvenile and adult animals. These results suggest that selection may have altered growth trajectories in this species, perhaps to ensure efficient locomotion of juveniles during group movements. To place these results in a broader evolutionary context, I calculated heritabilities, selection gradients, and genetic correlations of hands and feet (and other limb elements) for animals in this population. This was achieved by combining genetic-based parentage information with morphometric data and fitness proxies. Among limb elements, heritabilities range from 0.21 to 0.61 and genetic correlations are positive. Heritability values of hands and feet are low, likely indicating that past selection has purged additive genetic variation; this is concordant with the finding that directional selection acting on hands and feet is weak and constrained by correlations between limb elements.

**Stable isotope analysis as an indicator of diet and social status in La Tène Bohemia.**

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This study uses carbon and nitrogen stable isotope analysis of human and animal bone collagen to examine diet and social status in Iron Age Central Europe. Human and faunal skeletal remains from 6 La Tène flat inhumation cemeteries in

Bohemia (Kutná Hora, Radovesice I, Radovesice II, Praha-Jinonice, Praha-Ružyně, and Sobešuky) were examined and sampled for analysis. Bone collagen was extracted using a modified Longin (1971) technique and analysed by Isotope Ratio Mass Spectrometry (Finningan DeltaPlus XL) for  $\delta^{13}\text{C}$  (PDB) and  $\delta^{15}\text{N}$  (AIR) values. Analysis of the distribution and variation of the human  $\delta^{13}\text{C}$  and  $\delta^{15}\text{N}$  values for each site can be used to examine the spread of millet as a major dietary component in prehistoric Europe in the same way that the spread of maize has been examined in the New World. This can be achieved through a comparison with data obtained from earlier Hallstatt tumulus burials from northern Austria and previously published data from a Hallstatt site at Magdalenska gora in Slovenia (Murray & Schoeninger 1988). Patterns in  $\delta^{13}\text{C}$  and  $\delta^{15}\text{N}$  values can also be observed within individual La Tène burial grounds, with males buried with items of weaponry having higher  $\delta^{15}\text{N}$  values than males buried without items of iron weaponry, suggesting dietary divisions that are based on social variation as revealed through the provision of specific grave goods.

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**Sexual dimorphism in the Hadar A. afarensis sample: Another look.**

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Sexual dimorphism is a major mechanism of morphological variation in most species, and its degree has been associated with mating system in hominids and hominins. Therefore, a valid assessment of the degree and pattern of sexual dimorphism in *Australopithecus afarensis* sheds light on understanding their morphological variation and social structure. This paper asks two questions about sexual dimorphism in *A. afarensis*: do different skeletal elements show the same degree of sexual dimorphism, and what is the *afarensis* pattern compared to extant apes and modern humans? Examining these questions requires addressing several methodological challenges including the fragmentary record, comparability of different elements, unequal sample size, and sex assessment. This paper uses a recently proposed method (Assigned Resampling Method) to estimate the degree of sexual dimorphism for different skeletal elements (mandibular canine, humerus, femur) in the Hadar sample. The results show that the Hadar *afarensis* show a

different degree of sexual dimorphism for various skeletal elements: they are similar to or higher than gorillas for femoral variables, similar to chimpanzees for mandibular canines, and similar to modern humans for humeral variables. Clearly, the comparative level of sexual dimorphism in *afarensis* depends on the skeletal element examined. In fact, their overall pattern seems to be different from African apes or modern humans. These results are consistent with other studies indicating that conclusions of social structure drawn from comparing limited skeletal elements must be done with care.

**Conservation biology of Malagasy strepsirhines: A phylogenetic approach.**

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The lemurs of Madagascar are one of the world's highest conservation priorities. Lemur conservation efforts have focused on opportunistically protecting "flag-ship species" or on iterative exercises in assigning conservation priorities. However, there is little consensus among researchers as to which taxa and/or biogeographic region(s) require immediate conservation attention. This lack of consensus on conservation priorities indicates the need for a biological approach to lemur conservation in Madagascar. I used a taxonomic endemicity standardized weight (TESW) index to determine the evolutionary component of biodiversity and to prioritize areas for conserving lemur taxa. The TESW index is important because it: (1) is sensitive to both taxonomic distinctness and endemicity, (2) allows information from diverse taxa to be combined (i.e., different cladograms), and (3) uses complementarity to preserve the maximum number of taxa in a minimal number of protected areas. I used phylogenetic data from recent genetic studies of Malagasy strepsirhines at the species level. Data on distributions of lemur species came from surveys I conducted and published literature. I assigned each lemur species to mutually exclusive biogeographic forest regions. My TESW analysis indicated that lemur taxa in southern Madagascar have the highest conservation priority. This priority rating is a direct result of the rarity and limited geographic range size of lemurs in southern Madagascar. TESW priorities for lemurs are congruent with landscape patterns of forest loss, indicating the need to focus our conservation efforts on lemurs and forests in southern Madagascar.

### Evolution of primate life histories.

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Recent advances in developmental biology have important implications for understanding primate life histories. These findings show that dissociation and modularity characterize ontogeny. The present study evaluates the significance of these processes in primate life histories by focusing on primate ontogeny, with special emphasis on papionin primates. We determine whether or not the concept of life history "modes" can account for life history evolution in primates.

Our analyses concentrate on the ontogeny of key life history variables, such as brains, teeth, the skeletal system, and a variety of hormones. Data were obtained from museum specimens, literature sources, and long-term studies of captive specimens. Analyses evaluate the ontogeny of each variable across species primarily with regression.

Brain development in primates is highly variable both in terms of rate and duration. Similarly, body mass growth, patterns of dental development, and the scheduling of reproduction all show considerable heterogeneity and dissociation. Details of ontogeny assessed through analyses of papionins substantiate more general results.

Attention to the ontogeny of key life history variables demonstrates that a simple "fast vs. slow" continuum is insufficient to account for life history variation across primates. Instead, these data support the concept of a life history mode, which predicts that a range of quantitatively and qualitatively different pathways to adulthood have evolved in primates. These analyses emphasize the importance of modularity and juvenile adaptations in understanding life history evolution.

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### The relationship between midcarpal joint morphology and ulnar deviation of the hand in strepsirhine primates.

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Hamrick (1996) found a morphocline in the shape of the midcarpal joint of strepsirhines. In arboreal quadrupeds such as *Eulemur*, *Lemur*, and *Varecia*, the proximal surfaces of the capitate and hamate are flatter. The same surfaces are more

curved in vertical clingers like *Propithecus*, and most curved in slow climbers like *Nycticebus* and *Loris*. These differences in midcarpal joint curvature have been linked to differences in hand mobility, in particular the degree of ulnar deviation. However, few experimental data exist on this relationship between joint configuration and mobility. To this end, this study tests the functional link between midcarpal joint shape and the degree of ulnar deviation of the hand in living strepsirhines.

While under anesthesia, the hand of three individuals of each the following taxa was radiographed in neutral position and maximal ulnar deviation: *Eulemur fulvus*, *Lemur catta*, *Varecia variegata*, *Propithecus verreauxi*, *Nycticebus coucang*, and *Loris tardigradus*. For each individual, an ulnar deviation angle was measured and the position of the carpals was examined. On average, the hand of arboreal quadrupeds shows ulnar deviation angles that range between 35° and 43°. Ulnar deviation of the hand is greater in *Propithecus* (55°) and greatest in *Nycticebus* (70°) and *Loris* (92°). Greater ulnar deviation of the hand is accompanied by radial translation of the scaphoid, which is most extreme in lorises. This study supports the morphocline of midcarpal joint curvature and hand mobility reported by Hamrick (1996).

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### Leptin, body composition and energy metabolism in the Buryat herders of Southern Siberia.

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Leptin appears to play important roles in the regulation of body weight and energy balance. Previous research has shown that serum leptin levels are strongly associated with body fat stores; however, it is currently unclear whether leptin exerts a direct influence on energy expenditure independent of body composition. Additionally, since most studies of leptin have been conducted on industrialized populations, we have a very limited understanding of population variation in leptin levels and its metabolic correlates.

This study examines variation in serum leptin levels and the associations with body composition and resting energy expenditure (REE) in a sample of 41 men and 53 women from a rural herding population of southern Siberia (the Buryat). Buryat women have significantly higher leptin levels than men (females = 7.7±5.0 µg/L; males = 2.4±2.7 µg/L; P < 0.001); however, leptin levels in both sexes are low in comparison to those of US samples. In both men and women leptin levels are strongly correlated with the body mass index (BMI: r = 0.71 [males]; 0.75 [females]; P < 0.001), percent body fat (r = 0.74 [males]; 0.79 [females]; P < 0.001) and total fat mass (r = 0.72 [males]; 0.75 [females]; P < 0.001). REE in the Buryat is elevated relative to the Harris-Benedict predictions (+7.3% [males]; P < 0.001; +3.2% [females]; P < 0.02), and is positively correlated with leptin levels (r = 0.46 [males]; 0.35 [females]; P < 0.01). After controlling for body composition (Fat Mass and Fat-free Mass), leptin levels were not significantly associated with REE. Elevations in REE are common among northern-adapted populations and may partly explain why Buryat men and women have lower leptin levels than their US peers. However, it does not appear that leptin directly influences energy expenditure independent of body fatness.

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### Is fluctuating asymmetry a stable trait?

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Theory: Fluctuating asymmetry (FA) is a deviation from symmetry in bilateral characters resulting from developmental instability. Most studies use adult subjects, positing that FA reflects cumulative effects of developmental perturbations. Here we examine sequential patterns of FA in human children. We test three alternative hypotheses: (1) FA increases during development in response to environmental insults; (2) FA increases in response to environmental insults, but the direction of change is random; and (3) FA increases in response to environmental insults, but recovers toward symmetry during non-stressed growth.

Methods: To assess changes in FA, we repeated measures of 8 bilateral traits (digits, ears, ankles, wrists) from 234 children during 11 biyearly (1997-2003) surveys. FA was calculated as the difference of averages of duplicate measures. To examine longitudinal patterns of change

in FA, we developed a new variable, asymmetrical growth (AG). AG is the amount of asymmetrical growth that occurs during a specified time, calculated by taking the absolute value of the difference of signed FAs from two samples (six month intervals). AG is an indicator of the temporal stability of FA.

Results: (a) Longitudinal patterns of FA are more closely associated with environmental insults than cross-sectional FA data. (b) FA is not cumulative. Growth after insults can lead towards or away from symmetry. In periods without insults, growth reduces FA in six of the eight traits measured. (c) The direction of asymmetrical growth among traits is independent. These results are consistent with the recovery hypothesis (#3 above), and suggest ontogenetic mechanisms for symmetrical growth.

### **Endocranial capacity estimated from 3-D CT: Methodological issues.**

J.E. Lewis, P.T. Schoenemann, J. Monge. Department of Anthropology, University of Pennsylvania.

Cranial capacity has long been considered a key parameter in understanding the mode and tempo of hominid evolution. In recent years, 3-D computed tomography (CT) has been used to extract virtual endocasts (VE) from human and fossil hominid crania. Although the resolution of CT can be very high (submillimeter), subtle methodological decisions about how to delimit the endocranial margin can be shown to have large effects. Spoor et al. (1993) suggest using half of the maximum height of the peak in a histogram taken in cross-section of cortical bone to define the edge. While this method works for linear measurements, it is not suitable for large endocranial surfaces, which vary widely in thickness across more than ~60,000 surface voxels.

This problem is not clearly addressed in published studies of endocranial volume. To determine the extent to which the selection of a single global threshold value for edge delimitation can influence the estimation of cranial capacity, we extracted VEs from 13 *Homo sapiens*, 1 *Pan troglodytes*, and 1 *Gorilla gorilla* crania using two different threshold values: one that minimizes the need to hand-delimit thin areas of bone, and another arbitrarily chosen to be twice that value. Both VEs differ imperceptibly in shape, yet by 1.42% in volume on average. This translates into differences of ~20 cc for a 1400 cc endocast. Comparison with traditional bead-fill measurements on these specimens will also be presented. An image-

based edge-detection algorithm that may provide a more objective, accurate, and consistent solution will be discussed.

### **A preliminary assessment of the microfaunal assemblage from the Coopers D deposit, Gauteng, South Africa.**

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The Coopers site is a hominin fossil locality in the Cradle of Humankind, Gauteng, South Africa. The site is situated between Sterkfontein and Kromdraai, and dates to the Plio-Pleistocene. Recent work has focused on analyzing new hominin material, as well as the abundant and diverse faunal remains contained in the Coopers D deposit. This prior research suggests a date of between 1.6 to 1.9 Ma for the deposit.

In addition to the numerous large mammals excavated from the Coopers D deposit are a tremendous number of small mammal fossils. Current research on this large microfaunal assemblage is focused on identifying the species represented and using information from these species to rebuild the paleoenvironmental conditions of the site. Taxa uncovered thus far are represented primarily by *Otomys irroratus*, *Aethomys chrysophilus*, *Acomys spinosissimus*, and *Mystromys albicaudatus*, with the later group represented in the highest frequency. Other taxa identified belong to groups including the shrews, elephant shrews, and moles. These taxa are present in the Gauteng region today and have been recovered from other sites of similar age, although conclusive species identification awaits more complete cranial specimens.

Preliminary analysis of the fauna is consistent with interglacial conditions and a grassland habitat. The species are generally associated with rocky terrain and sandy soil, and the presence of *O. irroratus* suggests a permanent water source in the area. Analysis of the microfaunal assemblage allows the hominin fossils from Coopers to be viewed in a more detailed paleoenvironmental context.

### **Stained v. clean males: Female power maintains male bimorphism in Verreaux's sifaka (*Propithecus verreauxi verreauxi*).**

R.J. Lewis. Department of Biological Anthropology and Anatomy, Duke University.

Male Verreaux's sifaka exhibit a bimorphism that is reversible and related to dominance rank. Dominant males exhibit a pronounced brown staining around their sternal gland (stained males) and subordinate males do not (clean males). Adult sifaka in six social groups were studied in Kirindy Forest, Madagascar, to determine whether intersexual relationships vary with male chest status. Behavioral data were collected using focal animal sampling and all-occurrence methods from November 2000-March 2002. Results from this study indicate that the two male morphs behave significantly differently and that intersexual relationships in sifaka are dependent upon male chest status. Stained males scent-marked at higher rates and overmarked female scent-marks more frequently. Stained males also spent a greater proportion of their time in proximity to females. Per time in proximity, however, the clean males received a significantly lower rate of aggression from females. Females actively mated with both types of males and were observed to be hostile towards stained males attempting to interfere with females copulating with clean males. Moreover, females were responsible for maintaining proximity with the clean males but not with the stained males. Thus, male-female relationships in sifaka seem to be dependent upon male chest status, with females and stained males in direct conflict over clean males. This study demonstrates (1) the ability of females to manipulate male residency and (2) how female power can strongly influence social organization and dynamics. This research was funded by the Leakey Foundation, Wenner-Gren Foundation, and NSF Dissertation Improvement Grant (#0002570).

### **Functional differentiation between the clavicular and caudal heads of the pectoralis major muscle in *Homo sapiens*.**

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This study uses electromyographic and kinematic methods to investigate the functional differentiation between the clavicular and caudal heads of the pectoralis major muscle in *Homo sapiens*. The clavicular head of the pectoralis major muscle is present in *Alouatta*, *Lagothrix*, *Hylobates*, *Pan*, *Gorilla*, and *Homo*, but

not in *Ateles* and *Pongo*. Stern et al. (1980) suggest that the clavicular head of the pectoralis major muscle in nonhuman primates is used in the initiation of the recovery phase of the locomotor cycle in ricochet brachiation, vertical climbing, and arboreal quadrupedalism. The retention of the clavicular head of the pectoralis major muscle in *Homo* may be an exaptation for different functional roles required of the forelimb in bipedal locomotion or other complex activities involving the forelimb.

Electromyographic and kinematic data are collected on the clavicular and caudal heads of the pectoralis major muscle in a human during throwing, holding a 10-pound weight, walking, and running. Data are also collected from the anterior deltoid muscle, which functions similarly to the pectoralis major muscle in arm flexion and adduction, in order to explore the possible synergistic interactions between these arm flexors. We observe clear variation in onset times and distinction in the order of activation in different tasks between the clavicular and caudal heads of the pectoralis major muscle. These data provide evidence for functional differentiation between the clavicular and caudal heads of the pectoralis major muscle, supporting a unique role of the clavicular head of this muscle in *Homo sapiens*.

### Three-dimensional digital restoration of the Yunxian crania.

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This paper reports on the two *Homo erectus* fossil crania recovered from the site of Yunxian in southern China. The fossils (EV 9001 and EV 9002) were severely distorted, making accurate measurements of cranial dimensions difficult. In the present study, the specimens are CT scanned in order to obtain digital information of the fossils. We then use Multiple Planner Reconstruction (MPR), Curve Multiple Planner Reconstruction (CMPR), Surface Shadow Density (SSD), and Volumetric Reconstruction (VR) to obtain a more accurate reconstruction of the fossils. These methods also enable a more precise computation of cranial capacity, vault thickness, and a recovery of information that had been lost due to distortion and compression of the original fossils. We report these new figures, which will make possible a more definitive assessment of the craniometric features of these fossils and therefore their phylogenetic position within the Old World hominid lineage.

### Health as a reflection of bio-cultural discontinuity in the Neolithic Cis-Baikal.

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Cultural continuity in the Cis-Baikal region of Siberia appears to have been disrupted by a 700-year hiatus during the fifth millennium BC, after which a culturally and biologically distinct population inhabited the area. Earlier research on human skeletal material from this time period (the Neolithic and early Bronze Age) has suggested that considerable health differences between the pre- and post-hiatus populations, namely the poorer fitness of the former, may reflect the processes surrounding this bio-cultural discontinuity. In this study, skeletal remains from four Cis-Baikal cemetery sites (n = 318) – two preceding the fifth millennium hiatus and two succeeding it – were examined for indicators of overall community health, specifically enamel hypoplasia, dental and skeletal pathology, osteoarthritis, and trauma. While all four populations exhibited good health in general, significant differences were observed in the incidences of enamel hypoplasial defects and the prevalence of osteoarthritic joint degeneration, suggesting increased physiological stress during growth and development and increased physical stress during adulthood among the pre-hiatus people. The health patterns observed, and the factors ultimately responsible for them, offer substantial insight into the nature of the Cis-Baikal's fifth millennium hiatus.

### Admixture estimates in a Mexican population stratified by socioeconomic status.

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Previous studies have suggested that in México, low income groups have more Indian ancestry than the more affluent ones. In a hospital environment informed consent was obtained to draw blood samples from three groups of 75 adult individuals each, of: low (I) intermediate (II) and high (III) socioeconomic status, to perform admixture estimates with a maximum likelihood method considering two ancestral populations: Indians and Whites.

The markers studied were blood groups of the ABO, MN, Rh-Hr and Duffy systems, in addition to serum haptoglobin

types. Socioeconomic status classification was done by our Admissions Department, assigning each patient to one of ten levels from A to J, being A the lowest one. Group I included patients with classifications A and B, group II was formed with patients E and F and group III included levels I and J. Classification criteria include: years in school, occupation, income, type of housing, health status and access to medical services. All individuals had type II diabetes.

The amount of Indian and White ancestry in group I was 0.48 and 0.519, respectively. In group II the amounts were 0.504 and 0.496, and in group III 0.276 and 0.724 respectively. The differences between groups I and III agrees with the idea that people with a low socioeconomic status have a larger Indian ancestry (0.48) than the richer ones (0.276). The opposite is true in regard to White admixture, 0.496 and 0.724, respectively. The intermediate group is very similar to the first one, and the explanation may be that the social classification is not accurate enough for the purpose used. These results suggest that Mexican Indians have a lower opportunity to obtain adequate jobs due to a host of circumstances, related to poverty.

### 50 years of chimpanzee demography at Taronga Park Zoo, Australia.

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There has been a captive *Pan troglodytes* colony at Taronga Park Zoo in Sydney in 1949. While demographic data on these animals were first analysed in 1986 there is now a further 15 years of information available. The reproductive histories of 33 females within the colony have been recorded and these data form one of the larger collections of captive chimpanzee data from a setting that has, since 1970 involved natural breeding conditions. In particular, mothers are not separated from infants except in exceptional circumstances. These data, therefore, were analysed to establish the degree of variability present within chimpanzee reproductive parameters.

Age at first birth for the chimpanzee females was 123 months on average (n=16), 44 months before the average age at first birth of chimpanzees at Gombe (n=7). In line with this acceleration of reproduction, birth intervals are also significantly shorter than non-captive chimpanzee populations. The median birth interval for all surviving infants (based on Kaplan-Meier Survival Analysis) is 47



months (n=38) compared to a median of 69 for Gombe (n=20).

This increase in the reproductive span and decrease in the birth interval mean that in captive conditions the potential fertility of chimpanzees is significantly greater even in 'natural' breeding conditions and that mortality, particularly of young infants, is a significant dampener on population growth.

### Phylogenetic analysis of extant hominids using temporal bone morphometrics.

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Morphometric data are rarely used in phylogenetic analysis of primates, even though quantification of shape is regarded as essential in most other areas of inquiry. The bias against metric data is due to conceptual and logistical difficulties of treating measurements or angles as characters. Here we address some of these difficulties by using distance-based methods of phylogenetic analysis on three-dimensional landmark data. The focus is a set of 23 ectocranial landmarks from the hominoid temporal bone. Thus, we also ask whether the temporal bone in particular supports aspects of hominoid phylogeny that are well-supported by molecular data.

We analyzed the landmark data in two alternative ways: 1) using generalized Procrustes analysis to register and size-adjust individuals, and 2) determining all 253 interlandmark distances, which were then size-adjusted for each individual using their geometric mean. Euclidean distances among all taxa (*Homo sapiens* and subspecies of *Pan*, *Gorilla*, and *Pongo*) were calculated for each type of data. We used neighbor-joining and least squares algorithms to obtain phylogenetic trees from the distance matrices, and bootstrapping to evaluate support for clades. To root the trees, *Pongo* was treated as an outgroup to the other hominids.

A *Pan-Homo* clade is strongly supported in all analyses. Relationships among *Pan* taxa differ slightly among methods, although *Pan* is always monophyletic. These results reveal the potential for geometric morphometric analysis to shed light on phylogenetic relationships, and indicate the phylogenetic signal present in the hominoid temporal bone.

### African-American lineage markers: Determining the geographic source of mtDNA and Y chromosomes.

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In admixed populations the use of mtDNA and Y chromosome markers is an important first step in understanding the genetic structure of those populations. To determine African American ancestral areas of origin a sample of African-Americans (N=85) were typed for restriction site polymorphisms that identify the major sub-Saharan African mtDNA haplogroups (L1/L2, L3b, L3d, and L3e). We also typed the males in the sample (N=28) for the major Y chromosome biallelic variants that identify the major sub-Saharan African Y chromosome haplogroups (I, II, III and VI, Underhill 2001). To increase our knowledge of the mtDNA and Y chromosome variation of possible ancestral populations for modern African-Americans we included samples from two sub-Saharan African populations: Cameroonians (N=81; including 40 males that also were typed for Y chr variants) and Senegalese (N=113). For those African Americans that did not belong to one of the L haplogroups we did further analysis to determine their haplogroup affiliation, which included sequencing of ~340 bp of the mtDNA HVR-1.

Our results showed that although African-Americans have a higher frequency of non-L haplogroups there is no significant difference in the overall haplogroup frequencies among the three populations ( $\chi^2 = 0.19$ ,  $v = 11$ ). Of the 16 African-American non-L haplogroups nine belong to Eurasian mtDNA haplogroups. Of the Cameroonians 87.5% typed positive for Y haplogroup III, whereas only 75.0% of African-American males belonged to haplogroup III. The remaining African-American individuals belonged to haplogroup VI. Only two (7.1%) African-American males belonged to non-African Y chromosome lineages.

### Sacred cropraiders? An examination of sympatric associations among *Homo sapiens* and *Macaca fascicularis* on the island of Bali.

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This study of human-nonhuman primate interactions can contribute to the effective construction of both socio-ecological and conservation models. Humans (*Homo sapiens*) and long-tailed macaques (*Macaca fascicularis*) have lived in sympatric associations for centuries on the island of Bali, Indonesia. The goal of this project was to assess variance in human impact and ecological conditions for different human sympatric macaque populations on Bali. Data collected at ten sites reveal a wide spectrum of human perceptions and behavior regarding the monkeys.

Data were collected on macaque and human demography, habitat type, local human perspectives and interaction patterns, degree of provisioning, area use, level of habituation, and the degree of crop raiding by macaques. Interviews were conducted in Bahasa Indonesia, Balinese, and/or English. Data analyses reveal that the macaques engaged in crop raiding behavior at each site. However, we failed to discover a specific patterned relationship between intensity of crop raiding and human behavior and perception of the macaques. Macaque uses of different sites varied temporally, and in intensity of impact. Macaque group size and demography also varied across ecotype and geographic location. Hunting occurs at some sites even though previous reports suggest otherwise. Physical contact between the humans and macaques remains low, however it appears that humans keep some macaques as pets and may be acting as mechanisms of gene flow and disease transmission by releasing captive monkeys at non-natal sites.

### Human evolution in the far north-east: The significance of the Jinniushan fossil for models of modern human origins.

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The archaic human fossil specimen from Jinniushan in Liaoning Province, in northeastern China is dated to approximately 280,000 years ago and comes from the extreme periphery of the human geographic range in the Middle Pleistocene. This setting allows us to test models of modern human origins, particularly questions of continuity or replacement. Be-

cause it includes both cranial and postcranial remains from a single individual, the specimen permits us to examine a range of hypotheses focusing on multiple anatomical systems.

A number of scholars have argued that the cranial anatomy of the Jinniushan specimen shows evidence of modern morphology in an archaic specimen at a very early date. In addition, the Jinniushan female and its penecontemporary, the male specimen from Dali, show evidence, in other aspects of cranial and dental morphology, of continuity with later Chinese specimens. Its pelvic morphology is reminiscent of that seen in Atapuerca and later European Neandertal specimens from the distant western edge of the range of archaic *Homo*, suggesting a similar pattern of pelvic evolution across the Old World. Finally, its large body size, wide bi-iliac breadth and relatively short ulna (the only long bone represented) probably reflect an adaptation to the cold climate of its high latitude origin. The Jinniushan specimen thus provides evidence of a mosaic transition from archaic to modern *Homo sapiens* in China.

#### **Iron, stress, and immunity: A monkey model.**

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A healthy fetus and a healthy infant depend on a healthy pregnancy. A period of prolonged psychological stress during pregnancy can impact multiple systems during infant development. Work in our laboratory with rhesus monkeys has shown the impact of prenatal stress on neurobehavioral development, mother-infant interactions, and immunity. Another type of prenatal stress, often encountered in the developing world is a nutritional one, ranging from malnutrition to select micronutrient deficiencies. Iron deficiency is the most common deficiency during pregnancy, and continues to affect between 30-80% of infants worldwide.

Our studies have shown that newborn infant iron status is correlated with maternal iron status. Infants with low iron stores become anemic between 4-6 months of age, which is prior to the normal weaning age. Iron stores are also quickly depleted in rapidly growing infants, putting them at risk for longer-term iron-deficiency anemia. We have shown that anemia can result in behavioral, cognitive, and immunological deficits.

Infants born to mothers who were exposed to a psychological stressor during

pregnancy were more likely to become anemic, and to have lower Natural Killer cell activity ( $p < .05$ ) and reduced cellular proliferation to IL-2 stimulation ( $p < .05$ ). The interplay of prenatal stress with anemia has far reaching consequences for many of the world's children. Early assessments and early interventions may prevent longer term health problems.

#### **The size of the dentition.**

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Scaling analyses are popular in functional morphology because of their overarching explanatory value. Early dental studies by Pilbeam & Gould (1974) and Fortelius (1985) argued (paraphrasing) that the mammalian digestive system, which provisions the body, is composed of a sequence of steps, mastication being the first. The slowest step of the sequence determines the rate at which the whole process runs, so each has to operate sufficiently fast to satisfy the body's metabolic needs. The rate at which the resting mammalian body requires energy is related to  $M^{0.75}$ , where  $M$  is body mass. Gould (1975) predicted that larger mammals have relatively larger postcanine tooth areas (i.e. positive allometry) to match basal metabolic rates, while Fortelius (1985) argued that, because larger mammals chew slower, dental isometry is more probable. No mechanics was involved even though this is what chewing is all about. Here I derive scaling patterns of the teeth (and some facial characteristics) directly from the mechanical properties of foods. The analyses draw from Gurney & Hunt (1967) and studies by A.G. Atkins. Various alternative food behaviors (linear elastic, nonlinear elastic, elastoplastic or plastic fracture) can be modeled. The results show that isometry of the postcanine teeth is an upper limiting case and that many mammals (including primates) are likely to show negative dental allometry, while being totally consistent with the dentition's role in metabolism. A considerable body of evidence supports this. There is no single scaling rule for teeth – all depends on what the animal eats.

#### **Howler monkey (*Alouatta pigra*) populations in five Maya archaeological zones in southern Mexico and northern Guatemala.**

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Population data for the black howler monkey (*Alouatta pigra*) are vital to the evaluation of areas where this species is preserved and those where they may be at risk. To provide comparative data in continuous forest, five square kilometer study areas were surveyed in five archaeological zones between February and May 2002. Data were collected on population density, troop size, and demographic structure for *A. pigra* living within the ruins of Calakmul, Yaxchilán, Bonampak, and Lacanja in Mexico and Tikal in Guatemala.

Population densities in the study sites of Calakmul and Tikal are comparable to those reported for *A. pigra* in other sites within large forest tracts. *A. pigra* density are highest in Yaxchilán. In Bonampak and Lacanja, forests controlled by Lacandon Maya, densities of howler monkeys are low to nonexistent. Average troop size varies according to site, with a range of 6.5 to 8.7 individuals. Adult male to adult female sex ratios range from 1:0.6 to 1:1.32. The ratio of adult female to immature individuals range from 1:0.34 to 1:1.6.

I conclude that: 1) *A. pigra* are surviving in government protected forests; 2) Sites with little to no protection seem to be devoid of, or at risk of losing, their *A. pigra* populations; 3) Average troop size for *A. pigra* in continuous forest is generally higher than troop size in fragmented landscapes; and 4) The adult female to immature ratios indicate healthy populations that can continue to expand and grow, if human encroachment and other limiting pressures are minimal.

#### **An extant primate-based assessment of the likely importance of homoiology in hominid phylogenetics.**

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Homoiologies are morphological similarities that are phylogenetically misleading and primarily due to non-genetic factors, such as mechanical loading. Recently it has been claimed that homoiologies are prevalent in the hominid skull, especially in regions affected by mastication-related strain, and that their prevalence is a major reason why researchers have so far been unable to obtain a reliable estimate of hominid phylogeny (Lieberman, 2000). However, contrary to this "homoiology hypothesis", a recent study of extant hominoids found that high strain characters were in fact more informative regarding phylogeny than other craniofacial characters (Collard et al., in press). Here, we report an additional test of the ho-

moiology hypothesis that employed data for 60 hard-tissue characters recorded on members of another group of extant primates, the papionins. First, published information was used to classify the characters as high strain (n=22), low-to-moderate strain (n=22), or non-remodelling (n=16). Next, we sought to determine whether or not high strain characters are more plastic than the low-to-moderate strain and non-remodelling characters. Thereafter, we subjected the three groups of characters to cladistic analysis and compared the resulting cladograms with the well-supported molecular phylogeny for the papionins (Harris, 2000). The high strain characters were found to be significantly more variable than low-to-moderate strain characters, which supports the idea that mechanical loading induces high levels of variability in the catarrhine craniofacial region. However, there was no evidence that such plasticity leads to greater levels of homoplasy in the high-strain characters. Thus, our study also does not support the homoiology hypothesis.

**Cranial variation among the Plio-Pleistocene hominins from Dmanisi, Georgia.**

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This study addresses the significance of variation among the hominin crania from the Plio-Pleistocene site of Dmanisi, Georgia. Observable size differences among the three described specimens have resulted in controversy regarding the number of represented taxa. While the Georgian team (Vekua *et al.*, 2002) contends that this sample represents one taxon displaying considerable sexual dimorphism, other workers argue a minimum of two species is represented (Schwartz, 2000).

Variation was assessed with resampling methodology (bootstrapping) from measurements reflecting facial height and breadth, and neurocranial size. The analysis was performed for max/min ratios of geometric means, given that measures of relative variation (such as coefficient of variation) are not recommended for this sample. To determine whether differences likely reflect interspecific or intraspecific variation, including sexual dimorphism, samples of modern human, chimpanzee and gorilla crania were util-

ized as comparative taxa. The null hypothesis is that for each trial, the size variation in the Dmanisi hominins does not exceed that of the reference group.

Results demonstrate the Dmanisi hominins are more variable in neurocranial size than modern humans and chimpanzees but frequently fall within the gorilla range. However, results from facial size alone indicate that a comparable range could be sampled from each reference taxon with a high frequency. These findings do not reject the null hypothesis and suggest size variation in the Dmanisi hominins is consistent with a single species displaying a higher level of (presumably sexual) dimorphism in neurocranial anatomy than modern humans and chimpanzees. Partially supported by the L.S.B. Leakey Foundation and Sigma Xi Scientific Research Society.

**Local, national and international variation in human secondary sex ratio as a function of maternal condition.**

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Evidence is presented, from a village study in Ethiopia, that mothers with low BMI and low muscle mass are more likely to have had a daughter rather than a son at their last birth. Furthermore, data collected in the same year (2000) in Ethiopia by the DHS is used to show a similar effect nationally: malnourished mothers are more likely to have had a female child for their most recent birth. However this effect is only found in rural women. Finally we analyze global variation in sex ratio. We use only countries from the Old World (i.e. those not peopled predominantly by immigrants from Europe) and find that countries with high fertility and mortality tend to have more female-biased sex ratios. Overall these analyses suggest that when the costs associated with motherhood are high, births are more likely to be female, in line with predictions from evolutionary theory.

**Play patterns in small juvenile white-faced capuchin monkeys (*Cebus capucinus*) in Costa Rica.**

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This paper examines play patterns in small juvenile (1-3 yrs) white-faced capu-

chin monkeys (*Cebus capucinus*) in northwestern Costa Rica. I report findings from an 11-month study carried out in Santa Rosa National Park, Area de Conservación Guanacaste. Data were collected on two habituated groups of capuchins using a variety of sampling techniques, and all juveniles were recognized individually.

Play-chase was the most common type of play among the small juveniles in this study, comprising approximately 15% of their total sample time. Small juveniles play-chased the most with other juveniles. For example, four of the six small juveniles in this study had the highest rate of play-chase with other small juveniles, and two of the six had the highest rate with large juveniles. Play-wrestle was not as common as play-chase and comprised approximately 7% of the total sample time of small juveniles. As with play-chase, this behavior was performed most within the same age-class (e.g., small juveniles with small juveniles).

In addition to play-chase vs. play-wrestle behaviors, I will also discuss individual variation and possible reasons for play-partner preferences. Play serves many functions: it helps young animals assess dominance rank and social roles in the group, and it helps them learn how to control aggression. More generally, play helps the juvenile primate establish and solidify social relationships and to interact effectively in a social world, all of which are crucial for survival.

**Which species of hominoids are present at the early Miocene sites Napak and Moroto, Uganda?**

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Hominoid fossils from the early Miocene sites at Napak and Moroto were initially placed in *Proconsul* (or *Dryopithecus*) *major*, but up to four taxa are now recognized: *Proconsul major*, *Ugandapithecus major*, *Morotopithecus bishopi* and *Afropithecus turkanensis*. Here we report on new mandibular and dental specimens that bear on the taxonomic validity of these attributions.

BUMP 127, an edentulous right mandible from Napak, resembles KNM SO 404, but with a steeper and shorter planum alveolare and a less pronounced superior transverse torus. BUMP 269 is a lower M<sub>1</sub> from the same locality. These specimens help to demonstrate that the Napak hominoid is conspecific with the largest hominoid from the Tinderet sequence in

Kenya, but since this taxon has not been shown to be the sister of the three other *Proconsul* species, it should remain *Proconsul major*, not *Ugandapithecus major*.

BUMP 559, a lower  $M_1$ , is the first lower molar crown from Moroto. Among other traits, its slight buccal cingulum, relatively small protoconid and narrow mesial fovea and crown distinguish it from *P. major*, while a much narrower mesial fovea and the absence of grooves and wrinkles on the occlusal enamel distinguish it from *Afropithecus*. BUMP 551 is a right mandible that preserves the crowns of  $I_2$  and C and roots of  $I_1$ ,  $P_3$ - $P_4$ . It can be distinguished from *Proconsul major* and *Afropithecus* on the basis of orientation of the planum alveolare, canine shape and premolar proportions. These specimens support the occurrence of a single, highly dimorphic hominoid (*Morotopithecus bishopi*) at Moroto.

#### Weaning in early medieval England.

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During the early medieval period Britain experienced rapid cultural change with migration and colonisation from Scandinavia and North Europe. However there is little information about contemporary dietary practice. This paper presents initial results of macroscopic and chemical studies of Anglo-Saxon childhood diet utilising dental anthropology and stable isotope analysis.

Dental anthropology was recorded on 41 individuals ranging in age from neonates to children aged 7 years. Occlusal wear scores increased with age, only one individual displayed any wear before 1 year. Tooth wear correlation statistics indicate that children adopted a weaning diet between 1 and 3 years, and a fully adult diet after 6 years of age. Calculus deposition begins at 3 years and increases with age. Prevalence of dental caries does not rise until after 3 years of age, indicating an infant diet of low cariogenicity.

Oxygen isotope analysis of 36 molars from 8 adults and 6 juveniles ranging in age from 1 to 34 years gave values falling within the expected isotopic range for the area. There is a marked difference between deciduous and permanent molars with deciduous teeth demonstrating higher  $\delta^{18}O$ , consistent with a higher trophic level associated with breast feeding. Inter-tooth statistical analysis shows differences between first and second and third molars, but a low probability of difference between second and third molars.

Anthropological and oxygen isotopic analyses both suggest weaning in late infancy; this will be corroborated by forthcoming carbon and nitrogen isotope analysis. There is no biological indication of prolonged breastfeeding in this population.

#### The Culis of Costa Rica: An initial health assessment of an East-Indian-derived group in Costa Rica.

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Biological anthropologists are interested in the high prevalence of obesity, hypertension and NIDDM among rapidly-modernizing groups since J. Neel's proposal of the thrifty-gene hypothesis. High prevalence of hypertension in African-derived populations has been tied to the thrifty-gene hypothesis and to the proposition that electrolyte conservation was selected for during the conditions the slaves suffered during the Middle passage. Similar extreme conditions however, were also experienced by East-Indian indentured workers.

We present the initial findings of a study with the Culis of Westfalia Costa Rica, who descend from East-Indian indentured workers. The control group consisted of Afro-Limonenses". For both groups, we investigated the levels of obesity and hypertension.

Both communities had non-significantly different mean BMI's (Culis = 27.22, Afro-Limonenses = 25.62,  $p=0.3045$ ), systolic blood pressure (Culis = 122.26, Afro-Limonenses = 122.11,  $p=0.8414$ ), and diastolic blood pressure (Culis = 77.79, Afro-Limonenses = 74.26,  $p=0.2114$ ). If hypertension is defined as systolic BP > 160 mm, then hypertension was found in 4% of the Afro-Limonense sample and in 3% of the Culi sample. Considering a diastolic blood pressure > 95 mm as hypertensive, then 3% of the Afro and 10% of the Culi samples were hypertensive. An analysis of BMI shows that 25% of the Culis, and 18% of the Afro-Limonenses were obese (BMI > 30). These results support suggestions that African-derived groups outside of the USA do not have as large a frequency of hypertension as do those of the USA. The Culis had greater proportions of hypertension and obesity than did the Afro-Limonenses.

#### Preliminary analysis of dental morphology and identity of an early iron

#### producing population in the Mouhoun Bend, Burkina Faso.

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The 1999 and 2000 excavations of the Mouhoun Bend Archaeological Project (NW Burkina Faso) uncovered human skeletal remains and some of the earliest evidence (ca. 700-500 BC) for iron production in sub-Saharan Africa. Inhabitants of the site under study, which spans the time sequence ca. 700 BC to AD 1600, are believed to have been speakers of either early Kwa or Voltaic languages. They inhabited the region along the Mouhoun River (formerly known as the Black Volta) before the eastern Mande expansion altered the linguistic scene around the 15<sup>th</sup> century AD.

The purpose of the present investigation is to obtain an initial indication of genetic relatedness between these people and various groups from elsewhere in sub-Saharan Africa. To accomplish this goal, we employed the Arizona State University Dental Anthropology System to record up to 36 dental and osseous discrete traits in 12 fragmentary Mouhoun Bend skeletons. These data were then qualitatively and quantitatively (using a multivariate distance statistic) compared to those in 15 other sub-Saharan samples, previously recorded by Irish, to yield measures of pair-wise phenetic affinity. It is assumed here that phenetic similarity approximates or is an estimate of genetic variation. The comparative samples comprise Greenberg's three sub-Saharan African language superfamilies: Nilo-Saharan, Khoisan, and Niger-Congo (includes Bantu languages). The resulting, numerically-derived affinities shed additional light on the Bantu Expansion (beginning ca. 1000 BC) from West Africa into the eastern and southern regions of the sub-continent; previously, this vast, multi-stage migration has been documented, primarily, via linguistic and archaeological data.

#### Copulation calls and female mate choice in Guinea baboons and other primates.

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We hypothesized that copulation calls in primates are honest signals of reproductive condition that are used by females to encourage mate guarding by high-quality males and reduce the risk of sperm competition, i.e., they represent a form of post-copulatory female choice. We tested this hypothesis with data from a captive group of Guinea baboons collected over a 3-month period. Male copulatory success in this group was accounted for by dominance rank and age, being higher for dominant and younger males. Female copulation calls were most likely to occur in conjunction with peak sexual swelling. Variation in female tendencies to call after copulation was best accounted for by the copulatory success of the male with which each female copulated the most and by the number of copulating partners; females that copulated with two or more males were more likely to vocalize after copulation than females that copulated with only one male. These findings are consistent with the predictions that calls are likely to be associated with high-quality males and higher risk of sperm competition. The prediction that copulation calls increased the probability of post-copulatory mate guarding was also supported. Following copulation calls, the mating males were less likely to leave their female partner, more likely to follow her, and more likely to spend time in proximity with her. These findings suggest that female copulation calls may play an important role in post-copulatory sexual selection and are functionally equivalent to other forms of cryptic female choice documented in other animal species.

#### **QTL mapping in biological anthropology: Dental traits in pedigreed baboons.**

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The assumption of a significant genetic contribution to the phenotypic variance for dental traits on which many adaptive scenarios and phylogenies are based usually goes untested. Recently reported statistical genetic analyses have provided the first reliable estimates of the relative contributions of genes to normal variation in several dental crown features (enamel thickness, cusp position, and cingular remnant expression) in a nonhuman primate species: the baboon. We also have reported pleiotropy between related dental traits. Here, we present results of our

initial attempts to localize genes affecting these traits to specific regions of the baboon genome.

We performed whole genome multipoint linkage screens to localize quantitative trait loci (QTLs) influencing the degree of expression of the interconulus (maxilla) and interconulid (mandible) on succedaneous molars in 479 captive baboons (*Papio hamadryas ssp.*) from the pedigreed breeding colony at the Southwest National Primate Research Center. We used a maximum-likelihood-based variance decomposition approach to estimate the proportion of the variance in these traits due to a QTL at 1 cM intervals across the 20 baboon autosomes marked by nearly 300 highly polymorphic microsatellite loci. Significant evidence for a QTL (LOD>2.71, genome-wide  $P \leq 0.05$ ) influencing variation in cingular remnant expression in all three molars in both arches, was obtained at two locations on baboon chromosome 1 (homologous to human chromosome 1): one, at 175 cM (peak LOD=2.94) from the pter-most marker locus, and the other, at approximately 109cM (peak LOD=2.87). Given cercopithecoid-hominoid genetic propinquity, these results have implications for both primate evolutionary biology and biomedicine.

#### **Correlation between pelvic girdle measurements and foot length.**

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Maternal foot size has been suggested as a non-invasive indicator of incompatibility between maternal pelvic proportions and fetal head size during parturition. As a first step in the evaluation of this hypothesis, the allometric relationships between pelvic dimensions, pedal dimensions, and body size must be investigated.

This study examined measurements taken from skeletal material housed in the Hamann-Todd Osteological Collection: fifty males and fifty females, ranging in age from twenty to forty years. Measurements were taken from the bones of the pelvic girdle, plus length of the first, third, and fourth metatarsals, and femur. Specimen height and weight were noted from museum records. Correlation coefficients and log-log transformed regression lines were calculated for each pelvic dimension against metatarsal and femoral lengths, height and weight. Regression lines were further compared between males and females, to determine if sexual

dimorphism exists relative to the allometric relationships.

As expected, most pelvic dimensions, when regressed against metatarsal lengths, are sexually dimorphic. In most cases, there is not a strong correlation between pelvic dimensions and body size surrogates ('r' is greater than 0.50 in only 30% of the comparisons). In general, correlations are weaker when pelvic dimensions are regressed against metatarsal lengths ('r' ranges from 0.24-0.61; when regressed against weight, height, or femoral length, 'r' ranges as high as 0.74).

This study shows that there is a weak correlation between pelvic dimensions and pedal dimensions. These results do not support the hypothesis that foot size can predict pelvic insufficiency during parturition.

#### **Dietary adaptations in the Maya lowlands through time and space: First results of stable isotope analysis for the Yucatan.**

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For more than a quarter century stable isotope analysis of human skeletal remains has been used to determine the diet of ancient people. For the ancient Maya, the main questions that have been addressed include reliance on maize and how it changed over time; the importance of seafood or freshwater fish; whether dogs were consumed regularly; and if variations existed based on sex, social status, and local ecology. But while many areas of the Maya highlands and southern lowlands in Belize, Honduras, and Guatemala have been the subject of isotopic studies, until recently none had been done in the northern lowlands, in particular the Yucatan peninsula of Mexico.

Twenty individuals from Yaxuna, in the interior, and five from Chunchucmil, on the coastal plain, were specifically selected to provide some data for the Yucatan, and to complement eighteen samples from the site of La Milpa in northern Belize. Bone and tooth samples were prepared using well established procedures to ensure integrity and reliability, especially considering the poor preservation of many skeletal remains from this region. Stable carbon and nitrogen isotope ratios were then measured for bone collagen, and carbon isotope ratios for bone apatite and tooth enamel. The results obtained suggest significant differences between these three Classic Maya sites, with residents of Yaxuna consistently the most dependent on maize. There was also greater dietary variation between individuals at both

Chunchucmil, probably because of the availability of diverse resources, and at La Milpa, where the differences correlate directly with social status.

**Genotyping aids field study of un-habituated wild chimpanzees.**

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Habituation of wild chimpanzees (*Pan troglodytes*) without provisioning may take years, especially in open-country sites with low-density, wide-ranging apes. We report an alternative strategy for collecting non-behavioral data while subjects remain wary. Development of techniques for extracting DNA from non-invasively collected feces can provide socio-ecological data. We tested this on the wild chimpanzees at Mt. Assirik, in the Niokolo-Koba National Park, Senegal, West Africa. Fresh feces were collected at nest sites or during tracking and were desiccated in silica gel. Later in the laboratory, 53 of 54 samples yielded enough DNA after PCR for an amelogenin assay for sex determination. Of these, 32 samples yielded enough amplifiable DNA for reliable genotyping at nine microsatellite loci. From these, 21 genotypes were obtained.

Genotype data yielded information about kinship, group size, party size and composition, sex ratio and ranging, which shows the utility of the strategy.

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**Biomechanics of great ape and human hands and feet and its relationship with positional behavior.**

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Cheiridia are valuable indicators of positional adaptation in that they directly contact the substrate. This study examines cross-sectional geometry (CA and J) of metacarpals II-V and metatarsals I-V at 50% length across a sample (N=86) of

chimpanzees, gorillas, orangutans, and humans.

All cross-sectional variables are analyzed against bone length, body mass, and (body mass x bone length). RMA lines are calculated. ANOVA is performed as well as post-hoc comparisons using the Tukey's honestly significant difference for unequal samples. The "Quick test" by Tsutakawa and Hewett (1977) and the calculation of the percent prediction error (PPE) are used to evaluate differences between species.

This is the first attempt to give a biomechanical interpretation to both metacarpals and metatarsals within hominoids and to shed some light on their relationship with locomotion behaviors. Good results in characterizing the hominoids in relation to locomotion behavior are obtained when hands and feet are analyzed separately, but the best results are obtained comparing metacarpals and metatarsals of the same ray. It appears that knuckle-walker apes have a relative stronger metacarpal III and especially IV as compared to the other hominoids, and that humans have a relative stronger metatarsal V as compared to great apes. Interestingly, orangutans, which perform a quadrumanus arboreal behavior, have a relative metacarpal IV robustness between range of the knuckle-walkers and that of humans. On the whole metacarpal and metatarsal cross-sectional characteristics are strongly related to the locomotion behavior of hominoids, and may be useful in elucidating locomotion characteristics of fossil hominoids.

**African-American biohistory at President's Island, Tennessee.**

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The cemetery on President's Island is located in the Mississippi River directly offshore at downtown Memphis, Tennessee. In 1983, salvage archaeology in the wake of factory renovation unearthed 7 partial to complete skeletons in an excellent state of preservation. Marriage, death, and Freeman's Association documents demonstrate an historic African-American occupation from the middle nineteenth to the early twentieth century. Two adult males, three children and two neonates were recovered. Even though the sample is small and unrepresentative of the community, there is a high rate of trauma and pathology. Two children contain congenital neural arch defects. All have enamel hypoplasias, Wilson bands, and Harris lines indicating early childhood stress. One adult suffered a neuro-

cranial gunshot wound. While small and not representative, comparison to other historic African-American cemetery samples reveals a similar frequency of childhood stress, interpersonal violence, and dental disease. Besides metal coffin ornamentation, nails and glass buttons, each child was interred with special artifacts including coins, and clay and glass beads. Such items are rarely discovered with subadults in African-American mortuary sites.

**Body size and fat predict fertility and reproductive success among Hadza hunter-gatherers.**

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This study investigates the relationship between age-specific fertility (number of children born, controlled for age) and reproductive success (RS) (surviving children, controlled for age) and four variables (height, weight, BMI, and percent body fat). If positive energy balance is important for ovarian function in foraging women then we should expect a positive relationship between some of these anthropometric variables that reflect energy balance, and fertility. We might also expect a woman's energy balance to affect a child's survival prospects or a mother's ability to keep a child alive. There was no relationship between any of these variables and fertility or RS among men but among women, BMI was a positive predictor of both fertility and RS, with the later relationship being the stronger one. Weight was a positive predictor of both, but a stronger predictor of fertility. Percent body fat was also positively related to fertility and RS but height was not. In strictly food-limited societies, like most foraging societies, a woman's current weight and fat stores appear to be reliable measures of reproductive potential.

**QTL mapping in biological anthropology: Sex hormone variation.**

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Although sex hormones are recognized for their role in reproduction, they have diverse roles throughout the body and influence multiple disease processes including cardiovascular disease, obesity, and Alzheimer's. Therefore, understanding the genetics of sex hormone expression and action may provide unique insight into reproduction as well as disease processes. Direct analysis of sex hormone

variation may seem problematic because hormone levels such as estradiol vary throughout the menstrual cycle. This caveat can be overcome with the utilization of an appropriate model. For example, in baboons, menstrual cycle phase can be gauged quite accurately by assessment of perineal swelling. We obtained significant evidence of linkage for estradiol (LOD = 3.1) on chromosome 20. The inclusion of sex hormones as covariates may provide information about the action of the sex hormones outside of the reproductive system. In the San Antonio Family Heart Study, we demonstrated that genes differential influenced leptin levels ( $p < 0.00001$ ). However, when we included testosterone as a covariate, the genotype by sex interaction disappeared. Furthermore, when including testosterone as a covariate in a genome screen of leptin, we identified a novel QTL on chromosome 22 (LOD = 3.4). Therefore, by using sex hormones both as the primary phenotype and as covariates, we can successfully map genes; mapping genes is the first step in understanding the dynamics of the reproductive system and its interaction with other systems. This research was funded in part by NIH grants HL28972, HL45522, & MH59490.

**The emergence of obesity and related chronic diseases in developing countries: Causes and consequences.**

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"Obesity is increasing worldwide at an alarming rate in both developed and developing countries." WHO issued this conclusion despite the limited availability of nationally representative data and scarce information about trends. The note of alarm led us to analyze data from national nutrition surveys in the last 15 years to determine obesity levels and trends in developing countries. Most of these surveys focus on preschool children and women of reproductive age and provide limited information about other age groups.

Levels of obesity in women were extremely low in South Asia and in Sub-Saharan Africa, with the condition concentrated among urban and educated women. In more developed areas of developing countries, obesity levels were higher, often approaching USA levels, with obesity being more equally distributed in the general population. Obesity ceased to be a distinguishing feature of high socioeconomic status in Brazil, and in Mexico it has emerged as a marker of

poverty, as it is in developed countries. We were severely constrained by lack of data in assessing trends in obesity. Only a few countries, mostly in Sub-Saharan Africa and Latin America, had repeated surveys. These limited data and other sources suggest that obesity is increasing in Micronesia, the Middle East, and Latin America as it is in the United States and Europe.

Obesity is increasing in developing countries due to a mix of causes including economic development, the epidemiological and nutritional transition, urbanization, globalization and changes in diets and physical activity patterns.

**Postcranial, cranial, and body mass dimorphism in three sympatric West African primates.**

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Understanding sexual dimorphism in extinct species is critical for evaluating intra- and interspecific variation, as well as inferring possible social behaviors. Substantial variation in patterns of craniofacial dimorphism has been demonstrated for extant primates which can have a significant impact on interpretations of body mass dimorphism and inherent levels of intraspecific variation. Similar analyses of postcranial dimorphism have not yet been carried out. We present preliminary analyses of postcranial and cranial sexual dimorphism in three sympatric primates: *Procolobus badius* (n=25), *Cercocebus atys* (n=8), and *Colobus polykomos* (n=2) from the Ivory Coast's Tai Forest.

All specimens were collected over a period of ten years within our primary study grid following natural death. Body weights for individuals were collected whenever possible. Craniometric data were supplemented with data from museum specimens collected in the same locality. Lengths, midshaft diameters, and joint dimensions were collected for the humerus, ulna, femur and tibia. Dimorphism was calculated as the ratio of male means to female means. Patterns of dimorphism differed significantly between *P. badius* and *Cercocebus atys*, while *Colobus polykomos* resembled *P. badius* in spite of the small sample. Notably, postcranial dimorphism exceeds cranial dimorphism in *Cercocebus*, while the reverse is true in *P. badius*. In both species, though, there is significant and substantial variation in dimorphism among postcranial dimensions. The results strongly

suggest that extrapolations of size dimorphism from a single dimension of the postcranium be approached cautiously, and that further quantifications of variation in pattern of dimorphism need to be carried out.

**Angular dimensions are a good predictor of functional joint motion.**

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This study continues work on the relationship between structure and function as predicted from angular dimensions of articular structures. Our hypothesis states that for any given synovial joint, the range of motion can be predicted by subtracting the concave arc from the convex arc of the respective articular surfaces in a joint. We have shown that this relationship works well in humans (Masterson et al., 2002), and now are testing the hypothesis with other animal models. In this study, we tested 16 ankle and 16 elbow joints from eight *Canis familiaris* specimens of varying breeds. Range of motion values are taken from the literature. Specimens are transected with a bandsaw in the plane of motion to be measured. Range of motion values are correlated with articular surface characteristics measured by photographic methods and computer-based geometric analyses of the sections. Our results demonstrate a very strong correlation between the published and structurally predicted range of motion ( $r = 0.94$ ) values. The results from this study provide strong corroborative evidence of our earlier study in that this relationship between structure and function can be used by Paleontologists to refine predictions of functional motion for specimens represented in the fossil record. It is also relevant for understanding joint movement and restoration of joint function among health care professionals.

**Knuckle walking signal in the digits of Pan and Gorilla: Examining the curvature of the proximal and middle phalanges.**

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The question of whether or not our hominid ancestors practiced a form of knuckle walking has been widely debated. To test the ancestral knuckle walking hypothesis, researchers have sought skeletal indicators of knuckle walking in

the wrist morphology of *Pan* and *Gorilla*. Advocates of both sides of the debate have found support for their arguments in the carpal, radial and ulnar morphology of apes and early humans.

In an attempt to further elucidate this issue, ape phalangeal morphology was examined. Curvature angles of both the proximal and middle phalanges of the third digit were calculated for the common chimpanzee ( $n=25$ ), bonobo ( $n=3$ ), mountain gorilla ( $n=11$ ), western lowland gorilla ( $n=23$ ), orangutan ( $n=19$ ), and white-handed gibbon ( $n=97$ ). Using PCA and discriminant function analysis, a knuckle walking signal could be isolated. Chimpanzees and gorillas have relatively slight curvature of the middle phalanges coupled with marked curvature of the proximal phalanges, whereas their more suspensory relatives display marked curvature of both the proximal and middle phalanges. These differences can be understood in terms of the biomechanical forces to which the digits are subjected. The hands of knuckle-walkers must accommodate the forces engendered in suspension and ground locomotion. During the latter, the dorsal surfaces of the middle elements contact the ground and support the weight of the animal. Relatively straight middle phalanges are well suited to withstand these forces. A test of the relative curvatures of the proximal and middle phalanges of fossil hominids may prove informative vis-à-vis the debate over ancestral knuckle walking.

**Newly discovered Neandertal remains from the Les Pradelles site (Marillac-le-Franc, Charente, Southwest France).**

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The Les Pradelles site, about 3 km from the town of La Rochefoucauld (Charente, France), was discovered in 1898 and excavated by B. Vandermeersch between 1967 and 1980. These excavations resulted in the discovery of more than a dozen Neandertal cranial and postcranial remains in a la Quina Mousterian archaeological context. A new field project was begun in 2001 to acquire additional data about the chronology and sedimentological history of the site, to obtain samples for absolute dating and to increase the archaeological and human fossil collections. Initial efforts focused on the cleaning of the pro-

files and preparing the site for a series of future excavations. In the course of this work, a number of additional Neandertal fossil remains were recovered in disturbed sediments. These include: an adult right temporal bone, a left fragment of an occipital bone from a mature individual, the alveolar part of a right maxilla containing permanent canine through M3, a left P4 and a left M2. The morphology of these remains identify them as deriving from Neandertals; taken together with the human fossils discovered during the earlier excavations, they represent a substantial sample of human bones from a western European Middle Paleolithic site.

**Intra population variation of cranial nonmetric traits compared to discrete dental traits of the Illinois Bluff Mounds.**

A.T. Mayes. Department of Anthropology, University of Oklahoma.

Two methods were employed to determine homogeneity within the Late Woodland Emergent Mississippian population from Illinois Bluff, Jersey County, Illinois (Titterington Collection). Discrete dental traits were analyzed for comparisons to other North American indigenous and world populations, based on Scott and Turner's (1997) technique. Cranial nonmetric traits were also recorded and compared.

The burial mound populations analyzed here are located along the summits of the bluffs overlooking the Illinois River. This study collection consists of 307 individuals from 33 burial mounds within the geological confines of the Lower Illinois Valley. Conner (1990) used radiocarbon analysis to date sites that are closely associated, both geographically and culturally, with the mound sites of Illinois Bluff, placing them in the Late Woodland/Emergent Mississippian period (690-995 AD). Very few artifacts have been found with the skeletal remains, leaving few clues to the lives of these people and their role in the larger context of the Mississippi River Valley. Therefore, another means of assessing the relationship between burial mound populations in this collection was necessary. A suite of 39 cranial nonmetric traits, were used to resolve the question of biological distance of those interred in separate mounds over a substantial period of time. A secondary resource for determining biological relationships within the Lower Illinois Valley was carried out through the analysis of 34 discrete dental traits. Here, the two data sets are analyzed and compared for patterns of rela-

tionship both within the valley as a whole and between the two methodologies.

**Detecting subpopulations at Grasshopper Pueblo through the use of dental morphology.**

J.A. McClelland. Arizona State Museum, The University of Arizona.

Variation in dental morphology has long been an accepted tool for assessing biological distance between human populations. However, archaeological investigation increasingly focuses on detection of intrasite differences. The purpose of this study is to evaluate the effectiveness of a refined method of dental morphological analysis in detecting the presence of population subsets.

The collection of skeletal remains from the 14th century A. D. site of Grasshopper Pueblo in east-central Arizona is the subject of the study. Previous chemical isotope and archaeological studies have indicated the existence of distinct population subsets with differing geographic origins. Therefore, the efficacy of the analysis of dental morphology in detecting intrasite biodiversity may be tested against this independent source of information regarding population subdivisions.

A full suite of standard morphological observations were recorded for all adult and juvenile specimens. In addition, certain tooth crown components were measured through the use of digital imaging. Univariate comparisons of trait frequencies among suspected population subdivisions were inconclusive. A hierarchical cluster analysis utilizing Gower similarity coefficients proved more informative. Although there was not an exact correspondence between chemical isotope groups and dental groups, adult dental clusters formed a similar spatial pattern to that indicated by the chemical isotope study. This result tends to confirm the efficacy of dental morphology as a tool for intrasite biodiversity investigation. Furthermore, the inclusion of tooth crown component measurements appeared to increase the effectiveness of detection of intrasite biodiversity.

**Locomotor diversity among Miocene catarrhines: Another look at retroflexion of the medial epicondyle of the humerus.**

M.L. McCrossin. New Mexico State University.

Miocene catarrhines are commonly viewed as possessing the generalized locomotor capabilities of pronograde arbo-



real quadrupeds. But some workers suggest more specialized positional repertoires for late Miocene apes, including suspensory locomotion for *Dryopithecus* and terrestrial quadrupedalism for *Sivapithecus*.

I test these assertions by examining the orientation of the medial epicondyle in Miocene catarrhines and samples of modern anthropoids (Fleagle & Simons 1982; Harrison 1989; McCrossin 1994). Carpal and digital flexors take their origins from the medial epicondyle. Medially directed entepicondyles in suspensory hominoids and atelines reflect strong digital grasping. Posteriorly directed medial epicondyles in ground-dwelling cercopithecines, in contrast, are related to reduction in mass of the carpal and digital flexors (Jolly 1965, 1967). In addition, retroflexion of the medial epicondyle increases the moment arm of *m. pronator teres* around the axis of pronation (Birchette 1982). Between these two extremes, the humeral entepicondyle is postero-medially directed in pronograde arboreal quadrupeds such as *Cebus*, *Presbytis*, and *Miopithecus*.

Generalized pronograde arboreal quadrupedalism is indicated for a wide variety of non-cercopithecoid catarrhines from the Oligocene and early Miocene, including *Aegyptopithecus*, *Simiolus*, and *Dendropithecus*. Divergent trends emerge in the middle Miocene. The medial epicondyle of *Pliopithecus* is medially directed, most like that of atelines. *Victoriapithecus* exhibits a range of entepicondyle retroflexion most similar to that seen among semi-terrestrial cercopithecines. The strongest degree of posterior angulation of the medial epicondyle among Miocene hominoids is seen in *Kenyapithecus*, again indicating semi-terrestriality. Contrary to recent claims, pronograde arboreal quadrupedalism is indicated by the postero-medial entepicondyles of *Dryopithecus* and *Sivapithecus*.

### Human ecological immunology: Challenges and opportunities.

T.W. McDade. Dept. of Anthropology, Northwestern University.

Research on human immune function has proliferated in the past 25 years, and while clinical approaches have predominated, there is growing recognition that considerable insight may be gained from comparative, ecological, adaptationist perspectives. This presentation proposes an agenda for research in human ecological immunology, and highlights the challenges and potential contributions of an anthropological approach.

The complexity of immune function—with its multiple subsystems of defense and elaborate interconnections with other physiological systems—poses a fundamental challenge to the definition and measurement of immunocompetence. No single measure can provide a comprehensive assessment of immunity, and requirements for sample collection and processing place constraints on research conducted outside of clinical settings. In addition, an adaptationist, ecological approach requires testable hypotheses derived from theory-based conceptual models. Life history theory may be a useful source for such models, providing a predictive framework that highlights the major challenges and demands that are likely to shape immune function in a range of ecological contexts. Immune function is a major component of maintenance effort, and since resources are limited, tradeoffs are expected between investment in maintenance and other critical life history functions involving growth and reproduction.

Potential contributions of research in human ecological immunology include an appreciation for the ecological sensitivity of immune development, and insights into the range of population variation in immune parameters and risk for immunologically-mediated diseases. Future research should document this variation, and explore the ecological factors that shape immune development and mediate tradeoffs with other key life history functions.

### Anatomical components of locomotion in five genera of apes: A preliminary overview.

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The adaptive radiation of apes involved reorganization of the forelimbs— increase in length, mass, and proportions and changes in relative mass of muscles and joint action. In our study, variations on the ape theme are highlighted by whole body dissections and quantification of bone and soft tissue. Five genera of adult male apes comprise the sample: 1 *Hyllobates*, 1 *Symphalangus*, 4 *Pongo*, 3 *Pan paniscus*, 3 *Pan troglodytes*, 4 *Gorilla*.

In body composition, the species are within a similar range: skin relative to total body mass is lowest in *Symphalangus* (10%) and highest in gorilla and *Pongo* (14 and 15%). Muscle averages between 35 and 38% in the lesser apes, *Pongo* and *Gorilla*, and comprises 47% of mass in *Pan paniscus*.

In body proportions forelimbs are the heaviest in *Symphalangus* (22%) and *Pongo* (18%), and similar in other apes (16-17%). Hindlimb mass varies considerably with *Pongo* the lightest (14%) and *Pan* heaviest (25%), with marked variation in the mass of the foot segment.

Differences in forelimbs and hindlimbs are also reflected in individual muscles and muscle groups. For example, deltoid is 35% of arm segment musculature in gorilla, 30% in *Pongo*, and 24% in *Symphalangus*. In hindlimb musculature quadriceps femoris in *Pan paniscus* are twice the mass of hamstrings, whereas in *Pongo* the hamstrings outweigh the quadriceps.

These results reflect the similarities apes share but also highlight species differences in the relative strength and action of muscles and use of limbs during locomotion.

### Puberty, immunity and malnutrition in *Schistosoma japonicum*.

S.T. McGarvey. International Health Institute, Brown University.

Determining immunologic and developmental predictors of resistance in naturally exposed humans should be a fundamental component of research on ecological immunity. It also is a key part the ongoing effort to develop vaccines. We are investigating the prospective interrelationships among puberty, protective immune responses, and nutritional status in adolescent Philippine residents of *Schistosoma japonicum* endemic areas. Prior epidemiologic literature indicated that development of protective human immune responses to other schistosomes appears to occur around puberty in endemic communities. We are exploring the hypothesis that the hormonal changes of puberty, e.g., increasing dehydroepiandrosterone (DHEA), not cumulative exposure, initiate and promote the development of protective immune responses to schistosome infections. Schistosomiasis is causally linked to malnutrition leading to the hypothesis that chronic infection results in attenuated growth for age and possibly delayed pubertal development. Animal models of chronic parasitemia have identified TNF-alpha and IL-6 as mediators of malnutrition and cachexia. Production of these mediators is significantly attenuated by increasing DHEA(S) levels. These interrelationships suggest that a DHEA(S)-modulated cycle of infection, pubertal delay, and malnutrition may be responsible for the marginal nutritional status of schistosome infected adolescents. The research design is a longitudinal and

treatment-reinfection study of naturally exposed humans. We will determine the immunologic predictors of resistance to reinfection and their interrelationships with puberty. In addition, the prospective relationships among nutritional status, circulating mediators of inflammation and pubertal hormones will be examined. Baseline findings for over 500 individuals on parasitic infections, nutritional status, anemia and schistosomiasis-related morbidity will be described.

**An examination of Aleut and Eskimo genetic variation: Implications for divergence estimates and migration hypotheses.**

S. McGrath, D. A. Merriwether. Dept. of Anthropology, Binghamton University.

Data from archaeology and skeletal biology support hypotheses that Eskimos and Aleuts diverged 8,000 years ago, while linguists suggest a split approximately 5,000 years ago. The estimation of this divergence, based on patterns of genetic variation, was the focus of this investigation. This research includes a study of the migrations of humans in regards to the peopling of the New World through the examination and comparison of sequence data of mitochondrial DNA (mtDNA). Mitochondrial sequences from ancient Aleut and Eskimo skeletal remains were compared to mtDNA haplotypes of modern Native Americans from Kodiak Island, St. Lawrence Island, Southwest Alaska and St. Paul Island. These data were subjected to genetic population analyses to test hypotheses regarding 1) the time of divergence for New World arctic populations, 2) whether Eskimo and Aleut populations arrived in the New World at the same time 5,000+ years ago, and 3) how many waves of migration there were into the New World.

Preliminary results from this research indicate that there was one major wave of migration into the New World. Circumarctic populations show a trend towards low nucleotide diversity, indicating a relatively recent arrival into the arctic. Preliminary results also indicate a low amount of shared alleles between Eskimos and Aleuts, reinforcing ideas about the distinctiveness of the two populations. Measures of average nucleotide diversity enabled the estimation of Eskaleut divergence from Asian populations and the subsequent estimation of the time of divergence of Eskimos from Aleuts within the New World.

**Elementary technology of the wild chimpanzees of Fongoli, Senegal.**

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All long-term studies (>1 year's duration) show wild chimpanzees (*Pan troglodytes*) to be tool-users. More precisely, it is species-typical of these African great apes to use tools in extractive foraging to obtain social insects for food. However, such elementary technology is not universal, so the presence/absence and relative frequency and intensity of tool use, plus the composition of tool-kits, suggests that material cultural processes are involved in this variation. Ethnology requires ethnography, so here we report new cases of fishing for *Macrotermes* termites and dipping for *Dorylus* (*Anomma*) driver ants from Fongoli, a new study site for open country chimpanzees, in southeastern Senegal. Preliminary findings show both similarities and differences between Fongoli and Mt. Assirik, another study site where chimpanzees were studied in the Niokolo-Koba National Park, Senegal, which is 60 km to the northwest.

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**Vocal communication within a troop of mantled howling monkeys (*Alouatta palliata*).**

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This study looked at intra-group vocal communication of male howling monkeys within a single habituated troop on the island of Ometepe, Nicaragua. Previous studies have focused on howling vocalizations between troops as a means of inter-troop spacing. This study expands earlier work and examines male intragroup vocalizations within and between subgroups.

The sample troop consisted of fifteen animals; seven males, five females, and three immature. Male vocalizations were recorded for sixty hours in July-August 2003. Eleven categories of vocalizations were used (expanded from vocalizations defined by Baldwin and Baldwin (1976)), volume levels were differentiated, and distance of intragroup communication was assessed. Vocalization data was gathered by durational focal animal and group sampling, with 1,616 vocal bouts recorded. For each bout, the type of sound, behavior, proximity to, and vocal response from other animals were recorded.

Male howling monkey vocalizations were frequent and continuous throughout the day. Except when resting, the longest period with no observed vocalizations was twenty-three minutes. Vocalizations were most frequent during travel, and consistently heard when feeding, foraging, and when joining or departing the group. Almost half (47%) of vocalizations elicited or were in response to another call. These were observed between subgroups up to three hundred meters apart but were most frequently heard between animals within a thirty-meter range (93%). The majority of calls were at a diminished volume (77%). These findings suggest vocal communication within the group is an important component of male howling monkey interactions.

**Peopling Melanesia: A genetic synthesis.**

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The addition of many new mtDNA and Y chromosomal variation papers to the literature, in addition to new data from our own collaborations, has allowed for new insights to be drawn about the origins of the many peoples of Island Melanesia and New Guinea. Combining HV1 and HV2 sequencing with diagnostic RFLP typing and select whole mitochondrial genome sequencing has allowed us to make connections between new Melanesian haplogroups and older existing haplogroups around the world. We find the largest division between haplogroups based on whether or not a sequence is part of Macrohaplogroup M from Asia or not. While we detected many M-related haplogroups and haplotypes, nearly half were not related to M. We discuss our evidence for the associations we have discovered. The connections are quite old, so haplotypes are not shared with other regions, but haplogroups do appear to have linkages to Asia and other regions. Based on the distributions we report for these haplogroups, and their affiliations with haplogroups outside of Melanesia, we offer some scenarios for the earliest peopling of Melanesia.

**Geographic patterns of nasal morphology in *Homo*.**

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Nasal morphology represents a classic example of skeletal variation long depicted as reflecting adaptation to regional climatic regimes in both modern and fossil humans. Temperature, and especially humidity, have been implicated in strongly affecting nasal form, with longer, narrower and more projecting noses associated with dry, cold climates, and shorter, broader noses associated with hot, humid climates.

In this paper, we use 460 crania of known provenience from the Morton skeletal collection to test the hypothesis that nasal breadth associates with temperature and humidity across the five continents. Climatic data spanning the past 100+ years were collected for each crania's specific locality. Removing the effect of nasal height on nasal breadth via partial correlation, we confirm that human populations demonstrate a global gradient of decreasing relative nasal aperture as one moves to colder and dryer regions. However, analysis within continents reveals conspicuous exceptions to this pattern. For example, while nasal morphology on the African continent significantly associates with local climate ( $p=.001$ ), no such association was found in Asia ( $p=.63$ ) or in Europe ( $p=.74$ ). Similar results were found using nasal index, although this parameter of nasal form is not independent of nasal height.

We suggest that observed regional patterns of nasal morphology may be explained by the effects of population history, cultural practice, and by the fact that the respiratory functional matrix is not independent of selective forces acting on contiguous functional matrices. Neanderthal nasal morphology is discussed in light of these results.

### **The evolution of forensic anthropology in Los Angeles County, California: A 23-year perspective.**

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Recovery of human remains utilizing forensic anthropologists began at the County of Los Angeles Department of Coroner (LACDOC) in 1980. This paper details the growth of forensic anthropology through use of case examples and illustrates the importance of anthropology in the forensic setting. The 23 year period of anthropological recovery is divided into three phases. The Experimental Phase (1980-1992) includes 25 searches, primarily secondary searches (return to an al-

ready-processed scene). A team approach was initiated. The need for special skills was documented and teams were structured to include specialized anthropological, archaeological, and other skilled experts. The Formative Phase (1993-1999) includes 25 recoveries, predominantly secondary searches. The skills learned during the Experimental Phase were expanded into an exploration of field techniques in anthropological recovery. It was concluded that primary recoveries should include a team with specialized skills. The Organizational Phase (2000-present) began with the formation of the Special Operations Response Team (SORT), which is composed of skilled forensic and anthropological professionals. All relevant personnel are involved in the initial recovery effort, reducing the necessity for returns to scenes. Since 2000 there have been 55 anthropological field recoveries, two secondary searches. Since 1980, anthropology has played an important role in the recovery and analysis of human remains in Los Angeles County. That role has steadily increased in importance, due primarily to the commitment of LACDOC's personnel, and the consulting anthropologists.

### **A geometric morphometric comparison of *Gigantopithecus giganteus* and *Gigantopithecus blacki* with implications for hominoid taxonomy and phylogeny.**

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The taxonomic designation of *Gigantopithecus giganteus* has been questioned by some researchers who have claimed that the morphological differences between this material and *G. blacki*, warrant placement of the former into the separate genus, *Indopithecus*. While prior studies have used traditional analyses to examine the degree of morphometric similarity between these two forms, the application of geometric morphometrics to this problem has been relatively uncommon.

Here, we conduct a Principle Components of Shape (PCS) analysis on a GPA scaled 3D coordinate dataset collected from the mandibles of 75 extant hominoids and 24 extinct hominoid fossil casts, including both *Gigantopithecus* species. The 28 coordinate landmarks included in the study are a mixture of osteometric landmarks and a series of points that best approximate the overall shape of the mandibular corpus and symphysis.

PCS1 explains 50.13% of the variation in terms of overall corpus robusticity and symphyseal breadth, contrasting extremely robust mandibles with extremely

gracile ones. PCS2 contrasts large symphyseal dimensions with small corporal dimensions and vice versa, explaining 9.80% of the variance, while PCS3 explains an additional 8.54% of the variance dealing with differences in parallel or parabolic mandibular shapes. In cases where extinct forms are associated with extant ones, they appear to group along geographic boundaries. All PCS plots demonstrate a close affiliation of the *G. giganteus* specimen with the *G. blacki* specimens, indicating that these forms share similar morphology. As a result, there is no need to place *G. giganteus* in a separate genus such as *Indopithecus*.

### **Adult male-immature interactions in long-tailed macaques (*Macaca fascicularis*) at Padangtegal, Ubud, Bali, Indonesia.**

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We test two hypotheses explaining the occurrence of male care of infants: mating effort and the agonistic buffering. We investigated interindividual variation in the form and incidence of male-immature interaction in long-tailed macaques (*Macaca fascicularis*) of the Mandala Wisata Wanara Wana Monkey Forest, Padangtegal, Ubud, Bali, Indonesia. Using ten-minute continuous focal follows ninety-five hours of data were collected on sixteen adult males. For each focal animal we examined the frequency, direction, and proximity of social behaviors, including triadic behaviors. Unlike most other free-ranging long-tailed macaque populations, adult males affiliated with immatures regularly within this population. Grooming, play, and huddling were the most frequent forms of affiliation. Behaviors such as carrying or holding an immature on ventrum occurred less often. Significant age-related variation occurred among individual males in both the form and intensity of interactions with immatures. Older males primarily received grooming, and they huddled with immatures. Younger adult males received grooming, played, and huddled with immatures more than did older males. No overt agonistic buffering occurred, although three times triads involving two males and an immature took place. We also found little evidence to support the mating effort hypothesis, as rank predicted neither infant care nor mating success.

### A look at adult skeletal aging methods: A Mississippian example.

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Skeletal aging methods have been applied to human skeletal samples from both prehistoric and contemporary contexts. However, these aging methods have been developed from "modern" population skeletal material (Terry and Todd Collections, and modern forensic contexts). This study focuses on the application of seven adult skeletal aging techniques to a Middle Mississippian skeletal sample (N = 85) from the Orendorf Site in West Central Illinois (~AD 1150).

The goals of this study are twofold. First, a new skeletal aging technique, Transition Analysis, (Boldsen et al. [2002]) is applied to the Orendorf skeletal sample. Transition Analysis is a multiple component aging method, which can produce results when skeletal remains are fragmentary or incomplete. Furthermore, the age-at-death estimates of the elderly are given maximum likelihood age ranges and not lumped into a "50+ year" category. The second goal was to address how well the age ranges of Transition Analysis fit those produced from the application of other standard skeletal aging methods (Buikstra and Ubelaker [1994]). Findings indicate that elderly individuals are found in this sample, however, the maximum likelihood age ranges are wider than those produced for younger adults. One strength of Transition Analysis is its use of multiple skeletal components to age fragmentary individuals. The other individual aging methods tend to suffer to a greater extent when skeletal material is fragmentary. Despite this difference, Transition Analysis compared favorably to the age ranges produced from the combination of all other aging methods.

### Correlates of territorial boundary patrol behavior in wild chimpanzees.

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Territorial boundary patrols are a distinctive and unique aspect of wild chimpanzee behavior. Although patrolling has been frequently documented in nature, scant information is available regarding the proximate factors that affect decisions to engage in this activity. In this paper we demonstrate that considerable temporal variation exists in the frequency of

patrolling by chimpanzees at Ngogo, Kibale National Park, Uganda. We examine several ecological and social factors that potentially affect this variation. Results of regression analyses indicate that rainfall and intruder pressure from neighboring conspecifics do not affect the tendency to patrol. Instead, patrolling frequency is positively related to food availability and male party size. In contrast, the presence of estrous females inhibits males from patrolling. At Ngogo, territorial patrolling also seems to be temporally linked to hunting behavior. We use these findings to evaluate the costs of patrolling and discuss their significance in light of our current understanding of the hostile relationships that typically exist between communities of wild chimpanzees.

### The interorbital region of *Dolichocebus gaimanensis* (Platyrrhini, early Miocene, Argentina) based on high resolution X-ray CT imaging—phylogenetic implications.

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*Dolichocebus* is known from the type skull encased in a concretion, isolated teeth, a partial mandible, and a talus. The geologic age is <24 and > 21 Ma. Two aspects of the cranial anatomy are debated—the molar formula (2 or 3 molars) and whether there was a natural fenestra in the bony interorbital septum. Either claim, if sustained, would represent an apparent synapomorphy shared by *Dolichocebus* and an extant platyrrhine taxon—marmosets and tamarins in the first instance, and squirrel monkeys (*Saimiri*) in the second. As such, each claim would cast doubt on the precision of molecular clocks that posit branch times of <19 Ma for these cladogenetic events. CT-imaging and a new mandible reveal details relevant to the molar count and interorbital region.

The maxillary sinus, broken posteriorly, extended beyond the M2 leaving sufficient space for M3. A referred mandible shows an m2 with a distal interproximal facet for m3. Therefore, a claim for a *Dolichocebus*/callitrichine sister-group based on tooth formula is rejected.

Dorsal to the palate, the nasal septum, lateral nasal wall and maxillary sinus are preserved. Anterodorsally, an interorbital septum is present which narrows posteriorly, as in all extant platyrrhines, but is broken away more posteriorly, short of where an interorbital fenestra occurs in

*Saimiri*. Nor is the left apical medial wall of the orbit preserved far enough anteriorly to demonstrate a fenestra. Given the extensive postmortem bone loss and distortion, the state of the apical interorbital septum—fenestrated or not—is indeterminate. A claim for a *Dolichocebus*/*Saimiri* sister-group based on this feature cannot be supported.

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### Heterochrony and geometric morphometrics: A comparison of cranial growth in *Pan paniscus* versus *Pan troglodytes*.

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Heterochrony, the classic framework to study ontogeny and phylogeny, in essence relies on a univariate concept of shape. Though principal component plots of multivariate shape data seem to resemble classical bivariate allometric plots, the language of heterochrony cannot be translated directly into general multivariate methodology.

We simulate idealized multivariate ontogenetic trajectories and demonstrate their behavior in principal component plots of shape and size-shape space. The concept of "dissociation," which is conventionally regarded as a change in the relation between shape change and size change, appears to be algebraically the same as regional dissociation—the variation of apparent heterochrony by region. Only if the trajectories of two related species lie along exactly the same path in shape space, the classic terminology of heterochrony can apply and pure dissociation of size change against shape change can be detected.

We exemplify a geometric morphometric approach to these issues using adult and subadult crania of 48 *P. paniscus* and 47 *P. troglodytes*. On each specimen we digitized 47 landmarks and 144 semilandmarks on curves and the external neurocranial surface. While *P. paniscus* exhibits a general retardation of shape change during ontogeny, we also find an apparent dissociation of regional growth patterns. For example, when the overall retardation of the *P. paniscus* cranium relative to *P. troglodytes* is taken into account, the alveolar process is less pedomorph than expected.

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### The CT Database at the University of Pennsylvania Museum.

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The University of Pennsylvania Cranial CT Database is a collection of high resolution (sub-millimeter) CT scans of human and non-human crania from the Penn University Museum and other institutions. Because of advances in 3D imaging software, detailed anatomical studies can be accomplished without ever having to rescan (or handle) any of the specimens again. The database is designed to continually grow (it currently contains 160 scans) as new scans are obtained, and will be made available online, thereby maximizing their usefulness to researchers in anthropology, biology, and medicine worldwide.

The scans are primarily from the Morton Collection of human crania (collected in the middle of the 19<sup>th</sup> Century, curated at the U of PA Museum) from various geographic regions including Europe, Africa, Asia, parts of the Americas, and Australia. In addition, the scan archive now contains 18 chimpanzee skulls (from the American Museum of Natural History), 6 orangutans (Harrison-Hiller Collection, UPM) and 2 gorillas as well as a few other non-human primates. In the human collection, 24 specimens are sub-adult ranging in age from 8-month fetal to 8-10 years of age at death. Scans are stored both as "raw" images and in processed form using Analyze™ 7.5 image format. Information in the database includes details of the scans (# of voxels in the X,Y, and Z axes and their dimensions in millimeters) along with all data on the specimens themselves (collection, date, geographic information, and life history parameters where known).

### Ancient migrations and population expansions in East Africa: Genetic evidence for Tanzanian prehistory.

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East Africa, with its remarkable degree of ethnic and linguistic diversity, is best characterized as a mosaic of different cultures, subsistence patterns, and languages. Tanzania is the only region in Africa with populations currently belonging to all four of the major linguistic families of Africa (Khoisan, Afro-Asiatic, Nilo-Saharan and Niger-Kordofanian). Anthro-

logical and linguistic data indicates successive waves of migration into Tanzania, first by Cushitic speaking peoples approximately 5000 years ago, followed later by migrations of Nilotic, and Bantu speakers who displaced and absorbed indigenous hunter/gatherers in many areas.

A large panel of ~600 Tanzanian individuals, representing 15 diverse ethnic groups, was analyzed for mtDNA control region sequence variation and a set of informative mtDNA SNPs. Populations include the Khoisan-speaking Hadza and Sandawe, Cushitic-speaking Burunge, WaFiome (Gorowa), Iraqw, and Mbugu, Nilotic-speaking Maasai, Datog, Dorobo, and Akie, and Bantu speaking Mbugwe, Gogo, Rangi, Turu, and Pare. From this data we infer long-term population size, levels of population substructure and degrees of admixture between groups. Preliminary findings concerning the relation of the traditional foraging groups (Akie, Dorobo, Hadza, and Sandawe) indicate a genetic relationship amongst Tanzanian foragers that does not necessarily correspond to linguistic affiliation. Estimated timing and direction of gene flow between diverse subsistence groups suggests that current linguistic distribution across the landscape may overlay an earlier network of indigenous hunter-gatherers.

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### Inference of recent gene flow following complete population isolation.

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Most existing tools for inferring rates of migration rely on the assumption that migration rates between two populations are constant, either throughout time or following population divergence. Investigations of human history would benefit greatly from more complex models of migration. We have investigated several models of Complete Isolation followed by Recent Migration (CIRM). Specifically, we have considered (a) two populations of identical size that diverged from a common ancestor  $ts$  generations ago, with gene flow between these populations beginning  $tg$  ( $\ll ts$ ) generations ago, (b) same as above except with two populations of dramatically different size, (c) three populations that diverged  $ts$  generations ago, one of which has contributed migrants to each of the other two for  $tg$  generations, (d) four populations, one of

which has contributed migrants at different rates to each of the other three. Coalescent simulations indicate that where two populations have no identical and no similar sequences, we can readily rule out recent migration using DNA sequence data for non-recombining genetic regions such as the mitochondrial (mt) genome and the non-recombining portion of the Y chromosome. Model (c) may lead to the erroneous inference of recent gene flow. We have also characterized the parameter space (in terms of divergence times, population sizes, periods of gene flow and migration rates) wherein complete isolation followed by recent gene flow is distinguishable from no gene flow. We evaluate mtDNA data for a set of African populations in light of these results.

### Using SEM to qualitatively identify structural differences in the hairs of nectar-feeding prosimians.

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Nectar-feeding mammals have several anatomical modifications that assist in cross-pollination. Howell and Hodgkin (1976) note structural differences in the hair and tongues of nectar feeding bats. They suggest that effective cross-pollinators may have feathered tongues, laterally scaled muzzle hair, cranial modifications such as snout elongation, and/or diminutive dentition that allow non-destructive nectar feeding and successful cross-pollination.

Within the primate order, lemurs are noted as being highly nectivorous, where monthly nectar consumption can represent over three fourths of their total feeding time. Convergent with many nectar-feeding mammals, several lemur species are documented to have brush-like feathered tongues and cranial modifications. To date, however, no one has investigated the structural variation in prosimian hairs and how variation may be related to foraging behaviors. Using a scanning electron microscope, I identified the presence of specific modifications to the hairs of 12 prosimian species. Results indicate that frugivores show a generalized hair scaling pattern where the hair slightly deviates at an angle from the main hair shaft (divaricated). Interestingly, a few seasonal nectar feeding frugivores (e.g. *Eulemur mongoz*) have extreme scale derivation. Howell and Hodgkin argue that these divaricated hair scales aid in cross-pollination among nectar feeding animals.

Although not all nectar-feeding lemurs show cross-pollinating modifications to their hair, some do. Besides the Malagasy

lemurs, there are only three bat and four bird species acting as potential pollinators for Madagascar. Considering the dearth of other pollinators on the island, this suggests that some lemurs may play an important role in maintaining Madagascar's delicate ecosystem.

**The immunosomatic metabolic diversion hypothesis and testosterone correlates to intestinal parasitemia in wild male chimpanzees.**

M.P. Muehlenbein. Department of Anthropology, Yale University.

Parasite avoidance is one of the primary challenges that organisms face. Proper performance of the immune response to pathogens requires energy and is influenced by many physiological systems, including steroid hormones that modify energy allocation, reproductive function, and stress responses. The primary functions of testosterone are to support male reproductive function and maintain musculoskeletal performance. However, testosterone can also affect immune function by inhibiting inflammation, lymphocyte proliferation, cytokine production, and macrophage activity, at least *in vitro*.

Because energy used for one purpose cannot be used for another, organisms face energetic tradeoffs. Diversion of metabolic energy to support immune function during infection reduces the energy available for reproduction. Maintaining high androgen levels could have fitness costs because it may cause immunosuppression and increase morbidity and mortality. Such costs may be expressed in increased susceptibility to parasitic infection, which would be balanced against the reproductive benefits of testosterone. This is identified as the "Immunosomatic Metabolic Diversion Hypothesis" (ISMDH).

According to the ISMDH, testosterone levels should be positively correlated with measures of parasitic infection, such as parasite load, in male vertebrates. To test this hypothesis, fecal samples were collected from the adult and adolescent male population of wild chimpanzees at Ngogo, Kibale National Park, Uganda. Samples were collected for both parasitological and hormonal analyses. Correlations between parasite richness, intensity of infections, and testosterone levels are described. This is the first report of hormonal correlates to intestinal parasite infection in a wild population of chimpanzees.

**Patterns of ecological diversity in modern small mammal communities of Madagascar.**

K.M. Muldoon. Department of Anthropology, Washington University.

Current understanding of the ecological structure of both modern and subfossil Malagasy mammalian communities has been based almost entirely on studies of primates, due to a lack of complete mammal inventory lists for most field sites. Recent research has improved knowledge of the behavioral ecology of small vertebrates and provided current faunal lists for comparative ecological study. In light of this information, this paper investigates ecological diversity patterns of extant faunas in Madagascar by concentrating on the non-volant small mammals as a community.

Eighteen forests for which lists of mammalian species are available in the literature are chosen from six distinct ecogeographic zones in Madagascar, including spiny and ericoid thicket, dry deciduous forest, succulent woodland, lowland and subhumid rainforest. An ecological spectrum for each community is generated by assigning mammal species to taxonomic, trophic, locomotor and body size categories. Results show that in several measures, the dry forest communities of western Madagascar show less ecological diversity than do communities from eastern rainforests. The relative proportions of omnivory and terrestriality best differentiate between ecogeographic regions. Unlike results from continental faunas, broad taxonomic categories and body size are less informative of vegetative structure. This may be a consequence of recent extinction events in Madagascar.

The predictive value of ecological diversity analysis of micromammals in Madagascar is of significance for the reconstruction of the paleoenvironments of giant extinct lemurs, a key issue in the debate over the cause of the megafaunal extinction.

**Disease and trauma in skeletal remains from a Fifth Dynasty cemetery at Giza, Egypt.**

D.M. Mulhern. Department of Anthropology, NMNH, Smithsonian Institution.

Twenty-two individuals were excavated from Cemetery 2500 in the Western Cemetery at Giza, Egypt from 2001-2003 as part of the Howard University Giza Cemetery Project. Cemetery 2500 includes a series of mastaba tombs dating to the Fifth Dynasty (2494-2345 B.C.). The purpose of this study is to present and discuss the skeletal indicators of pathology observed in the human remains from Cemetery 2500.

The study sample includes ten males, nine females and three individuals of indeterminate sex. The youngest individual is 7-8 years at age of death and the oldest is over 55 years. Only four individuals are younger than 20 years.

*Cribrra orbitalia* is present in eight individuals, with no difference between the sexes. Osteoarthritis is present in all but one adult. All major joints are involved, with the vertebrae, shoulder and knee joints most widely affected. Vertebral osteophytes are present in 15 individuals and Schmorl's depressions are present in three individuals. Twelve individuals exhibit healed fractures, with ten out of twelve exhibiting multiple fractures. The most commonly observed types of fractures include depressed cranial fractures, vertebral compression fractures and hand fractures, which are each present in four individuals, as well as clavicle, rib and distal ulnar (parry) fractures, which are each present in three individuals. The overall pattern of fractures suggests interpersonal violence was present. Three notable pathological conditions include a case of diffuse idiopathic skeletal hyperostosis (DISH), a case of vertebral infection, possibly brucellosis, and a probable case of gigantism.

**Evidence of interpersonal violence in the W. Montague Cobb skeletal collection.**

J.L. Muller. Dept. of Anthropology, University at Buffalo.

In anatomical and historical skeletal samples, the coupling of archival data with skeletal analyses can provide insight into the cultural and environmental factors that may be associated with injury. The Cobb collection, comprised mainly of African American remains, is one of the largest collections of documented human skeletons. These skeletons were processed and collected from the anatomy dissections performed by medical students at Howard University, Washington DC. This collection provides both biological and archival records of the poorest of Washingtonians, living from the mid-19th century to the 1960's. Archival documents for this time period address the sexual division of labor within the African American community. The majority of males were laborers, while females worked as domestics. This information, in conjunction with modern clinical data on injury rates, aid in forming the hypotheses that 1) trauma pattern, in the form of fractures and dislocations, is consistent with accidental injury and 2) males have a higher frequency of trauma than females.

This paper specifically addresses the results of craniofacial trauma analysis of Cobb collection individuals. Of the 139 crania examined, 53.2% show evidence of fracture. The cranial vault is fractured in 12.9% of the sample. However, the greatest frequency of trauma is to the facial elements (46.8%), with the majority of such injuries affecting the nasal region. These frequencies are high when compared with other anatomical and archaeological samples. The pattern of fractures found in the crania suggests that interpersonal violence, rather than accidents, is the more probable cause of cranial injury.

#### **Dominance, cortisol and stress in wild chimpanzees.**

M.N. Muller. Dept. of Anthropology, Harvard University.

Field studies of endocrine function in a range of social mammals suggest that high dominance rank is commonly associated with elevated production of stress hormones (glucocorticoids). This is puzzling, because in stable dominance hierarchies, high status is normally associated with social control and predictability, key predictors of low psychological stress. One solution to this problem may be that high rank is commonly associated with elevated energetic expenditure, leading to increased metabolic stress and glucocorticoid secretion. I conducted behavioural observations and non-invasive hormone sampling of male chimpanzees in Kibale National Park (Uganda), and Gombe National Park (Tanzania) to examine the relationship among cortisol, dominance and stress in wild chimpanzees. Results indicate that in both sites male dominance rank positively correlated with urinary cortisol excretion in a stable dominance hierarchy. Detailed data from Kibale show that cortisol excretion also correlated positively with rates of male aggression. I suggest that the relationship between cortisol and rank in chimpanzees is primarily driven by energetic factors rather than psychosocial ones. This interpretation is supported by the observation that in Kibale urinary cortisol levels correlated negatively with food availability. These findings suggest that dominant chimpanzees experience significant metabolic costs that must be set against the presumed reproductive benefits of high rank. Metabolic stress may mediate the relationship between rank and cortisol in other social mammals.

#### **Mitochondrial D-loop analysis of bovid skeletal material from Eritrea.**

C.J. Mulligan, M.S. Ascunce, A. Kitchen, P.R. Schmidt. Department of Anthropology, University of Florida, Gainesville.

Bovine skeletal materials excavated from two sites in Eritrea, one dating to approximately 900 YBP (Adi Nefas) and the other dating between 2800 and 2400 YBP (Sembel), were analyzed in order to determine the feasibility of a large-scale genetic study. The Adi Nefas site was a seasonal pastoral settlement and the tested sample was obtained from a garbage midden. The Sembel site was part of a pre-urban complex. The two tested Sembel samples date to 2500 YBP and were excavated from a garbage pile in a small alley.

Three different primer pairs were tested for their ability to amplify the mitochondrial D-loop and a single primer pair (156bp product) successfully amplified extracts from all three specimens. Stringent ancient DNA precautions were observed and no positive controls were used that could introduce contaminating DNA. Phylogenetic analysis was performed in order to classify the three ancient sequences. Sequence data from all available *Bos* (oxen), *Bison*, *Bubalus* (Asian buffalo), and *Syncerus* (African buffalo) species were included. Based on 120bps of sequence data, all species formed monophyletic clades with the exception of *Bos taurus* and *Bos indicus*, which intermingled in a single monophyletic clade. The sequence from Adi Nefas clustered with *B. taurus* and *B. indicus* sequences suggesting a cattle designation. Sequences from the Sembel specimens formed a distinct clade, with 100% bootstrap support, that was closest to *Bubalus bubalis* (Asian water buffalo). Presence of water buffalo in Eritrea 2500 YBP contrasts with historical reports that suggest water buffalo was first introduced to Africa in Egypt (1400-1000 YBP), presumably via Mesopotamia.

#### **Did *Proconsul heseloni* have a tail?**

M. Nakatsukasa. Laboratory of Physical Anthropology, Kyoto University.

Taillessness in Miocene hominoids has been an issue of debate. Nakatsukasa et al. (2003) revealed that 15 million-year-old *Nacholapithecus* did not have a tail. However, it is still unclear whether tailless-hominoids had existed before 15Ma. *Proconsul heseloni* is the key species to this question. There are three important specimens. Harrison (1998) identified KNM-KPS V9 and V10 as caudal vertebrae of *P. heseloni* while Ward et al. (1999) claimed that these bones are de-

formed lumbar vertebrae. KNM-KPS V42 is a last sacral vertebra described by Ward et al. (1991). The authors concluded that the tapering of the body evidences the taillessness. However, Harrison (1998) presented a contradictory interpretation of this specimen. I examined V9 and V10 by using a micro CT and reached to the conclusion that these are deformed lumbar vertebrae. Internal structure of these bones is composed of fine trabecular meshwork. Their trabecular texture is very similar to that of V3, a lumbar vertebral body collected from the same locality. In primates, most of the caudal vertebrae have a shell structure except proximal (short) ones. Since V42 is distorted, it may be difficult to draw the unarguable conclusion about its tapering. However, it preserves the hiatus sacralis, which is observed only in humans and apes among living anthropoids. Therefore, *P. heseloni* probably did not have a tail. Supported by Grant-in-Aid from the JSPS (#14654182).

#### **Dental microwear analyses of *Sivapithecus* and contemporaneous fauna.**

S.V. Nelson. Museum of Paleontology, University of Michigan.

This investigation seeks to determine the preferred diet of *Sivapithecus*, fruit availability in its habitat, and any changes in fruit availability that might have coincided with its extinction. A new light microscope technique is used which allows for analysis of many specimens, and a Bayesian approach to statistical analyses of data allows dietary results to reflect degree of similarity to multiple modern species or diets, permitting the possibility that there is no perfect modern analogue to a fossil diet. Furthermore, fossil diets can be interpreted in terms of how much each food type contributed to the diet and how those contributions may have changed over time.

A total of 195 fossil teeth from 13 taxa from the Siwaliks of Pakistan were analyzed for dental microwear. Results indicate that *Sivapithecus* was frugivorous, as were many other contemporaneous taxa, including suids, tragulids, and some bovids. The large proportion of Siwalik fauna that were frugivorous suggests that *Sivapithecus* habitat preference was similar to that of modern apes in fruit abundance, although it is unknown whether it was similar in terms of seasonal fruit availability. Fruit availability appears to decrease around the time *Sivapithecus* became extinct, with fruit replaced by browse in some taxa, and browse replaced by  $C_4$  graze in others, indicative of forest

replacement by more open habitat. However, persistence of frugivorous suids, tragulids, and very small bovids after the disappearance of *Sivapithecus* suggests that moist forests did not disappear entirely, but likely became too fragmented to support a large-bodied frugivorous ape.

### **Reproductive suppression: The critical process of implantation.**

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Physiological mechanisms aimed at reducing the chances of successful ovulation, conception, implantation and gestation are advantageous if they prevent women from expending reproductive effort under sub-optimal conditions.

Traditionally, research has focused on those mechanisms that hinder ovulation or early pregnancy after implantation. Less is known about the mechanisms that impinge on implantation. Although mechanisms affecting ovulation and gestation are important, we propose that it is during the implantation process that the reproductive axis should be most sensitive to suppression mechanisms.

The implantation process is decisive because at this time the mother begins to lose hormonal control of the pregnancy to the embryo. The embryo's endocrine emancipation accelerates after implantation and physiological interruption of gestation becomes increasingly difficult. In addition, the costs and risks associated with pregnancy begin to rise after implantation. Thus, the ability of the mother to hamper the implantation process during times of distress may be critical.

In this paper, we draw on results from a year-long longitudinal study to propose a mechanism for control of implantation. Using a random effects model, we identified a negative association between urinary levels of cortisol, an indicator of stress, and progesterin at the time of implantation. Our findings confirm similar reports in both, human and non-human primates, suggesting a mechanism through which maternal stress may physiologically impinge on implantation.

### **Geometric reconstruction of the MLD 37/38 endocranium.**

S. Neubauer, P. Gunz, P. Mitteroecker, G.W. Weber. Institute for Anthropology, University of Vienna.

MLD 37/38 is an incomplete but well preserved cranium of *Australopithecus africanus* excavated in Makapansgat in 1958/59. Parts of the neurocranium (ant. of the coronal suture) and most of the face are missing. The endocranial cavity is filled with stone matrix. Here we present a geometric reconstruction of the endocranium and give an estimate for the total endocranial capacity.

Using CT scans, we produced a virtual endocast of MLD 37/38 by distinguishing fossilized bone from stone matrix on the basis of different grey values slice by slice. Eight anatomical landmarks on the ectocranium and 455 semilandmarks on the endocranial surface were measured on MLD 37/38 and STS 5, another *Australopithecus africanus* specimen. The latter was used as reference specimen because of its completeness. Thin plate spline warping was applied to reconstruct the missing portions of the MLD 37/38 endocranium: the homologous landmarks on STS 5 were warped to those available on MLD 37/38; thus, landmarks on the missing part of MLD 37/38 were estimated by this deformation function.

The unreconstructed endocranial capacity is 382 cm<sup>3</sup> while the estimated volume of the reconstructed endocranial cavity of MLD 37/38 is about 440 cm<sup>3</sup>. This result, calculated on the reference-based reconstruction indicates a slightly higher capacity than previously published (425 cm<sup>3</sup>; Conroy et al., 1990) and lies well within the known range of other *Australopithecus africanus* specimens (428-515 cm<sup>3</sup>).

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### **'From the mouths of babes': Patterns of enamel hypoplasia in the deciduous teeth of non-human primates.**

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While awareness of the distribution of enamel hypoplasia in the permanent dentition of non-human primates is rapidly expanding, analyses of hypoplasia in the deciduous dentition are taxonomically limited. Previous studies have exclusively examined hypoplasia in the apes (Eckhardt and Protsch von Zieten, 1993; Lukacs, 1999, 2000, 2001; Skinner and Newell, 2003). However, the potential import of a study of enamel hypoplasia in the deciduous teeth of non-hominoid primates has been recognized (Lukacs, 2001). By providing data on the prevalence of linear (LEH) and pitting hypoplasias in the deciduous dentition of 189 individuals from 16 taxa, the present research expands the

comparative context for the study of deciduous enamel defects.

Of the primate suborders, only anthropoids had linear defects. Among anthropoids, only four catarrhine taxa were affected: *G. gorilla*, *P. troglodytes*, *H. muelleri* and *M. mulatta*. Three colobine species and all platyrrhines were defect-free. Chi-square analysis indicates that permanent teeth are significantly more affected by LEH than the deciduous teeth ( $p < .01$ ). Therefore, a descriptive comparison of the distribution, severity and multiplicity of linear defects is made for these dentitions. Of 16 taxa, only catarrhines exhibited pitted enamel. Differences in the frequencies of LEH and pitting hypoplasia are significant ( $p < .01$ ). However, unlike the dentition of adult primates, pitting hypoplasia is more frequent in the deciduous teeth than LEH. Structural and developmental factors (e.g. crown size, patterns and onset of formation) that may contribute to a further understanding of the patterns of enamel defects in deciduous teeth are examined.

### **Comparative sequence analysis of a repeat polymorphism in the monoamine oxidase A (MAOA) gene promoter region in primates: Evidence for selection?**

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Monoamine oxidase A (MAOA) is an important enzyme that catabolizes dopamine and serotonin in the brain, and is critical for maintaining normal synaptic neurotransmission. A functional repeat polymorphism in the promoter region of the human MAOA gene alters expression and is associated with a number of psychiatric and behavioral traits, including aggression and impulsivity. Here, we investigate whether the promoter polymorphism is present across primates, including hominoids, Old and New World monkeys and prosimians. To date, all taxa screened possess the repeat polymorphism. Repeat structure size ranges from < 80bp in *Pan* to > 180bp in *Erythrocebus*. Preliminary sequence data indicate that the polymorphism is homologous across primates and that internal sequence composition is largely conserved, but repeat motif size and number varies considerably within and between taxa. For instance, *Macaca* repeat motif size is 18bp with 5-7 repeats compared to 30bp in *Homo* with 3-5 repeats. The mechanism by which the polymorphism affects transcription and expression of MAOA is not well under-



stood, although in *Homo* a major transcription factor (Sp1) binding site is present within each repeat block, suggesting a direct link between the gain or loss of transcription factor binding sites and MAOA gene promoter activity. Based on the degree of sequence conservation observed in the promoter region and the potential modulatory effect on MAOA gene expression through the gain or loss of repeats, we postulate that allelic variation has important selective consequences that explains, in part, the maintenance of polymorphism in this locus among primate species.

**Comparison of size and shape patterns in the postcranial skeleton of *Macaca*, with attention to locomotor variation in *M. fascicularis* and *M. nemestrina*.**

K.A. Nichols-Bown, K. Ratteree. Anthropology Department, University of Colorado at Boulder.

The Cercopithecidae have been considered traditionally to be taxonomically diverse yet morphologically conservative. Even so, field studies document a high degree of behavioral variation that is inconsistent with limited anatomical variability. We address this issue by assessing postcranial size and shape variation among one group of Old World monkeys, the macaques (*Macaca*).

The relatively more arboreal *Macaca fascicularis* and the relatively more terrestrial *M. nemestrina* are: (1) sympatric in the wild; and (2) well-studied in terms of locomotor behavior. We reported on scaling relationships in the postcranial skeletal anatomy of these taxa, utilizing univariate and multivariate statistical analyses on standard osteometric variable data collected from skeletons of wild-caught adult macaque specimens ( $n = 60$ ). The results are compared to those obtained from other species of *Macaca* to determine if *M. fascicularis* and *M. nemestrina* linear skeletal dimensions correlate with: (1) a generalized macaque pattern of size variation; and/or (2) with identifiably distinct locomotor adaptations.

Least-squares regression analyses suggest varying degrees of scaling effects and variation associated with divergent locomotor adaptations. For example, scapular width does not strongly scale with scapular height for most taxa, including *M. nemestrina*, but suggests scaling effects for *M. fascicularis*. In contrast, the relationship of humeral length to humeral midshaft circumference supports scaling effects in all macaques studied. In addition to interspecific variation in postcranial

proportions, intraspecific variation is present in adult males and females of some species. These results suggest that macaque skeletal dimensions reflect subtle variations in concordance with established behavioral diversity.

**Behavioral differences in hierarchical relationships: Aggression and grooming among male and female *Macaca fascicularis* at Pedangtegal, Bali, Indonesia.**

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Here we report on an analysis of aggression and grooming patterns among high and low-ranking individual *Macaca fascicularis* in three groups at a semi-free ranging site in Bali, Indonesia. Aggression and grooming rates for 19 males and 40 females were calculated from over 1,700 hours of observational data and means were evaluated across a 4 year period, 1999-2002. Dominance ranks for adult males and females were calculated annually from approach-retreat interactions (displacements), the results of aggressive contests and priority of access to disputed resources. Individual rates of aggressive and grooming behaviors were examined for high ranking and low ranking same-sex individuals and between sexes. The aim of this analysis is to examine grooming and aggression in the context of dominance relationships.

While we found no significant difference between the grooming rates of males and females on the whole, we did find a significant difference in grooming between high ranking males and females, with high ranking females involved in grooming more frequently than males. Males displayed higher overall rates of aggression. Within the males, low ranking individuals were significantly more aggressive than high ranking individuals. In addition to these general trends a number of individual patterns of aggression and grooming emerged for both males and females. Data from this population adds to the ongoing attempt to enhance our understanding of the relationship between grooming, aggression and rank in *Macaca fascicularis*.

**Pigmentation variation in Island Melanesia and associated candidate gene variation.**

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thropology, Binghamton University, <sup>4</sup>Institute of Medical Research, Papua New Guinea.

Pigmentation of the skin and hair is one of the most variable phenotypic traits observed in human populations. This variation is most often explained via natural selection acting on melanin content of the skin at different latitudes. This paper describes pigmentation variation of the skin and hair of 1135 Papuan and Austronesian speaking individuals living in the Bismarck Archipelago, Bougainville, and New Guinea. These pigmentation measurements were examined for sex-, linguistic-, and geographic-based differences. Skin pigmentation in Island Melanesia is extremely variable; significant differences were found between males and females; between the major island populations; and between language groups. Regional variation in skin pigmentation is also being studied at the genetic level, using 3-5 SNPs from the pigmentation candidate genes *MC1R*, *TYR*, and *TYRP1* typed in representative samples from the major island and language groups. An initial study using individuals from West New Britain and New Ireland suggests an association between the *MC1R* variant Thr314Thr and decreased skin pigmentation in these two groups. Current investigations are pursuing whether this relationship and others are due to a true association between the *MC1R* SNP and skin pigmentation, or if they are instead due to an artifact of population differences between these two groups.

**Origin of the inhabitants of Bronze Age Bactria: A dental morphological investigation.**

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A previously unknown Bronze Age civilization (Oxus Civilization) centered on the oases of Central Asia features a sudden appearance of large cities resting directly atop sterile soil. Given the absence of local archaeological antecedents, many have speculated over where the inhabitants of these ancient cities came from. Three hypotheses have been offered to account for the origin of Oxus Civilization populations of North Bactria. These include the early influence model, the late colonization model, and the Indus intrusion model.

Ten morphological traits of the permanent tooth crown, scored as 25 tooth-trait combinations were compared among ten

Aeneolithic and Bronze Age samples, encompassing 375 adults from the North Bactrian oasis, Turkmenistan, and the Indus Valley to test which, if any, of these hypotheses are supported by the pattern of phenetic affinities possessed by the Oxus Civilization inhabitants of the north Bactrian oasis. Differences in the patterns of dental morphology trait frequencies were compared with the mean measure of divergence statistic (MMD) and patterns of phenetic affinity were assessed with cluster analysis, multidimensional scaling, and principal coordinates analysis.

The results of this study provide no support for the Indus intrusion model, but offer some support for both early intrusion and late colonization models. However, occurrence of near phenetic identity between colonizer (Altyn depe) and colonized (Sapalli) expected under the late colonization model is not present. Rather, a scenario of limited gene flow from outside (Geoksyur) into an extant North Bactrian population, expected under the early intrusion model, appears best supported.

#### **Growing up in diverse environments: Effects on adult salivary estradiol.**

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Historically, most anthropological studies investigating inter-population variation in ovarian function have focused on measurements of salivary progesterone given the better-established assays for its analysis, and its cheaper costs. However, methodological improvements in recent years have resulted in higher quality and more cost-effective assays for salivary estradiol. We report here our findings of relative levels of salivary estradiol among migrant Bangladeshi women living in London, U.K.

We compared women who moved to London at different times (infancy, childhood, and post-menarche) and compared them to women living in Bangladesh, as well as to second-generation Bangladeshi women and white women born and resident in London. We analyzed levels of salivary oestradiol and progesterone, as well as data on anthropometry, physical activity, diet, reproductive history and general health.

Based on the "fetal programming hypothesis" we predicted that women born and raised in poorer environments will have lower hormone levels than those born and raised in more affluent ones. We

also hypothesized that women who moved to a more affluent environment when growth was still ongoing will exhibit intermediate levels.

Preliminary analyses show that, whereas both these predictions hold true for progesterone, this is not the case for estradiol. These results also differ from previous findings of significantly lower estradiol levels in populations in more extreme ecological settings living at the margins of subsistence. We discuss possible explanations for these differences and their significance for developmental hypotheses.

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#### **Comparative studies of immune system parameters and disease risk in nonhuman primates.**

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Across species, the risk of disease is likely to vary with social and ecological parameters. Several recent comparative studies have quantified disease risk using data on immune defenses, particularly white blood cell counts, based on the assumption that higher values will be found in species that experience greater risk of acquiring infectious disease. I will report on one study that used these data to investigate three hypotheses in nonhuman primates. Specifically, disease risk was predicted to increase with (1) group size and population density, (2) terrestriality, e.g. through greater proximity to soil-borne pathogens, and (3) increased numbers of mating partners.

Phylogeny-based comparative studies provided strongest support for the third hypothesis. Several classes of white blood cells, particularly neutrophils, increased with the number of mating partners, the duration of estrus and relative testes size (controlling for body mass). Results remained significant in multiple regression analyses that included predictor variables from the non-sexual hypotheses. Thus, mating behavior, possibly in combination with other factors, is associated with disease risk in primates.

Several recent studies have documented further support for the hypothesis that mating promiscuity correlates with white blood cell counts in mammals, while additional variables, such as rainfall and predation, have been shown to correlate with basal immune defenses in primates. The general assumptions of this comparative

approach will be evaluated, and steps will be outlined for future research on disease risk in human and non-human primates, particularly by integrating physiological data with actual patterns of parasitism and behavioral defenses in natural populations.

#### **Spatial distribution of childhood morbidity patterns in a Dominican village.**

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Standard epidemiological models predict that population density is causally associated with morbidity. Contact frequency is expected to facilitate pathogen transmission. The precise mechanisms linking social contact and disease that underlay the macro-scale relations, however, have not been extensively studied. Here we examine relations among population density, rates and types of contact, and morbidity using GIS, health survey, and ethnographic data from a sixteen-year biomedical study of a rural community on the island of Dominica.

Cross-sectional analyses do not indicate significant relations between population density and morbidity. Effects of contact rates are complex and involve details of social interaction. Preliminary analyses of longitudinal data on temporal patterns of disease suggest that social contact is associated with transmission of specific pathogens (e.g., varicella virus).

Micro-level studies are essential to determine the associations between population density, contact frequency, and morbidity. Longitudinal ethnographic data enhances standard epidemiological models and elucidates the complexities of social interaction that impact contact frequency.

#### **A bug's life: A paleoentomological case study from Chachapoya Perú.**

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This paper explores the contribution that applied forensic entomology can have for our understanding of prehistoric mortuary behavior. Samples of insect remains were recovered from a mummy bundle that has been attributed to the Chachapoya people that occupied the northern highlands of Perú. The samples were identified to the family level and subsequently utilized to create a hypothetical timeline of events. The individual in question suffered several blows to the

head, followed by surgical intervention in the form of two trepanation events. Periosteal reaction in association with one of the trepanations suggests that the individual survived for perhaps 5 - 7 days following the initial insult. Further, based upon the type of insects recovered from the cranial cavity, it appears that individual was wrapped in textiles shortly after death. The possibilities and implications that this technique and these results have for mummy studies in general, and Chachapoya mortuary archaeology in particular, are discussed.

#### **Effect of psychogenic stress on ovarian cycle dynamics in the baboon.**

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The mechanisms underlying the effect of psychogenic stress on ovarian function are unclear. This is partly a result of the lack of a useful etiologic model. We propose a new approach for examining the effects of stress on ovarian function.

Twenty female baboons aged 15-18 years were moved from outdoor social cages into indoor individual cages. Ten were moved in the luteal phase and ten in the follicular phase of the ovarian cycle. No other procedures were performed. Daily urines were collected for 120 days, and assayed for FSH, E1C and PDG. Turgescence and menstrual bleeding were recorded daily.

Of the animals moved in the luteal phase (LP), six had the most serious cycle disruptions (anovulation, inadequate luteal phase, reduced or lost FSH peak) in the third cycle after being individually caged. In contrast, five animals moved in the follicular phase (FP) had the most serious disruptions in the first cycle. Three LP animals and one FP animal had no disruptions. Two FP animals had no LP disruptions but had sustained hyper-FSH secretion just after being moved. One FP animal stopped cycling for the remainder of data collection.

These data show that the cycle-phase of stress experience affects when and how subsequent cycles are disrupted. We propose that the temporal differences relate to variation in the vulnerability of maturing follicles at different stages of development. Our data suggest a new model for examining how stress affects ovarian function.

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#### **Primate speciosity, taxonomic distributions, and power law behavior.**

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The relative speciosity of Order Primates has implications for understanding adaptive radiations and for expected speciosity in the primate fossil record. Emphasizing the mean number of species per genus, and based on comparisons of frequency distributions with a normal curve, previous authors have argued that primates are not particularly speciose mammals. Recent models of self-organized critical evolution based on the properties of dynamical systems, however, have revealed that the size distributions of taxa are best understood as a power law distribution rather than a normal curve; the mean number of species per genus thus has little value in inter-taxon comparisons. In a power law distribution, the frequency of species per genus equals the number of species per genus raised to some exponent:

$$P(\text{species} / \text{genus}) = (\text{species} / \text{genus})^{-\lambda}$$

The value of  $\lambda$  has been demonstrated to be relatively invariant, both in models and in actual biological radiations. In the present study, published taxonomies were employed to catalogue every mammalian and avian order, family, genus, and species, and the resultant power law distributions of taxonomy were compared. Primates have the same distribution of species per genus as other mammalian and avian orders, and power law behavior may be a general property of adaptive radiations. Implications for the primate fossil record and for primate adaptive radiations are considered in light of the power law distribution. The consequences of using different taxonomic schemes in order to assess speciosity are also discussed.

#### **Patterns of phylogenetic signal in primate long bones.**

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Studies of interspecific biomechanical scaling of long bones assume that size-corrected variables reflect adaptive responses to locomotor performance and *in vivo* loading. Consequently, similarity due to common ancestry (phylogenetic signal) is assumed to disappear after scaling. This study tests both of these assumptions

using a new method for quantifying phylogenetic signal.

Bone lengths, articular surface dimensions, and diaphyseal (cross-sectional) properties of the humerus and femur of 16 primate species characterized by a "generalist" locomotor mode were examined for the presence of phylogenetic signal before and after scaling. Length and articular variables were scaled to body mass using residuals from conventional least-squares regression. Cross-sectional properties were scaled to body mass•bone length. A working phylogeny with divergence times was taken from the literature. The mean squared error of the phylogenetic variance-covariance matrix was compared to the same statistic for 1000 random permutations of the tip data. The fit of the tip data to the variance-covariance matrix was compared to a Brownian motion (neutral) expectation using the statistic K.

Before biomechanical scaling, all variables exhibited significant phylogenetic signal. However, when the data were scaled, phylogenetic signal could no longer be detected at a statistically significant level. K was less than the Brownian motion expectation in all scaled variables. The results of this study suggest that scaling using conventional regression removes phylogenetic signal from primate long bone data. In addition, the K statistic suggests stabilizing selection influences relative bone length and joint size, and that adaptive modeling/remodeling influences the evolution of diaphyseal cross-sectional robusticity.

#### **Dental microwear at Mission San Luis de Apalachee.**

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The site of San Luis de Apalachee was formalized in the 1630s, during the second period of Spanish missionization in the Georgia-Florida corridor, eventually becoming the western center for colonization of the American Southeast (Larsen, 2001). The structure of the San Luis community was unusual for the late Florida Mission period, including Apalachee natives, and military and non-military Spaniards, with peak populations approaching 1500 individuals.

Paleoethnobotanical remains yield evidence of diverse (but not abundant) agricultural production at the site - typical of nearly all Early and Late Mission period sites (Larsen et al., 2001). Stable isotope analysis and dental caries evidence at San

Luis, however, suggest that these cultivars were not the focus of the diet at San Luis, and ethnohistorical research indicates a heavy reliance on meat consumption at the site.

This study examines dental microwear of 84 maxillary molars from six Native American, Mission period sites in the Georgia-Florida corridor. Epoxy casts of molar crushing facets were photographed under 500X magnification in a scanning electron microscope. Photomicrographs were digitized using Microware 4.02 (Ungar, 1994), and statistically evaluated using one-way ANOVA and post hoc Tukey's Multiple Comparisons tests. Results indicate that the number and percentage of pits exhibited on San Luis molars are significantly greater than for any other Mission period site in this study ( $p < 0.05$ ). These results may be consistent with the stable-isotope data and ethnohistorical records indicating the relative less importance of cultivars in the diets of San Luis residents. As a result, these data may provide insights into the molar microwear patterns associated with greater meat-eating in this setting. Supported by the National Science Foundation.

#### **Differential maternal investment and sex allocation in wild Hanuman langurs.**

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Animals should invest in their offspring to increase their reproductive success. In polygynous species variance in male reproductive success is generally higher than in females. Therefore, the Trivers-Willard hypothesis predicts that females in good physical condition, who have more to invest, will produce more male than female offspring, whereas females in poor physical condition, with less to invest, will produce fewer male than female offspring. Using long-term data from a population of wild Hanuman langurs (*Semnopithecus entellus*) collected between 1991 and 1996 we investigated in a first step whether investment in sons ( $n=34$ ) was higher than in daughters ( $n=29$ ). Specifically, we predicted that (i) weaning age of sons will be higher than that of daughters and (ii) the interbirth interval will be increased after giving birth to male offspring. Next, we analyzed whether (iii) the sex of the offspring was indeed influenced by the mother's physical condition at the time of conception or by her dominance rank. As predicted, producing sons was more costly than producing daughters, as could be inferred from an increased lactation pe-

riod as well as from longer interbirth intervals after giving birth to male offspring. Although maternal investment in sons was higher than in daughters, and sons can theoretically increase a mother's reproductive success stronger than daughters, this did not translate into differential sex allocation depending on maternal physical condition or dominance rank. Supported by Alexander von Humboldt-Foundation, German Research Council, Stony Brook University.

#### **The effects of logging on the densities of the Pagai, Mentawai Island primates.**

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Primate population densities primarily reflect a balance between reproduction and death rates. These rates are influenced by genetic factors, including phylogeny, body size, and life history strategies, as well as differences in zoogeography, habitat, natural and anthropogenic successional changes, seasonal and inter-annual variations in food production and quality, inter- and intraspecific competition, and disease and predation. Of this partial list, the effects of one factor – logging – on the Pagai, Mentawai Island primates (*Hylobates klossii*, *Macaca pagensis*, *Presbytis potenziani*, and *Simias concolor*) was examined.

Standard line transect primate surveys were conducted in nine dipterocarp forests. Three of the forests surveyed were never logged, three forests were logged between 10 and 12 years ago, and three forests were logged between 20 and 23 years ago.

The results indicate that densities of Mentawai gibbons and macaques were similar between the three logging categories, while leaf monkey and simakobu densities varied according to logging stage. Leaf monkey densities were significantly higher in forests that were logged approximately twenty years ago than they were in forests that were logged 10 to 12 years ago or in unlogged forests. Simakobu densities were significantly higher in unlogged forests than they were in logged forests. Thus, it appears that selective logging as practiced thus far on the islands is compatible with the maintenance of gibbon, macaque, and leaf monkey populations, but not for the simakobus. Therefore, a habitat mosaic with tracts of both secondary and primary forest might support the healthiest population of Pagai primates.

#### **Histological analysis of ribs from a 20<sup>th</sup> century Black South African population: Differentiating a microstructural pattern for pellagra and general malnutrition.**

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This report reviews histological findings for individuals known to have died from either pellagra ( $n=10$ ) or general malnutrition ( $n=17$ ). The rib samples used for this project are from the extensive "Raymond Dart" skeletal collection housed at the University of Witwatersrand's Medical School, Johannesburg, South Africa. It is one of the few skeletal collections with documented pellagrins. Pellagra, a niacin deficiency disease, is most often associated with high-maize/low protein diets. The sample was drawn from a Black South African population who became increasingly dependent on maize during the 20th century.

In an earlier report, we indicated that there were a number of gross skeletal and dental pathologies linked to pellagrins, however, these indicators were not pellagra specific. We recently examined ribs from the same individuals to see if there might be microstructural patterns specific to pellagra. Our findings suggest that there are. Seventy percent of the pellagrins exhibit extremely thin cortical bone, in some cases only one secondary osteon thick; 100% had large Haversian canals; 30% exhibited Howship's lacunae; and 50% of them showed type II & double zonal secondary osteons. Take as a whole these indicators and their frequencies separate the pellagrins from those who died from general malnutrition. The implications of these results contribute to a clearer understanding of the diet and health of maize-dependent populations both past and present.

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#### **How important is immunostimulation in causing growth stunting?**

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Early growth stunting is a near invariable feature of childhood in developing countries. For infants living in unhygienic environments, this problem is not resolved solely by dietary intervention:

proper food is clearly necessary but not sufficient to ensure good growth. Chronic exposure to infections with consequent overstimulation of inflammatory and immune systems will inevitably slow growth.

Persistent immunostimulation has been demonstrated even in apparently healthy children of The Gambia and Nepal. A damaged small intestine is the likely site of entry of environmental macromolecules into the body. In The Gambia, greatly elevated endotoxin plasma levels relate closely to the severity of gut damage, growth faltering, and raised acute phase proteins and immunoglobulins. Intestinal enteropathy is extremely common, starting with weaning and worsening throughout infancy: a growth-limiting enteropathy was detected in all village children included in a longitudinal study, for more than 70% of the time during the first 15 months of life. Growth faltering is probably caused by cytokines released during immunostimulation, acting both indirectly by lowering appetite and directly by inhibiting long-bone growth.

Elucidating exact mechanisms and documenting the importance of immunostimulation for growth stunting in other cultures are important challenges for anthropology. The hypothesis advanced for Gambian and Nepali data signifies that better growth for infants with chronic immunostimulation will come from better hygiene, not just better nutrition.

**Identification of sex specific mining activities from enthesopathies on the ancient Hallstatt skeletons.**

D.E. Pany. Natural History Museum, Vienna, Department of Anthropology.

In recent years, various studies on occupationally-induced stress markers on ancient skeletal remains have produced reliable and useful results concerning the reconstruction of habitual activities of past populations. These markers, also known as "musculoskeletal stress markers" (MSM), or "enthesopathies", are a result of repeated occupational hyperactivity, appearing as pittings or furrows on the bony cortex where muscles, tendons or ligaments insert.

In this study, MSM were recorded on skeletons from the Hallstatt (Austria) cemetery, dating 800-450 B.C. ("Hallstatt Period"). This Early Iron Age cemetery is located in a difficult accessible mountain valley next to the oldest yet known salt mine in Europe. Obviously, the people buried there were wealthy salt miners.

A total of 99 adult male and female skeletons was examined macroscopically and scored for MSM type and severity,

following the scoring system by Hawkey (1995). The data were compared with the ones from equally examined prehistoric populations originating in the lowlands, presumably farmers.

The present study brings gender specific interests into focus. From the archaeological record, it remained unclear whether females actually worked in the mines in the Hallstatt Period. From the existing data it seems that females were strongly involved into the mining process. A wide range of activities could be reconstructed from the enthesopathy pattern, consistent with the archaeologically known way of mining in the ancient salt mines. A division of labor between the sexes can be concluded. Generally, the males show higher MSM scores in muscles used in stroke movements, the females in carrying movements.

**Quantifying male ejaculate volume: High-resolution x-ray computed tomography scanning of primate sperm plugs.**

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Although high-resolution X-ray computed tomography (CT) scanning is commonly used for osteological material, this is the first use of this technology to scan primate copulatory (sperm) plugs to obtain measures of male ejaculate volume. A sperm plug forms when ejaculate coagulates in the vagina, and can be displaced when a female mates with a new mate. Displaced sperm plugs were collected opportunistically during data collection on ringtailed lemur (*Lemur catta*) mating behavior on St. Catherines Island, USA. Plugs were frozen following collection to maintain structural integrity, and were transported to the High-Resolution X-Ray Computed Tomography Facility at the University of Texas-Austin. A total of nine plugs were CT scanned. Despite our small sample size, scanned sperm plugs exhibit a fair amount of variation in shape, and a wide range of volumes: 1.76 - 5.01 cm<sup>3</sup>. Mean plug volume ( $\pm$ SD) is 2.69  $\pm$ 0.96 cm<sup>3</sup>. Although more than one plug was obtained for only two of the study males, it is clear that intra-individual differences in plug volume can be considerable, and in some cases, are greater than inter-individual differences in plug size among males. Because plug size may indicate the vaginal depth at which a male was intromitted at the time of ejaculation (smaller plugs may result when a greater amount of ejaculate passes through the cervix), future work will ex-

plore the relationship between displaced sperm plug size and male fertilization success. This project shows the utility of using high-resolution X-ray CT scanning to accurately measure primate sperm plug size parameters.

**Morphology of the proximal radius: Implications for locomotor adaptations of early hominins.**

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Hominoids have an elbow joint that permits a high degree of mobility in an arboreal setting; some also need to maintain stability against compressive stresses (African apes) or dislocation while brachiating (hylobatids). In this study, functional shape variables representing adaptations of mobility and stability were derived from measurements from a sample of proximal radii of extant hominoids and casts of seven early hominins. A discriminant analysis differentiates African apes, hylobatids, and australopithecines (Stw 139, Stw 431, KNM-ER 1500, SKX 3699) from *Pongo*, modern humans, and *Homo erectus* (SK 18b) along the first function. The second function separates the hylobatids and the South African hominins from the others. Univariate analyses of *Australopithecus anamensis* (KNM-ER 20419) and *Praeanthropus afarensis* (AL 288-1p) reveal traits similar to both African apes and lesser apes.

Morphology of the proximal radius suggests that the earliest hominins had an elbow joint that permitted *both* mobility and stability. Recent comparative studies of the hominoid distal radius have suggested a knuckle-walking ancestry for modern humans. However, a distinctive morphology for such behaviors was not evident from the proximal radius when comparing extant hominoids. Rather, the proximal radius reveals a primitive condition for early hominins that is shared with both African apes and hylobatids suggesting either habitual suspensory behaviors in early hominins or the retention of a suspensory morphology from a common ancestor. Traits of the proximal radius often cited as "African ape-like" for early hominins converge in African apes and hylobatids making it difficult to tease apart specific locomotor behaviors.

**Negotiating the demands of pregnancy in a high fertility population.**

C.L. Patil. Department of Anthropology, The Ohio State University.

Pregnancy is not an isolated physiological event in a woman's reproductive span. Women concurrently negotiate the demands of weaning, the next pregnancy, and living children in a specific social context. The objective of this presentation is to examine pregnancy within that context while considering the nutritional and energetic demands influencing immediate outcome and ultimately fitness.

To achieve this objective, the Iraqw, agropastoralists of north central Tanzania, are used as a case study to illustrate daily negotiations while pregnant. Their traditional support system is in flux due to increasing poverty, disintegrating social bonds, and migration. Time allocation, interview, and pregnancy outcome data for 45 fecund women between 20 – 32 years of age were recorded. Anthropometric measures corroborate previous research linking adequate maternal nutritional status and higher birthweights, with mean birthweights of  $3085.8 \text{ g} \pm 393.6$ . Given dramatic social change among the Iraqw, this analysis examines variation in outcomes by household composition and indices of maternal psychosocial stress, social network, and autonomy.

In sum, this case study situates the biocultural interface of pregnancy while considering trade-offs and constraints on women's fitness. Research examining how pregnancy unfolds within the context of the reproductive span across populations may offer a more detailed perspective on life history theory and reproductive success and complement medical and demographic literature focusing on the proximate determinants.

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#### **Recent research on the historical relationships of the Papuan languages.**

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Recent research on the genetic relationships of the 750-800 'Papuan' (non-Austronesian indigenous) languages of Melanesia and eastern Indonesia indicates more overall diversity than was recognized by Wurm (ed. 1975) but less than was proposed by Foley (1986). Foley rejected the 'Trans New Guinea' (TNG) group advanced in the 1970s but new evidence supports a grouping containing at least 400 languages extending over much of New Guinea and into the Timor region (Pawley 1998, 2001, Ross 2000,

2001). The core of the sound system of proto TNG has now been reconstructed along with some 200 lexical units, a full set of independent pronouns and fragments of verb morphology. Ross (2000) compared pronoun paradigms in 605 Papuan languages or about 80 percent of the total. 311 languages showed one or more reflexes of pTNG pronouns and another 36 languages were assignable to TNG on other grounds. The subgrouping of TNG favors an early dispersal centre in the central Highlands of Papua New Guinea.

Ross's pronoun study gave no support for Wurm's (1975) East Papuan phylum, comprising all Papuan languages in the region from New Britain to the central Solomons. Instead eight distinct genetic stocks are recognized, consistent with ancient *in situ* diversification. The Sepik-Ramu phylum proposed by Laycock (1973) is not supported. This breaks down into four groups. The Torricelli family is supported. Slight evidence is found for extending the West Papuan group to include the East Bird's Head, Yava, the Sentani group and a few other isolates from northwest New Guinea.

#### **World-wide variation in the residual strength of the humerus, femur, and tibia.**

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"Residual strength" describes the strength of a long bone's shaft relative to the primary forces that act to deform it: body weight and the bone's length. A simple way to quantify residual strength is to divide the sum a bone's midshaft AP and ML diameters by the breadth of one articular end. This study examines patterns of residual strength in the humerus, femur, and tibia in ~30 groups of recent and fossil humans. External shapes of the long bones' diaphyses were also compared; correlations with lifestyle and habitats are discussed.

The groups that have the greatest residual humeral strength include males of Tierra del Fuego, Australian Aborigines, and Zulus. Gravettian people (both sexes) and European Mesolithic females have the weakest humeri. The highest averages for the residual strength of the femur are found in Jebel Sahaba females, Ganges Mesolithic males, Khoisan (both sexes), and Zulu females, while the lowest mean values are for male Sami, U.S. whites, and Chinese. For the tibia, the strongest groups include Neolithic Danes, Magdalenian males, and Neanderthal females; the weakest are Sami (both sexes) and U.S. white females.

Femoral and tibial residual strength show only a moderate correlation ( $r = 0.43$ ); both show only slightly lower correlations with humeral residual strength ( $r = 0.33$  and  $0.27$ , respectively). The correlation between midshaft tibial shape and the pilastric index is quite low ( $r = -0.13$ ). Well-developed femoral pilasters and platycnemic tibiae probably develop in response to different mechanical stimuli.

Supported by the University of New Mexico.

#### **Biological indicators of social heterogeneity.**

E.A. Pechenkina. Department of Anthropology, Queens College of CUNY.

A complex society functions through cooperation and antagonism among social, occupational, and ethnic groups. Bioarchaeological studies frequently rely on funerary context as a proxy for social standings of individuals (e. g., Rothschild 1979, Cucina and Iscan 1997, Robb et al. 2001). Weak and often insignificant correlations between the social standing assessed from mortuary practices and health studied from the skeletons are expected, since funerary contexts are affected by numerous factors not necessarily related to the social standing of the deceased. Group affiliation is not static during life and changes in accordance with occupation, marriage, and other experiences.

In this study the usual vector of analysis is reversed; the analysis begins with inferring social, ethnic, or occupational heterogeneity from the properties of human skeletons. Multiple skeletal indicators of diet, health, and activity are used to assess the biological status of each skeleton in the sample. Multidimensional scaling is used to analyze the underlying structure of the skeletal data and to identify the presence of social heterogeneity. This approach is tested with two large skeletal samples, one from Villa el Salvador cemetery (AD 50 – 150) located on the central Peruvian coast (N=47) and another from the 13-14<sup>th</sup> century city of Sarai Berke (N=140). We demonstrate that the pattern of skeletal indicators detected by this analysis corresponds to some indicators of social standing, such as cranial deformation and location of the burial, but not to others.

#### **Preliminary report on the human skeletal remains from the Kubinski site (11WI1186), a Middle Woodland period ossuary.**

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On November 17, 1986, construction workers excavating for the foundation of a new home in Romeoville, Will County, Illinois exposed instead a mass of commingled human skeletal remains. The assemblage, designated 11WI1186, has since been identified by means of direct radiocarbon dating (sample Beta-21888) as an ossuary belonging to the Middle Woodland Period, between 20 and 400 AD (2 sigma, calibrated). The present study attempts to understand both the nature of the ossuary and the life histories of the individuals whose remains it holds.

First, the results of an osteological examination of the remains are discussed in an attempt to better clarify the rationale behind the apparent mass contemporary deposition of these 15 individuals (MNI). In the absence of corroborating archaeological information (no archaeological finds were recovered), analysis of demographic, pathological, and traumatic patterning are employed in order to determine whether the basis of the ossuary stems from a single catastrophic occurrence or the attritional loss of life. Next, prevalence of skeletal and dental pathology and trauma markers, along with metric and non-metric analysis, are utilized to ascertain the general health of the sample population. Finally, an observed pattern of cranial asymmetry, occurring repeatedly in both adults and sub-adults (overall prevalence of 82%, 9 of 11 sufficiently complete crania) is explored. The quality and quantity of the deformation is detailed, and the results of the paleopathological and taphonomic analyses form the basis for several potential etiologies.

**Nucleotide sequence variation of the Arginine Vasopressin Type II Receptor (AVPR2) gene in ethnically diverse human populations.**

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The primary action of the peptide hormone arginine vasopressin (AVP) is antidiuresis. This is accomplished by the binding of AVP to the type II AVP receptor in the kidney. Mutations in the AVPR2 gene encoding this receptor, located at Xq28, cause the disease X-linked diabetes insipidus. While a number of studies have identified AVPR2 mutations in individuals with diabetes insipidus, nucleotide sequence variation at this gene has not

been previously investigated in healthy individuals from ethnically diverse populations. Here, we present the analysis of ~2,500 bp of AVPR2 and its proximal promoter region from over 200 ethnically diverse individuals from both African and non-African populations. We have identified over 20 single nucleotide polymorphisms (SNPs), including several common amino acid replacement SNPs that are found in close proximity to the receptor's transmembrane region. We also provide estimates of nucleotide sequence divergence using several non-human primate species to determine how AVPR2 protein evolution may have occurred since the split of humans from their most recent common ancestors. Because AVPR2 plays a critical role in the maintenance of water balance, we have tested for evidence of selection acting at this locus across populations originating from ecologically and geographically diverse groups practicing pastoralist, hunter-gatherer, and agriculturalist lifestyles. Funded BWF and David and Lucille Packard Career awards, Leakey Fund, Wenner Gren, and NSF grant BCS-0196183 to ST and NSF IGERT training grant BCS-9987590 to LP.

**Relationship between tooth size and mandibular size and shape in primates.**

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The phenomena of mandibular robusticity, postcanine megadontia and canine reduction are co-occurring features in early hominin evolution. It has been argued that large canine roots affect corpus dimensions both in the anterior and post-canine regions, and that large molar tooth size produces greater mandibular robusticity. We test these hypotheses using comparative analysis of anthropoid primate tooth and jaw dimensions.

Dental and mandibular dimensions (canine tooth size, lower m1 tooth size, corpus depth and breadth at m1/2, and symphyseal breadth and depth) were gathered for a sample of 1684 specimens representing 84 primate species and subspecies. Corpus and symphyseal shape were calculated as the ratio of height to depth. Correlation analyses were carried out within each species for males and females, both separately and combined. Interspecific analyses were carried out for male and female species means using phylogenetic contrasts. Results show that within-species correlations between tooth size

and jaw size are driven largely by sexual dimorphism. Interspecific analyses show a near zero correlation between tooth size and mandibular or symphyseal robusticity. Canine size is positively allometrically associated with corpus dimensions, but this appears to reflect covariation between size dimorphism and canine dimorphism, rather than a direct consequence of canine size. Thus, we find little support for the hypothesis that either canine size or tooth size drive corpus size or shape across primates. Supported by NSF SBR 9616671 and BNS 8814060.

**Patterns of dental variation in chimpanzees and gorillas: A comparison with implications for the choice of model in reconstructing fossil taxonomy.**

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Due to the paucity of fossil material ranges of variation in closely related extant taxa commonly serve as models for assessing species diversity in the fossil context. Ranges of variation in extant taxa however are influenced by patterns of variation based on their own unique evolutionary trajectories and modes of speciation. In this study the patterns of dental variation in two closely related taxa, *Pan* and *Gorilla* are compared with the aim of evaluating their appropriateness as models for reconstructing fossil taxonomy.

About two hundred dental characters were measured on 371 chimpanzee and 299 gorilla specimens. About 200 qualitative characters were recorded using discrete codes. The samples were sorted into populations and subsequently into commonly recognized subspecies and species. Using frequency counts, coefficient of variation (CV) and Mahalanobis distances, within- and between-group patterns of variation were assessed.

Frequencies of discrete characters and the CV of molar dimensions indicate that high levels of variation characterize chimpanzee populations. Variation does not increase up the taxonomic ladder from population to subspecies to species. Mahalanobis distances between chimpanzee populations are low. Gorillas, on the other hand, display a predictable increase in ranges of intragroup variation from population to species, and between-population Mahalanobis distances are fairly high. These differences in patterns of variation between two closely related taxa signal caution when using models from the extant context for reconstructing fossil taxonomy. Chimpanzee patterns of variation are similar to modern humans, making

chimpanzee models appropriate for assessing patterns of diversity in extinct hominins.

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**Patterns of human variation as reflected by multi-locus genetic comparisons.**

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Patterns of genetic variation in human populations have revealed a complex evolutionary history for our species, reflecting both demographic events that have affected the entire genome as well as selective events that have affected individual loci. Here we examine patterns of DNA sequence variation at five loci to address questions about demographic processes. Data from four compartments of the genome are presented, including mtDNA, Y-chromosomal, X-chromosomal, and autosomal loci. Data for each locus were derived from the same eight local populations, consisting of at least forty individuals each from four African (Dogon, Khoisan, Bantu, and Cameroonians), two European (Italians and Dutch), and two Asian (Mongolians and Sri Lankans) populations.

Consistent with previous studies, levels of genetic diversity were highest in Africans for all loci examined. The average Tajima's D value for the autosomal and X-linked loci is slightly negative (-0.49) for African populations and slightly positive (+0.59) for non-African populations. This contrasts with the patterns of mtDNA and Y-chromosome variation, for which there is an increase of the proportion of rare polymorphisms outside of Africa. The combined biparentally-inherited DNA data are consistent with the hypothesis that Africans have maintained a larger effective population size, and non-Africans have experienced a phase of population size reduction. Patterns of variation in the haploid compartments of the genome may be more consistent with recent population expansion outside Africa. Population and/or sex-specific demographic processes may also contribute to contrasting patterns among compartments of the genome.

**Forty days and forty nights: Biocultural perspectives on the energetics**

**of the immediate postpartum period among subsistence horticulturists in the Brazilian Amazon.**

B.A. Piperata, D.L. Dufour. Anthropology Department, University of Colorado.

Lactation has been of interest to biological anthropologists because it is the most energetically demanding phase of the reproductive cycle, increasing the maternal energy budget by 25-30%. Many human populations recognize the immediate postpartum, the period during which lactation is established, as a special time. While distinct cultural practices during this period have been described for some societies, little data is available on the biological significance of these practices. This paper reports data on maternal energetics during the immediate postpartum period among tropical horticulturists in the Brazilian Amazon. These subsistence farmers depend on bitter manioc as their dietary staple and fish as their main protein source.

Data on maternal physical activity, dietary intake, and anthropometry were collected over an 18-month period as part of a longitudinal study of maternal energetics during lactation. Regionally, the immediate postpartum period is referred to as "*resguardo*." During *resguardo*, women spend considerably more time lying and sitting and others perform most of their normal house and horticultural work. The diversity of their diet is restricted because many foods are avoided, but based on a preliminary analysis, total energy intake appears to be adequate. In addition, they show little change in weight or body composition during the early stages of lactation. These results suggest that the period of *resguardo* serves to protect the nutritional status of women during a period of high energy demand, and underscore the important role cultural practices may play in helping women meet the energetic demands of reproduction.

**Evidence that female choice impacts the evolution of dimorphism in primates.**

J.M. Plavcan. Dept. of Anthropology, University of Arkansas.

Primate sexual dimorphism is widely viewed as a product of male reproductive skew resulting from male-male competition. It has long been recognized that female mating strategies affect male mating success. In principle, female mate choice can either re-enforce male reproductive skew where females actively prefer to mate with a dominant male, or temper it

if females actively mate promiscuously in spite of male monopolization attempts. Reports documenting female patterns of mating behavior have become common enough in the literature to allow a preliminary comparative test. However, the impact of such behavior on sexual dimorphism has not been systematically explored.

Data on canine tooth size, body mass, and skull size dimorphism are available for 90 primate species. Species are classified by whether females are reported clearly to prefer dominant males, exhibited some promiscuity while signaling ovulation (the "graded signal" hypothesis), show no clear preference for a particular male, or mate promiscuously. Data are analyzed using species values and the matched-pairs method of independent contrasts. All results show a strong, significant association between dimorphism and the behavioral classifications.

Primate mating strategies are a combination of male competition resulting from skewed operational sex ratios, as well as female counter-strategies to potential male coercion. The results of this analysis suggest that dimorphism is a function of this interplay between male and female mating strategies. This study strongly suggests that female mating tactics need to be incorporated into models of dimorphism and sexual selection. Supported by NSF SBR 9616671 and BNS 8814060.

**Mechanical regulation of tibiofemoral joint growth: A computational analysis.**

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Interpretations of joint form are commonly used in anthropological investigations to reconstruct behavior, yet the precise mechanical determinants of joint shape are incompletely understood. The chondral modeling theory proposes that joint surface growth is regulated by hydrostatic compressive stress in articular cartilage. Stress-regulated growth is hypothesized to adapt articular size, shape, and curvature to prevailing load magnitudes, frequencies, and orientations throughout postnatal development.

In this study, we use a computational approach that employs modern finite element-based structural optimization procedures to evaluate the chondral modeling theory. A 2-dimensional model of the medial tibiofemoral joint was generated



from an MRI of a healthy 12-year-old male. The articular surface was then “grown” through a numerical shape optimization procedure that maximizes hydrostatic pressure in articular cartilage, simulating stress-regulated growth under the chondral modeling theory. Load magnitudes and distributions were comparable to those experienced during normal gait. The model was validated through comparisons with MRIs of health adults.

The results of the analysis support the chondral modeling theory. The growth model accurately simulated medial tibio-femoral joint growth as regulated by gait-related stresses. Joint surface growth in the model is characterized by increased joint congruence, increased distribution of articular cartilage stresses, and enlarged articular contact. The chondral modeling theory may allow anthropologists to more accurately infer the magnitude and direction of habitual peak joint loadings in past humans.

**The Jack Sprat hypothesis: Diet competition in a female-dominant species.**

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Although males and females have different reproductive strategies, in mammals, the differential costs of reproduction have been documented primarily in sexually dimorphic species (e.g. red deer, baboons)—rarely in monomorphic species. The Milne-Edwards' sifaka (*Propithecus diadema edwardsi*) of Ranomafana National Park, Madagascar, is monomorphic but not monogamous; females are dominant to males. We test the hypothesis that males defer to females so that females can obtain a diet geared towards energy storage. This “Jack Sprat” hypothesis suggests that, unlike females, males can afford to be thin without sacrificing fertility.

We found that females ate seeds—a potentially high-fat resource—at a significantly faster rate than males, and the proportion of these seeds constituted a significantly greater proportion of female diet than male diet. The sexes did not differ in their consumption patterns for any other food type.

Female sifakas win virtually every aggressive interaction. Why do males lose all interactions? We suggest that males concede to benefit their personal reproductive success. If a male increases a female's access to nutrition by submitting to aggression, he may increase the number of fertile females available in the next

breeding season, thereby increasing his odds of mating with an estrous female in this polygynous species. After conception, male submission may increase the probability of gestation, and after birth, male submission may increase the probability that the female can successfully nurse the infant that could potentially be his.

**Size, shape, and integration in hominoid crania.**

J.M. Polanski. Department of Anthropology, University of Iowa.

Studies of cranial integration in primates have become more common in the literature in recent years. However, most studies have been based on raw data, and many fewer studies have looked at integration in both the African and Asian hominoid groups. This study examines integration in the cranium, comparing both size and shape distilled variables to discover what, if any, differences exist.

16 cranial measurements were taken on 131 specimens of extant members of *Homo*, *Pan*, *Gorilla*, *Pongo*, and *Hyllobates*. Using the techniques of Darroch and Mosimann (1985), shape was then distilled from size. Using conditional independence modeling, both the raw data and the shape transformed variables were tested for integration. In both cases, the African hominoids were less integrated overall than were their Asian counterparts.

As shape accounts for a larger percentage of the variation in the cranium (about 80%), it is of interest to see if a disparity exists between integration values for size and shape in the hominoid cranium. When the integration values of both size and shape are compared for each genus, size and shape values group closely with each other indicating that similar patterns of integration exist for both the raw and shape distilled data. The only exception to this is modern humans, whose integration values in size and shape differ more so than their ape counterparts, due to higher overall levels of integration in shape.

**Mesolithic and Neolithic subsistence in Belgium: Evidence from stable isotopes.**

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In the last 200 years, more than 200 Holocene sepulchral caves have been excavated in the Meuse Basin. Burials cover a timespan from Ancient Mesolithic to Late Neolithic, with a gap from Middle Mesolithic to Early Neolithic. Very little is currently known about the environment and subsistence during these periods. Carbon and nitrogen stable isotopic composition of bone collagen has been used as tracer of dietary proteins for 93 human and 22 faunal specimens. All of these presented a very good state of preservation: their nitrogen amount is higher than 0.6 %, indicating that they have retained at least 15 % of their original collagen. Isotopic ratios show that during Ancient Mesolithic times, the main dietary proteins must have been provided by terrestrial mammals, by hunting, with the possible addition of freshwater resources for some individuals. During the Middle Neolithic, the contribution of freshwater resources seems to have increased for a majority of the analyzed specimens, with the remaining proteins provided by terrestrial mammals (wild game or domestic mammals). The contribution of freshwater resources seems to have become negligible during the Late Neolithic period.

**The effect of leg length on human locomotor performance.**

H. Pontzer. Dept. of Anthropology, Harvard University.

Did the long legs of *Homo ergaster* improve locomotor performance compared to relatively short-legged *Australopithecus*? Despite proposals that longer legs increased running speed and efficiency in early *Homo*, physiological studies have shown no correlation between leg length and running performance, and only limited correlations for walking. This study developed and tested a new biomechanical model relating leg length to the metabolic cost of locomotion and speed in walking and running, further developing the “Force Production” model proposed by Kram and Taylor (*Nature* 346: 265-267) which found running was “priced by the step.” The model is the first to explicitly link leg length to the rate of muscular force production, and thus the rate of oxygen consumption, during locomotion. To test the model, 12 recreationally fit human subjects performed a series of walking and running trials on a treadmill while oxygen consumption and kinematics were measured. Observed oxygen consumption data fit predictions of the model as well or better than observed contact time, and significantly better than other anatomical predictors of cost including

body mass and Froude number. Results suggest that longer legs increase speed and decrease energy cost during walking and running, but that other factors such as excursion angle and knee compliance also affect cost, complicating this relationship. Preliminary application to the fossil record provides a quantitative assessment of locomotor performance in *H. ergaster* versus *A. afarensis*.

### **Mitochondrial DNA analysis of the prehistoric people of Eel Point Locust C San Clemente Island, California.**

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San Clemente Island is one of seven islands forming the Channel Islands off the coast of southern California. At the time of historical contact, the southern Channel Islands, and the adjacent mainland were occupied by the Gabrielino. To the north, inhabiting the northern Channel Islands and adjacent Santa Barbara Mainland, were the Chumash. The Gabrielino were linguistically, culturally, and possibly genetically distinct from their Chumash neighbors. Mitochondrial DNA analysis was completed on a late Middle Holocene cemetery population from San Clemente Island to test models of closest genetic affinities for the prehistoric people of San Clemente Island. DNA was extracted from nine individuals. PCR amplifications targeting loci containing polymorphisms defining the five Native American haplogroups for both restriction sites in the coding region and the D-loop were completed. Reproducible sequence data were collected for eight individuals. Seven burials were found to possess both restriction site and D-loop markers belonging to one of the five Native American haplogroups. However, the haplogroup could not be determined for one individual as they did not possess any of the defining characters for haplogroups A, B, C, D, or X. Haplogroup frequency distributions were as follows: Haplogroup A, 0.125; haplogroup B, 0.250; haplogroup C, 0.500; haplogroup D, 0.00; haplogroup X, 0.00. Comparison of these data with published haplogroup frequencies for extant Native Americans demonstrate that closest mitochondrial affinities may have been with extant California Uto-Aztecan speakers, however the presence of haplogroup A in this population supports a model of admixture with their Chumash neighbors.

### **The response of the Ngogo chimpanzee (*Pan troglodytes*) community to a period of ripe fruit scarcity.**

K. Potts. Dept. of Anthropology, Yale University.

Chimpanzees (*Pan troglodytes*) predominantly eat ripe fruits whenever they are available. During periods of fruit scarcity, chimpanzees rely on "fallback" foods, such as terrestrial herbaceous vegetation, unripe fruit, and pith, to maintain nutrient intake. I examined the feeding behavior of the Ngogo chimpanzee community in Kibale National Park, Uganda, during a period of ripe fruit scarcity between May and August 2003. The members of this community responded to the ripe fruit shortage primarily by 1) feeding upon unripe (but plentiful) fruits of trees large enough to support groups of chimpanzees for long periods of time without risk of depletion (e.g., *Pterygota milbraedii*); 2) exploiting fruits of *Ficus* spp. trees, which are relatively common in the Ngogo range and often contain at least unripe (and, sometimes, ripe) fruit even during periods of general fruit scarcity; and 3) eating leaves of several common tree species. The Ngogo chimpanzee community is the largest yet observed. Its size is particularly striking when compared to the Kanyawara community, which is located within the same contiguous forest as Ngogo but contains far fewer individuals. Microhabitat differences between the two sites may explain why Ngogo is able to support such a large community compared to Kanyawara. Such characteristics include the presence of certain "fallback" resources commonly utilized at Ngogo that are absent or extremely rare at Kanyawara (e.g., *P. milbraedii*).

### **The scarcity of African mid-Pleistocene hominin fossils.**

R. Potts. Human Origins Program, NMNH Smithsonian Institution.

The dearth of hominin fossils in African mid-Pleistocene sediments dated 1.0 to 0.5 million years old (Ma) contrasts with the abundance of Pliocene and early Pleistocene hominin specimens  $\geq 1.0$  Ma. In Pliocene sequences, such as Olduvai, East Turkana, and Omo, hominins are typically represented by several dozen specimens per million years, or 0.5% of large mammal fossil assemblages, analyzed by geologic member, submember, or stratum. By comparison, mid-Pleistocene hominins are found as isolated specimens from any given locality, and none has been reported from Africa with a definitive age

between about 1.0 Ma (Buia, Daka) and 0.6 Ma (Bodo).

The scarcity of mid-Pleistocene specimens is exemplified by Olorgesailie (1.0 to 0.5 Ma), southern Kenya rift valley, where no hominins had been found in 62 years of investigation since 1942, despite recovery of abundant *in situ* fossil mammals (N>3000, taxonomically identified to family) and stone artifacts (N>40,000). Absence of hominin specimens in richly-fossiliferous lowland settings (lake margin, fluvial, floodplain, and paleosol) and extensive use of highland rock outcrops suggest that mid-Pleistocene hominins moved largely to upland settings and tended to die in these non-burial terrains, in contrast with lowland natural-burial contexts of hominins in older sedimentary basins. Acheulean handaxes are concentrated in sediments near lava ridges that connect the highlands and lowlands, which further indicates that these contact zones were frequented by mid-Pleistocene hominins. New material discovered at Olorgesailie in 2003 confirms the importance of highland-lowland sedimentary contacts as foci of hominin activity and fossil discovery.

### **Physique and climatic adaptations of Paleoindians.**

J. Powell, O. Pearson, J. Smart. Department of Anthropology, University of New Mexico, Albuquerque.

Paleoindian crania differ morphologically from most or all living Native American populations either due to microevolution or population replacement. Paleoindian postcranial remains have not been studied as intensively. Postcrania can provide important indications of adaptation to climate. Paleoindian postcrania can help to calibrate the pace of climatic adaptation in the Americas.

We compared a sample n=7 of Paleoindian skeletons to 18 populations from around the world. We expected the Paleoindians to have proportions typical of contemporary cold-adapted peoples, given their emergence from the "cold filter" of Beringia. Long bone lengths and articular breadths were obtained on original specimens by Powell. Comparative data were collected by Pearson or taken from the literature. Data were assessed separately by sex.

On average, Paleoindians have less markedly stocky, cold-adapted physiques than many later populations, especially those from cold habitats such as Alaskan Inuit, South Dakota Arikara, and people from Tierra del Fuego. The Indian Knoll Archaic population tends to have propor-

tionately smaller humeral and femoral heads relative to bone lengths than Paleoindians, while Paleoindians resemble the prehistoric Schild population in these ratios. Our results indicate that the First Americans were neither very cold adapted nor heat-adapted; they possessed a physique that falls near the average of worldwide samples.

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#### **Genotype/phenotype analysis of lactase persistence in Tanzanian populations.**

K. Powell, S.A. Tishkoff. Department of Biology, University of Maryland, College Park.

Lactase is an intestinal enzyme responsible for digestion of lactose, the sugar found in milk. Lactase persistence (LCTP) is the genetically determined ability to digest fresh milk in adulthood. The ancestral state for this trait among humans and other mammals is lactase non-persistence. Human LCTP may have developed as an adaptation to an ancestral lifestyle centered around cattle herding (pastoralism). Lactase persistence and non-persistence phenotypes can be distinguished using the lactose tolerance test (LTT) in which blood glucose rise is measured after consumption of lactose. Recent studies have identified two Single Nucleotide Polymorphisms (SNPs) located ~14,000 (C/T) and ~22,000 bp (G/A) upstream from the gene encoding the lactase enzyme (LCT) that are strongly associated with LCTP in the Finnish population. We have measured lactase activity in over 10 ethnically diverse Tanzanian populations (including Pare, Gorowa, Iraqw, Mbugu, Mbugwe, Maasai, Akie, Hadza, Sandawe, and Dorobo) practicing pastoralist, agriculturalist, and hunter/gatherer lifestyles. We find that the frequency of lactase persistence in populations does not always correspond with subsistence methods, likely due to recent admixture between populations. We have genotyped these individuals for the C/T and G/A SNPs upstream of the LCT gene. Our findings suggest that these alleles are not associated with lactase persistence in African populations. We are currently using haplotype analysis to elucidate the evolutionary history of lactase persistence in Africans and the genetic basis of adaptation. Funded by BWF and Packard Career awards, Leakey Fund, Wenner Gren, and NSF grant BCS-0196183 (ST) and NSF IGERT training grant BCS-9987590 (KP).

#### **Evolutionary modifications of primate visual cortex.**

T.M. Preuss. Yerkes National Primate Research Center, Emory University.

The origins of primates, of haplorhines, and of anthropoids were each accompanied by major modifications of the central visual system. Comparative studies indicate that the origin of primates was marked by a proliferation of new visual areas, organized into functionally segregated dorsal (vision for action) and ventral (object vision) processing streams. The major inputs to these streams originate in the primary visual area (V1). In primates, area V1 acquired a powerful influence over higher-order visual areas by means of dual cortico-cortical and cortico-pulvinocortical feedforward projections, and by the restriction of major geniculocortical projections to V1. The net result is that cortical visual processing in primates is more hierarchically organized and V1-dependent than in other mammalian groups. The origin of haplorhines was marked by elaboration of V1 lamination, which may reflect expansion of the parvocellular retinogeniculate system. The origin of anthropoids was accompanied by addition of cortical areas in the superior temporal sulcus (STS), areas that integrate information from the dorsal and ventral streams related to biological motion.

Different anthropoid taxa exhibit characteristic specializations of the cortical visual system. Hominoids, for example, exhibit histochemical changes suggesting reorganization (or perhaps loss) of the parvocellular geniculate projection to layer 4A of area V1. Human layer 4A displays a unique part of compartmental organization, the functional significance of which is at present unclear, although one of the tissue compartments may be related to the magnocellular pathway. Humans evidently also possess modifications of the dorsal-stream visual areas, which may contribute to human tool-using capabilities.

#### **Developmentally mediated intra-individual variation in inorganic stable isotopes.**

E.A. Quinn, J.D. Kingston, G.J. Armelagos. Dept. of Anthropology, Emory University.

Stable isotope analysis is an established technique in dietary reconstruction. Through the use of isotopic ratios in bone, teeth, and organic tissues, complex food webs and population dietary breadth can

be established. However, while dietary reconstructions are based largely on bulk samples from individuals, recent research has begun to explore and characterize individual dietary breadth, dietary shifts and associated physiology.

This project focuses on intra-individual variation. Thirty-five samples were collected from a complete infant burial from the Roman period of Hesbon. Sampling strategy was based on known fetal development trajectories and timing. Both endochondral and intramembranous forming bones were sampled, as well as primary and secondary centers of ossification and pairs of bones to access lateral symmetry. Samples came primarily from limbs, ribs, cranial bones, vertebra and clavicles. The objective was to collect time-sensitive samples relative to fetal development. The infant provides an additional means of control in this research, as bone remodeling is minimal *in utero*, and only begins to accelerate in the first few months of life.

Additional samples were collected from four other individuals. Two additional infants were sampled, as well as a juvenile and adult. Groups of five to seven samples were taken from each individual. These samples provided both controls and base lines for the individual variation, and illustrated some of the variation present between individuals. Variation found suggests that further research into intra-individual variation is merited. These sorts of analyses are necessary as isotope studies move beyond bulk sampling to address high resolution dietary reconstruction.

#### **Life history variables and nucleotide substitution rate variation in the catarrhine primates.**

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Recent research finds nucleotide substitution rate variation both between loci in the same species and between species at the same locus to be characteristic of molecular evolution. It is also well established that rate variation, if not analytically predicted and controlled, may significantly impact the accuracy of phylogeny reconstruction and divergence date estimates. Hypotheses proposed to account for rate variation implicate differences in life history, biological, and eco-

logical variables. Goodman first noted a rate difference between the hominoid and cercopithecoid primates and termed it the "hominoid slowdown." This hominoid slowdown hypothesis has been contentious, but recent publications and our results here clearly indicate a consistent rate difference between the slower hominoids and the faster cercopithecoids. Goodman suggested a link between generation time and the observed rate differences. There is a correlation, but confounding factors have also been implicated: body size, metabolic rate, long-term effective population size, and intrinsic differences in DNA replication and repair enzymes.

We examined DNA sequences from complete mitochondrial genomes, sex, and autosomal markers in a broad sample of catarrhine primates. Using phylogenetically independent contrasts and likelihood based methods, we find no statistically significant effect resulting from differences in metabolic rate among species. Long term effective population size, body weight, and generation time are tightly inter-twined variables, but to the extent that it is possible to disentangle them, generation time appears to show the greatest effect on the rate of nucleotide substitution.

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#### **Papio brain and sulcal growth: A comparison with Macaca.**

M.L. Raguette-Schofield, S.R. Leigh. Anthropology Department, University of Illinois.

This study examines cortical sulcal growth in baboons (*Papio spp.*) and macaques (*M. mulatta*) to ascertain whether or not the two species exhibit similar patterns of brain ontogeny. Allometry, or shape change in response to size change, is used ontogenetically by comparing reduced major axis (RMA) slopes of sulcal length regressed against cranial capacity for individuals at various developmental stages of the two taxa. This analysis tests the hypothesis that ontogenetic scaling characterizes brain size and shape differences in these species.

Using a MicroScribe 3D digitizer, four sulci (lateralis, temporalis superior, centralis, and parieto-occipitalis) were measured on each hemisphere of 30 baboon brains collected from the Southwest Foundation for Biomedical Research in San Antonio, Texas. Comparable data for macaque sulci were provided by J. Cheverud. RMA analysis of the baboon

sulci demonstrates minimal allometry in lateralis right, centralis left/right, and parieto-occipitalis left. Baboon sulci exhibited isometry in lateralis left, temporalis superior left/right, and parieto-occipitalis right. All macaque sulci analyzed (lateralis left/right, centralis left/right) scale with strong positive allometry. The lack of shared slopes indicates that the two species follow different allometric pathways during ontogeny.

These results suggest fundamental differences between *Papio* and *Macaca* brain sulcus ontogeny. If macaques represent the ancestral condition, then baboons have diverged from this pattern of strong shape change. Instead, baboon sulci change little with size and age. This divergence may reflect the consequences of selection early in postnatal life.

#### **The effects of limb mass distribution on primate quadrupedalism.**

D.A. Raichlen. Department of Anthropology, University of Texas at Austin.

Primates have more distally distributed limb mass than many other mammalian quadrupeds because of their adaptations for grasping hands and feet. Although researchers have noted primates' unique limb shape, the effects of this limb mass distribution pattern on quadrupedal mechanics have yet to be examined. Some researchers have predicted that distally distributed limb mass produces relatively low stride frequencies. Others have predicted that distally distributed limb mass leads to increased energetic costs of quadrupedal locomotion because distal mass requires more work to move the limbs during locomotion.

This study uses an ontogenetic sample of infant baboons (*Papio cynocephalus*) to test these predictions. Infants have mass distributed more distally than adults because infant primates must grasp their mothers' fur during their early development. Infants' limb mass migrates proximally as their need to grasp their mothers' fur decreases with age. To examine the effects of limb mass distribution on the mechanics of quadrupedalism, limb inertial properties, quadrupedal kinematics, and mechanical internal work were measured over an eight-month period in a sample of infant *Papio*.

As the infants grow, and their limb mass migrates proximally, their relative stride frequencies increase. The prediction that limb mass distribution affects stride frequency is therefore supported. Surprisingly, the work needed to move the limbs is not higher when the infants have relatively distal limb mass. These results

indicate that the relatively lower stride frequencies used by young infants may mitigate the negative energetic effects of their relatively distal limb mass by reducing limb velocity.

#### **The peopling of Americas. The 'Out of Beringia' model tested from cranio-functional morphology.**

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Following the Out of Beringia model of the settlement of Americas, modern Amerindians derive from a mongoloid migration in the Early Holocene. Therefore, since Amerindian populations have a recent and common origin it is expected 1.- that morphological variability among them would be lower than the variability among extra-American populations and 2.- that Amerindians present greater affinities with north-eastern Asian groups than with any other populations.

A method based on the functional cranial theory was used to analyse 791 skulls of 19 Amerindian and 18 extra-Amerindian populations. Canonical analysis and Fst were obtained for Amerindian, extra-Amerindian and total populations. Cluster trees were built from canonical scores.

Results demonstrate that variability among Amerindian population is similar to the variability among extra-Amerindian populations, even if the geographical distribution of the latter are impressive larger than the former. Furthermore, cluster tree for all populations altogether shows Amerindian populations are spread on it and do not present a particular link with northeast Asian populations.

The high variability among Amerindian populations could be due 1) to a gene flow between Amerindians and paleoamerican groups, or 2) to multiple migrations to America from different geographic areas, or 3) to microevolutionary processes which have required a longer period to occur. In any case, results do not support the Out of Beringia model.

#### **Patterns of genetic diversity and linkage disequilibrium at interleukin-4 (IL-4) and interleukin-13 (IL-13) in human populations.**

A. Ranciaro, E. Tarazona-Santos, S.A. Tishkoff. Department of Biology, University of Maryland, College Park.

IL-4 and IL-13 are important cytokines mapped to 5q31 and involved in the Th2 immune response against parasites such as *Plasmodium falciparum* and helminthes. Because parasite infection has likely resulted in selective pressure during human evolutionary history, IL-4 and IL-13 are candidate genes to be targets of natural selection. They also play a role in susceptibility to common complex diseases of the immune system such as asthma and allergies. We have examined nucleotide variation at 5 kb of IL-4 and 3.9 kb of IL-13 in 150 individuals from West Africa, East Africa, Asia, Europe and South America. Considering that the distance between IL-4 and IL-13 loci is only ~12kb, we also assessed the extent of linkage disequilibrium between both loci. We observed different patterns of nucleotide diversity, haplotype structure and linkage disequilibrium in African and non-African populations, which are in part consistent with the different demographic histories of these populations. However, we have also detected evidence that natural selection has shaped the pattern of genetic variation at IL-4 and IL-13. We discuss the implications of our analysis in regard to the genetic basis of resistance to infectious disease and the effect of parasitic infection on human evolutionary history and the co-evolution of human and parasite genomes. Funded by BWF and Packard Career awards, Leakey Fund, Wenner Gren, and NSF grant BCS-0196183 to ST.

#### **Image-based weighted measures of skeletal stiffness: case studies of great ape mandibles.**

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Traditional measures of structural stiffness in the primate skeleton do not consider heterogeneous material stiffness distribution. Given the fact of bone heterogeneity, errors associated with these measures are likely but remain largely undocumented. For example, bending resistance in the mandible has been assumed to be proportional to a moment of inertia unweighted for material variation ( $I_0$ ), which is implicitly scaled by a single material stiffness (e.g., modulus  $E$ ) to represent stiffness for a particular load (e.g.,  $EL_0$ ). Measures of weighted stiffness can be developed by including heterogeneous grayscale variations evident in computed tomographic (CT) images. Since grayscale correlates with material stiff-

ness, the distribution of bone quality and quantity is simultaneously considered.

We use customized software to calculate weighted and unweighted measures of bending resistance at three locations along the mandibular corpus from Great Ape CT images. For the cortical and cancellous bone in each section, the product of each pixel area and squared distances from reference axes are multiplied by the pixel grayscale. Products are summed to determine weighted moments about the reference axes; the weighted centroid location completes the determination of the principal weighted moments  $I_w$  and their principal axes.

Our  $I_w$  and unweighted  $I_u$  values differ by about 5% to 10%. Differences between orientations of weighted and unweighted principal axes are typically small, on the order of 1° to 2°. The use of  $I_w$  for interspecific comparisons permits more robust tests of the functional linkage between mandibular morphology and the biomechanical demands of distinctive diets and feeding behaviors.

#### **A preliminary study of the demography and ecology of Mouse Lemurs (*Microcebus griseorufus* and *Microcebus murinus*) in the Beza Mahafaly Special Reserve, southwest Madagascar.**

E. Rasoazanabary. University of Massachusetts at Amherst.

Closely related sympatric species provide a natural setting from which to investigate niche overlap at study sites. Ecological, social, and demographic data collected on each species provide insights into the potential for interspecific competition. I present preliminary data on two species of mouse lemur (*Microcebus murinus* and *M. griseorufus*) in three phenologically distinct forests at Beza Mahafaly Special Reserve.

Between April and August 2003, I conducted censuses, captures, and radio tracking observations on each species across three forest types: dry, gallery, and spiny. Live-traps were placed at even intervals using grid coordinates within each forest type. Gallery and dry forests had high numbers of *M. griseorufus* and no *M. murinus*. Spiny forests were dominated by *M. griseorufus* but also contained *M. murinus*. Across the three habitats, sex ratios ranged from approximately equal in the dry forest to a heavy male-bias in the spiny forest; the gallery forest also showed a slight male-bias in sex ratio. Capture data also revealed a bias in habitat use and ranging patterns of all species within the delineated trap-grid.

Taken together, these data provide information on species-specific preferences in habitat types, as well as demography and microhabitat structure. They have implications for conservation because females are the rate-limiting entity in population growth. Comparisons with other study sites in Madagascar can provide baseline data for the potential causes of differing population densities within *Microcebus* habitats.

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#### **MicroCT analysis of the ontogeny of mandibular biomineralization in *Archaeolemur*.**

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Previous analyses of symphyseal fusion in *Archaeolemur* identified several functional characteristics of joint morphology that vary postnatally (Ravosa & Simons, 1994, *AJPA* 95:63-76). To complement this study, we employ a novel imaging technique (microCT) that provides data on individual and ontogenetic variation in the biomineralization of the mandibular symphysis in this extinct Malagasy primate.

Our sample consisted of the same juveniles with unfused symphyses examined by Ravosa & Simons (1994). Each was imaged (~18 $\mu$ m volume elements) with slices parallel to the frontal plane, i.e., orthogonal to the symphyseal articular surface. At each of the five sites ranging from the labial to the lingual aspect of the joint, 40 contiguous slices (18- $\mu$ m intervals) were collected.

Preliminary investigation of *Archaeolemur* indicates that, within individuals, cortical bone adjacent to the symphyseal rugosities tends to be characterized by greater biomineralization (especially more inferior sites). Postnatally, progressively larger regions of the joint tend to exhibit elevated bone density (corresponding to increases in overall joint size and the number of symphyseal rugosities). Thus, ontogenetic patterns of symphyseal biomineralization, form and fusion are consistent with the presence of significant dorsoventral shear stress during unilateral mastication. Higher bone density

along the posteroinferior aspect of the joint also suggests the presence of low-to-moderate levels of 'wishboning' during mastication. Lastly, bone density patterns are consistent with the presence of vertical bending during incision. Our research highlights important benefits of microCT to a more complete understanding of skeletal form and function in living and fossil taxa.

**Stress, life history, and dental development in the vervet (*Chlorocebus aethiops*) and baboon (*Papio hamadryas*) from dental histology.**

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Stressful events are recorded in the developing dentition as a pattern of accentuated lines that appears within the normal growth increments visible in transmitted polarized light. We previously examined the dentitions of female baboons from the Awash National Park hybrid zone and suggested that stresses occurred at life history transitions, including the acquisition of independence from the mother, and the onset of reproductive activity. To test this hypothesis, we examined the pattern of accentuated increments in the dentitions of a female vervet monkey from Uganda and a male anubis-like baboon from the Awash hybrid zone, collected at the same time as the females in our previous study. Growth increments visible in standard histological thin sections were used to reconstruct dental development and calibrate the timing of accentuated increments.

The female vervet exhibited stresses at 3mos, from 5 to 11mos, and from 1.6 to 1.9yrs. The early stresses are consistent with the timing of acquisition of independence in this taxon. An interesting finding was an extremely significant stress at 16-20 days. Without knowledge of the animal's history, all interpretations are speculative, but it is interesting that allomothering is common in this species. None of our baboon specimens show significant stress at such an early age. Like the female baboons, the Awash male shows intermittent stress in a random pattern. The longest period of frequent stress, however, occurs from 7.3-7.9yrs, at an age when males may be dispersing.

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**Comparison of "sex blind" dimorphism indices with application to the *A. afarensis* fossil assemblage.**

P.L. Reno<sup>1</sup>, R.S. Meindl<sup>1</sup>, M.A. McCollum<sup>1,2</sup>, C.O. Lovejoy<sup>1</sup>. <sup>1</sup> Matthew Ferrini Institute of Human Evolutionary Research, Department of Anthropology and Division of Biomedical Sciences, Kent State University, <sup>2</sup>Division of Basic Medical Science, School of Medicine, Mercer College.

Skeletal dimorphism is a key correlate of social structure and reproductive behavior in mammals, and is potentially detectable in fossil analyses. However, when sex is assigned to individual fossils *a priori* (based on size), dimorphism is virtually always overestimated, except in those rare species in which male and female distributions do not overlap. Several "sex-blind" dimorphism indices can potentially reduce this bias. While their performance has been evaluated using both computer modeling and direct sampling of real primates, their behavior has not been thoroughly studied in data generated by replicate random sampling (bootstrapping), a method commonly used to estimate hominid skeletal dimorphism.

Here we compare six dimorphism indices (Mean Method, Median Method, Method of Moments, Binomial Dimorphism Index, Coefficient of Variation, and Maximum/Minimum Ratio) calculated from random samples of humans, chimpanzees, and gorillas that exactly replicate the A.L. 333 and Middle Awash fossil assemblages of *A. afarensis* (Reno et al., 2003, PNAS 100:9404). In each simulation (1000 iterations) two samples were generated: 1) estimated femoral head diameter based on skeletal ratios using a template specimen; 2) actual femoral head diameters taken directly from the sampled (known sex) populations. All indices properly rank ordered dimorphism of the three taxa. However, the methods of moments and maximum/minimum ratio performed poorly as judged by correlations with true dimorphism, and the variance of simulated distributions. All methods were equivalent in demonstrating that the skeletal dimorphism of *A. afarensis* was most similar to modern humans.

**Architectural and biomechanical alterations in medieval humeri: Is there a pre-adaptive relationship to humeral form?**

J.A. Rhodes, C.J. Knüsel. Biological Anthropology Research Centre, University of Bradford.

Cross-sectional properties are investigated in two different samples of later medieval period blade-injured males and a control group of non blade-injured males through CT images of the humeral shaft at 20%, 35%, 50%, 65% and 80% of maximum length to investigate population differences in levels and directions of mechanical loading. Bilateral asymmetry is investigated and comparisons are made with different populations of varying activity levels. Humeral torsion and other measures of diaphyseal shape are investigated to determine the relationship of architectural changes and biomechanical efficiency.

Results indicate disparity between cross-sectional measures of diaphyseal robusticity when compared with external measures of humeral robusticity. Significant differences exist between blade-injured samples in PCA at the distal 20% slice and the proximal 65% and 80% slice parameters and in Ix/Iy at the 50% and 65% slices. There are no significant side differences in any of the variables examined. The population with the highest resistance to torsional forces (J) across the humerus is not that with the greatest amount of cortical bone. Resistance to torsional forces in the Towton population is met by means other than increased cortical bone. This indicates a two-phase alteration to humeral form to accommodate strenuous activity with greater biomechanical efficiency. A pattern of fluctuating asymmetry within the humerus is highlighted, dominant within the blade-injured samples, where the pattern of greatest CA shifts from proximal dominance in the ipsilateral humerus to dominance in the contralateral distal humerus. The variations between samples likely relates to differences in habitual movement patterns and possibly to distinctive weapon use.

**Acculturation and bone density: Is there a link?**

J.L.Z. Rice. The Ohio State University.

Despite the continued presence of Mexican Americans in the United States, research and intervention regarding health issues including disease prevalence and prevention are lacking and not proportionate to the population. This presentation reports on a research project investigating bone densities of the hip and spine of premenopausal Mexican American women. Dual Energy X-Ray Absorptiome-

try or DEXA was used to assess bone density. One hundred and six women in and around San Antonio, Texas were recruited for the study.

This research focuses on the influence of acculturation on bone density in this subgroup. As immigrant groups come in contact with the new culture of their host country, acculturation processes take place. These changes occur on a continuum from very little change seen in some immigrants while maintaining close cultural ties with their home country to total immersion in the culture of the host country by others. Acculturation encompasses both attitudinal and behavioral changes as individuals undergo new contact with the host group. While most immigrants maintain some level of ethnic identity, changes in language, foods, music preference, customs, beliefs and values occur.

After both generation and acculturation levels were determined, analyses were conducted between these cultural variables and bone density measurements within the sample. Results indicate that increased generation and acculturation levels are positively correlated with higher bone densities of both the hip and spine regions.

#### **Trabecular bone structure in human and chimpanzee knee joints.**

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Researchers continue to disagree over two major aspects of early hominin locomotion, namely whether bipedal gait was modern humanlike or more apelike (bent-hip, bent-knee), and whether or not arboreality remained an important component of early hominin positional behavior. Resolution of these disagreements will likely require new sources of data, such as bone structures known to respond to variations in mechanical use during growth. This study examines the degree to which differences in trabecular bone structure in chimpanzee and human joints reflect function, particularly the degree of knee flexion.

The femoral medial condyles of *Homo sapiens* and *Pan troglodytes* were scanned at 0.05mm slice intervals using a Stratec XCT Research micro CT scanner. Separate spherical volumes of interest (VOI) were selected along an anteroposterior

axis through the medial condyles. The bone volume fraction (BV, bone/total volume) and degree of anisotropy (DA), among other properties, were calculated using the software Quant3D.

In all regions examined, the human medial condyle has a greater amount of bone per unit volume (BV mean, human=0.341, chimpanzee=0.253). Relative to the chimpanzee, human trabecular patterns are also more strongly oriented perpendicular to the articular surface, with few mediolaterally oriented trabeculae. VOIs in the human mid-anterior condyle appear more anisotropic than in posterior regions. These differences in trabecular volume and structure can be related to greater habitual stress in the biped, and to differences in joint postures. Analyses of trabecular structure show promise for reconstructing positional behavior of fossil taxa.

Supported by the George Washington University.

#### **Affinities of the Middle Pleistocene crania from Dali and Jinniushan, China.**

G.P. Rightmire. Dept. of Anthropology, Binghamton University (SUNY).

Human occupation in China is documented at numerous Middle Pleistocene localities. *Homo erectus* occurs at sites such as Zhoukoudian, Hexian and Hulu Cave (Nanjing), and the species persisted in this region until perhaps 300,000 years ago. Other fossils have most frequently been termed "archaic" *Homo sapiens*. Although often incomplete, these crania have been interpreted as intermediate in their morphology and demonstrative of a phyletic link between the earlier Zhoukoudian populations and recent humans. The Dali and Jinniushan discoveries provide critical evidence in this regard. Both specimens resemble *Homo erectus* in some features but are clearly derived in characters of the nasal region, hard palate, temporal squama, occiput and cranial base. Encephalization is increased even in comparison to late *erectus*. However, the assignment of Dali and Jinniushan to any local (East Asian) evolutionary lineage must be questioned. The crania differ from those at Zhoukoudian or Hexian in many of the same traits that distinguish European and African Middle Pleistocene hominins from *Homo erectus*. Individuals from Arago, Sima de los Huesos, Petralona and perhaps also Bodo, Broken Hill and Elandsfontein may now be regarded as representative of *Homo heidelbergensis*. When Dali and Jinniushan are compared to these assemblages, there are

numerous similarities. Although there is variation from one paleodeme to another, it is reasonable to view the Chinese hominins as an eastern branch of *Homo heidelbergensis*. Such an hypothesis implies that Dali and Jinniushan document a dispersal of populations from western Eurasia rather than gradual change in the Far East.

#### **Forelimb morphology of bovids found in swamps and edaphic grasslands: Reconstructing habitat preference.**

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Several studies have shown the utility of bovid postcrania in examining habitats of African Pliocene hominin sites (Bishop and Plummer, 1994; Kappelman et al, 1997; Robb, 2003). However, several of these studies have had difficulty classifying extant bovid species that live in intermediate habitats. Given recent hypotheses concerning the habitat preference of robust australopithecines, this study proposed to examine the forelimb morphology of bovids preferring swamps and edaphic grasslands. These habitats have been classified in previous bovid postcranial studies variably as intermediate (Bishop and Plummer, 1994) or closed (Kappelman, 1991). Given the locomotor specializations required of ungulates living in these habitats, forelimb morphology should indicate whether these species group more closely with open, intermediate, or closed habitat species, or possibly in a habitat category of their own.

Twelve species of extant bovids were examined in this study, three in each habitat category: open, intermediate, closed, and edaphic/swamps. Species included in the latter category include *Tragelaphus spekei*, *K. leche*, and *R. redunca*. Twenty measurements of the distal humerus and proximal radius were analyzed using Principle Components Analysis and Discriminant Function Analysis. Results indicate that while several morphological characters of the forelimb are unique to species living in edaphic and swampy areas, the majority of the morphological characters examined indicate that these species group more closely with species preferring closed habitats. Therefore, reconstructions of hominin sites that indicate closed habitats should be further examined to differentiate between closed woodland and edaphic environments.

**Attrition in the dentition of a population of Peruvian tamarins (*Saguinus mystax mystax*).**

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Studies of dental attrition in non-human primates are rare. Using dental casts of a wild breeding, mixed age population of *Saguinus mystax* from Padre Isla, Peru, this study examines the possibility that attrition and spacing of teeth can be used to estimate age-at-dental-impression. New scoring methods are presented for the examination of dental wear in non-human primates.

Casts of upper and lower right dentitions were made of 101 *Saguinus mystax* individuals that were wild-tranquilized as part of 1990 and 1993 fieldwork in Padre Isla, Peru. Since each tooth type is presumed to serve a different function in food procurement and processing, different attrition scoring systems were developed for each tooth category (incisor, canine, premolar, and molar). Each tooth was assigned an attrition score. These scores were averaged for an individual's single attrition value (AV). Individual AV's were seriated and correlated to field estimates of the ages of the tamarins.

With age, moustached tamarins show extreme overall wear. In addition, three key dental features are distinctive to older Padre Isla moustached tamarins: 1) development of spaces between I1 and I2; 2) unusual dual wear pattern on incisors; and 3) extremely worn molar entoconids, paracones, and protocones. Diet is significant in determining patterns of dental variation and wear; the anterior tooth changes may relate to a specialization for harvesting woody legumes. As Cuozzo (2003) suggested, documentation of morphological variation due to food procurement within a breeding population has implications for assessing dental variability and species diversity in the fossil record.

**Analysis of cranio-mandibular shape differences between *Pan paniscus* and *Pan troglodytes* using geometric morphometrics.**

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Genetic, morphological and behavioral studies have supported the separation of *Pan paniscus* and *P. troglodytes* into dif-

ferent species. It is often suggested that morphological features distinguishing these species are size-related, although quantitative studies of cranio-mandibular variation in *Pan* have only analyzed a limited number of linear measurements, particularly in the mandible. This study is the first to explore three-dimensional shape differences both in the cranium (n=89) and mandible (n=99) using geometric morphometrics. This analysis provides a means of quantifying shape differences, and therefore differences in character states, of variable traits which are difficult to obtain using caliper measurements. 21 cranial and 23 mandibular landmarks were collected using a Microscribe 3DX portable digitizer. Specimen configurations were superimposed using GPA in TPSSMALL. The projections of the fitted coordinates to tangent space were statistically analyzed (PCA, CVA). Shape differences along PC axes were explored using GRF-ND. Results indicate significant differences between the cranio-mandibular morphology of *Pan paniscus* and *P. troglodytes*. Cranial shape differences separating bonobos from chimpanzees include their less prognathic, less dorsally rotated palate, their higher, more filled out and less postorbitally constricted vault and their more flexed basicranium. Mandibular shape distinctions include a shallow mandibular corpus and symphysis, a more vertically oriented symphyseal axis and a shorter postincisive planum in *Pan paniscus*. A regression analysis of the principal components scores against centroid size suggests that many of these differences are size-related.

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**An informative 9.1-kb in/del polymorphism on chromosome 22 across Island Melanesian populations.**

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We report the genotypes and allele frequencies of a 9.1-kb in/del polymorphism in 19 separate language groups, speaking either Austronesian or Papuan languages, living in the Bismarck Archipelago, Bougainville, and New Guinea. We find the highest values for the 9.1-kb allele, approaching fixation, in Papuan-speakers,

such as Ata and Baining (Kagat dialect), as well as in some neighboring AN-speakers, such as Mamusi, Mengen, and Nakanai (Loso dialect), in the interior of New Britain. A similar pattern was observed in Papua New Guinea: the samples from Trans New Guinea Phylum areas, who live in the interior, were all homozygous for the deletion, a result similar to the one observed with the Nasioi sampling from Bougainville. Instead, the coastal Sepik population, which speaks languages belonging to a different Papuan family (Sepik-Ramu), was found to be polymorphic. Moreover, we found the lowest values for the 9.1-kb allele among shore-dwelling AN-speakers throughout the region, particularly in the Notsi of New Ireland and in the Nakanai (Bileki dialect) of New Britain. In conclusion, we describe a repeating pattern of genetic diversity in different islands of significant size, like Bougainville, New Britain and New Guinea. Papuan-speaking and AN-speaking populations in more remote regions of the islands tend to share an allelic profile which is distinct from the one shared by shore populations, whether Austronesian or Papuan-speaking. This pattern is consistent with findings in mtDNA variation across the same populations. The signature of apparently ancient genetic distinctions has been blurred, but not lost in these instances.

**Biomechanical model of the index finger during simulated hardhammer percussion.**

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This study presents a biomechanical model of the index finger that relates the orientation and magnitude of forces along its proximo-distal axis with moments generated at the metacarpophalangeal and carpometacarpal joints. Although there are good data on grips and hand muscle contractions during object manipulation, there is currently little knowledge of the dynamics of stone tool manufacture with respect to the forces acting on individual segments of the hand and the moments generated about its joints. To test the proposed model, subjects wearing a glove fitted with force sensors were asked to strike a force plate with a hammerstone. Force data were collected from the second metacarpal, metacarpophalangeal joint, proximal, middle and distal phalanges, as well as the proximal and distal phalanges of the thumb. Reaction forces were calculated from the force plate. The hammerstone was held in a three-jaw chuck grip, with the index placed superiorly, and



the thumb and third finger in mediolateral opposition.

Results indicate that the index distal phalanx is subjected to significantly higher forces at impact than its middle or proximal phalanges. Moreover, forces recorded from the thumb's distal phalanx were significantly higher than those on the index phalanges. The data suggest that the thumb and third finger assist in reducing the vertical forces on the index through opposition. These results are in accord with hand muscle activity studies (Marzke et al 1998), highlighting the importance of the long digital flexors in maintaining the stability of the metacarpophalangeal joints during stone tool manufacture.

### **The spread of HIV/AIDS in Latin America: The impact of globalization and tourism.**

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At present, Latin America and the Caribbean have an overall HIV prevalence rate of 71 per 1,000, second only to Sub-Saharan Africa. Population movement, whether due to labor migration, forced displacement in war-torn countries, or tourism, is a major contributing factor to the spread of the epidemic in the region. This paper provides a general overview of the ways in which socio-cultural factors related to population movements in areas undergoing rapid change associated with participation in the global economy may contribute to the spread of HIV/AIDS. This impact is especially important among populations that present high rates of sexually transmitted infections, tuberculosis, and other underlying problems such as malnutrition.

As an illustration, this paper presents preliminary results from an on-going study of community perceptions on the relationship between tourism and HIV risk in Monteverde, Costa Rica. Dependence on tourism may increase prostitution, which provides a source of income for locals in places where other economic alternatives may be limited. Increases in casual non-commercial sex between locals and tourists and in the use of recreational drugs which may, in turn, heighten the risk for HIV are also common in tourist areas. Thus, while the constant influx of tourists proves highly beneficial to the economy of the region, it also has the potential to negatively affect the health of the population. The design and implementation of community-based preventive programs is crucial at this point in time in

order to avert a major AIDS epidemic in the region and the country at large.

### **Neanderthals from El Sidrón cave (Asturias, Spain). Presentation of a new sample.**

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Neanderthal evolutionary history is being clarified in the last few years, and seems to be much longer than previously considered. In this regards, fossil evidence coming from the Iberian Peninsula is essential. However, the fossil record from the early Late Pleistocene is still too scarce. We present here new findings of a large sample of Neanderthal remains found at the Sidrón Cave. A first set of 120 remains was first discovered by amateur speleologists. In a preliminary study, two lower jaws were compared and unambiguously assigned to *Homo neanderthalensis*. Later on, three qualified field seasons have been carried out at the site recovering over 800 new specimens, which include two frontal bones (adult and immature) as well as several fragments of parietal and temporal bones, 3 mandibular fragments, ~70 isolated teeth, several pieces of long bones, ~100 hand and foot bones, vertebrae, etc.

Taphonomical analysis will eventually clarify the origin of the accumulation, though sedimentology analyses indicate a short displacement of the bones from a near primary emplacement. In the light of the sample recovered at excavation, there seem to be biases towards small size elements (teeth, phalanges, vertebra, fragmented bones), which co-occur with elements in anatomical connections (a partial foot and vertebrate column). A further interesting aspect is the presence of cutmarks on the immature frontal bone as well as on several other bone fragments. The Sidrón sample substantially increases the fossil record of the European hominid evolutionary lineage and offers a large potential for exploring regional variations of Neanderthal populations.

### **A time to be born: Why does human pregnancy last nine months?**

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Portmann characterized human newborns as being secondarily altricial, meaning that our babies are helpless at birth relative to other primates and as a result require considerable parental care and buffering from the environment. Ashley Montagu described the modern human infant as an "extero-gestate fetus" that continued the pattern of intra-uterine growth for the first months of life, effectively in a cultural womb. Fossil and comparative evidence suggests that this developmental pattern may be as old as 1.6 million years.

This paper looks from the neonatal point of view at the many factors that contribute to the balance of selection resulting in an average modern human gestation length of 38-40 weeks. Although in absolute terms this gestation length is quite similar to those of the great apes, our babies are born at a relatively earlier stage of brain growth as well as neurological and physical development. We will review a number of systems that are involved including: 1. energetic issues of pregnancy versus lactation, 2. the constraints of a biped giving birth to a large-brained baby, 3. the minimal state of development necessary for life outside the womb, and 4. the positive benefits of significant portions of brain growth occurring postnatally. In conclusion, we propose a model summarizing the often competing selective forces operating on a time to be born and the premium placed on intensive parental care and cultural buffering of the human newborn.

### **Lumbar vertebral number in early hominids: Anatomical and developmental considerations.**

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The long lumbar column of modern humans likely represents a key adaptation to bipedality. Three specimens, Sts 14, Stw 431, and KNM-WT 15000, are sufficiently complete to provide data on its length in early human evolution. Each has been described as possessing six lumbar. Haeusler et al. (2002 *JHE* 43:621-643) argue that each had only five, the mode in humans.

Here we here review these specimens in order to clarify this discrepancy. 1) We find little evidence that can elucidate lumbar number in KNM-WT 15000. 2)

Given Sts 14f's mosaic nature, Robinson's original attribution as a lumbar is primarily terminological, but does not preclude a key functional role in lordosis. 3) Using a comparative sample of modern humans (N = 40) and chimpanzees (N = 20), we agree with Stw 431qb's placement as the sixth presacral element. We conclude, however, that the next most cranial element, Stw 431l, which is the transitional vertebra, is not contiguous with Stw 431qb. If Stw 431qb is T12, then the transitional vertebra would be at T10, a pattern that is unreported for modern humans. We conclude that Sts 14 and Stw 431 had six lumbar, while the number in KNM-WT 15000 remains unknown.

Haeusler et al. present developmental evidence purportedly supporting constraints on precaudal vertebral number in hominoids. However, these authors failed to address issues of *Hox cis*-regulation during vertebral morphogenesis and furthermore conflate the processes of segmentation and vertebral specification. We present a more appropriate developmental model.

#### **Geomorphometric evidence for a Caribbean multiple population dispersal.**

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Several migration routes have been proposed for the settlement of the Caribbean including crossing the Yucatan passage or dispersing across the Straits of Florida into Cuba and then dispersing eastward. However, the most recognized Antillean dispersal hypothesis is a direct jump from South America followed by dispersal into the Lesser Antilles and westward. To further evaluate these hypotheses, a preliminary study of facial shape variation was conducted among pre-contact Taino groups from Cuba (N=21), Hispaniola (N=16), Puerto Rico (N=9), Jamaica (N=7), and a pre-contact group from Colombia (N=5), Venezuela (N=4), and Mexico (N=27).

Three-dimensional coordinates were collected using a *Microscribe 3-DX*® digitizer for ten facial landmarks. GPA superimposition was performed using *Morpheus et al.* (Slice, nd). I performed a randomization test (999 repeats) to mitigate the effect of small samples and a principal component analysis (PCA) of the covariance matrix on the GPA transformed coordinates to reduce dimensionality. The degree of differentiation was assessed using Mahalanobis D<sup>2</sup> of the PC scores. In addition, an UPGMA Clustering analysis was performed from the D<sup>2</sup> matrix. The non-parametric MANOVA detected sig-

nificant group differences. Results indicate that Pre-contact Cubans branch notably from the rest of the Caribbean series, suggesting that Cuban crania are dissimilar from the rest of the Caribbean Tainos, reflecting different origins. These preliminary results suggest two separate migration routes for the peopling of the Caribbean, including a northwest movement along the Antilles arch from South America and a southbound migration across the Straits of Florida to Cuba.

#### **In vivo jaw kinematics and mandibular bone strain in *Eulemur fulvus* and *Chlorocebus aethiops* and the functional significance of phase II.**

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The functional significance of phase II movements during chewing has been called into question by in vivo data showing that in macaques peak principal strains in the working side mandibular corpus precede minimum gape (Hylander et al., 1987), and in baboons masseter muscle force has significantly reduced prior to minimum gape (Wall et al., 2002). These data suggest that in cercopithecines, little bite force is exerted during phase II movements. To investigate whether this is also the case in strepsirrhines, and to compare jaw kinematics in anthropoids and strepsirrhines while controlling for jaw length, data on jaw kinematics and bone strain in the mandibular corpus were collected simultaneously in two *Chlorocebus aethiops* and three *Eulemur fulvus* during mastication on various foods. Peak shear strain in the working side mandibular corpus preceded minimum gape by an average of 31 msec in *C. aethiops* (n=167) and 24 msec in *E. fulvus* (n=222). In addition, the temporal length of the power stroke was longer in time and the chewing frequency slower in *C. aethiops* than in *E. fulvus*. These data reveal that phase II jaw movements are not associated with significant bite force in *Eulemur fulvus*. They also provide some support for the hypothesis that anthropoids have longer power strokes than strepsirrhines. Research supported by NSF Physical Anthropology 0109130; lemurs loaned by DUPC.

#### **A new species of stem catarrhine from the early Miocene of Uganda.**

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Although the small-bodied non-cercopithecoid catarrhines from the early Miocene of east Africa are known primarily from dentognathic remains, the only convincing indications of their higher-taxonomic affinities have come from the few cranial and postcranial specimens that are currently available. Further recovery of such material should help to refine our understanding of this critical period of diversification among early catarrhines.

Recent collection at the ~19 million year old Napak IX locality has yielded a partial face (BUMP 266) of a small-bodied non-cercopithecoid catarrhine that preserves regions of the middle and upper face that were previously unknown for such taxa in east Africa. This specimen represents a new species of small catarrhine that is more primitive than its east African contemporaries in several respects including the configuration of its premaxillary-nasal contact, nasal bridge topology, and mesiodistal brevity of the upper P3. Its facial morphology combines primitive catarrhine traits (such as an extensive premaxillary-nasal contact) with mid-face and periorbital features found elsewhere only in hylobatids and the Eurasian pliopithecoids. This morphology contrasts with the well-supported crown catarrhine morphotype inferred from shared features found in *Aegyptopithecus*, *Afropithecus*, and *Victoriapithecus*. Consequently, the constellation of features exhibited by this new stem catarrhine provides new insights into the polarity of several facial characteristics, as well as the inferred branching sequence of stem catarrhine lineages.

#### **mtDNA Variation in Old Believer and ethnic Russian populations of northern Siberia.**

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In 1653, the Patriarch Nikon modified liturgical practices to bring the Russian Orthodox Church in line with those of the Eastern (Greek) Orthodox Church, from which it had split two hundred years earlier. 'Old Believers' (*staroveri*) rejected these changes, and continued to worship using the earlier practices. Their actions

resulted in persecution by the Russian Orthodox Church, which forced them to disperse across Siberia, where they formed remote communities. For the next three centuries, they lived in relative isolation from other Russian groups. To assess genetic diversity within Old Believers, along with the biological consequences of their isolation, we surveyed ~200 unrelated individuals from several villages for mtDNA variation, including Burnyi in the Baikitsk Raion of the Krasnoyarsk Krai, and Isetsk and Kirsanovo in the Tyumen Oblast. We also surveyed mtDNA variation in ~200 ethnic Russians from different parts of Siberia to determine the genetic relationship between Old Believers and other Slavic groups. Initial results indicate that West Eurasian haplogroups H, J and T are the predominant mtDNA lineages present in Old Believer communities, with mostly West Eurasian haplogroups (I, W, X) comprising the remaining mtDNAs. Somewhat surprisingly, haplogroup C mtDNAs were also detected in the Old Believers. This finding implied that they had admixed with local indigenous groups, since haplogroup C mtDNAs are not usually found in ethnic Russians. The pattern of mtDNA diversity in Old Believers, and their genetic affinities with ethnic Russian and other Slavic populations, is investigated.

#### **Can sexual dimorphism in skeletal size be used to assess sexual dimorphism in body size?**

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Sexual dimorphism in body size in the fossil record has most commonly been evaluated through estimation of body masses from preserved skeletal remains. Recently, Reno et al. (PNAS, 2003) employed a novel method whereby variation in a single articular dimension (femoral head breadth) was used to assess variation in body size in a fossil assemblage (A.L. 333) relative to that for living hominoids. Such a method relies on the assumption that skeletal articular size variability, within species, reflects body mass variability. We tested this assumption in a large sample of modern catarrhines with known body masses and femoral head dimensions. A total of 180 individuals in 13 species, all wild-shot and adult, were included in the study. Sexual dimorphism was evaluated as the log-transformed ratios of male/female body mass and

male/female cube of femoral head superoinferior breadth.

The correlation between sexual dimorphism in body mass and in femoral head breadth is fairly high ( $r=.877$ ) although with a %SEE of 16%, indicating substantial variation in the relationship between the two. More importantly, there is a tendency for larger species to have relatively greater sexual dimorphism in body mass than in femoral head breadth (RMA slope of 1.331,  $p<.07$  compared to 1.0). In plots of males against females, there is more variation in body mass (%SEE = 32%) than in femoral head breadth (%SEE=24%), primarily due to the reduction in femoral head dimorphism in the larger species. Thus, intra-species articular size variation may give biased estimates of intra-species body size variation.

#### **The relationship between locomotor behavior and the fabric principal direction of trabecular bone.**

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Recent work has demonstrated a close correspondence between the fabric and mechanical main directions in trabecular bone specimens (Odgaard et al., 1997). This work suggests that the elastic principal directions of trabecular bone can be accurately predicted and characterized by fabric measures, thereby confirming that the mechanical behavior of trabecular bone is governed mainly by its three-dimensional architectural arrangement. Here we quantify the principal orientation of trabecular bone in the femoral head and relate these principal fabric directions to loading patterns during various locomotor behaviors. The proximal femora of a diverse sample of prosimians were scanned using a high-resolution X-ray computed tomography scanner with resolution less than 50  $\mu\text{m}$ . Spherical volumes of interest were defined within the femoral heads and the three-dimensional fabric anisotropy was calculated using the mean intercept length and star volume distribution methods. In addition to differences in bone volume and anisotropy, significant differences were found in the spatial orientation of the principal trabecular axes depending on locomotor behavior. The principal orientations for leapers (*Galago*, *Tarsius*, *Avahi*) are relatively tightly clustered ( $\alpha_{95}$  confidence limit: 8.2; angular variance  $s$ : 18.2°) and oriented in a superoanterior direction while those of non-leapers are more variable across a range

of directions ( $\alpha_{95}$ : 16.8;  $s$ : 42.0°). The mean principal directions are significantly different for leaping versus non-leaping taxa. These results further suggest a relationship between bone microstructure in the hip joint and locomotor behavior and indicate a similarity of loading across leapers despite differences in kinematics and phylogeny.

#### **Comparative mtDNA analysis of adapting to life at high altitudes.**

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Previous studies have shown that there are quantitative genetic differences associated with adapting to life at high altitudes. We collected data on three high altitude human populations. These populations include Ethiopian Highlanders from the Simien Plateau, Bolivian Aymara from the Andes, and Tibetans from the Himalayas. Four phenotypic adaptive responses to high-altitude hypoxia are used to make comparisons between and within these populations. The responses include resting ventilation, hypoxic ventilatory response, oxygen saturation, and hemoglobin concentration. Since mtDNA encodes for protein subunits involved in cellular respiration and energy production, our hypothesis is that mutations in mtDNA may be associated with adaptation to life at high altitude.

For this study, the first hypervariable region (HVS-I) of mtDNA is used to determine if there are point mutations or haplotypes associated with altitude adaptation. We use both discrete variable tests (Chi Square, Fishers Exact Test, etc.) and continuous trait variable tests (multiple regression, etc.) to look for associations between mtDNA mutations/haplotypes and phenotypic adaptive strategies in the three different highland populations. We apply nested cladistic analysis, using a Reduced Median network (Bandelt, 1995) to generate the cladistic network required for the analyses.

While the Ethiopians share no mtDNA haplotypes with the Tibetans or Aymara, there were a number of haplogroups shared between Tibet and Bolivia indicating their common ancestry in Asia, likely some 15,000 to 30,000 years ago.

**Seed dispersal by black howler monkeys (*Alouatta caraya*) in a north-eastern Argentinean flooded forest.**

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Primates are reported to be important seed dispersers for a large number of tropical tree species. In the case of New World primates, several authors have suggested that howler monkeys serve an important role as agents of seed dispersal in forest regeneration. In the present research, we present the results of a two year field study on the behavior and feeding ecology of black howler monkeys (*Alouatta caraya*) in a flooded forest in Argentina.

Data were collected on ranging patterns and diet of two black howlers groups inhabiting Brasileria island. In addition, fecal samples were analyzed and germination tests were conducted. We also examined the seed shadow created by howler defecation and seed dispersal. The results indicate that howlers disperse seeds in a complex distribution pattern: seeds were either deposited as part of "individual defecations" or in large 'latrines' associated with main sleeping trees, and also in small 'latrines' associated with secondary sleeping trees or areas where neighboring groups engaged in territorial conflicts. Only 1.1% of removed seeds were deposited under the crown of the parent tree. Seed ingestion did not have a significant effect on seed germination for most species except for *Banara arguta* and *Eugenia punicifolia*. The seeds of both species germinated more quickly after passage through the howler gut than control seeds. Additional relationships between howler feeding behavior, food passage rates, seed shadow, and seed and seedling survivorship are discussed.

**Patterns of damage in Egyptian mummies and related causes.**

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Mummification can preserve a body for several millennia, but it is a popular misconception that these bodies are in pristine condition. The activities of tomb robbers, archaeological excavation and transportation, and the mummification process itself may damage the body. This paper examines the published reports on Egyptian mummies from museum collections in the United States, Europe, and Egypt for

the presence of osteological fractures, dislocations and other related damage. These reports offer biographical information on the mummies including results of examinations that used one or a combination of methods, such as unwrapping, autopsy, x-ray, and CT-scans. The data was then examined for patterns, which were subsequently compared with descriptions of ancient and historical Egypt and the Egyptian antiquities trade.

Data from a sample of over 250 Egyptian mummies was collected. Approximately 60 percent of the mummies analysed showed evidence of damage. The damage was more frequently found to the head and thorax than to the pelvis, arms, legs, hands, and feet. Although the types and probable sources of damage did vary, no strong patterns emerged when comparing the frequency of damage to different historic periods. In examining the Egyptian mummies as a group rather than as individuals, this study, although still in its preliminary stages, provides insight into damage the mummies have incurred.

**Molecular variability and sociocultural change - Past, present, and future.**

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The extraordinary development of molecular and bioinformatic techniques opened new horizons for the investigation of human evolutionary history. It is now possible, through the investigation of DNA variability, to infer a series of demographic changes undoubtedly related to sociocultural processes that occurred in the past. The structure of human populations changed dramatically along the 200 thousand years of our history, as our way of subsistence changed from a hunter-gatherer to agricultural and industrial practices. Models for the analysis of these developments can be found in Latin America, and our group has been investigating them for half a century now. Recent examples involving South American Natives include extensive investigation of autosomal, Y-chromosome and mitochondrial DNA (mtDNA) regions using RFLP, STRP, L1 and *Alu* insertions, as well as SNP polymorphisms, exploring general questions related to intra, interpopulation, and intercontinental variability. Special attention has been given to the 3' UTR of the *LDLR* gene and to two enigmatic populations, the Aché and Ayoreo of Paraguay. In relation to mtDNA a specific search was made for haplogroup X in extant South American populations. Con-

comitantly, the relationship between lifestyle changes and variations in genes related to lipid metabolism was undertaken. In non-Native populations a focus was in the spatiotemporal analysis concerning the formation of the Brazilian population.

**Bilateral asymmetry in the upper arm bones of chimpanzees (*Pan troglodytes*).**

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There is much current debate in behavioral primatology on the existence of population-level handedness in chimpanzees. The presence or absence of functional laterality in great apes may shed light on the origins of human handedness and the evolution of cerebral asymmetry. The plasticity of long bone diaphyses in response to mechanical loading allows functional interpretation of differences in cross-sectional geometric properties. While sagittal asymmetry in upper limb diaphyseal morphology has been found in human populations, it remains relatively unexplored in apes. We studied bilateral asymmetry in 54 wild-caught chimpanzee skeletons using the humerus, second metacarpal, and femur. The total subperiosteal area (TA) of the diaphyses was measured at 40% of maximum humeral length and the midshaft of the metacarpals and femora using external latex molds. Overall, the TA values of the left humeri were significantly greater than the right, indicating directional asymmetry. This effect was even greater when the magnitude of difference in TA between each pair of humeri was compared. The right second metacarpals showed a non-significant trend toward greater area than the lefts. The lack of significant asymmetry in the femur serves as a lower limb control and suggests that the upper limb results are not a product of fluctuating asymmetry. These findings imply behavioral laterality in upper limb function in chimpanzees and suggest a complementary relation between precision and power.

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**Regression modeling to predict energy expenditure: Comparison between adults and children.**

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A simple, non-invasive, and affordable method for estimating energy expenditure (EE) was developed. The regression-based method predicts oxygen consumption ( $VO_2$ ) from heart rate (HR) along with several covariates. Atypical of most similar approaches, the primary measures are taken as the difference between exercise and resting  $VO_2$  ( $\Delta VO_2$ ) and the difference between exercise and resting HR ( $\Delta HR$ );  $\Delta VO_2$  partially corrects for posture and resting metabolic rate, and  $\Delta HR$  controls for posture and inter-individual variation in physiology. Two groups of twenty individuals were chosen: sea level adults (16-58) and high altitude children (8 and 13). Anthropometric measures were taken, and  $VO_2$  was assessed while the subjects either walked on the treadmill or performed graded exercises on a cycle ergometer. A repeated-measures predictive equation was developed for each group, and parameters were estimated by least squares and maximum likelihood methods. For both models, we get a high coefficient of correlation with  $\Delta HR$  and  $\Delta HR^2$  explaining most of the variation in the regression. This suggests that a useful predictive equation can be produced using paired  $VO_2$  and HR measurements on a relatively small reference sample. The variable that explained the most of the correlation was not  $\Delta HR$ , as anticipated, but  $\Delta HR^2$ . This unexpected finding points to a need to further our understanding of the physiology that might underlie this variable.

**Biological variability of wild ring-tailed lemurs, *Lemur catta*: Effects of habitat and Sex.**

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Biological information was collected on 71 *Lemur catta* as part of a long-term study regarding the effects of habitat on lemur biology. Troops inhabiting three habitats were compared: those within the protected Beza Mahafaly reserve, ("Reserve groups"), heavily degraded habitats ("Marginal groups") and those who included the research camp and village as a substantial part of their range ("Camp groups"). Given that Camp groups have access to human food and water, it was predicted that these groups would exhibit enhanced nutritional and developmental status. Measurements that reflected current nutritional status (body mass, skin

fold, number of ectoparasites) and developmental consequences (body lengths, lower arm and lower leg lengths, muzzle lengths, scapular lengths) were collected. Given that this species is female dominant it was predicted that females would show more positive health and nutritional status than males.

Habitat had a significant ( $p = .05$ ), effect on measurements. Camp groups were heavier, had greater skin fold measurements, and were larger than both Marginal and Reserve groups. Marginal group females were smaller than both Camp and Reserve groups. Habitat did not affect the mean number of ectoparasites observed during measurements but it did affect sexual dimorphism. Camp group and reserve females had longer body lengths than did males, while camp group females also had longer lower arm measurements. Other sex differences were also significant. Females had greater skin fold measurements, fewer ectoparasites, and a lower incidence of skin lesions and scars/wounds. These results are discussed with regard to biological plasticity in this species.

**(Non)allometric craniofacial sexual dimorphism in hominoids.**

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Patterns of craniofacial sexual dimorphism in primates vary by taxon and by region within taxon. We examined these patterns in five hominoid taxa: *Homo sapiens*, *Pan paniscus*, *Pan troglodytes*, *Gorilla gorilla* and *Pongo pygmaeus*. A total of 94 points (35 landmarks and 61 semilandmarks from five ridge curves) were located on 268 adult and subadult specimens; the sample was in approximate balance by taxon and sex. Analysis was by a relatively new method, principal components and principal coordinates in size-shape space, from the geometric morphometric toolkit. We find that the contribution of ontogenetic scaling to sexual dimorphism varies substantially by taxon. *P. pygmaeus* shows the greatest allometric component, followed by *G. gorilla* and then *Homo*.

But in *Pan*, and especially bonobo, barely half of the observed sexual dimorphism in adults is allometric. We interpret regional aspects of both these components by the usual thin-plate splines. Scatters of the first few principal coordinates of non-allometric allometry locate *Pongo* at con-

siderable distance from a cluster of the other four taxa.

Allometric and non-allometric regional components of sexual dimorphism may help to distinguish this complex process from interspecific variation, a distinction that is a frequent concern of the recent literature, and may even extend to the use of these patterns as characters for taxonomic analysis in the fossil record.

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**Y chromosome variation in Melanesian populations.**

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Genetic analyses of mtDNA and autosomal loci in the Southwest Pacific have revealed high degrees of variation as well as regionally restricted polymorphisms. We conducted intensive Y chromosome analysis in the Bismarck Archipelago, a region critical to understanding the prehistoric settlement of the Pacific, and that has been under sampled to date. We genotyped 565 unrelated male samples residing in New Britain, New Ireland, and surrounding islands. The sample includes more than 20 language groups and dialects, both Austronesian and Papuan-speaking. We assayed for 7 microsatellite markers and 25 biallelic polymorphisms on the non-recombinant portion of the Y chromosome (NRY) that have been shown to be variable and particularly informative in the area. Sampling bias in marker selection was prevented by a preliminary long sequencing of >3kb of the NRY in an attempt to identify new or regionally important variants. The results reveal significant heterogeneity in the ascertained NRY results that are comparable to mtDNA variability across the same sample. The distribution of NRY variation shows distinctions even among dialect areas of specific languages and islands. Therefore, both linguistic distinctions and geographic distances have influenced male gene flow in the Bismarcks.

### Woodland to Mississippian dietary transitions in Indiana as indicated by dental microwear analysis.

C.W. Schmidt. University of Indianapolis.

Dental paleopathology and macrowear data from a recent study by the author suggest that, in Indiana, the Late Woodland diet is intermediately cariogenic and macroscopically abrasive when compared to diets representing the Early/Middle Woodland and Mississippian periods. It is hypothesized that, like the caries and macrowear data, the Late Woodland microwear data are intermediate.

Dental microwear analysis was conducted on the teeth of 22 Early/Middle Woodland, 18 Late Woodland, and 23 Middle Mississippian adults predominantly from Indiana. The microwear analysis followed standard procedures for casting/molding, scanning electron microscopy, photography, and feature scoring (i.e., Microwear 2.2, Ungar, 1995). Data were collected for the following variables: percentage of pits, pit length, and scratch width. Quantitative comparisons were conducted using ANOVA.

The results suggest that the Late Woodland dental microwear profile is not intermediate. The Late Woodland values are virtually indistinguishable from those of the Early/Middle Woodland. By contrast, the Late Woodland profile has significantly more pits and wider scratches than that of the Mississippian.

The current study suggests that the increase in cariogenesis during the Late Woodland did not result from substantial changes in food preparation since the microwear did not change. Moreover, the new cariogenic foods did not immediately replace what was eaten previously. By the Mississippian, the diet was markedly different in that it was both softer (e.g., had fewer pits) and less abrasive (e.g., had narrower scratches) than the preceding Woodland diets.

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### Timing characteristics of two different facial signals: Deliberate and spontaneous smiles.

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The smile is a frequently observed, multi-functional social signal in humans. Physical characteristics of the human smile, primarily upturned and laterally drawn lip corners, are consistent across

individuals and form the defining characteristic of this facial signal. Inferences about the nature and purpose of individual smile displays, however, are often based on the timing of lip corner movement. Previous qualitative studies have proposed that the social impact of the smile may depend on the speed and duration of lip corner movement. In this study, movement characteristics of smiles known to be deliberate (directed action task) were compared with spontaneous smiles observed in the same individuals (N=65). An automated tracking algorithm provided data on the position and timing of lip corner movement in these smiles. A within subject repeated measures analysis showed that both maximum speed (F(1,64)= 118.65, p<0.001) and amplitude (F(1,64)= 113.90, p<0.001) of lip corner movement differed between spontaneous and deliberate smiles. Duration of smile onset did not differ between the two types of smiles (F(1,64)=0.074, p=0.78). Spontaneous smiles are both faster and larger in amplitude during onset, suggesting possible neurobiological differences in production. Contrary to the results of previous studies, we did not find that asymmetry differed between spontaneous and deliberate smiles; both displays showed a moderate degree of asymmetry.

### Intact non-collagenous extracellular matrix proteins in ancient human bones from different time periods.

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Ancient bones in a good preservation state, controlled by microscopic techniques, conserve extracellular matrix proteins over thousands of years. Using a special technique (Schmidt-Schultz and Schultz 2003), intact extracellular matrix proteins extracted from ancient bones are solubilized, separated by 1-dimensional and 2-dimensional electrophoresis and identified in western blots by special antibodies against different human extracellular matrix (ECM) molecules of bone. ECM human bone molecules such as osteonectin, osteopontin, alkaline phosphatase were confirmed by different types of specific antibodies in recent and archaeological human bone samples of individuals of different age groups. The archaeological bone samples date from different time periods (e.g., Late PPNB, Bronze Age and the Middle Ages).

The preservation of intact extracellular matrix proteins in ancient bones dating from recent times into the Late PPNB and

the use of reliable new techniques to identify these proteins represent a big challenge for further research. In combination with the results of macro- and microscopic examinations, the results of the biochemical investigation will make it possible to obtain a better understanding of bone in health and disease.

### Analysis of chimp-human brain differences via non-rigid deformation of 3D MR images.

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Understanding human brain evolution requires knowledge of exactly how human brains differ from those of our closest ancestors. While differences in overall size are easy to gauge, differences in relative proportions of individual cortical areas are more difficult. Partly this is because areas of interest often do not have obvious and easily-delimited sulcal boundaries, and the methods used have relied on delineating areas by hand. One area of particular interest is prefrontal cortex, which is both behaviorally interesting and particularly difficult to delimit.

We apply a novel approach to this question by using non-rigid deformation techniques – developed originally for functional imaging studies to morph sets of human brains into the same coordinate system – to a set of 6 *Pan troglodytes* (3 male, 3 female) and 12 *Homo sapiens* (6 male, 6 female) brain MRIs. Because these methods are voxel-based, local deformation in one area can be independent of deformation in another area. The average *Pan* brain was non-rigidly deformed into the average *Homo* brain resulting in a 3D deformation matrix describing the distortions necessary to transform one into the other on a voxel-by-voxel basis. Within-species sets of deformation matrices are used to determine the significance of species differences. This method bypasses the need to individually delimit regions of interest by hand, and results in a global atlas of species differences covering all areas of the brain. Our results confirm that the prefrontal cortex occupies a proportionately larger part of the brain of *Homo sapiens* than it does in *Pan troglodytes*.

Image analysis research using MRI of human and primate brains has suggested that the frontal lobe as a whole in humans is not especially elaborated, while other research has suggested that the prefrontal

itself is larger as a percentage of total cortex than in non-human primates.

**Kinematics and kinetics of bonobo (*Pan paniscus*) climbing.**

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In order to gain new insights into the evolution of hominid bipedalism, the understanding of the relationship between form and function in extant primates is essential. Despite a lot of great kinesiological studies on living primates, sufficient data on the kinematics and particularly kinetics of climbing are still lacking. This study focuses on 3D-kinematics and kinetics of arboreal locomotion in bonobos.

We used a setup, consisting of an inclinable pole instrumented with 3D force transducers, that allowed for measurement of dynamic forces applied by bonobos during locomotion on sloping substrates. Climbing sequences were recorded simultaneously by four video cameras. Substrate reaction forces (1000 Hz) and coordinates of each joint (50 Hz) were used to calculate total, quasi-static joint moments during a complete stride. Moment arms of important hind limb muscles (needed for the interpretation of the calculated joint moments) were measured for an adult female, using the 'tendon-travel method'.

Analysis of sequences on a slope of 30° revealed that the highest moment of the hind limb is generated in the hip. Moments are smaller for respectively knee and ankle joints. Front limb joint moments are much smaller, with the shoulder having the highest values.

In general, there is good correspondence between the joint angle at which the calculated moment is high, and the muscle moment arms of the extensors of the joint considered. Future research should elucidate whether this remains true for climbing at steeper angles, and for terrestrial locomotion.

**Metric variation in the dentition of *Ouranopithecus macedoniensis* (de Bonis and Melentis, 1977).**

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This study examines the relative variation and degree of sexual dimorphism in the dental metrics of the Miocene fossil hominoid *Ouranopithecus macedoniensis*. It tests the hypothesis that the coefficient of variation (CV) and the sexual dimor-

phism index (SDI) of the fossil sample do not exceed those of extant great apes. The study uses mesiodistal (MD) and buccolingual (BL) tooth measurements from *Ouranopithecus* mandibular canines (n=7) and first molars (n=6) from Ravin de la Pluie and Nikiti 1, Greece, and from extant *Gorilla*, *Pan* and *Pongo* samples (n>40). Bootstrapping (resampling with replacement) is the method used to compare the fossil sample to the comparative samples.

Plots of the metric data for *Ouranopithecus* canines and first molars both produce bimodal, non-overlapping distributions. The relative variation in *Ouranopithecus* canines does not exceed that in *Gorilla* or *Pongo*; however, the relative variation in lower M1 MD exceeds that for all extant apes. The probability that the degree of relative variation in the *Ouranopithecus macedoniensis* lower M1 BL width measure would be found in extant ape populations is also low (<.01 in *Pan* and *Gorilla* and <.06 in *Pongo*). The SDIs for *Ouranopithecus* canines approximate the values for *Pongo* and *Gorilla*. The SDIs for M1 MD and BL exceed 1.20. These are greater than the values for any extant great ape. The high levels of molar metric variation in *Ouranopithecus macedoniensis* would appear to be the consequence of extreme sexual dimorphism, similar to what is observed in the Miocene ape from China, *Lufengpithecus*.

**Native American interests and human genetic research.**

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Ethical and legal questions that have arisen with advances in human genetic research have found an arena for discourse in the unprecedented political voice of Native Americans, as evidenced by organizations such as the Indigenous Peoples' Council on Biocolonialism and articles published in journals like *Gene Watch* and *Cultural Survival Quarterly*. However, these political interests have also raised concerns that may be regarded as red herrings, such as the mining of the Native American genome or the creation of super viruses targeted at Native Americans. These red herrings detract from more imminent issues, including the appropriateness of group consent, the patenting of genes, and the storage of samples, that potentially threaten both Native American sovereignty and progress in

genetic studies. Such issues demand increased dialogue among Native Americans, genetic researchers, government agencies, and lawyers.

In this study, we anonymously survey 83 Native Americans affiliated with tribes focused in California, plus a sampling across the United States, to assess the concerns and interests of Native Americans as they pertain to human genetic research. The preliminary results of this survey suggest that the opinions of many Native Americans on human genetic research may be inaccurately reflected by Native American activists. The results also reveal specific issues researchers may address to further unify the interests of Native Americans with those of researchers. The engagement of Native Americans in this survey has laid a foundation for increased dialogue and collaboration between Native Americans and anthropologists.

**Does digestion time limit group size in folivorous primates?**

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In general, it is assumed that folivorous primates are facing lower feeding competition than frugivores. Consequently, group size of folivores should be less constrained. In contrast to this assumption, however, most folivorous primates live in smaller groups than frugivorous. One possible explanation for this 'folivore-paradox' may be the existence of a different mechanism constraining group size. Usually, increased travel expenses with increasing group size might be compensated for by prolonged feeding time at the expense of resting time. A highly fibrous diet, however, may not allow for such a solution, because resting time is vital for fermentation. Hence, folivores might be constrained by digestion time. We tested this idea using long-term data for three Haplorhina langur groups (*Semnopithecus entellus*) of different sizes. Data were collected between 1991 through 1996 at Ramnagar, southern Nepal during focal animal follows. Instantaneous samples were obtained on general activity and specifics of feeding behavior including plant species and part. Chemical analysis of nutritional content together with individual ingestion rates and feeding times

for all major food items are used to estimate fiber intake. In a multivariate approach we analyse time budgets in relation to group size, overall feeding time and total fiber intake. The study represents an important step in the evaluation of the ecological constraints model for the limitation of group size. Supported by Alexander von Humboldt-Foundation, German Academic Exchange Service, German Research Council, and Stony Brook University.

#### **Microscopic diagnoses in ancient treponema diseases.**

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The microscopic investigation of human skeletal remains from archaeological sites provides a unique perspective on the world-wide evolution of treponematoses. As written historical texts report, the Old World first became aware of these diseases at the beginning of the 16th century. However, there are archaeological skeletal remains which suggest that the treponematoses were already present in the Old World before this date. Therefore, treponematoses may be a relatively old group of diseases which affected man some thousands of years ago.

As there are now techniques available (e.g., Schultz 2001, 2003) which enable us to study the histopathology of ancient bones, archaeological skeletal remains suspicious of treponema diseases can be studied to elucidate the evolution, the spread and the history of this group of diseases.

About 30 cases dating from recent and prehistoric times which demonstrate the characteristic macroscopic features of treponema disease were examined by macroscopic, radiological, scanning-electron microscopic and light microscopic techniques. There are specific features (e.g., polster, grenzstreifen) which characterize syphilitic lesions in long bones at the microscopic level, the differential diagnoses of inflammatory bone diseases can be more reliably established.

#### **mtDNA variation in indigenous Altaians, and their genetic relationships with Siberian and Mongolian populations.**

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The Altai Mountain region has been suggested as the homeland for the ancestors of both indigenous Siberian and Native Americans, who may have emerged from this area many millennia ago. Currently, a number of distinct ethnic groups that differ linguistically and anthropologically from each other now populate this region, with these differences probably reflecting their heterogeneous origins and ethnic histories. To elucidate their biological histories, and to determine the extent of the genetic contribution of Altaian populations to the peopling of Eurasia and the Americas, we analyzed genetic variation in several ethnic groups from the Altai Republic, including the southern Altai-kizhi, and the northern Chalkans, Kumandinians, and Tubalars. Our initial results indicate that about 75% of Altai-kizhi mtDNA haplotypes belong to East Eurasian maternal lineages, namely, haplogroups CZ, D, F, G, M8a and M9a, while the remainder belong to West Eurasian haplogroups H, TJ, XI, and UK. Relatively similar frequencies of these haplogroups had previously been observed in a general sample of northern Altaians, who exhibited fewer West Eurasian haplogroups than the Altai-kizhi, but higher frequencies of haplogroups H and U. This analysis will further characterize mtDNA diversity in northern Altaian ethnic groups, and assess the genetic differences between northern and southern Altaian populations. We will also investigate their genetic relationships with other Turkic-speaking groups such as Tuvans, Tofalars and Yakuts, with whom they have biological and linguistic affinities, as well as with Mongolian populations, who have genetically influenced Altaian groups over the past two thousand years.

#### **Single osteons and seasonality: A SIMS analysis of human bone from Wadi Halfa.**

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At Wadi Halfa, in N. Sudan, White and Schwarcz (AJPA, 93:165-187, 1994) found that diet was dominated by low-C-13 (C<sub>3</sub>) wheat and barley; and high C-13 (C<sub>4</sub>) sorghum and millet, mainly consumed during and just after their respective harvests. A seasonal cycle in C-13/C-12 ratio is detectable in scalp hair, and should be

detectable in other continuously deposited tissues.

We used a secondary ionization mass spectrometer (SIMS, Cameca model 4f) at the Oak Ridge National Laboratory, Oak Ridge TN, to analyse variations within single osteons of individuals from Wadi Halfa. In sections normal to the osteon's axis, C-13/C-12 varies by up to 8 per mil, O-18/O-16 by 7 per mil in. O and C isotopic cycles were out of phase. Along the axes of single osteons, we see variations of up to 17 per mil in C-13/C-12, and 7 per mil in O-18/O-16, again with opposite phase. The high C-13/C-12 ratios correspond to summer periods when millet and sorghum were consumed; summer snow melt-water (from Ethiopia) may lower O-18/O-16 in the Nile at this time.

We conclude that it is possible to observe seasonality of diet within single osteons using the SIMS. Similar variations in O-18/O-16 and D/H should be observable in individuals from sites where seasonal changes in isotopic composition of drinking water occur. Applications to study the rates of bone remodeling are also being investigated.

#### **Developmental basis of canine dimorphism in early Eocene Notharctines.**

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Canine sexual dimorphism (CSD) is an important trait in primate paleontology because of its strong links with many behavioral, socioecological and phylogenetic variables. However, little is known about the developmental mechanism underlying CSD. One recent study demonstrated that within extant hominoids, CSD is the result of differences in the duration of canine crown growth (bimaturism). Virtually nothing is known about the mechanism(s) responsible for the development of CSD in the earliest known canine-dimorphic primates, Eocene Notharctines. We investigated evolutionary patterns of CSD to determine whether the developmental basis of this important morphological feature is similar across different temporal groups of primates or simply the phenotypic expression of differing developmental trajectories.

Standard histological markers of tooth growth were used to chart canine crown growth in a small sample of sexed specimens (n=15) representing two species of *Cantius* (*C. trigonodus* and *C. mckennai*)



and *Notharctus robinsoni* from the early Eocene of North America. In most teeth, short- and long-term incremental lines were visible in enamel, and less often, in dentine. The periodicity of long-period lines in enamel ranges between 2 and 3 days – similar to that in other small-bodied extant prosimians. Cuspal formation times are similar in male and female *Cantius*, with averages of 70.7 and 63.5 days respectively, while total crown formation times average 218.7 days (0.61yrs.) and 181.2 days (0.49yrs.), respectively. Similar growth rates suggest that CSD results from bimaturism, indicating that perhaps this aspect of primate growth has been developmentally constrained since the rise of Euprimates.

**Brunhilde in Lilliput? Sexual dimorphism in English skeletal samples from the Romano-British period to post-medieval times.**

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Osteometric data of twenty skeletal samples from eleven different sites in England, covering a time span of *circa* sixteen centuries, show a widely varying degree of sexual dimorphism between and within the samples. In particular, female stature does not show as much variation over time and between samples as does male stature. Based on a comparison of male and female brachial, crural, and intermembral indices, female body proportions also appear more uniform in the analysed samples over time. Male body shapes show increased variation in relative weight for stature, as well as relative lower limb length, while female body shapes do not. The conclusions drawn from these findings are that the females of the twenty analysed samples appear to be more resistant to environmental stressors, especially stressors related to socio-economic and health factors. In those samples interpreted to derive from comparatively low-status populations, the degree of sexual dimorphism in stature is very low or even absent, while there is a high degree of sexual dimorphism in stature in high-status samples. The overall conclusion is that male growth, and therefore male stature and proportions, is more sensitive to living conditions than is female growth. This reduced female sensitivity to living conditions is thought to relate to female biological buffering from an enhanced immune system, and possibly from the differences in growth timing and maturation between the two sexes.

**Parapatric groups of black and common squirrel monkeys (*Saimiri vanzolinii* and *Saimiri sciureus*) in the central Amazon.**

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*Saimiri vanzolinii* inhabits an area of seasonally flooded varzea islands subdivided by a mosaic of river channels at the Japura River mouth in the Mamirauá Sustainable Development Reserve, Brazil. We present the results from a study undertaken to refine our knowledge of *S. vanzolinii*'s range, with particular emphasis on exploring areas where it might co-occur with *Saimiri sciureus*. We recorded 190 *S. sciureus* and 149 *S. vanzolinii* group locations across an approximately 1800 km<sup>2</sup> area. We found that the range of *S. vanzolinii* is smaller than originally thought, comprising only 533 km<sup>2</sup> when large areas of back-swamp vegetation where it does not occur are excluded from the range calculation. Areas inhabited by both species are only 10 km<sup>2</sup>, with most area surveyed inhabited by only one form of *Saimiri*. Mixed feeding associations between *S. vanzolinii* and *S. sciureus* groups were observed occasionally, but these associations invariably separated. Together these observations indicate that *S. vanzolinii* and *S. sciureus* are biologically-valid species. Small river channels are important in segmenting *Saimiri* populations in the varzea; species range boundaries predominately followed river channels; and some islands with suitable habitat have no *Saimiri*. Variation in the number of group sightings in some areas between months implies that *S. vanzolinii* groups move seasonally, perhaps due to spatial variation in fruit abundance as waters rise during the yearly flood. Ten years before this survey, we observed *S. vanzolinii* groups approximately 6 km beyond a portion of their current range. This area now is exclusively inhabited by *S. sciureus*, suggesting that the range of *S. vanzolinii* is diminishing.

**Dermatoglyphic phenotypic heterogeneity among individuals with non syndromic cleft lip with or without cleft palate (CL/P) and their relatives in China and the Philippines.**

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CL/P is a common birth defect (birth prevalence ranging from 1/500 to 1/2500) with a complex etiology. Traits potentially related to CL/P, such as dermatoglyphics, may mirror the heterogeneity seen in CL/P. The relationship between CL/P and the frequency of dermatoglyphic pattern types is unclear. Phenotypic heterogeneity between populations might be the result of methodological differences among studies of different ethnic populations, or might indicate underlying population differences. We propose that general ethnic differences in dermatoglyphic patterns account for some of the differences in previously reported associations of dermatoglyphic pattern frequency and CL/P.

Dermatoglyphic prints were taken from individuals with non-syndromic CL/P (n=460) and their unaffected relatives (n=254) from the Philippines and China. For both samples, three raters designated the patterns as *arch*, *ulnar loop*, *radial loop*, *whorl* or *other*. Standard ANOVA of pattern type included both CL/P cases and their relatives with affection status, gender, and population group as parameters. The results indicate that pattern type differences between cases and controls were not consistent across these populations. For each pattern type, except *arches*, population was a significant parameter (p<0.008); for *radial loops*, affection status was an additional significant parameter (p< 0.001). When only cases were included in the ANOVA, 'population' was again a significant parameter for the *ulnar loop* (p= 0.002), *whorl* (p<0.001) and *other* (p<0.01) patterns. With methodological differences minimized, these results support our hypothesis that population-specific differences in dermatoglyphic patterns exist for CL/P cases and their relatives. Supported by grants DE-09886 and DE-08559 from NIH/NIDCR.

**Bovoid metapodials, late Miocene paleoenvironments, and hominoid evolution.**

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Remains of late Miocene hominoids increasingly indicate both taxonomic and adaptive diversity. Understanding hominoid paleoenvironments may illuminate the selection pressures relevant to this diversity. Previous analysis of bovids from the Siwalik hominoid locality Y0311 based on a taxon-free discriminant analysis of bovid femora suggested forested habitats

and some less densely covered areas. A new analysis of distal and complete bovid metapodials assigned to five habitats was applied to three fossil sites: Pikermi (Greece), Can Llobateres (Spain) and Y0311 (Pakistan).

The distal and complete metapodial models reported here performed between 3.8 and 4.2 times better than chance. Compared to prior models of the bovid femur (Scott et al, 1999; Kappelman, 1988), astragalus (DeGusta and Vrba, 2002) and metapodials (Plummer and Bishop, 1994) all results reported here resulted in more robust values of Press's Q statistic and better performance when compared to chance than previous models. With an additional step of crossvalidation, discriminant results were between 3.2 and 3.7 times better than chance comparing favorably with the uncrossvalidated results of earlier models.

Results for fossil localities suggest that Pikermi included bovinds adapted to more densely covered habitat in agreement with alternative lines of evidence. Similarly, results confirm a diversity of habitats at Y0311. While sample size is small, the hominoid site of Can Llobateres was potentially more densely covered and less diverse than Y0311. It appears that diverse hominoid habitats reflect taxonomically diverse hominoid taxa.

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#### **A craniometric view from the Late Pleistocene and Early Holocene of East Asia: The Zhoukoudian Upper Cave and Minatogawa.**

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Craniometric data are used to assess the similarity and differences between prehistoric and recent world-wide samples, and between these samples and a similar representation from the Asian Upper Paleolithic. The data are analyzed by discriminant function analysis, canonical variate plots, and posterior probabilities and typicality probabilities.

The preliminary study found that; 1) the most closely related group among the reference populations to the Zhoukoudian Upper Cave 101 are Mongolian Bronze Age Chandman, but not to recent Mongols, Chinese Neolithic, Chinese Bronze, or recent Chinese populations; 2) Minatogawa 1 shows strong affinity with Jomon and Ainu, as well as Archaic Native Americans, and it can be suggested that Jomon type people had occupied the Ryukyu Islands in Late Upper Paleolithic times.; 3) Jomon, Ainu, Mongolian Bronze

Age Chandman, and Mongol Hunnu show craniofacial affinities to the US-Canadian border Native Americans and the Archaic Native Americans.

Land-bridges formed several times following sea-level changes during the Middle Pleistocene Ice age to the Late Pleistocene Ice age, and allowed the Japanese Archipelago to be connected to the Asian main continent (Oba, 1983; Yasuda, 1990). Also, the Ryukyuan archipelago formed a land-bridge and connected to the Asian Main continent by Taiwan several times until 15,000 B.P. (Kimura, 1985).

All of these may suggest a population continuity from Eurasia, to the Japanese islands, to the New World extending across a northern route. Jomon/Ainu could be the descendants of the Pleistocene inhabitants of northern Eurasia before the expansion of Neolithic populations into Siberia and East-Northeast Asia.

#### **New dental and postcranial remains of late Eocene *Wadilemur elegans* (Galagidae, Lorisiformes).**

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The late Eocene primate *Wadilemur elegans*, from Quarry L-41 (Jebel Qatrani Formation) in northern Egypt, was originally described as an anchomomyin adapiform based on two mandibles preserving information from p3-m3. Recent work has led to the recovery of new material referable to this species, including the first record of the upper dentition (P4-M2), a complete hemimandible preserving p2-m2, and a proximal femur. A phylogenetic analysis that includes this new material supports stem galagid, and not anchomomyin adapiform, affinities for *Wadilemur*.

Relatively small and mesiodistally compressed alveoli for the lower canine and incisors suggest that *Wadilemur* had a toothcomb. The p2 is caniniform with a mesially oriented protoconid, as in extant galagids. The upper molars are similar to *Saharagalago* and Miocene-Recent galagids in having deeply notched distal margins, cuspidate hypocones, small paraconules, trenchant postprotocristae, and buccally oriented postmetacristae. P4 has a long and buccally oriented postparacrista and a small hypocone, but differs from extant galagids in lacking a metacone. The proximal femur is similar to extant galagids in having a cylindrical head with flattened posterior and medial

surfaces, a large fovea capitis, an articular surface that extends onto the posterior and dorsal portions of the neck, and an anteroposteriorly elliptical and mediolaterally compressed shaft, but retains some plesiomorphic features that are also seen in Miocene *Komba*.

Unless all of these similarities to galagids are primitive or due to convergence, *Saharagalago* and *Wadilemur* support an Eocene divergence of Galagidae from other lorisiforms, and imply a surprisingly ancient origin for both crown Lorisiformes and crown Strepsirrhini.

#### **Multivariate comparison of divergent ossification patterns in the mammalian proximal femur.**

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A comprehensive understanding of the proximal femur's complex developmental history is required to fully understand its functional morphology and internal structure. In humans, the femoral head and greater trochanter ossify separately from a common chondroepiphysis and remain so throughout growth. However, the pattern of development in other mammalian taxa is largely unknown, and we therefore previously examined femoral neck ontogeny in a wide range of mammals. We observed two distinct types of ossification: a "separate" pattern in which the femoral head and greater trochanteric epiphyses remain discrete throughout development as in humans, and a "coalesced" pattern in which a single osseous epiphysis emerges to cover the entire end of the bone much like the proximal humerus. We found clear morphometric differences between these two classes of epiphyseal ossification. However, our previous analysis was limited to juveniles, and age- and size-related factors may complicate simple interpretation of the results.

To determine whether these patterns persist throughout ontogeny, we examined adult femora from diverse mammalian species of known ossification type (based on our previous analysis). We found a strong relationship between adult femoral morphology and developmental mode. In general, species that display "separate" ossification have deeper trochanteric notches and longer femoral necks compared to species that display "coalesced" ossification. In addition, "separate" spe-

cies have more constricted and well-defined femoral necks than do "coalesced" species which have more humerus-like proximal femora. As ossification type varies within Primates, these developmental differences must be considered when comparing femoral anatomy and architecture across diverse primate species.

**The habitat and trophic preferences of *Paranthropus*, a new theoretical model.**

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Researchers have actively investigated the ecological preferences of *Paranthropus* for fifty years. Fossils attributed to *Paranthropus* have been recovered from Plio-Pleistocene sites in Ethiopia, Kenya, Tanzania, Malawi and South Africa, indicating a broad geographic range. The suite of unusual morphological features that diagnose this taxon exhibited remarkable stability for over one million years, suggesting a stable adaptive regime. Co-occurrence with *Homo* at several localities reinforces the impression that *Paranthropus* occupied a distinct niche. Four major hypotheses have been advanced to explain the ecology of *Paranthropus*: it has been reconstructed as a strict herbivore living in relatively closed, mesic conditions (Robinson), as a grass-seed eater in open country (Jolly), as a frugivore (Walker), and as a generalized omnivore (several recent researchers). Here a fifth hypothesis is proposed that is shown to be more congruent with all available lines of evidence. The new model states that the most derived members of *Paranthropus* (*P. aethiopicus/boisei* and *P. crassidens*) inhabited wetland environments, and that feeding on hard-shelled invertebrate prey constituted the selective force that led to their specialized craniofacial and dental morphology. This hypothesis is consistent with anatomy, biomechanics, dental microwear, environmental context, and community structure. The new model is testable through an analysis of microwear and isotope signatures in fossil and modern specimens of *Aonyx* (Cape clawless otter) and *Atilax* (marsh mongoose), organisms that occupy niches analogous to that hypothesized for *Paranthropus*.

**Biobehavioral adaptations in a Late Upper Paleolithic Southeast Asian population (Tam Hang, Laos).**

L.L. Shackelford. Dept. of Anthropology, Washington University.

Most information about patterns of postcranial robusticity in the Upper Paleolithic comes from well-studied regions of western Europe. Ongoing fossil discoveries and analyses continue to contribute information about lesser known areas of the world. This research makes use of recently analyzed fossils from Southeast Asia (Tam Hang, Laos), as well as other available data from the Upper Paleolithic of Asia, Europe and North Africa. General measures of robusticity are examined to analyze humeral and femoral strength under axial loading (cortical area) and against torsion and bending (polar moments of area) for Tam Hang. Changes through time are considered, as are differences between fossils from the broad regions specified above. Tam Hang is similar to other Late Upper Paleolithic humans in having relatively robust humeri. Patterns of humeral asymmetry in Tam Hang are unusual for late Pleistocene humans, with two of six individuals showing left-hand dominance. Lower limb robusticity in Tam Hang falls within the range of other Upper Paleolithic individuals.

Late Upper Paleolithic humans have greater humeral axial strength than Early Upper Paleolithic humans, though there are no discernable differences in polar moments of area. There are no significant changes in femoral strength through time. With respect to regional differences, North Africa differs from all other areas in standardized measures of cortical area in the humerus and all measures of femoral robusticity. Patterns of robusticity in Tam Hang are similar to other fossils from Europe and Asia, which have been interpreted as representing biobehavioral changes towards decreased mobility.

**Foraging, ranging, and spatial memory in the mantled howler monkey (*Alouatta palliata*).**

C.A. Shaffer. Department of Anthropology, Washington University in St. Louis.

Anecdotal evidence for the use of spatial maps is common in the primate literature but quantitative studies are few. I collected 120 hours of data on the foraging and ranging patterns of mantled howler monkeys (*Alouatta palliata*) on Isla de Ometepe, Nicaragua to assess what type of spatial information they may use when traveling between feeding and resting sites.

Howlers spent almost 70% of their day resting, and concentrated feeding on

young leaves (74%). Howlers had a small home range (5 Ha) and had an average day range of about 600 m. Howler feeding and resting trees showed a clumped spatial distribution (Coefficient of Dispersion greater than 1). Howler travel was very direct between feeding and resting trees and howlers traveled only 29% more than the straight line distance between these goals on average. Also, howlers rarely backtracked during travel (78% of turning angles less than 90 degrees from straight line travel) and generally traveled in single file. Howler travel appeared goal-directed. In addition, howlers reused travel routes frequently and usually used the same pathways when traveling to previously used feeding trees (67% of the time).

Nicaraguan howlers, therefore, appear to rely predominantly on topological or route-based spatial information when moving from one goal to another. They counteract the patchiness of their feeding and resting sites through goal-directed travel and the use of topological spatial representations. These results have important implications for the selective pressures acting on goal-directed travel and spatial representations in humans.

**Allometric influences on facial form in lesser apes.**

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The lesser apes offer a strong case study for examination of allometric influences, since they comprise a closely related and adaptively similar suite of taxa which differ in body size. This adult size variance is almost as great within the cluster of gibbon species, as it is between the large siamang and the biggest of the gibbons. In this study we utilize the extensive published dataset of N. Creel and H. Preuschoft to test the previously unexamined hypotheses that (1) facial proportions exhibit significant allometric variation across gibbons of differing terminal adult size; and (2) siamang-gibbon differences in facial proportions follow the trajectory observed within the gibbon cluster. We examined 12 measurements mapping upper, middle and lower facial lengths (perpendicular to a vertical line through the external auditory meatus); mean values for adult males and females were available for 9 gibbon species plus the siamang. The hypothesis of within-gibbon allometry was supported, since facial dimensions were moderately strongly correlated with a global (Sneath) size variable,

and all dimensions exhibited regression slopes greater than the isometric prediction of 1.0. Our second hypothesis was also supported, since the addition of the siamang values to the within-gibbon regression slope did not yield a group slope value significantly outside the original 95% confidence interval for any of our variables. The implications of these preliminary findings for the role of allometry in patterning morphological craniofacial variation within the gibbons, within the hylobatids as a group, and within the entire hominoid radiation will be discussed.

**Immunity and micronutrient status: New directions for field research.**

B. Shell-Duncan, Dept. of Anthropology, University of Washington.

Nutrition is a critical factor modulating immune homeostasis and thereby the outcome of host-microbe interactions. In community-based studies of nutrition and immunity, much attention has been devoted to assessing the immunosuppressive effects of protein-energy malnutrition. This focus has been directed in part by methodological considerations regarding the availability of "field-friendly" methods of assessing nutrition. It is recognized, however, that in populations with limited dietary diversity, protein and energy intakes may be adequate, while micronutrient deficiencies arise. Furthermore, it is evident that several micronutrients influence immunocompetence, and affect infection-related morbidity and mortality. Deficiencies of iron and vitamin A are of particular concern because they are widely prevalent in developing countries. Severe deficiencies of iron and vitamin A have been shown to alter specific immune mechanisms, particularly cell-mediated immunity. Additionally, both micronutrients modulate the innate immune system, vitamin A through its effect on epithelial integrity, and iron by becoming sequestered and unavailable for microbial replication. Restricted iron availability also is an important regulatory signal controlling the expression of toxins and other virulence determinants in pathogenic bacteria. Still, the role of vitamin A, iron and iron-binding proteins in the immune system is complex and far from completely understood.

Field studies of iron and vitamin A status are becoming increasingly feasible due to the development of simplified, minimally-invasive methods. This discussion will 1) highlight select field-friendly methods for assessing micronutrient nutrition and immunocompetence,

2) demonstrate the feasibility of such methods in recent fieldwork in northern Kenya, and 3) outline directions for future field research.

**Isotopic analysis of mummified human remains from northwestern Argentina: A dietary reconstruction.**

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Isotopic analysis was performed on samples of mummified human remains, ranging in age from 4000-500 BP, from several sites in the Mendoza and San Juan provinces of northwestern Argentina. The analysis of stable carbon and nitrogen isotopes is integral to the understanding of prehistoric subsistence patterns, and provides complementary quantitative data to zooarchaeological and paleobotanical evidence. This technique reveals the proportions of C3 and C4 plants and the contribution of aquatic resources to otherwise terrestrial diets, as well as variations in trophic level of the foods consumed.

Bone collagen, bone apatite, tooth enamel, nail, flesh and hair samples were used to evaluate the relative importance of dietary contributions of flora and fauna, particularly maize and fish, in the subsistence of the region's human population, as well as seasonal variation. The results obtained are compared with chronological and isotopic information available for other sites in this part of South America. The analyses of bone collagen and apatite portray the average diet over the last several years of life, while those of tooth enamel reflect diet during the age of crown formation. This combination of analyses is useful for contrasting the juvenile and adult diets of individuals, but conclusions are limited to the representation of average diets. In contrast, the isotopic analyses of small segments of hair reveal seasonal, even monthly, dietary variations. In combination, the analyses of multiple tissues allow the reconstruction of a dietary life history for these well-preserved individuals from the edge of the Inca world.

**Measurement of urinary C-peptide in chimpanzees offers a noninvasive tool for comparative studies of energetics.**

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Human life history patterns and energetics often gain perspective with greater understanding of comparable attributes in other apes and nonhuman primates. Field research designed to address questions related to ecology, energetics and life history trade-offs could benefit greatly by methods that allow noninvasive measures of physiological states related to energy regulation.

C-peptide has been used widely in clinical research as a biomarker of insulin levels in humans. C-peptide is the "connecting" chain of amino acids present in proinsulin, which is subsequently cleaved and excreted as a metabolite in urine. In recent years, urinary C-peptide has been applied to anthropological field studies of human energetics and reproduction. Urinary C-peptide has also been used as a reliable indicator of endogenous insulin secretion in laboratory studies of diet-restricted rhesus macaques.

We set out to validate a protocol for measurement of urinary C-peptide in chimpanzees for use in field research. We report the results of our laboratory procedures, including modification of a C-peptide radioimmunoassay kit developed for humans and measurement of C-peptide in matched serum and urine samples from captive chimpanzees. In addition, we present preliminary data on urinary C-peptide values in wild chimpanzees from Kanyawara, Kibale National Forest in Uganda.

We conclude that measurement of urinary C-peptide can provide a valuable method for assessing energetic condition in chimpanzees and possibly other non-human primates. We highlight the potential uses for comparative studies of energetics and reproduction in particular.

**Haplotype resources in dbSNP: NCBI's database of genetic variation.**

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NCBI's dbSNP database of genome sequence variation offers data for population structure and haplotype analysis, association studies, and functional analysis. The database serves the community in dual roles; both as an author-driven archive and curated resource for whole genome annotation. The complete contents of dbSNP are available freely to the public.

dbSNP currently contains submissions for 11.45 million sequence variations observed in 19 species. Organized by class of sequence variation the database contains: 11.1M single nucleotide polymorphisms SNPs; 331K deletion/insertion polymor-

phisms (DIPs), 331 polymorphic retroposons and 5K short tandem repeats (STRs). The high levels of redundant submissions require active curation and clustering by the dbSNP staff. Identical, independent submissions are currently grouped into 7.04M RefSNP clusters. These clusters provide a stable identifier space, with accessions provided by dbSNP anchoring the higher dimensional data of linkage structure, haplotype diversity and ethnic differentiation to the reagents and final deliverables of the genome project. dbSNP currently catalogs extensive variation in humans and other model organism genomes: mosquito, mouse, chimpanzee, and rat. These resources can provide tremendous utility in theoretical, experimental and clinical contexts.

NIH is supporting this potential through a substantial investment in reference reagents such as clone repositories of mammalian genes and immortalized cell lines developed from large samples of contemporary world populations. When complementary reagents are unified by genotypes and systematic measures of linkage disequilibrium across the genome, a framework is established that connects theoretical, experimental and clinical research programs. Stable reference genome sequence is an organizing template for many annotation efforts. Polymorphism annotation currently includes large-scale polymorphism detection results; functional variants in coding regions; individual genotypes in out-bred populations and strain-specific haplotypes in model organisms. Population measures like genotype and allele frequencies are now being supplemented with local coverage-corrected measures of sequence diversity. dbSNP is structured to integrate these basic properties of variation and serve them to the research community through database queries, annotation, distribution of content and network interfaces.

### **Two new Neandertal brain endocast reconstructions from Krapina.**

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The Krapina fragments, "C" and "E" (now 3 and 6 respectively) have not previously been endocast. Both have enough cranial material on one side to allow fairly reliable reconstruction of hemi-endocasts that provide accurate volumes. The vol-

umes were determined to be between 1205 (#6) and 1255 (#3) ml. These newer volumes suggest that they were females, and when added to the total Neandertal sample, reduces the average endocranial volume to a value very similar to modern *Homo*. Could it be that Neandertals did not have a larger cranial capacity than anatomically modern *Homo*?

### **Detecting relationships in the Great Lakes region using ancient mtDNA.**

B.A. Shook. Dept. of Anthropology, University of California Davis.

Linguistic studies suggest an extensive expansion of the Algonquian language family across the Great Lakes regions throughout the Late Archaic and Woodland periods (approximately 3000bp to contact). Seemingly in contrast, archaeological studies indicate the Great Lakes region experienced significant cultural diversification, extinctions, and/or replacements during this time, confusing the relationship among prehistoric populations and the ancestry of modern Algonquian speakers. In this study, mtDNA was extracted and analyzed from 52 individuals from five prehistoric populations, providing a useful tool in estimating the likelihood of biological relationships and aspects of demographic history in this region.

Previous ancient mtDNA analysis of the Norris Farms Oneota population (600bp, Stone and Stoneking 1998) displays a haplogroup distribution common to contemporary Native Americans across the Northeast, showing that biological continuity extended at least as far back as proto-historic times (Malhi et al. 2001). MtDNA haplogroup and control region sequence analysis of ancient human remains from the Morse site (Red Ocher, 3000bp, n=12) and the Orendorf site (Mississippian, 1000bp, n=16), all from the same county as Norris Farms, however, indicate biological continuity does not date that far back. Similarly in Southern Ontario, mtDNA haplogroup and haplotype analysis of individuals from the Great Western Park site (Great Western Basin tradition, 800bp, n=6) indicate genetic continuity existed across the Great Lakes until at least 800bp, but earlier Glacial Kame populations (3000bp, n=18) are genetically distinct. This paper will use further compare these populations and discuss potential explanations for the genetic diversity seen before 1000bp.

### **Charting genomic variability for clues on population history and genetic adaptation.**

M.D. Shriver. Department of Anthropology, Penn State University.

The completion of the human genome sequence and recent technological advances have provided the opportunity to perform genomic-level studies of human variation. There is substantial potential for such "population genomic" approaches to assist efforts to uncover the historical and demographic histories of human populations. Additionally, these genome-wide datasets allow for investigations of variability among genomic regions. Although all genes in a population may have experienced the same demographic events, they have not been affected by these events in precisely the same way. Much of the variability among genomic regions is simply the result of genetic drift, but some is also the result of genetic adaptation, which will only affect the gene under selection and nearby regions. We (a consortium of over 20 investigators) have performed one such study using a new DNA typing assay developed by Affymetrix, Inc (Santa Clara, CA). 203 individuals from a selection of 12 geographically diverse populations (including the Nasioi from Bougainville) were assayed using this new method, which facilitates typing 11,555 SNPs after a single whole-genome amplification PCR reaction. We have investigated the evolutionary histories of these individuals and the populations they represent using neighbor-joining trees, principle coordinates analysis, ancestral allele frequency and linkage disequilibrium analysis. For each of these analyses we have examined not only the average parameter estimate for the population, but also the degree to which there is variability about this average that might in some way reflect locus-specific random and directional effects. Our findings will be discussed with particular emphasis on Island Melanesia.

### **Validating subjective signals of ovulation.**

L.L. Sievert, C. DuBois. Department of Anthropology, University of Massachusetts, Amherst.

About 50% of women think they know when they ovulate. Are they correct in this belief? In an ongoing study of the perceived signals of ovulation, 38 women aged 20.9 to 44.0 (mean 30.4 years) have been recruited to provide urine samples across three menstrual cycles. Criteria for recruitment include ages 18 to 45 years, regular menstrual cycles, not using hormonal contraception, and perceived ovulation. Subjective signals of ovulation vary

between women and between cycles, but include ovulatory pain, vaginal discharge, and changes in libido or mood. In order to test if women are correct, they are asked to collect and refrigerate urine samples from day 5 through day 20. When ovulation is perceived, participants cease to collect urine and contact investigators. The samples collected within 48 hours of the perceived signal are then tested for a pre-ovulatory LH surge. Women have participated in the study from one to six cycles and, to date, 42 cycles have been tested. Urine is tested only when women perceive ovulation to have occurred. Of the 42 cycles, 10 were positive for a pre-ovulatory LH surge (23%). In this presentation, concordance between perceived and measured ovulation will be examined in relation to method of detection (i.e., subjective signal), age, education level, BMI, sexual activity, reproductive history, minutes of exercise per day, daily self-reported levels of stress, smoking habits, caffeine intake, and symptoms of PMS. This work was supported by the Wenner-Gren Foundation for Anthropological Research.

**Reconstruction of ear ossicles from the most primitive primate cranium known using ultra high resolution computed tomography.**

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The anatomy of the ear ossicles influence the range of sounds that an animal can hear, and comparison of the relative proportions of these bones can provide a guide to the habitual frequencies perceived and the range of sounds that can be discriminated. Fossil ear ossicles are rarely recovered, however, both because of their small size, and because of their tendency to fall out before fossilization. Even if ossicles remain in the middle ear cavity, it may be impossible or impractical to remove them for study. Ultra high-resolution X-ray computed tomography (uhrCT) offers a method for non-invasive study of ear ossicles while they are still in place. Ear ossicles have been successfully reconstructed from uhrCT data in a comparison sample of modern primates, rodents, and marsupials using a new technique. The malleus and incus have also been successfully reconstructed from the late Paleocene (Clarkforkian) skull of a micromomyid plesiadapiform primate. Recent phylogenetic hypotheses place the

Micromomyidae as one of the most primitive families of primates known, with only purgatoriids (unknown from the cranium) occupying a more basal position. This new micromomyid skull is therefore the most primitive primate cranium currently known. Micromomyids are among the smallest primates (30-40 grams) and the ear ossicles preserved are each about 1.2 mm long in the longest dimension. Analyses of these bones allows for new insights into the auditory environment experienced by the most primitive primates. Research supported by NSF grants BCS-0003920 and BCS-0129601 to A. Walker and G. Gunnell, respectively.

**Early Pliocene hominids and their environments from Gona, Ethiopia.**

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Four field seasons of fieldwork in the Early Pliocene deposits at Asa Duma within the Gona Paleoanthropological Research Project Area, Ethiopia have resulted in the recovery of numerous fauna, including hominids. Radiometric and paleomagnetic data indicate an age between 4.32 and 4.51 mya. Remains from at least eight individual hominids have been discovered. The hominid dental anatomy (molar and canine crown size and shape, premolar root morphology, enamel thickness) indicate attribution to *Ardipithecus ramidus*.

Faunal composition is rich and diverse. Analyses of the stable carbon isotopes from the soil carbonates and dental enamel of the major macrofauna (except primates) were undertaken. The soils have  $\delta^{13}\text{C}$  values between  $-12.0\text{‰}$  and  $-3.9\text{‰}$  (mean =  $7.7\text{‰}$ ) indicating that the carbonates formed in a woodland or grassy-woodland setting. The majority of the fauna had a significant fraction of  $\text{C}_4$  (warm temperature) grasses ( $\delta^{13}\text{C} > -6.0\text{‰}$ ) in their diets with only most tragelaphine bovids and a deinotherie indicating a significantly browsing diet. Mesowear on the bovid maxillary teeth reflects this predominance of a grazing diet.

The Early Pliocene environment at Asa Duma included lakes, swamps, springs, and low energy streams. Woodlands pre-

dominated along the watercourses and springs that graded into grassy-woodlands. Faunal composition and stable isotopic composition of their enamel show a dietary emphasis on grazing. *Ardipithecus ramidus* at Asa Duma commonly associated with these fauna in a woodland and grassy-woodland environment.

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**A comparison of craniofacial sexual dimorphism in *Papio ursinus* and *P. cynocephalus*.**

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Our interpretation of variation in the fossil record is highly dependant upon our understanding of variation within and between living species. A large proportion of intraspecific variation in primates is attributable to sexual dimorphism, and a number of studies have evaluated such dimorphism, especially in body and canine size. Relatively few have compared patterns of craniofacial dimorphism across closely related but geographically distinct species.

Here we use Euclidean Distance Matrix Analysis to compare patterns of sexual dimorphism between two species of baboons. 3-D coordinate data were collected from eighteen landmarks on the face and cranial vault of chacma baboons (*Papio ursinus*; N=22) from the Western Cape, South Africa, and compared to existing data from Kenyan yellow baboons (*P. cynocephalus*; N=16). Shape and form difference analyses were performed between sexes and species. PCOORD analyses allowed visualization of differences in facial shape.

For both species, measurements of the neurocranium and orbits are less sexually dimorphic than those of the nasal and oral regions. However, yellow baboons show relatively more overall dimorphism, despite their smaller body size. Patterns of dimorphism differ considerably: yellow baboons are more dimorphic in posterior palate height and overall facial width, and chacma baboons in the nasal and oral regions. These results suggest that: (1) differences in dimorphism patterns are not driven solely by body size dimorphism, but may be linked to evolutionary history, geographic distribution and/or ecological adaptation; (2) patterns of dimorphism are not necessarily shared by closely related species, confounding interpretation of variation in the fossil record.

**An evaluation of the coefficient of variation and average taxonomic distance to detect multiple taxa in extant hominoid samples.**

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Hominin taxonomy benefits from analytical techniques that quantify intraspecific variation in fossil samples and provide objective data from which the likely presence of more than one paleospecies could be assessed. Average taxonomic distance (ATD) and the coefficient of variation (CV) are used to assess intraspecific variation within fossil samples, yet they have not been adequately tested on extant hominoid samples. In fossil samples that contain two taxa, each taxon will not necessarily be represented equally.

This study evaluates the performance of ATDs and CVs of size and shape measures of the mandibular corpus to: a) measure intrataxon variation, b) detect the presence of two, closely related taxa in a sample with 50%, 25%, 10%, 5%, and 1% representation of one taxon relative to another, and c) perform each of these tasks with sample sizes similar to those found in the hypodigms of hominin taxa. The study sample includes 50 individuals each of *Gorilla gorilla*, *Pan troglodytes* and *Pan paniscus*.

Results indicate that when samples consist of two species the CV of mandible size and the mean and maximum ATDs returned by exact randomization are substantially elevated for samples with taxa mixed at 50%, 25%, 10%, 5% and 1% compared to those values for any single species. Identification of two species within a single sample using shape variables proved difficult at any level of mixing between *P. troglodytes* and *P. paniscus* but possible between *G. gorilla* and *P. troglodytes* at the 50%, 25% mixing level. (MS is supported by the George Washington University Presidential Fellowship, BW is supported by the Henry R. Luce Foundation)

**Modeling the precision of landmark location data.**

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The toolkit of geometric morphometrics centers on Procrustes shape coordinates

for landmark location data. The geometry of these coordinates is tuned to one specific model of the *error variance* of the raw data: a model of identical variability of each Cartesian coordinate, independently, in the space of the digitizing machine. When studies are of multiple specimens, and digitizing is by multiple operators, questions arise concerning the realism of such summaries.

While the full covariance of these deviations is complicated to visualize, a simpler summary, via the *trace* of the covariance matrix, is amenable to analysis. We selected eleven skulls from the collection of Naturhistorisches Museum Wien. From 35 initial point landmarks, 27 could always be located over a total of 32 separate digitizing-redigitizing sessions by one of five operators.

While it is a commonplace that landmarks vary in variability—triple sutural points are best, extremal points like opisthocranium worst—it came as a surprise that often interoperator effects and interspecimen effects on the trace are both substantial. Such heteroscedasticity (variability of variance) causes the multivariate analysis of the ensuing Procrustes shape coordinates to lose power no matter how noise covariance is modeled.

To resolve these difficulties, the field should consider new landmark definitions that clarify the geometric verifications assigned to the digitizer wherever local anatomy or its variation is sufficiently complicated. We might also consider replacement of punctate landmarks by semi-landmarks in regions where tenable point definitions that acknowledge the variety of human/primate morphology prove tricky to construct.

**An empirical test of mortality bias in the skeletal series from Hasanlu.**

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Since the controversial article by Wood and colleagues regarding the "Osteological Paradox" was published in 1992, the question of whether skeletal samples from cemeteries are truly representative of the demography and health of the groups that created them has been a central question for paleodemography. Two major categories of bias were presented in that work: selective mortality bias, and the "osteological paradox". In the former, the possibility that individuals who enter the cemetery sample at young ages are more frail than members of their generation who survive to older ages is considered. The osteological paradox, on the other hand, considers the fact that most stress

that leaves markers on the skeleton is chronic, and that to have survived long enough to produce bony response to disease is ironically a marker of comparatively good health.

This study uses a unique archaeological sample from Hasanlu (N=335), comprised of two distinct components: a conventional cemetery with individual burials, and a destruction layer, resulting from the sacking of the city by foreign invaders ca. 800 B.C.E. The destruction layer represents a cross-sectional sample, containing individuals who died for reasons unrelated to their health, and thus provides a control group to which the cemetery sample may be compared for incidence of both biases. This study did not find any compelling evidence that either the osteological paradox or selective mortality bias is as important in the reconstruction of past peoples from their skeletal remains as is the circumstantial bias surrounding their excavation.

**Apical tuft morphology in subfossil lemurs and living primates: function and phylogenetic inertia.**

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Various giant extinct (subfossil) lemurs from Madagascar, such as the palaeopropithecines and *Megaladapis*, have been reconstructed as arboreal and antipronograde. *Archaeolemur*, in contrast, was a pronograde, terrestrial quadruped. Recent findings permit us to examine one aspect of the digital morphology of subfossil lemurs for the first time—morphology of the distal phalanx. This study focuses on the size and shape of the apical tuft of the distal phalanges to elucidate the morphological affinities of the hands and feet of subfossil lemurs *Archaeolemur*, *Babakotia*, *Megaladapis*, and *Palaeopropithecus*.

Two indices of relative size were used: robusticity (maximum mediolateral tuft width divided length of phalanx) and expansion (tuft width divided by basal width of phalanx). A sample of extant primates was measured similarly in order to evaluate morphological affinities of the subfossil lemur taxa. Differences among and between taxa were tested using one-way ANOVA and Tukey post hoc multiple comparison statistics.

Subfossil lemur apical tufts were significantly larger than those of living suspen-

sory primates. Subfossils were most similar to extant prosimians, especially lemurs and tarsiers, regardless of locomotor category, and to a lesser extent cercopithecines and humans. This implies that giant extinct lemurs may have sported expanded, fleshy pads on their fingers and toes—as do their living strepsirrhine counterparts. Despite having long and highly curved proximal phalanges, the distal phalanges of sloth lemurs show little morphological affinities with those of suspensory anthropoids. Phylogenetic inertia appears to be stronger than the functional signal in this clade. [Supported by NSF BCS-0129185 & SBR-963350]

**Patterns of mitochondrial variation in Melanesia and implications for the settling of the Pacific: Haplogroup 8.**

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The Bismark Archipelago has been identified by archaeologists as the homeland of the Lapita people, the first settlers of outer Oceania, yet little genetic research has been undertaken in these islands to test hypotheses of migration to Polynesia. We have analyzed a total of over 1000 samples from Austronesian and non-Austronesian speaking populations of New Britain and New Ireland sequenced for over 1000 base pairs of HVS 1 and 2, and we are currently sequencing additional samples from Papua New Guinea, Ontong Java, and Bougainville as well as from Remote Oceania. A transition at position 16468 of the Anderson, et al. sequence was identified which is common in New Britain populations and found in outer Oceania but is absent from all the New Guinea samples (as well as from Southeast Asia sequences found in GenBank). This is a key defining mutation of a previously undescribed mitochondrial haplotype we have named Group VIII. Its pattern of diversity and distribution indicate a very old age for the haplogroup, with the Bismarcks as its source of origin. This restricted haplogroup may shed some light on the age and distribution of the first peoples of Island Melanesia, and possibly give insight into the origins of the Lapita people.

**Population structure of Irish migrants to northern England in the late nineteenth century.**

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This paper explores the population structure of Irish communities in northern England by means of isonymy and migration history. Our hypothesis is that whereas the English-born populations will be expected to show isonymic relationships reflecting geographical distance (mediated through isolation by distance), the Irish-born, as recent migrants, will not.

Using a sample of 33,625 Irish-born heads of households and lodgers resident in the counties of Cumberland, County Durham and Northumberland, and 29,630 English born controls sampled from the 1881 census of England, random isonymy was calculated among Irish-born and English-born populations. Contrary to the hypothesis, both showed marked geographical heterogeneity, notably a distinction between the populations of Cumberland and those of Northumberland and Durham.

The pattern of isonymic relationships among the English-born can be interpreted in terms of isolation by distance and the topography of landscape, although labour migration associated with industrialisation has blurred local associations between isonymy and geography. The heterogeneity of Irish populations needs a different explanation, based on the limited birthplace information available for the Irish in the 1881 census, and conventional historical evidence. Irish settlement in northern England was determined by various factors, including migration streams within Ireland and England and the sea-routes between them. Settlement patterns were neither arbitrary nor individualistic, with family- and locality-based "chain migration" providing a major conduit. There was also a sectarian element to the economy and geography of settlement, with skilled Protestant workers employed in shipbuilding, whilst Catholics were more likely to work as general labourers in heavy industry.

**A preliminary study of seed dispersal by white-faced capuchins (*Cebus capucinus*) and mantled howlers (*Alouatta palliata*) in Costa Rica.**

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Primates are reported to play an important role as seed dispersers in tropical forests. Seeds ingested and defecated by

primates are often viable, and show increased frequencies and rates of germination when compared to non-ingested seeds. The degree to which this pattern varies among seeds of different plant species or with different primate dispersers is unclear.

I compare germination frequency and germination rates of seeds of *Castilla elastica* defecated by white-faced capuchins and mantled howlers with seeds obtained directly from the fruit. *C. elastica* is an important plant species consumed by howlers and capuchins during the wet season. Fecal samples from capuchins (N = 36) and howlers (N = 76) were collected from May – July 2003 at Estacion Biologica La Suerte in northeastern Costa Rica. Seeds of *C. elastica* found in feces (capuchins, N=73; howlers, N = 184) and seeds obtained directly from the fruit (N = 188) were placed in petri dishes with moist filter paper and checked daily for germination.

Nearly all control seeds (99.5%) and seeds passed by capuchins (97.3%) germinated, whereas seeds passed by howlers had lower germination frequencies (82.5%, chi square = 32.9, df = 1, p < 0.001). Seeds passed by capuchins had similar average latency periods (3.7 days) to control seeds (3.5 days), whereas seeds passed by howlers had slightly longer average latency periods (4.4 days). These results suggest seeds of *C. elastica* are affected differently during gut passage through mantled howlers and white-faced capuchins. Additional relationships concerning primate frugivory, seed dispersal, gut passage rates, and forest regeneration are discussed.

**A new method for measuring soft tissue thicknesses of the face using ultrasound.**

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A reliable baseline for soft tissue facial thicknesses is needed for forensic reconstruction and for assessing surgical changes. Cadaver measurements are limited and affected by postmortem changes. Ultrasound has been used on living subjects for measurement at discrete landmarks. Our method extends this research by allowing the scanning of continuous contours without deforming surface tissues.



Software (Echotech; GE Medical Systems) is available that can create 3D reconstructions of scanned objects, but the potential of such software has not been realized for anthropological research because standard probes do not conform to facial contours and moving probes over facial tissues causes tissue distortion. Our purpose is to report the development of a new technique utilizing a water bath in which subjects briefly submerge the face; the probe is applied to the water container rather than the face. The operator follows the facial contours by viewing the subject's face in a mirror placed beneath the clear container. Anatomical landmarks can be located precisely by placing reflective markers at desired points. Skin, subcutaneous fat, and muscle thickness can be measured separately. Repeat measurements of several landmarks on seven adult subjects indicate good reliability, ranging from average differences of 0.73 mm for the upper lip (A-point tissue thickness average, 12.7 mm) to 1.47 mm for nose projection (projection length average, 26.5-26.6 mm).

Ultrasound is relatively inexpensive and is applicable to large numbers of living individuals. Extension of this method of measuring facial tissue thicknesses to 3D continuous contours is now possible.

### **Is there a valid morphological basis for primate macrosomia or microsomia?**

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The terms "macrosmatic" and "microsmatic" were first used to contrast levels of olfactory function among animals such as dogs and humans (Turner, 1891). Later quantitative studies on olfactory structures in primates concluded that the olfactory sense is more reduced in haplorhines than strepsirhines, and in diurnal primates compared to nocturnal primates. Because authors have varied in their approach to comparing olfactory structures (e.g., absolute versus proportional measurements), we explored the importance of allometry to the concept of microsmia using data on olfactory structures in primates and insectivores.

Existing data on insectivores revealed that measurements of the olfactory epithelium are weakly correlated with total brain volume or body mass, whereas there is a strong correlation of olfactory bulb volume with total brain volume or body mass. Furthermore, at lower taxonomic levels, interpretations based indices of

olfactory structure size relative to body mass conflicted with interpretations based on total receptor neuron population. Our observations also revealed that receptor density in the olfactory epithelium varies among primates and insectivores, with no clear relationship to body size. These observations suggest that scaling may needlessly distort data when low and intermediate taxonomic level comparisons are made. If neuronal numbers are assumed to be the most appropriate quantifier of chemosensory acuity, then measurements of absolute size may be compared, provided that cell density is similar in the species under study. It appears appropriate to reevaluate the categorization of haplorhines as "microsmats", as well as the morphological concept of microsmia itself.

### **Relative enamel thickness in a large sample of *Pan* and *Pongo* molars.**

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Enamel thickness has played a substantial role in discussions of hominid origins for several decades, despite the fact that little has been known about its variation until recently. Martin (1983) devised a measure of relative enamel thickness (RET) that permits comparisons among primates, and found that RET shows high variability within species and within the molar row, with enamel thickness generally increasing posteriorly. However, no study has been able to show this for non-human primate permanent molars with statistical significance, nor has intra-specific variation been accounted for. In this study, RET is quantified for sections through mesial and/or distal cusps in 34 molars from 26 chimpanzees and 51 molars from ten orang utans, and analyzed using unpaired and paired t-tests. *Pan* shows a general, although non-significant, trend of increase in mesial RET from M1 to M3, while the larger sample of *Pongo* shows a significant increase ( $p < 0.01$ ). Mesial sections are significantly thinner than corresponding distal sections in both taxa ( $p < 0.05$ ). These differences in RET are due to increases in enamel and decreases in dentine posteriorly both within the tooth and the molar row. These trends are related to decreasing distal cusp area in posterior molars, and implies that RET values should not be lumped for molar

positions. The range of intra-specific variation in RET is related to variation in crown height and breadth. Finally, results for *Pan* and *Pongo* M1s are compared to revised values for *Gorilla*, which shows significantly thinner enamel than *Pan* or *Pongo*.

### **Body composition and proportions in gibbons (*Hylobates*) and siamangs (*Symphalangus*): A preliminary report.**

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Gibbons and siamangs are small-bodied apes that inhabit the rainforest canopy of Southeast Asia and are well known for their locomotor skills. When these closely related genera are sympatric, behavioral distinctions in foraging, feeding, and locomotion become apparent. For example, gibbons move more quickly and have larger day ranges. Our study explores the anatomical similarities and differences in body composition, body proportions, and muscle groups. Whole body dissections were carried out on five females representing both genera. Major components (muscle, bone, skin) were separated and weighed to determine their distribution through the segments of the body (head, trunk, forelimbs, hindlimbs). Individual muscles were also weighed and compared. Although gibbons are lighter in body mass than siamangs, the two genera are similar in overall body composition (average 35% muscle, 19% bone, 12% skin). The two genera differ, however, in body proportions and distribution of mass to the limbs. When taken as a percent of total body mass, gibbon forelimbs are lighter than hindlimbs (17.1% vs. 19.5% respectively). In contrast, siamang forelimbs are heavier than hindlimbs (19.5% vs. 17.7%). The two genera differ significantly in the distribution of mass within limb segments (e.g. thigh, leg, foot) and the proportions of functional muscle groups. For example, in gibbons the knee extensors are almost three times heavier than flexors, while in siamangs they are less than two times as heavy. The ranges of these measures do not overlap. This study increases our understanding of the intricate locomotor and behavioral adaptations of gibbons and siamangs.

### **Quantitative trait linkage mapping studies in the Schmiedeleut Hutterites of South Dakota.**

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Genetically isolated (endogamous) populations are expected to share a greater proportion of "background" genes for complex traits and have fewer major locus mutations relative to the general, non-endogamous population. Combined with large mean sibship sizes, communal lifestyles, and extensive genealogical information, these factors make endogamous groups like the Hutterites of North America ideal populations in which to detect, characterize, and localize genes influencing variation in complex traits or susceptibility to common complex diseases. We have begun collaborative epidemiological and statistical genetics research focused on age-related changes in bone among the Schmiedeleut Hutterites of South Dakota. The ultimate goals of this collaboration are to identify genes influencing these changes, as well as variation in skeletal responses to endocrine, nutritional, and physical activity variables.

Compared to rural non-Hutterites, initial epidemiological analyses of DEXA, pQCT, and ultrasound data disclosed significantly greater bone mineral content, density, and quality in the hip, spine, and forearm, among the Schmiedeleut. Our statistical genetic analyses of data from over 700 Schmiedeleut predominantly from a single, inbred pedigree, returned significant heritability estimates ( $P < 0.01$ ) for all measures. We have detected significant contributions of nutritional factors, reproductive hormones, and physical activity measures; and have detected significant genotype-by-physical activity interactions on BMD. With methods developed specifically for data from such populations, we propose to expand our sample to over 2000 Schmiedeleut from 16 South Dakota colonies -- all from a single, inbred pedigree -- in order to conduct whole genome linkage screens for QTLs responsible for these effects and interactions.

**Acoustic variation in the long calls of wild spider monkeys (*Ateles belzebuth belzebuth*).**

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Many primates produce 'long calls,' species-specific acoustic signals of great intensity that carry over long distances. Such vocal signals may provide a means by which individuals can broadcast and gather important information from or about widely dispersed conspecifics. This

study investigated the function of the white-bellied spider monkey (*Ateles belzebuth belzebuth*) long call in Yasuní National Park, Ecuador. Both male and female spider monkeys produce long calls that are audible over distances of at least 1 km. These calls are thought to be used to regulate individual spacing and association patterns or to advertise the location of food resources; they may also play a role in mate attraction and selection. These different functions are not necessarily mutually exclusive, and it is possible that long calls function in multiple contexts. In support of this possibility, spider monkeys seem to produce acoustically different variants of the long call and to produce long calls in several different contexts. If these calls do function in multiple contexts, calling behavior or the acoustic structure of the calls themselves should vary according to context, in order to clarify the 'meaning' of the signal and provide receivers with accurate information. Current field research is investigating if different acoustic forms of long calls vary according to the context in which they are emitted. Contexts under consideration include whether individuals are in or near a food source, are moving, or are found in a particular social setting (specifically, according to the number, sex and dominance rank of others present).

**Seasonality and australopithecine diets: New high-resolution carbon isotope data.**

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Biogeochemistry has made significant contributions to our understanding of early hominid diets in recent years. Studies of the stable carbon isotopes locked in tooth enamel demonstrated that australopithecines ate not only fruits and leaves, but also C<sub>4</sub> foods in the form of grasses, sedges, or animals that ate these foods. However, such studies have been limited to producing values for "average" diets—usually over a period of years. Thus, it has been impossible to determine if the C<sub>4</sub> foods were utilized regularly throughout the year, or primarily on a seasonal basis (e.g., as fallback foods during the dry season). In this paper we present new high-resolution carbon isotope data of *Australopithecus* and *Paranthropus* teeth, enabling a first look into seasonal variability

in Plio-Pleistocene hominid diets. We also present high-resolution strontium isotope data in an attempt to discern australopithecine mobility patterns.

**GPS collars for monkeys: The state of technology.**

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GPS collars hold out the promise of dramatically increasing the efficiency and accuracy of wildlife telemetry. GPS collars are already used routinely by wildlife ecologists on large mammals and birds. However, few GPS collars are commercially available now that are small enough for routine use on small to mid-size mammals, including most primates. This paper reviews the state of technology of GPS collars for smaller animals, and the performance of GPS collars tested on Japanese macaques (*Macaca fuscata*).

The technological features of a GPS collar are constrained by the weight and capacity of the battery. To maximize electrical efficiency in small GPS collars, engineers choose among the many desirable features, such as high positioning frequency and quality, collar drop-off device, radio data down-load, and computing capacity to carry out complex programs. Commercially available GPS collars are designed with some combination of these features.

In this study, we are testing a GPS collar with radio communication capability. The GPS device succeeded in fixing positions under forest canopy, although at a lower success rate compared to when under an open sky. On a collar worn by a monkey, the GPS antenna faced skyward while the monkey was sitting upright or standing, but the monkey occasionally rotated the collar by hand. Radio communication allowed researchers to monitor the activities of both the monkey and the GPS device during the study. However, communication errors increased the amount of time used to down-load data, and probably reduced the number of days the GPS device operated.

**Arboreal bipedalism in Bwindi chimpanzees: Implications for models of the evolution of hominid bipedalism.**

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Researchers working on the origins of hominid bipedal posture and locomotion have long debated the relative merits of terrestrial versus arboreal precursors to ground-based habitual bipedalism. Beginning with Keith, arboreal postures and feeding have been considered an alternative to the view that hominids arose from terrestrial quadrupeds. The positional behavior of free-ranging great apes is a key piece of evidence in this regard. This paper presents results of a long term study of wild chimpanzees in Bwindi Impenetrable National Park, Uganda, in which bipedal posture occurred frequently. Bipedalism in Bwindi chimpanzees was seen only in arboreal feeding contexts. All age-sex classes except infants were seen foraging bipedally; females sometimes foraged bipedally while carrying infants dorsally. The majority of bouts (>85%) were seen in large *Ficus sp.* tree crowns. The frequency and duration of bipedal bouts showed significant positive correlation with the diameter of the substrate. Frequency and duration of bipedal bouts also varied positively with fruit abundance in the target tree.

I consider several hypotheses to explain why bipedal posture appears to be used by chimpanzees in Bwindi more often than at other study sites. These include forest structure, food preference, cultural tradition, and anatomical constraints on foraging imposed by snare wounds. Observer bias cannot be discounted; most observations of bipedal posture at Bwindi have been made from ridge tops, looking eye-level at chimpanzees in tree crowns, rather than the more typical ground-based observations.

**Early life stress and adult health: A view from the Western Hemisphere sample.**

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The Western Hemisphere database discussed in *The Backbone of History* contains four indicators of childhood health, along with three indicators of adult health for over 12,000 individuals who lived at 65 localities. The former include stature, linear enamel hypoplasias, cribra orbitalia and porotic hyperostosis, and the latter consist of age at death, dental decay and degenerative joint disease. This database is used to examine the relationship between childhood health and adult health and is inspired by debates in the medical community over the so-called Barker hypothesis. Barker and colleagues use modern studies to establish a positive empiri-

cal link between early childhood indicators of biological stress such as birth weight and early childhood growth, and adult health as measured by age at death and by diseases such as hypertension, diabetes and cancer. Much controversy surrounds the nature of the biological pathways by which such a link exists. This research clarifies the connection between childhood and adult health by studying diverse skeletal samples for evidence of the types of child-adult connections that existed across diverse ecological environments, which were quite stressful biologically compared with those faced by modern populations. Across all localities, dental health among adults had no relationship with any of the childhood indicators while degenerative joint disease increased with the incidence and severity of porotic hyperostosis, cribra orbitalia and linear enamel hypoplasias. Thus, joint formation may be compromised by early life stress.

**Cold adaptations of the Polynesians: Nasal morphology.**

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The evolution of the Polynesian cranial and postcranial morphology has been explored and several attempts have been made to explain it. The research of Houghton and co-workers has investigated the climatic influences on the Pacific and Polynesian peoples physique and cranial morphology. In an apparent suspension of Bergmann's Rule, some of the largest and most muscular people on earth are and were found within certain regions of Polynesia which lie firmly in the tropics. Within the tropical regions of the Pacific, the open ocean environment can be windy, cold and wet, and when combined with Neolithic sailing technology, only individuals approaching Polynesian proportions and body mass could survive this "cold environment". However, the research of others has argued that the unique morphology of the Polynesian body is due to other factors such as cultural and sexual selection, diet, disease, genetic drift, and growth trajectories.

Climatic influences have been strongly linked to variation in nasal morphology (Beals et al., 1984; Carey and Steegmann, 1981; Franciscus and Long, 1991). This study examines cranial skeletal material to evaluate the variation of Polynesian populations' nasal and nasal cavity morphology, and determine its consistency with other tropical or arctic populations

and that a "cold environment", either experienced in open ocean sailing or temperate climates in Melanesia/Polynesia, could have been the evolutionary force producing the morphology seen in extinct and extant Polynesians. The data collected for this study are from the cranial skeletal samples of Polynesians and from reference samples of populations from arctic and tropical environments curated at the AMNH, New York. Linear and landmark coordinate (3D) data are collected with a Microscribe 3-D digitizer. The coordinates are fitted using Generalized Procrustes Analysis and are analyzed using multivariate statistical techniques. The patterns of Polynesian nasal morphology are described and implications of these findings for determining the validity of the Polynesians adaptation to a "cold environment" are discussed.

**Alpha-globin gene triplication in orangutans.**

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Most primate species have two gene copies of a-globin, the gene encoding one of the peptides that make hemoglobin. However, triplicated a-globin genes are known in some primate species. This study is the first to analyze DNA sequences from the triplicated a-globin gene of orangutans. The triplicated a-globin locus, termed a-trip, is not simply a duplicated a-globin gene, the gene is derived at four amino acid sites. Pairwise  $K_a/K_e$  methods and likelihood ratio tests (LRTs) were used to test hypotheses for the selective history of a-trip. The results show that the evolutionary history of a-trip has been marked by either neutral or positive evolution, but not purifying selection. An analysis of the amino acid replacements in a-trip show that 2 of the 4 changes form a bond with one another, crucial to the proper functioning of hemoglobin, suggesting a correlated change and bolstering the case for positive evolution. Functionally, this locus may create a thalassemic phenotype, possibly as an adaptation to combat the orangutan's *Plasmodium* parasites, in a manner similar to human adaptations to malaria. This system also provides a rare view of gene duplication prior to the fixation of the gene duplicate and therefore has implications for understanding the evolutionary fate of duplicated genes.

**Morphological variation in the hominoid vertebral column: Implications**

**for the evolution of human locomotion.**

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The vertebral column of hominoids is central to locomotion, and should thus be under strong selection. Bipedes require lumbar lordosis to center the Head, Arms, and Trunk over the hip. This requires a long, flexible lumbar region. Large bodied arboreal hominoids, however, exhibit a stiff, immobile lower back that may prevent flexion during arboreal bridging. Our examination of extant ape and human vertebral columns reveals that mobility or stiffness in the hominoid lumbar region has been achieved in multiple ways, including 1) alteration of pre- and post-zygapophyseal orientation (which determines whether movement is restricted to lateral rotation (thoracic orientation) or flexion and extension (lumbar orientation)) and 2) entrapment of lower lumbar(s) by the ilia (which eliminates flexibility and stiffens the lower back). There are additional and highly variable morphological characteristics that also impact potential motion, including asymmetric zygapophyseal orientation, elongated transverse processes, and sacralized lumbar transverse processes. Our data show extreme variability within, and distinctly different trends between species. They therefore suggest 1) that selection primarily targets early pattern formation and that substantial developmental plasticity obtains during subsequent morphogenesis, and 2) parallel evolution has characterized vertebral evolution in the African apes and humans. The most striking difference among these groups is the low occurrence of iliac-entrapped lumbar vertebrae in humans. Ultimately, reduction of iliac height may be the initial course of action that liberated the lower back for human lordosis.

**Influence of support type upon stride duration and duty factor during primate arboreal quadrupedalism.**

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Animals residing in arboreal habitats regularly encounter mechanical challenges associated with variability in branch diameter, orientation and stability. Numerous studies have suggested that primates may meet these challenges by altering their limb postures on arboreal supports, for example, by flexing at the elbows and knees to lower the center of

mass. Yet individuals may not be limited to postural solutions, as increasing the duration of a stride and the percentage of that time spent in contact with an arboreal support may also help to improve balance. This study examines effects of branch diameter, orientation and flexibility upon stride duration and duty factor in six species of quadrupedal primates, including cheirogaleids, lemurids, and lorises. To do so, locomotor kinematics were recorded on simulated arboreal supports, and stride durations and duty factors were calculated. Although few consistent patterns were seen in absolute stride durations on arboreal supports, the majority of the study animals did utilize higher relative contact times on narrow, declined and flexible supports. These higher duty factors were generally brought about by increasing stance phase durations on narrow and flexible supports, and by decreasing swing phase durations on declines. Consistent changes in duty factor were not observed on either shallow or steep inclines. These results suggest that very different locomotor strategies can have similar effects upon duty factor on arboreal supports, yet not all aspects of the arboreal environment favor greater relative contact times with a support. Supported by the Sigma Xi, LSB Leakey, and National Science Foundations, and OUCOM.

**Reproductive measures, fitness and migrating Mennonites: An evolutionary analysis.**

J.C. Stevenson, M. Grimes, P.M. Everson. Anthropology Department, Western Washington University.

Given the same reproductive span, more children with shorter interbirth intervals (IBI) and less parenting should not do as well. There should be intermediate optima in family sizes but only two studies have demonstrated optima. The goal here is to determine if the relationship between fitness and fertility is linear and whether this relationship masks variation in reproductive behaviors in a Mennonite congregation that lived in two disease settings, Prussia/Russia vs. Kansas. The relationships between children born and fitness were determined by calculating linear and quadratic regressions for total, Prussia/Russia vs. Kansas, families with deaths vs. families with no deaths for total, Prussia/Russia and Kansas. Variation was examined in terms of measures of reproductive success, reproductive span and for interbirth intervals with comparisons by t tests with Bonferroni correction. Regressions demonstrate equally well that

the more children women bear, the higher the reproductive success, both in Prussia/Russia and Kansas whether or not women experience deaths. Prussia/Russians bore significantly more children ( $6.5 \pm 0.3$ ) than Kansans ( $5.6 \pm 0.2$ ) over a longer time between 1<sup>st</sup> and last births (TFLB's) but did not significantly increase the number of surviving children. Families experiencing deaths exhibit significantly longer TFLB's (13.6 vs. 8.8 mos., resp.) reflecting a significantly earlier start and later finish and produce significantly more children ( $5.4 \pm 0.2$  vs.  $4.2 \pm 0.2$ ) significantly closer together. Most average IBI's are longer than the 2-3 year threshold above which survivorship stabilizes. This and perhaps adequate nutrition may explain the lack of optima in fitness.

**Differential constraints on the pattern of skeletal robusticity in human limbs relative to climatic and behavioral influences on morphology.**

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There is considerable evidence that human skeletal robusticity is influenced by habitual behavior, climate and physique. It has been argued that the robusticity of proximal limb elements best reflect behavioral differences between populations. It remains unclear how the pattern of robusticity in the skeleton relates to adaptive constraints on the ability of the bones of different limb segments to respond to mechanical loading. This study investigates the pattern of robusticity in humeri, ulnae, femora and tibiae relative to climate and habitual behavior of human foragers. Cross-sectional geometric properties of the diaphyses are compared among four groups of foragers, from: Southern Africa (n=83), the Andaman Islands (n=32), Tierra del Fuego (n=34), and the Great Lakes region (n=15). Variability in both proximal and distal limb segment robusticity correlates with climate and patterns of terrestrial and marine mobility among these groups. However, the relative correspondence between robusticity and these factors varies throughout the body. Proximal elements have greater inherent variability in robusticity than distal elements, where morphology may represent a greater optimization of the relationship between safety factors and tissue economy. There is a greater tendency for the robusticity of proximal elements to covary with climate. Due to reduced inherent variation in di-

mensions of distal elements, a greater relative proportion of observed variability correlates with habitual activity. Lower levels of random variation in distal element robusticity suggest that in distal limb segments, there may be a stronger relationship between observed patterns of diaphyseal hypertrophy and behavioral differences between populations.

**Social dynamics of captive male western lowland gorillas living in all-male groups.**

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Gorillas (genus *Gorilla*) show considerable variation within and across species in the number of males in a group. Studies of wild mountain gorillas (*G. beringei beringei*) have provided an understanding of male-male social dynamics across a range of social groupings (e.g. single-, multiple-, and all-male groups); such data are lacking for western lowland gorillas (*G. g. gorilla*). This study examined the social dynamics of 25 male western lowland gorillas living in nine captive all-male groups. Over 1,300 hours of data were collected using group scan and all-occurrence sampling methodologies. Groups were cohesive, with males spending approximately one-third of their time within five meters of another individual. Although complete linear dominance hierarchies within a group were not observed, dominance relationships between individuals were evident for the majority (66%) of dyads. Social interactions varied as a function of age, with subadults engaging in significantly more affiliative behavior and less non-contact aggression than either blackbacks or silverbacks ( $p < 0.05$  for both). Rates of contact aggression, however, did not vary with age ( $p > 0.05$ ). Visual/olfactory access to females also increased rates of non-contact aggression. Social interactions did not vary as a function of early familiarity or relatedness. Such results suggest all-male groups are cohesive units, with males maintaining relationships through both affiliative interactions as well as tolerance/avoidance, and provide insights into factors influencing male sociality in this species.

**Bridging histories: The bioarchaeology of Seminole ethnogenesis.**

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In some ways, Florida mission-period and post-mission, Seminole histories exist somewhat independently in the literature, an unfortunate fact considering the mission environment set the stage for the formation of the Seminole identity. This paper examines the biological precursors to Seminole ethnogenesis using population genetic applications of phenotypic R-matrix methodologies. It is hypothesized that the establishment of the mission systems, and the multi-ethnic mission environment, led to increased gene flow among previously biologically divergent population groups (the Apalachee, Timucua, and Guale). Additionally, it is proposed that the population restructuring evident during the mission period provided the necessary biological precursors for Seminole unity and identity, which were then reified by socio-cultural mechanisms relating to social organization.

The results of the R-matrix analysis indicate that the mission system initially led to an increase in genetic diversity among populations, followed by a dramatic decline in genetic diversity after AD 1650. The former result is attributed to the cessation of conflict among native groups, which during precontact times led to small amounts of long range gene flow. After 1650 however, massive population decline and the alteration of traditional exchange networks led to genetic drift among populations involved in a single mate exchange system. This indicates the biological patterns consistent with the emergent Seminole identity predated formal definition of the tribe by 100 years. These results are discussed in light of current criticisms of biodistance approaches in anthropology.

**Assessing the role of biomechanical variables during primate mastication using finite element analysis.**

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During mastication, bone strain in the facial skeleton is produced by a complex interaction of several biomechanical variables: 1) the magnitude, orientation and relative timing of muscle forces, 2) reaction forces at the bite point and the temporomandibular joints (TMJ), and 3) variation in the material properties of facial bone. This study uses finite element analysis (FEA) to assess how varia-

tion in each of these variables affects overall patterns of strain.

A model of a *Macaca fascicularis* skull was constructed using 145,680 elements. Muscle forces were modeled using data on physiological cross-sectional area (Anton, 1993) and simultaneous EMG for the anterior temporalis, deep masseter, superficial masseter, and medial pterygoid muscles. Material properties data were obtained using ultrasonic analysis from 25 locations on the skull. The model was constrained so that the skull rotated around the right and left TMJs onto a fixed bite point, producing reaction forces at those locations. Prior studies have demonstrated that the model is realistic insofar as strain values obtained from FEA are similar to those obtained from *in vivo* chewing experiments.

Several analyses were performed in which muscle forces, constraints and material properties were modified one at a time while holding the other variables constant. Comparisons among these analyses reveal how strongly each variable influences strain.

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**A longitudinal study of the proximate and ultimate causes of child mortality in the Dogon of Mali.**

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We report the results of a longitudinal study of child health, growth, and survival among the Dogon of Mali, West Africa. Our statistical approach was Cox proportional hazards analysis in SAS Proc Phreg with an adjustment for the non-independence of children by the same mother. We measured time varying covariates such as weight-for-age in the initial year (1998) as well as in each of two follow-up years (1999 and 2000). Mortality was extreme: 137 deaths occurred in a sample of 1382 children in nine villages. As predicted, the higher the putative genetic relatedness of a child to the work-eat group (weg) boss, the lower the mortality risk (hazard ratio = 0.19,  $p = 0.02$ ). If the child's father was living but was not the weg boss, then child survival was similar to that of offspring of deceased fathers. If the child's mother was living, then the hazard of death was 79% lower ( $p = 0.0004$ ). Offspring of women in arranged marriages had 35% ( $p = 0.03$ ) lower mor-

tality than other offspring. The survival status of grandparents (maternal or paternal) made no apparent difference. Except in the largest and wealthiest village, weg polygyny was associated with increased mortality. Controlling for weg wealth, as the ratio of married women to men in the weg increased by one, the child's hazard of death increased 1.5 times ( $p = 0.03$ ). We discuss the implications of these findings for life history theory, energetics, and human evolution.

#### **Population demography of northern muriquis (*Brachyteles hypoxanthus*).**

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Fewer than 500 northern muriquis (*Brachyteles hypoxanthus*) are estimated to survive in the remaining Brazilian Atlantic forest. Over 40% inhabit the 890 ha forest at the Estação Biológica de Caratinga /RPPN-FMA, in Minas Gerais, Brazil, making this population the largest, most viable one of its kind. Long-term data on one group have documented an increase from 22 to 79 members over a 21-year period. Opportunistic sightings and a population-wide census in 1999 indicated a comparable increase in the size of a second muriqui group, and the establishment and growth of a third group. More recent extended efforts have identified a fourth possible group. Here, we examine the demographic structure of this population and evaluate its potential for future growth.

A total of 205 individuals, recognizable by their natural markings, were present as of July-August 2003. Group sizes ranged from 25 to 79 individuals, with the two original groups being substantially larger than the two more recently established groups. Overall, 53.2% of the population was female, with a higher proportion of female members in the smaller groups than the larger groups. Females accounted for 57.3% of all adults, but only 47.7% of all immatures. Although the proportion of adult females carrying dependent infants ( $\leq 2$  years old) was only slightly lower (0.63) than that expected (0.67) based on their 3-year birth intervals, the decline in the proportion of immature females relative to males is projected to stabilize, if not reduce, the effective population size within two decades.

#### **'Meeting your ancestor': Some notes on Robert Broom's first encounter with the Taung Child.**

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Raymond Dart's announcement of the discovery of the Taung Child (*Australopithecus africanus*) in 1925 is one of the most important events in the history of paleoanthropology. However, Dart's interpretation of *Australopithecus* and its place in human evolution had only a small number of supporters in the following quarter of a century. Broom had openly supported Dart from the beginning, and his discovery of adult australopithecine specimens at various South African sites (from 1936 onwards) later led scientists to redefine the diagnostic features of the postulated human ancestors. The decisive event that convinced Broom that Dart was correct seems to have been his visit to Dart on 21 and 22 February 1925, when he had a chance to examine the Taung fossil. Analysis of hitherto unpublished material from the University of the Witwatersrand's Archives provides an insight into this historic meeting and Broom's role in the early days of australopithecine research. These documents include Broom's first reconstruction of the Taung fossil which, except in some minor details, is not at variance with present knowledge, and his first reconstruction of the human family tree including *Australopithecus* as a direct ancestor of modern humans. They also show Broom's ability to transcend the boundaries of the generally accepted paleoanthropological views of the time and pave the way for a new understanding of human evolution. His first study of *Australopithecus* was the beginning of his own 'adventures with the missing link' which would have a profound effect on the development of paleoanthropology.

#### **Morphological variation in the genus *Perodicticus*.**

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The genus *Perodicticus* once housed five separate species and is now generally considered to have a single moderately polytypic species, *Perodicticus potto*. Current listings and publications still tend to recognize 3 subspecies (*potto*, *ibeanus*, and *edwardsi*). It has been suggested that that previously unrecognized craniodental morphs may yet exist in this group, and a new taxon, *Pseudopotto martini*, was pro-

posed as an example of previously unrecognized diversity within collections of pottos. A basic documentation of the characteristics and distribution of morphological variation is essential for correctly suggesting and testing systematic statements and evolutionary explanations, and in this study a broad sample of specimens assigned to the genus *Perodicticus* ( $n=109$ ) were described and compared to provide such a foundation.

The results are highly revealing. In the pottos' westernmost range individuals have a configuration of their lower "caniniform" first premolars described as a fin, while a subset of these specimens have a tendency toward a reduced lower and upper middle premolar. The latter trait has been listed as indicative of *P. potto* even though it appears to suggest a subset of the specimens from that taxon's range. A trait listed as descriptive of *Pseudopotto martini*, the primitive retention of an entepicondylar foramen on the humerus, appears to be distributed throughout the range of *Perodicticus* and is not exclusive to specimens sharing *Pseudopotto*'s other diagnostic traits. This study explores the implications of these and other results in the context of variation below the species level, systematics, and the effect of taxonomic choices.

#### **The efficacy of female choice in chimpanzees of the Tai National Park, Côte d'Ivoire.**

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Until recently, sexual selection was thought to be driven predominantly by male-male competition. Increasingly, female choice is recognized as an important factor affecting differential reproductive success. In order to understand how sexual selection influences a species' evolution, it is important to determine the effectiveness of male and female sexual strategies on non-random mating. To influence paternity, females must be able to influence whether or not sexual interactions occur, particularly during the periovulatory period. This study focuses on the effectiveness of female choice in wild chimpanzees (*Pan troglodytes verus*), and in particular examines the extent females influence sexual interactions, either by mating with preferred males, or deflecting mating attempts by non-preferred males. Over 2600 hours of data were collected on two habituated chimpanzee communities

between 1998 and 2000 in the Taï National Park, Côte d'Ivoire. Female mate preferences were measured by quantifying proceptive and resistance behaviour toward males. Female efficacy was measured by quantifying the ratio of proceptivity success to proceptivity attempts and the ratio of resistance success to resistance attempts. Results indicate that female proceptivity and resistance rates correlate with male mating success in the peri-ovulatory period. Outside the peri-ovulatory period, female proceptivity rates mirrored male mating success, but resistance rates did not. Overall, female resistance was effective and in most cases did not result in copulation. Also discussed are predominant factors influencing female ability to exert mate preferences.

#### **Island Melanesian pasts - A view from archaeology.**

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It is often thought that since the initial occupation of the Bismarck Archipelago at 40,000 years ago the region was relatively insular till the arrival at 3,300 years ago of Austronesian speaking settlers who went on to colonise Remote Oceania. Yet the latest archaeological research in the Bismarck Archipelago suggests that this is not so, with the area never closed to outside influences or interactions as evident by the introduction of new animals from mainland New Guinea and the distribution of obsidian at 20,000 years ago, and numerous changes to the archaeological record over the following millennia. This paper presents the latest archaeological discoveries from the region, and makes an attempt to model the nature of these early societies and changes that took place over 40,000 years.

#### ***Oreopithecus bambolii*: An unlikely case of hominid-like grip capability in a Miocene ape.**

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*Oreopithecus* is said to possess a hand that matched that of hominids in pattern and function (Moyà-Solà, Köhler and Rook, P.N.A.S. 96:313-317, 1999). Moyà-Solà et al. concluded this from 1) a novel restoration and reconstruction of the hand of IGF 11778, 2) a reconstruction of the sub-adult hand BA #140, and 3) assessment of assorted individual hand bones assigned to *Oreopithecus*. The authors

conclude *Oreopithecus* had a hand with a long thumb and other hominid features.

I studied morphometrics of the original fossils and counterparts in Old World monkeys, apes and humans. Findings indicate that the conclusion of Moyà-Solà et al. that *Oreopithecus* had a hominid-like hand is based on the misidentification of thumb and finger bones in both the fossils and extant species. Consequently, the authors obtain both an overestimate of thumb length in *Oreopithecus* and an underestimate of finger length. Spurious results come from 1) substituting a middle (finger) phalanx for the proximal phalanx of the thumb in IGF 11778 and, 2) substituting the fifth middle phalanx for the second. Other morphological features of the wrist and palm discussed by Moyà-Solà are not determinative of the question of hominid grasping.

When proper account is taken of thumb and finger bones in extant catarrhines and *Oreopithecus*, the latter has a typically short, ape-like thumb with typically long fingers. These findings are consistent with the high intermembral and hand length index, curved manual phalanges and other arboreal indicators in *Oreopithecus*. There is no evidence that *Oreopithecus* utilized hominid-like precision grasping.

#### **Social behavior and aggression among semi-free ranging ringtailed lemurs.**

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After a recent literature review on activity patterns among naturally-occurring primates, Sussman and Garber (2002) found that little time was spent in social interactions in contrast to maintenance behaviors. For example, in various studies of ringtailed lemurs, 2-7% of the time was spent in direct social interaction. Results from data on ringtails in Madagascar supported conclusions of the literature survey, with 0-4.3% of the day being spent in social activity, depending on sex, and very little time spent in agonistic interactions (Sussman et al. 2003).

To examine how these results compare to those on provisioned, semi-free ranging animals, we studied ringtails in natural enclosures at the Duke University Primate Center. We collected focal all day samples on 2 males and 5 females (340 hours). Activity was noted every 5 minutes and all occurrences of social bouts and events were recorded throughout the day.

Semi-free ranging ringtails spent twice as much time in active social interaction as did wild ringtails (4.5-11.0%) and less time was spent in traveling and feeding by the Duke animals. As in the wild, most social interaction at Duke consisted of allogrooming. Less than 1% of social interactions were agonistic (one agonistic event per 2 hours). There was less of a distinction between the sexes at Duke than in the wild.

This project was conducted as part of an undergraduate summer field course and follows an AAAS (*Science* 2001) initiative to introduce and train undergraduates in scientific research, and to inspire in them a passion for discovery.

#### **Modern human variation in the femoral bicondylar angle: Functional analysis and model-building.**

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Human evolution researchers have long considered bipedalism to be a hallmark adaptation of humans and their direct ancestors. The femoral bicondylar angle is considered a direct consequence of bipedalism in modern humans and an important skeletal indicator of bipedality in the fossil record. However, variability in the bicondylar angle in modern humans is not well understood. For example, Tardieu and Trinkaus (1994) suggest that sexual dimorphism in relative pelvic width drives this variation, but their own preliminary data challenge this model. This study uses a broader sample (N=112, covering six populations) to further test this model and to more fully characterize variation in the angle and potentially related variables.

The null hypothesis that there is no direct relationship between relative pelvic width ( $100 * \text{biacetabular diameter} / \text{maximum femoral length}$ ) and the bicondylar angle could not be rejected for the total sample, within sexes, and in all but one population. Further, no potentially causal factors were identified among a suite of features of the pelvis and proximal femur using multiple linear regression. These results indicate that the roots of modern human variation in the femoral bicondylar angle are far more complicated than has been suggested previously. As with other femoral traits (e.g., neck-shaft angle and torsion), the bicondylar angle changes throughout ontogeny and may continue to change in adulthood. This modeling and remodeling may obscure otherwise straightforward functional relationships. This issue must be resolved before the relatively high bicondylar an-

gles of early hominins can be accurately interpreted.

### **Geometric modeling of the center of gravity in *Pan troglodytes*.**

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Chimpanzees have often been used as a reference point by which early hominid locomotor anatomy has been evaluated, making an understanding of their biomechanics critical to our conception of early hominid locomotion.

For biomechanical studies to be effective, accurate models that include body segment parameters (BSP) must be known. Many of the methodologies developed for determining human BSP are extremely invasive and are therefore unsuitable for live chimpanzees. During the summer of 2002 data were collected on four live chimpanzees housed at the Knoxville Zoological Gardens to estimate total center of gravity using the Hanavan (1964) 15-segment model. Despite known limitations, this model was selected because it is important to first investigate methodologies that minimize animal stress. The reaction board method for determining center of gravity was used to evaluate the geometric model.

The Hanavan model provides rough estimates of the center of gravity. Estimates deviated from reaction board values by as little as 2.95 cm, although one deviated by as much as 16.85 cm. Encouragingly, some limb segment centers of gravity do approach values known from cadaveric studies including the arm, forearm, and thigh. More complex models will undoubtedly increase the accuracy of determining BSP, but they will require longer data collection times exposing the animals to longer periods of sedation. Although the BSP derived here are of limited value, future investigations can look to this research as justification for the use of more complex models that generate more accurate data.

### **Assimilation pelvis in human obstetrics and evolution.**

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The human sacrum modally has five vertebrae. High and low assimilation pelvis is fusion to the sacrum of the last lumbar vertebra and coccyx, respectively. Females with high assimilation are reported to have obstetrical difficulty. I evaluate the assimilation pelvis using a sample of 1,810 females and males of

blacks and whites (BF, WF, BM, WM) whose ages at death are 20 years and older from the Hamann-Todd and Terry Collections. Museum records were consulted for sex, race, and age at death. BF, WF, BM, and WM are nonsignificantly different in their incidence of high assimilation, which is 6%. Low assimilation occurs more frequently in whites than blacks (48% WF, 30% BF, 53% WM, and 34% BM), though the difference is related partly to the samples' demography. The incidence of low assimilation increases with advancing age in whites but not blacks; high assimilation is nonsignificantly related to age. Individuals with an extra thoracic or lumbar vertebra (modal number of these vertebrae is 17) have a high incidence of high assimilation. Those with one less thoracic or lumbar vertebra than the modal number have a high incidence of low assimilation. Nevertheless, most individuals with low assimilation have 17 thoracic and lumbar vertebrae. I measured 300 pelves of females and males, including those with five sacral vertebrae and high and low assimilation. Significant differences are seen in posterior sagittal diameter of the outlet and length of the five sacral vertebrae. Obstetrical and evolutionary implications of the assimilation pelvis are discussed.

### **New eosimiid species from the latest middle Eocene of Pondaung, Myanmar.**

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Eosimiidae is an extinct haplorhine family represented by the two genera, *Eosimias* and *Bahinia*, from the middle Eocene of Eastern Asia: the former is discovered from two localities of China, and the latter is from the latest middle Eocene of Pondaung, central Myanmar. In the last decade many researchers have paid attention to eosimiids as the "possible basal anthropoids," which may resolve the problem of anthropoid origins.

During the 2001 field season, Myanmar-Japan Joint Expedition Team discovered very small left and right mandibular fragments (NMMP-KU 1203) at the Pk-2 locality, Pondaung, Myanmar. Pk-2 is about 2.5 km far from the Bh-1 locality, where *Bahinia* was discovered, and stratigraphically the two localities are nearly same horizon. NMMP-KU 1203 preserves no tooth but M<sub>3</sub> unfortunately, but the combination of a relatively deep mandibular corpus and a reduced paracoid on the M<sub>3</sub> trigonid strongly suggests

that this animal belong to the family Eosimiidae. Although in mandibular size NMMP-KU 1203 is much larger than *Eosimias* but apparently smaller than *Bahinia*, indicating a new species status, the generic status is still unestablished due to the lack of most dentition. At the Pk-2 one small primate calcaneus (NMMP 23) referred to eosimiids have been discovered so far. However, the estimated body weight of NMMP 23 and NMMP-KU 1203 are 110.7 g and 410 g, respectively, indicating that they are unlikely to belong to the same species.

### **Testing a theory explaining the adaptive value of secondary osteons (haversian systems)**

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Several explanations for the predominance of secondary osteons in humans and dogs have been offered, but all seem inconsistent with known features of these microscopic structures. Elsewhere, I proposed another explanation, that they are essential to remodeling during growth, especially for long bones, replacing areas of compacted cancellous bone, known to be relatively weak, with oriented osteons. This would make bone more resistant to bending and fracture. The idea is tested with serial cross sections from major long bones of growing dogs, using a silver nitrate block stain which reveals localized intensity of bone mineralization and allows identification of regions of compaction. Trabeculae incorporated into the shafts were found in 8 series which also contained osteons. Twenty osteons were traced in each series. Invariably the osteons remained within the confines of the highly mineralized trabeculae. Significantly, the osteons closely paralleled the axis of the shaft, even though the lamellae trabeculae usually transverse to that axis. This supports the hypothesis and suggests that osteons important strengthening features of bone during growth. Color photomicrographs of sample series illustrate these processes. The present study does not address the question of why osteons continue to develop in areas where compaction can no longer be demonstrated or most likely never was present. Resorption spaces preferentially advance in areas of highly mineralized bone in such regions, however, just as they do in highly mineralized trabeculae. This suggests further lines of research.



**High levels of variation at the mitochondrial 9bp repeat locus in the Sakha of Siberia.**

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The mitochondrial 9bp deletion, located in the COII/tRNA (Lys) intergenic region, is a commonly studied polymorphism that exhibits a distinct frequency cline in Asian populations. Southeast Asian populations have a very high incidence of the deletion, east Central Asian populations display moderate frequencies, and the deletion is absent in indigenous Siberian populations. We examined the deletion frequency in the Sakha (also known as Yakut) of northeast Siberia. The Sakha are the second largest indigenous group currently living in this region (population size = 330,000), although they are believed to have migrated from the Lake Baikal region <1000 years ago.

We assayed variation at the 9bp repeat locus in 779 individuals from fourteen Sakha villages. The deletion, i.e. one copy of the repeat, was detected in 17 individuals and triplication of the repeat sequence was found in nine individuals. Four individuals were heteroplasmic at the 9bp locus: two individuals with 2/3/4 copies, one with 2/3 copies, and one with 1/2 copies. These results were confirmed by cloning and sequencing the 9bp locus in the heteroplasmic individuals. Furthermore, the mitochondrial control region was sequenced in a subset of individuals carrying the triplication allele and in the four heteroplasmic individuals. Based on haplotype analysis, these individuals are not closely related suggesting that the triplication and heteroplasmy may have multiple origins in the Sakha. Very few studies to date have detected the triplication allele or heteroplasmy at the 9bp repeat locus. The high level of variation found in the current study suggests a possible role for selection in the evolution of this locus.

**Masseter muscle fiber architecture in tree-gouging (*Callithrix jacchus*) and non-gouging (*Saguinus oedipus*) callitrichids.**

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In this study, we compare fiber architecture of the superficial masseter muscle in common marmosets (*Callithrix jacchus*) and cotton-top tamarins (*Saguinus oedi-*

*pus*). These two callitrichid species share broadly similar diets of fruits, insects and tree exudates. However, *C. jacchus* differs from *S. oedipus* in that they actively elicit tree exudates flow by biting into trees with their anterior dentition, while *S. oedipus* is an opportunistic gum feeder that does not routinely gouge trees. Vinyard et al. (2001, unpublished data) demonstrated that *C. jacchus* generates maximum gapes during gouging that approach the maximum gapes possible for these animals, suggesting that common marmosets gouge with gapes that approach their maximal structural capacity for jaw opening.

We conduct the first comparative assessment of masticatory muscle fiber architecture in primates with divergent biting behaviors. Fiber length is proportional to muscle excursion and, by extension, contraction velocity. As tree gouging in common marmosets has been linked to relatively large gapes during gouging, we test whether *C. jacchus* has relatively longer muscle fibers and, by extension, a relatively greater potential muscle excursion/contraction velocity, as compared to *S. oedipus*.

As predicted, *C. jacchus* has absolutely and relatively longer masseter muscle fibers as compared to *S. oedipus*. These findings suggest common marmosets are capable of greater muscle excursion and contraction velocity. Furthermore, our results support the hypothesis that masseter fiber architecture in common marmosets is adapted for producing large gapes during tree gouging. Additionally, these results support previous hypotheses (Herring et al., 1979) linking jaw-muscle fiber length and gape in mammals.

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**Hypoplasia of the tooth root: A new unspecific stress marker in human and animal paleopathology.**

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Linear enamel hypoplasia (LEH) and Harris' lines (HL) are well known marker for unspecific stress. Several publications are dealing with these features. The developmental age of LEH and HL can relatively exactly be determined. Regarding LEH, the crown of the third molar is developed with approx. 12 years. HL can be observed until 16 or 18 years, when the epiphyseal union of the tibia or other long bones is completed.

For archaeological osteological material it is obvious, that teeth, including their roots, are often better preserved than long bones. Hypoplasias of the tooth root (HTR)

are a nearly unknown feature in human, as well as in animal paleopathology. However, they can be quite regularly observed in the osteological record. Their developmental age can approximately be determined. HTR can, therefore, give important information on development disturbances, after the tooth crown is completed. The range of their developmental age is similar to HLs.

Two children's skeletons (9-10 years and 12 years old) from coastal sites in Northern Germany were studied for the presence of HTR, LEH, and HL, as well as diseases of the skull and diseases of the postcranial skeleton. The children are dating into the pre-Roman and Roman Iron Age, respectively. Furthermore, different single molars of humans, and domestic animals like cattle, swine and sheep were studied.

In domestic animals, HTR were quite common. In pigs, LEH and HTR could often be observed on the same tooth. Due to more or less thick layers of dental cement on the molars of cattle and sheep, LEH could only sometimes be observed. In contrast, HTR could, however, easily be detected in these teeth.

In humans, HTR were generally not very common. In both children, LEH and HL were present, in the 12 years old child also HTR. They developed in the last months before the children's death. In the 9-10 years old child, LEH and HL were probably caused by an inflammation of the sinus sagittalis superior and the sinus transversus. The inflammatory process affected also the occipital pole. At time of death, the disease process was organised, but not healed. In the case of the 12 year old child, it can be assumed that the same cause was responsible for HTR, LEH and HL.

HTR can easily be observed in human and animal single teeth or in fragmented jaws. In completely preserved jaws, they can be displayed by computer tomography. They can be a useful tool for determining unspecific stress, both in humans and in (domestic) animals. It is a useful addition to LEH and HL, in particular in badly preserved bones.

**Chimpanzees at Ngogo - The noble savage?**

S. Teelen. Department of Anthropology, Yale University.

The chimpanzee community at Ngogo, Kibale Forest National Park, Uganda, is the largest known in the wild, with about 150 members. Its members prey heavily on red colobus monkeys: the chimpanzee hunting success rate is extremely high,

and chimpanzees kill many individuals per successful hunt. Census data had suggested that the population is declining and that predation by chimpanzees may be contributing to this decline.

In this paper, I address the impact of hunting on the red colobus population at Ngogo.

To test the hypothesis that chimpanzee hunting is sustainable, I am using demographic data collected on red colobus monkeys over a period of three years, as well as fecundity and mortality data from previous studies of this species. I apply matrix models and vortex analyses using a sensitivity analysis approach to project future population development. Results show that current rates of hunting are not sustainable, which indicates that present rates of hunting are a recent phenomenon.

#### **A comparative volumetric analysis of the human and ape hippocampus.**

K. Teffer, N. Schenker, K. Semendeferi. Dept. of Anthropology, University of California at San Diego.

The hippocampus is involved in acquisition and maintenance of memories, including those with spatial content. Existing comparative information on its size in apes is limited to four individuals. We measured the volume of the hippocampus (cornu Ammonis, dentate gyrus, and subiculum) in one human, three chimpanzees, two bonobos, one gorilla, three orangutans, and two gibbons using stereological techniques.

The absolute volume of the human hippocampus is three times that of most of the great apes, and roughly six times that of the smallest gibbon hippocampus. A significant rightward asymmetry was present in all specimens with the exception of the two female chimpanzees. This asymmetry is consonant with the human literature, which also suggests the greater involvement of the right hippocampus in spatial memory. There is a significant positive correlation between degree of asymmetry and age among the 8 ape specimens for which exact age at time of death is available.

Hippocampus size varies greatly in humans. A wide range also exists in our sample of apes, despite its small size. The ratio of hippocampus to brain volume varies as much as 25% within a single species. The values for chimpanzees and bonobos overlap with each other and are larger than values for orangutans or the gorilla ( $p < 0.05$ ). Additionally, the infant bonobo and subadult orangutan have smaller relative hippocampi than the adult specimens. The presence of this

variation within our sample emphasizes the importance of including multiple individuals per species in studies that examine the influence of evolutionary pressures on the brain.

#### **Feeding and ranging of hoolock gibbons (*Hylobates hoolock*) in the Borajan Wildlife Sanctuary, Assam, India.**

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Animals respond to seasonal food shortages in at least three ways: (1) resorting to lower quality diets, (2) expanding territories while maintaining the same diet, or (3) shifting to a different dietary pattern. Gibbons provide an excellent test of alternate strategies because they are territorial and live in highly seasonal environments. To better understand the constraints on feeding, we initiated a study on hoolock gibbons (*Hylobates hoolock*) in the Borajan Wildlife Sanctuary in Assam, India. The sanctuary is approximately 5 km<sup>2</sup> and home to eleven gibbons and three other primate species. The study occurred during the monsoon season (June-July) when precipitation is highest. We concentrated on a group of two individuals (a male and a female) with a home range of 0.031 km<sup>2</sup>.

During the study period, young leaves of trees, creepers and lianas comprised the greatest portion of gibbon diet (~60%) followed by fruit (35%) and insect material (5%). We observed a single incident when the male ranged beyond its range border and suspect this was an exploration for territorial expansion. We witnessed four incidents of aggressive behavior of the male towards the female over access to choice food including ripe fruit. Based on preliminary observations, we conclude Borajan gibbons meet seasonal fruit shortages by resorting to a diet consisting largely of leaves. We discuss this conclusion in the context of similar data on *Hylobates lar*, *H. moloch* and *H. syndactylus*. A long-term study of the Borajan gibbons is currently underway to provide rigorous testing of alternative hypotheses.

#### **Alterations in growth rate underlie fetal adaptive strategies.**

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Reproductive ecological studies have demonstrated that growth and maturation rates are related to environmental conditions, particularly the diet and resulting

energy availability encountered during development. While few reproductive ecology studies have focused specifically on the developing fetus, gestation represents an especially responsive developmental stage. Important both evolutionarily and developmentally, the fetal period is one in which sensitivity to ecological and energetic constraints emerge. While the fetus responds to the maternal physiological environment by altering growth rates, it does not do this merely as a homunculus adjusting size to available resources. The fetus experiences organ and tissue specific alterations in growth patterns, managing resource signals within a morphogenetic program. As the maternal environment is an indicator of the socioecological milieu, this process shapes the anatomy and physiology of the fetus in ways that track the external environment and promote postnatal fitness.

Ultrasound measurements of 12 body dimensions from 450 maternal fetal pairs collected by the same ultrasonographer provide data illustrating how the developing fetus responds to challenging maternal environments, such as those created by maternal smoking, diabetes and poor nutrition. Altered growth patterns and rates result in altered body proportionality in this sample.

As is predicted from life history and reproductive ecology theory, the tempo of fetal growth and development is altered by *in utero* environmental conditions and energy availability. These data permit an assessment of the utility of life history theory and reproductive ecology as frameworks from which to investigate the role of pressures shaping pregnancy in the past and present.

#### **Ancient Maya population structure and social dynamics. A palaeodemographic approach to the Classic coastal site of Xcambó, Yucatán.**

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Demographic parameters of archaeological populations are usually biased by three major factors. The first one presumes stationarity (*i.e.*,  $r = 0$ ), which if incorrect miscalculates both mortality and age structure. Second, traditional methods for determination of skeletal age underestimate the cemetery's oldest individuals and overestimate the 30-40 year class. Finally, it bears repeating Ken Weiss' caution that "if an unbiased, representative sample . . . cannot be assumed, further demographic analysis is not likely to

be productive." (*American Antiquity*, 1973, p. 58). The present investigation explores the demographic profiles of the Classic Maya site of Xcambó, with particular attention to the major biases of paleodemography.

The small coastal settlement, which functioned as a salt production center during the first millennium A.D., was explored between 1996 and 2000 by the INAH. The explorations at Xcambó brought to light a representative sample of 514 skeletons from the settlement's residential areas dated to the early and late occupational phases (250-550 AD/550-750 AD), and constituting one of the largest and best preserved burial populations from the Yucatec Peninsula. Assuming demographic stability, we model the distribution by sex and age using total fertility measures from historically documented peninsular women. This provides new information on life expectancy, reproductive rates, growth, and mean generational length of this sedentary coastal enclave during the Early and Late Classic. Considered jointly with other life style indicators and archaeological data, the reconstructed demographic profiles provide new insights into Classic Maya population dynamics.

**Description and analysis of postcranial elements of *Paradolichopithecus arvernensis*: A large-bodied papionin from the Pliocene of Eurasia.**

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The Plio-Pleistocene cercopithecoid *Paradolichopithecus arvernensis* is best known from Seneze (France), Valea Graunceanului (Romania), and Vatera (Lesvos Island, Greece). Of these sites, Graunceanu and Vatera have yielded postcranial elements assigned to this species that have been said to be similar to those of *Papio*, while the craniodental remains from all sites have suggested a relatedness to *Macaca*. Description and analysis of the postcrania was conducted to test hypotheses concerning the locomotor behavior and phylogenetic affinities of this fossil monkey. The postcranial material assigned to *P. arvernensis* includes partial humeri, ulnae, radii, femora, a distal tibia, an astragalus, third metatarsal, and several pha-

langes. These postcrania are compared to those of extant cercopithecids using traditional measurements, as well as 3-D coordinate data. Measurements were analyzed using standard ratios and statistical analyses, while the coordinate data were analyzed using geometric morphometric techniques.

The results indicate that *P. arvernensis* practiced a form of terrestrial locomotion similar to that of modern baboons, which is consistent with previous hypotheses and paleoenvironmental reconstructions suggesting open savannah woodland at both sites. The overall morphology of *P. arvernensis* resembles *Papio* and *Theropithecus* more than *Macaca* or *Mandrillus*, although the implications of this result are still unclear because separating size, phylogeny, and function remains problematic in cercopithecids. The 3-D data presented will also be used in future studies to help address this complex issue and hopefully provide more information on the evolutionary history of the Plio-Pleistocene large-bodied cercopithecoid radiation.

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**Co-evolution of malaria infection and the human genome: Implications for human evolutionary history.**

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Infectious disease has likely had a large impact on the evolution and differentiation of human populations. Those individuals who have some natural resistance to infection are more likely to survive and pass their genes onto their offspring. Thus, genes that play a role in resistance to infectious disease are likely to be targets of natural selection. Characterization of nucleotide variability at these genes will be important for understanding how selection shapes patterns of variability in the human genome and co-evolution of human and pathogen genomes.

Malaria, resulting from infection by the *Plasmodium* parasite, is one of the leading causes of death in the global human population. During the course of human evolution in regions where malaria is prevalent, naturally occurring genetic defense mechanisms have evolved for resisting infection by the *Plasmodium* parasite. We have examined nucleotide variation at several candidate genes involved in resistance to malarial infection: Glucose-6-phosphate dehydrogenase (G6PD) on Xq28 and two linked cytokine genes, inter-

leukin-4 (IL4) and interleukin-13 (IL13), on 5q31. We have detected signatures of historic selection acting at these loci. In the case of G6PD, we have dated the age of the mutations to within the past 12,000 years in Africa. This date estimate is consistent with archaeological evidence suggesting that malaria has only had a significant effect on humans in the last 10,000 years, after the advent of agriculture, animal domestication, and increased human population densities in the Middle East and Africa. Funded by BWF and Packard, Leakey, WennerGren, and NSF grant BCS-0196183 (ST).

**Roman Period fetal skeletons from the east cemetery (Kellis 2) of Kellis, Egypt.**

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We present an analysis of 82 fetal/perinatal skeletons recovered from Kellis 2, a Roman Period cemetery dated to the third and fourth centuries A.D., located in the Dakhleh Oasis, Egypt. Most of the fetuses were wrapped in linen and all were buried among the general cemetery population in a supine, east-west orientation with the head facing to the west. Gestational age estimates are calculated from diaphysis lengths using published regression and Bayesian methods. The similarity between the fetal age distributions calculated from the regression and Bayesian methods suggests that the correlation between diaphysis length and gestational age is typically strong enough to avoid the 'regression' problem of having the age structure of reference samples adversely affecting the age distribution of target samples. The inherent bias of the regression methods, however, is primarily reflected in the gestational age categories between 36 and 42 weeks corresponding with the expected increase in growth variation during the late third trimester. The results suggest that the Kellis 2 fetal age distribution does not differ from the natural expected mortality distribution. Therefore, practices such as infanticide can be ruled out as having a significant effect on the observed mortality distribution. Moreover, the Kellis 2 sample is well represented in each gestational age category suggesting that all premature stillbirths and neonatal deaths received similar burial rites. The age distribution of the Kellis 2 fetal remains suggests emerging Christian concepts,

such as the “soul” and the “afterlife”, were being applied to everyone including fetuses of all gestational ages.

#### **Variation in omomyid ankles and its implications for phylogeny reconstruction.**

M.A. Tornow, Southern Illinois University.

Phylogenetically informative characters used in reconstructing omomyid relationships have come almost exclusively from the dentition (e.g. Williams, 1994; Muldoon and Gunnell, 2002). While postcrania are known for a limited number of omomyids, the data provided by these elements appear to offer little information regarding intraomomyid phylogeny and are used instead to address higher-level relationships between omomyids and other primate clades (e.g. Ross et al., 1998; Dagosto et al., 1999). One result of these higher-level, all-primate analyses is the inability to delineate even higher-level relationships (e.g. subfamily) within Omomyidae, suggesting homogeneity in omomyid postcranial morphology.

The purpose of this research is to evaluate potential variation in the ankle morphology of omomyid primates and to explore the usefulness of postcranial elements in delineating relationships within omomyids. Seventeen characters are scored from the calcaneus and astragalus of eight omomyid genera, *Cantius*, *Plesiadapis* and *Tarsius*. All characters are weighted equally in an exhaustive search using P.A.U.P.\* 4.10, and the results are evaluated using MacClade 4.05.

Results of the analysis demonstrate that omomyid ankle bones are not homogeneous and that the differences do contain phylogenetic signal. Parsimony analysis differentiates the anaptomorphines from omomyines with *Teilhardina belgica* forming a basal trichotomy with *Cantius* and the omomyid clades. While the washakiin taxa *Shoshonius* and *Washakius* possess a combination of omomyine and anaptomorphine characteristics, these taxa group most parsimoniously with the omomyines. Features differentiating omomyid clades include calcaneal peroneal tubercle position, astragal body shape, and posterior astragal shelf development.

#### **Human skeletal remains from the Island of the Sun, Lake Titicaca, Bolivia.**

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In 1895 Adolph Bandelier collected 37 crania from the Island of the Sun, Bolivia for the *American Museum of Natural History*. The Island of the Sun was a shrine and pilgrimage center of interregional importance that was incorporated into the state activities of the both the Tiwanaku and the Inka. While a very small sample, these crania are among the few human remains available from the Island of the Sun. As such, a bioarchaeological analysis provides some insight into individual lives in this important area.

The crania come from five pre-Columbian sites that include the moments of state occupation and are all adults (16 female, 20 male, 1 indeterminate). There are low rates of osteoarthritis (n=1; 2/7%), cribra orbitalia (n=3; 8.1%) and porotic hyperostosis (n=2; 5.4%). Osteological indicators suggest that the population is in generally good health. In contrast, rates of healed cranial trauma are rather high (n=8; 21.6%). There are no significant differences between the sexes ( $\chi^2=0.122$ ,  $p=0.727$ , ns). This may be the result of a sampling bias or error, or perhaps, given the nature of the Island, reflect ritual activity. Cultural modifications are also present. One female and three males (10.8%) had evidence of trepanation. Additionally, all 37 crania had pronounced annular cranial modification. This is consistent with results from elsewhere in the Altiplano. These analyses indicate that the Island of the Sun's population shared many traits with those in surrounding areas and that their health most likely benefited from state support.

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#### **Expanded X-chromosomal dataset offers increased phylogenetic resolution in the Cercopithecini**

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Recent molecular studies suggest there are four, deeply-divergent, guenon lineages: (1) *Allenopithecus*, (2) *Miopithecus*, (3) a clade of *Erythrocebus patas*, *Cercopithecus aethiops*, and the *Cercopithecus lhoesti* species group, and (4) a cluster of the remaining (arboreal) *Cercopithecus spp.* The present work examines the phylogenetic relationships within the “arboreal” *Cercopithecus* clade. To date, we have surveyed 17 guenon species and 3 outgroup taxa for 5 kb of intergenic DNA from X-chromosomal region Xq13.3. Parsimony and maximum likelihood analyses of the X-dataset consistently cluster mem-

bers of the *cephus* and *mitis* species groups to the exclusion of other guenon taxa. Although members of these two groups occasionally hybridize in the wild (i.e. *C. ascanius* x *C. mitis*; *C. cephus* x *C. nictitans*), the large numbers of autapomorphic mutations carried by each species suggests that the phylogenetic pattern recovered here is not due to recent gene flow. This pattern is most likely due to either true shared ancestry or ancestral hybridization. We support the former explanation because (1) a previously-reported Y-chromosomal insertion is uniquely held by members of both the *cephus* and *mitis* groups, and (2) gene-tree congruence is less likely to result from allelic introgression at multiple loci than from simple shared ancestry. However, this phylogenetic inference needs to be further tested by the survey of multiple conspecific individuals and additional loci.

#### **QTL mapping in biological anthropology: Skeletal maturation.**

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The skeletal age (SA) of a healthy child can differ from that child's chronological age by up to 3 years, but few studies have examined genetic influences on normal variation in skeletal development. We present here initial findings from linkage analysis of the SA of children participating in the Fels Longitudinal Study. Annual SA data from chronological ages 1 to 17 years were available for 1,069 children from 220 families who had a total of 9,865 hand-wrist radiographs taken between 1931 and 2002. Estimates of SA were made using the FELS method. An initial subset of 478 participants was genotyped for 377 autosomal markers spaced approximately every 10 cM. A variance components-based linkage analysis method, SOLAR, was used to analyze these data and obtain multipoint LOD scores. Significant LOD scores (> 3.0) were found for SA during middle childhood - a LOD score of 3.37 for linkage of SA at chronological age 8 to a QTL on chromosome 8 at 122 cM (between markers D8S270 and D8S1784), and a LOD score of 3.40 for linkage of SA at chronological age 10 to a QTL on chromosome 3 at 44 cM (between markers D3S2338 and D3S1266). Nine suggestive LOD scores (> 1.9) were found for SA at chronological ages 1, 2, 4, 7, 11, and 13. Future work in

this QTL mapping project will focus on identifying specific genes that influence particular aspects of skeletal maturation during different stages of childhood skeletal development.

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**Cremations of the Linearbandkeramik culture in relation to the burial practices of early Neolithic communities in south-western Germany.**

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This paper presents a pilot study that seeks to identify possible trends and tendencies that clarify the role of cremations in the burial record of the Linearbandkeramik culture of Central Europe. The characteristically homogenous culture originated in communities along the middle Danube in Hungary 7,500 years ago and existed for 700 years. Using cremated remains from the LBK cemeteries of Schwetzingen and Fellbach-Oeffingen, Baden-Württemberg an attempt will be made to determine whether cremations represent a special burial form limited to certain individuals or groups of individuals within the community, based on a certain social status, differentiation among sex or age groups, or manner of death.

The overall preservation of the cremated remains, similarities of burn stages and degree of fragmentation, imply a consistent cremation ritual throughout the LBK. Twice as many females as males were identified in the sample, yet the presence of both sexes among the identified material suggests that sex was not the only factor determining whether an individual was to be cremated. Statistically, all age categories were identified. The percentage of sub-adult to adults is nearly identical for both cemeteries. Similar distribution was recorded for body burials, implying that age of an individual was also not the decisive factor for cremation. It has been concluded that cremations represent a group of individuals with special social status, either within the LBK culture or attributable to other factors such as belonging to a different cultural group.

**Raiding and ritual violence in the ancient Andes: A study of cranial trauma among populations from Majes valley, Peru.**

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This paper examines frequencies and patterns of skeletal trauma to infer levels and kinds of violence among two contemporaneous archaeological populations from southern Peru. Based on comparisons to archaeological, ethnohistoric, and modern data on bodily injury, this study also attempts to identify the kinds of violent activities that produced the observed traumas.

The skeletal samples are derived from Middle Horizon (AD 600 – 1000) sites in the Majes valley of southern Peru: a village site (Beringa) and a ceremonial/mortuary site (La Real). Overall, Beringa and La Real trauma frequencies are statistically similar. Nearly a quarter of the Beringa sample (N=56) and almost one-third of the La Real sample (N=104) exhibit cranial trauma. At both sites, the majority of wounds are well-healed, indicating that most violent encounters were non-lethal. Males show more head trauma than females at each site, a sex-based difference that is nearly statistically significant for both. Although overall trauma frequencies are similar between the two sites, the differences in locational patterning of head wounds are striking, suggesting that distinct violent interactions produced the injuries. The Beringa crania show the majority of wounds on the posterior, while most wounds on La Real crania are on the anterior. These patterns suggest that Beringa inhabitants may have been victims of raiding, while La Real individuals may have engaged in face-to-face combat, perhaps akin to ritual battles known as *tinku* in the Andes.

**Isotopic analysis of life history and social stratification at two Wheeden Island mound sites in central Florida.**

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This study establishes stable isotope values for individuals from two diachronic mound populations from Florida. Bone organics and inorganics as well as microsampled dental enamel are analyzed to reconstruct life history patterns of diet and migration at different stages of development. Two skeletal samples are compared to examine intra-/inter-individual differences in diet and migration related to various stages of life, burial style and culture period. One sample (N=14) is from mortuary mounds at the McKeithen Wheeden Island site (AD 350-475), and

includes a single, mostly complete individual with differences in burial location and style. The second sample (N=3) consists of poorly preserved remains from nearby Leslie Mound (AD 750-1200). For both groups, multiple samples of buccal enamel from each available molar and premolar were analyzed for  $\delta^{18}\text{O}$  and  $\delta^{13}\text{C}$ , while samples of mandibular collagen and apatite were analyzed for  $\delta^{13}\text{C}$ ,  $\delta^{18}\text{O}$  and  $\delta^{15}\text{N}$ .

Given marked differences in burial styles, the remains from the McKeithen site likely represent individuals of different sociopolitical and/or religious status. As the presence of maize in the region circa AD 350-475 was largely ceremonial, variation in isotopic composition may reflect differential access to resources signifying status. The later remains from Leslie Mound may reflect any possible increases in regional maize prevalence. Previous isotopic studies of human and faunal enamel have illustrated the potential of using life history data to reconstruct dietary patterns at different developmental ages, thus the refined focus and interpretive framework of social stratification of this study contribute to a growing body of literature.

**Prehistoric diet in the central Himalayas: Stable isotope results from Malari, Garhwal (India).**

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Recent archaeological discoveries at Malari (Chamoli district, Garhwal, India) demonstrate that humans settled near the Tibetan border, at an altitude of 3500 m, by 1000 BC. While contemporary sites are known in the lower river valleys, e.g. at Thapli in the Tehri district, it is hypothesized that the subsistence adaptations that enabled people to survive in the harsh ecological setting of Malari were profoundly different. One individual in a cave burial at Malari may also have had preferential access to certain foods because of his status. In this region, both C3 (e.g. wheat, barley, oats, peas and beans) and C4 (e.g. millet, amaranth) plants are known, while animals include Himalayan species of buffalo, cattle, goat, and horse. Stable isotope analysis of bone collagen and apatite was performed on nine human individuals from Malari, and on more than 30 faunal samples from Malari and other sites in Garhwal. The results show significant collagen carbon isotope enrichment for all humans tested, while many of the faunal samples tested had

similarly enriched carbon isotope ratios. Relatively less enriched carbon isotope ratios in bone apatite suggest that much of the protein in the human diets came from such animals. The difference in nitrogen isotope ratios between the humans and the fauna is greater than can be explained by the trophic level effect, suggesting that there was also dietary stress among the people living at Malari. These results provide important insights into the motivation for and means of early settlement in the central Himalayas.

**The effects of intentional cranial deformation on the development and pathology of the temporomandibular joint.**

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This study examines variation in temporomandibular joint shape and frequency of degenerative joint disease (DJD) between sub-groups of intentionally deformed (modified) and non-deformed human crania in a sample ( $n=57$ ) of Tiwanaku V Peruvian crania from Chen Chen. Based on findings of previous investigators (Anton, 1989 and Cheverud et al., 1992), the expectation is that intentionally deformed crania will display altered temporomandibular joint morphology in comparison with non-deformed crania.

Mediolateral width, anteroposterior length, and depth of glenoid fossae were measured for both left and right sides of individual crania. Crania were scored for degree of deformation and degree of degenerative change in the TMJ, both on a 0-4 scale.

Statistical analysis revealed significantly greater mediolateral width in the right TMJ and lesser anteroposterior length and depth in the left TMJ ( $t$ -test,  $p<0.05$ ). Moreover, there is an association between deformation and DJD prevalence—deformed crania display a higher frequency of DJD than non-deformed crania. These findings suggest that artificial cranial deformation likely influences both TMJ morphology and pathology.

**“Fall on your knees”: Squatting facets and Byzantine monasticism.**

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An ongoing study of Byzantine remains from an ossuary on the grounds of St. Stephen's monastery in Jerusalem has

uncovered evidence of sustained repetitive kneeling for prayer. Osteological analysis has found an arthritic response in the majority of individuals associated with deep flexion of the leg. Arthritic changes at the knee and ankle, as well as non-metric analysis of features of the hip and heel have corroborated the historical evidence for sustained repetitive genuflection. The objective of this study was to examine the extent of hyperdorsiflexion of the ankle by scoring the presence of medial and lateral “squatting” facets on the tibia and talus.

A total of 130 tali and 122 tibiae were examined from the St. Stephen's collection. Lateral facets occurred on 55% of right tali (31/56), and medial facets on 6% of right tali (3/51). Chi-square tests revealed no significant difference between right and left tali for either the lateral or medial facet ( $p>0.05$ ). Lateral facets occurred on 30 of 58 right tibiae (52%), and medial facets were on 4 of 57 right tibiae (7%). There was no significant difference between right and left tibiae for lateral facets ( $p>0.05$ ), but there was a significant difference between the two sides in number of medial facets. There were no medial facets on the left tibiae, while there were four on the right tibiae ( $p<0.05$ ). These facets are comparable in frequency to other Byzantine sites from the same region, and contribute to an understanding of kneeling and monasticism within the biocultural model. They constitute one part of an overall biomechanical model of activity for this monastic collection.

**Freezing, fighting and falling; An exploration of trauma causality in the Neanderthals, Fuegians, Eskimo and Aleut.**

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It is a peculiarity of the Neanderthal skeleton that a high frequency of trauma is commonly observed. This has been postulated as being a result of close contact with large prey species during hunting as well as inter-personal violence (Berger and Trinkaus, 1995). Here a comparative approach is adopted to explore the reasons for such a pattern. The Tierra del Fuegian Indians and the Inuit are used as comparative populations because of their similarities in skeletal adaptation and broad synchronicity of habitat. A long bone trauma profile of each specimen was recorded and combined for each population as a whole compared, and any convergence identified. 28.6% of the Nean-

derthal sample ( $n=35$ ) display trauma with one incidence of multiple trauma. 6.4% of the Selk'nam sample ( $n=47$ ) display trauma with 2 incidences of multiple trauma. 3.6% of the Eskimo sample ( $n=112$ ) display trauma with 2 incidences of multiple trauma. 5.3% of the Aleut sample ( $n=57$ ) display trauma with no incidences of multiple trauma. To explore causality the approach adopted was to model the foraging energetics of the Neanderthals and to compare the trauma patterns found in the skeletal record to those of the other two populations. Broad models are then used to explore the causality of trauma patterns and to seek explanations for the Neanderthals perceived ill-adaptation to their habitat. Statistical analysis was used to identify the underlying causes of such a pattern within each population.

**Molar topography and dental functional morphology of *Australopithecus afarensis* and early *Homo*.**

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Few studies have examined the dental functional morphology of early hominins for clues to diet. This is due, in part, to methodological limitations for analyzing worn teeth, which make up the vast majority of fossil assemblages.

This study involved an examination of worn M2s of early hominins using dental topographic analysis. High-resolution replicas were prepared for undamaged specimens of *Australopithecus afarensis* ( $n = 15$ ) from the Hadar and Laetoli and Early *Homo* from Koobi Fora, Olduvai Gorge and West Turkana ( $n = 9$ ). Specimens were scored for wear stage, and occlusal surfaces were digitized in 3D by laser scanning at lateral and vertical resolutions of 25.4 microns each. Data were imported into GIS software, and average surface slope and relief (a ratio of 3D surface area to 2D planometric area) were computed. Resulting data were compared with those published for gorillas ( $n = 48$ ) and chimpanzees ( $n = 56$ ).

Early *Homo* specimens had both higher average slope values and more occlusal relief than *Australopithecus afarensis* at given stages of wear. Further, early *Homo* mean slope and relief values were intermediate between gorilla and chimpanzee values in nearly all cases. Finally, *A. afarensis* average slope and relief values were the lowest of all taxa at all wear stages.

Given sample size caveats, these results suggest that early *Homo* molars were better suited to shearing tough foods than

were those of *Australopithecus afarensis*. Supported by the L.S.B. Leakey Foundation.

### **A stone in their hands... are monkeys tool users?**

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Tool use represents a very specialized form of cognitive behavior and problem-solving, that only has been reported in a small number of primate species. This paper reviews the literature on spontaneous cases of "tool use" in captive, semi-free, and wild New and Old World monkeys. We reviewed over 150 references that contained "tool use" or "object use" as key words. These data were evaluated to determine whether the presently available evidence supports the contention that monkeys naturally use tools and have insight into how the tool functions in solving a task.

Following Panger's (1998, 1999) distinction between tool-using and object-using, we found extremely limited evidence for spontaneous "tool use" in monkeys. The overwhelming number of published reports were associated with species of three primate genera, *Cebus*, *Macaca* and *Papio*. Moreover, the majority of observations described in the literature as "tool use" were examples of object use. Considering the extremely small number of reported "tool-using" events, the low frequencies at which "tool-using" occurred and the fact that typically only 1 or 2 members of a group were observed to manipulate objects as tools, we conclude, (a) the presently available evidence does not support the contention that monkeys naturally use tools, and (b) in those cases when monkeys are reported to use tools it remains unclear from descriptions of the animals' behavior the degree to which they understood how the tool functioned (casual knowledge) in accomplishing the task. Additional questions concerning primate cognition, tool use, social learning, and problem-solving are addressed.

### **New research on the Palaeolithic of Lurestan, West Central Iran.**

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The cessation of fieldwork by foreign expeditions after 1979 in the Zagros

Mountains prompted some Iranian archaeologists to continue research on the pre-Neolithic archaeology of western Iran. We began our survey in late December 2000 and continued to work until early January 2001. During our survey we discovered, mapped and sampled 21 sites. In addition, we revisited and mapped the sites sounded earlier by Hole & Flannery (1967). Flint artefacts were used to estimate the age of the sites, which ranged from the Middle Palaeolithic to the Neolithic periods, some continuing to be occupied even later. The sites we discovered fall into three major types: caves, rock-shelters, and open-air sites. In general, the lithic assemblages found in our survey can be divided into four groups: 1-The Palaeolithic, comprising Mousterian, Zagros Aurignacian, and probably Zarzian industries; 2-possible late Epipalaeolithic and early Neolithic industries; 3-possible Chalcolithic and Bronze Age lithic assemblages; and 4-unidentified flake industry.

Our preliminary analysis of the data suggests two different environmental settings for the Palaeolithic and post-Palaeolithic sites. The older sites are primarily located in what is known as the Zagros Thrust Zone in central Lurestan. The younger, post-Palaeolithic sites are located in the geologically Folded Zone in southwestern Lurestan. Once our research is completed, we should be able to attribute the various environmental niches of these sites to their chronological positions.

### **Analysis of four contemporary trophy skulls in Los Angeles County, California.**

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The act of collecting human crania as trophies was practiced by many cultures throughout human history. In particular, several authors (e.g. Bass, 1983; Ousley and Sledzik, 1991) have noted collection of trophy crania by American servicemen during WWII and the Korean and Vietnam conflicts. This study focuses on four skeletonized human crania received by the County of Los Angeles Department of Coroner during the past decade which were listed as potential trophy skulls.

To determine the forensic significance and potential origin of the remains they were subjected to morphologic, metric and taphonomic analyses. Additionally, the history of the crania as told by the persons from whom they were recovered was considered. The morphologic analysis involved determination of ancestry, sex and

age to the extent possible. The metric analysis involved comparison with published data from known or assumed trophy skulls using FORDISC 2.0. Finally, the taphonomic analysis involved examination of the crania for intentional alterations (e.g. the presence of writing/drawing, candlewax) and similarities with known trophy skulls.

It was determined that three of the four crania were likely trophy skulls; these three appear Japanese in origin and show candlewax and other intentional alterations. The fourth is problematic, with FORDISC 2.0 indicating an almost equally strong likelihood that the cranium is Japanese and Native American; there is intentional alteration of this cranium in the form of drawing. The methods and techniques used in making these determinations are presented, along with a discussion on the importance of anthropological analysis in the forensic setting.

### **Patterns of sexual dimorphism in *Homo*.**

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Uncertainty regarding the degree and nature of sexual dimorphism in fossil hominids is a major obstacle in their accurate taxonomic classification. Modern analogs for sexual dimorphism, either generated from single populations or from geographically dispersed samples, are often used to interpret the degree of sexual dimorphism in fossil hominid samples, consisting of different populations spread over time and space. This approach, often necessitated by the nature of the fossil record, rests on two assumptions; (1) that variation in the past is partitioned similarly as variation is in the present, and (2) that sexual dimorphism is expressed similarly between comparative samples both in nature and degree.

In this paper, 460 skulls from the Morton skeletal collection were used to test several hypotheses generated from this latter assumption. Examination of numerous craniometric traits in this worldwide sample reveals that sexual dimorphism is expressed heterogeneously in different regions and different populations. Given that populations have unique histories of genetic drift and natural selection, this is not surprising. It does, however, prompt a closer examination of the nature of comparative samples as analogs of sexual dimorphism for the past. If, as our data suggest, males and females differ in different ways and to different degrees in different populations, any attempt to

apply a uniform standard for the expectation of dimorphism should be done cautiously.

**Leveling coalitions in primate males: Toward an explanation of human egalitarianism.**

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Concerted attacks by multiple males aimed at displacing higher-ranking targets from valued resources are called leveling coalitions when they do not permanently change the dominance ranks of either the coalition partners or the targets. We develop a model for such coalitions. We predict that leveling coalitions should occur where the contest potential among the males is moderate at best, should involve many males, who are mid-to low ranking, and should produce conditions where dominance ranks no longer affect reproductive success, eventually leading to their dissolution. Overall, the predictions fit the observations: leveling coalitions are formed by low-to mid-ranking males in primate groups with large numbers of adult males and females, often with a tendency toward seasonal breeding (and hence moderate contest potential), although they are generally smaller than predicted by the model.

We then apply the model to human foragers, among whom large leveling coalitions have successfully produced egalitarianism. Indeed, human foragers fit the model better than nonhuman primates. We compare the merits of this model with that of alternative explanations for the origin, subsequent loss, and more recent re-emergence of egalitarianism among human males.

**Reconstructing diet and dietary histories in a colonial Afro-Caribbean population from Guadeloupe, West Indies.**

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Recent investigations of diet via stable isotope analysis of human bone and teeth have not only demonstrated the potential for refining of our knowledge of dietary details, but for the identification of those individuals that may have undergone substantial dietary changes between different stages of their life. Such changes may be detected through the analysis of skeletal elements that form during different life stages. Bone tissue will reflect

diet during the last decades of life since it remodels slowly throughout life. In contrast dental enamel does not turnover after development in childhood, and therefore, will reflect childhood diet. Since dietary changes are often associated with residential migration, identification of these changes may pinpoint individuals that have migrated into an area.

This study reconstructs diet and traces dietary histories in a sample of human bone from the colonial cemetery site of L'Anse Sainte-Marguerite, Guadeloupe, West Indies (c. A.D. 1750). Stable isotope analysis was conducted on bone samples from 60 adult individuals to obtain  $\delta^{13}\text{C}$  and  $\delta^{15}\text{N}$  of the bone collagen, and  $\delta^{13}\text{C}$  of the bone apatite. Tooth enamel apatite samples were also analysed to obtain  $\delta^{13}\text{C}$  values.

Comparison of bone and tooth enamel apatite  $\delta^{13}\text{C}$  values demonstrates that 40% (12/30) of these individuals have substantial differences between the two tissues (mean 4%). Placed in the context of the site, it is likely that the dietary shift seen in these individuals was related to enforced migration from their place of birth in African to the Caribbean.

**The bipedal brachiator: A kinematic analysis of bipedal walking in *Hylobates lar*.**

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Analyses of bipedal gaits of living primates provide important information essential to evaluate the prevailing hypotheses on pre-hominid locomotory behavior. With this study we provide detailed kinematic data of gibbon bipedalism, in continuation with previously published results on plantar pressure distributions and 3D ground reaction forces. Additionally, we compare gibbon bipedalism with the main characteristics of bonobo (*Pan paniscus*) and human bipedalism.

We recorded video sequences at 50Hz of four non-trained white-handed gibbons in the Animal Park of Planckendael, Belgium with four S-VHS cameras. The cameras were placed frontally and laterally to a walkway, with built-in pressure mat and force plate, to obtain a 3D view of the bipedally walking gibbons. All devices were synchronized and the different views were digitised with Kwon3D3.1 software to obtain linear and angular kinematic parameters.

Gibbons are characterized by a relatively fast and bouncing-like mode of locomotion

with large side-to-side movements. The trunk is slightly inclined and the knees are never fully extended. The center of gravity moves downward during mid-stance, which is reflected in the single-peaked vertical force curve. The foot is placed flatly onto the substrate without initial heel-strike. There is a strong dorsiflexion of the ankle at toe-off and a strong plantarflexion and extension of the foot at touch-down.

The integration of kinetics and kinematics allows us to make a detailed description of hylobatid bipedalism that adds to our knowledge of hominoid locomotion.

This study is supported by a grant from the FWO Flanders and by the Centre for Research and Conservation (KMDA, Belgium).

**Where the wild things are: Linking lab and field work in studying tree gouging in common marmosets (*Callithrix jacchus*).**

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Robust tests of evolutionary adaptive hypotheses realistically require data from traditionally separate disciplines. We have been testing hypotheses of morphological adaptation to tree gouging in the common marmoset head. Our *in vivo* lab research suggests that marmosets do not necessarily generate relatively large bite forces during gouging of simulated tree substrates. These *in vivo* performance data are of questionable use for studying marmoset adaptations without a direct link to the gouging environment experienced by marmosets.

We quantified the mechanical properties of trees gouged by common marmosets from two sites in Brasil and compared them to those of our lab substrates. We recorded the stiffness, toughness and hardness of the bark and outermost sapwood for 86 trees from 20 species in the Estação Ecológica do Tapacurá and the campus of the Universidade Federal Rural de Pernambuco.

The mechanical properties of two lab substrates, fresh-cut maple and sweetgum, fall within the range of mechanical properties of trees gouged in the wild. Conversely, our pine and oak lab substrates are far stiffer than trees gouged by marmosets. Theoretically, this increased stiffness adds to the stress an animal



must generate to fracture a substrate and hence likely misrepresents the forces needed to gouge trees in the wild. Given that we see marmosets using significantly different gouging forces on our fresh-cut tree substrates versus these oak and pine substrates, this observation emphasizes the importance of considering the natural environment when collecting in vivo lab data.

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### **Interpretation of postcranial variation in South African Plio-Pleistocene hominids.**

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Paleoanthropologists continue to debate the number of species in the hominid fossil record. Arguments concerning species recognition often focus on levels of variation exhibited within fossil assemblages. In order to further understand hominid fossil postcranial variation and thus attempt to designate species for fossil hominid postcrania, an empirical framework based upon extant hominoid postcranial variation needs to be established.

I present results from an analysis of humerus, ulna, radius, femur, and tibia variation in South African Plio-Pleistocene hominids. The South African hominid fossils present a unique opportunity to examine both inter-site and intra-site variation. Inter-site analyses were conducted by comparing fossil CVs to bootstrapped confidence intervals from extant hominoids (see Cope and Lacy 1992). The null hypothesis of one fossil species was rejected if the fossil CV exceeded the 95% bootstrapped value in extant hominoids. Intra-site analyses proceeded using both bootstrapping procedures and variability profile analyses, where two different CV profiles are examined for concordance using Kendall's Coefficient of Concordance.

Results from inter-site analyses indicate that few CVs for fossil dimensions exceed extant hominoid bootstrapped values. Fossil CVs decrease when the sample is restricted to one site as compared to the inter-site fossil CV. The intra-site variability profiles tended to differ among sites, suggesting that the postcranial fossils may exhibit disparate variation patterns at the different South African hominid sites.

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### **GIS and Palaeoanthropological Surveys - Experiences.**

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In this case study we present our experiences with the use of Geographic Information Systems (GIS) for documentation and analysis of palaeoanthropological surveys in the Ethiopian Rift system.

The joint Austrian, German, Ethiopian and American PAR (PaleoAnthropological Research) Team conducts fieldwork at the site of Mt. Galila in the southern Afar depression of Ethiopia since 2000. The early to middle Pliocene sedimentary and volcanic successions yield a rich sample of fossil vertebrates, on the just sparsely sampled recent surface stone tools are also abundant.

For documentation and analyses of the spatial distribution of fossils and artefacts, we used a GIS at large (regional) and small (locality) scales as well. As base layer we used remote sensing data (Landsat TM7, Corona, Ikonos, ASTER) due to a great lack of cartographic material of sufficient quality. Positions of individual findings, observations and geological samples were recorded using standard handheld GPS receivers. Stratigraphic, sedimentological, taphonomical and further geological field data were recorded at the site in standardized field forms and notes. The coordinate database was imported to ArcGIS 8.1, while the contextual information is stored in an Access database, which was merged with the GIS.

The combination of geological, sedimentological, taphonomical and paleontological data allows the visualization and analysis of spatio-temporal distribution of taxa, and supports the regional reconstruction of the palaeoenvironment at the western rift margin.

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### **The Middle to Upper Paleolithic interface in Central Asia and the status of Obi-Rakhmat.**

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After giving a short overview of the late Middle and early Upper Paleolithic sites of Central Asia, the author dwells in more detail on the question of the status of Obi-Rakhmat. Obi-Rakhmat is a cave site in Uzbekistan notable for the existence of a well developed blade technology in the layers predating 40 kyr bp. While some workers consider this industry either transitional or early Upper Paleolithic, the other believe it is still Middle Paleolithic. To resolve the issue a new methodology has been used that treats MP and UP not as some static conditions, but rather as ideal polar extremities each characterized by a number of polar attribute states (e.g. flat vs. volumetric cores, non-marginal vs. marginal flaking, flakes vs. blades, rare vs. common evidence of hafting, scarce vs. abundant formal bone tools, etc.). The real MP and UP industries form a continuum of states between these two ideal extremities and the position of any given assemblage or culture on this scale can be assessed in quantitative terms. The values obtained for Obi-Rakhmat are close to those obtained for the Aterian and therefore gravitate rather to the MP pole than to the UP one. They are lower than values characteristic of the Uluzzian, Chatelperronian, and early Streletskian assemblages, let alone Ahmarian, Spitsynian, and Aurignacian.

### **Preliminary study of nighttime parenting behaviors among primiparous adolescent and adult mothers.**

L.E. Volpe, J.J. McKenna. Dept. of Anthropology, University of Notre Dame.

While research has explored the developmental implications of different patterns of infant care, relatively little is known about how parents care for their infants at night. Studies of the ecology of nighttime parenting behavior have become a focus of medical and anthropological inquiry only within the last decade. Previous studies have shown significant differences between routinely bedsharing and routinely solitary sleeping mother-infant dyads in the form and frequency of particular behaviors, including breastfeeding, body position, and use of physical materials in the sleep environment. These differences suggest a hidden regulatory effect of sleeping location and decision to breastfeed on the infant's physiology (McKenna *et al.*, 1999). The purpose of the present study is to determine if such inferences apply to first-time mothers,

particularly those in at-risk populations, based on overnight infra-red video recordings collected at the Mother-Baby Behavioral Sleep Laboratory. Data were obtained on a sample of 25 primiparous adolescent mothers (mean 16.6 years) and 15 ethnically-matched high-resource adult mothers (mean 26.7 years), (57% Caucasian, 36% African-American, and 7% Mexican American). The study presents group differences in infant feeding method, sleep location, presence of environmental safety hazards during sleep, and potential neglect issues. Breastfeeding initiation rates were 50% for adolescent mothers and 85% for adult mothers, with 29% of adolescents and 50% of adults continuing to breastfeed at 4 months. The study reveals much more variation both within and between sub-groups of adolescent and adult first-time mothers in all indices than would be predicted by current literature.

**Progress in the aDNA identification of syphilis in archaeological human remains.**

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Many have been searching for and contemplating the origins of syphilis. By understanding its emergence as a human pathogen we will be better able to elucidate its evolution through time and space as well as shed light on its current state. Ancient DNA techniques used to isolate *Treponema pallidum* subsp. *pallidum* DNA from archaeological human specimens provides direct evidence of its existence in the past. To date, only Kolman et al. (1999) have been successful in this endeavour. Since this publication many other labs around the world have been trying to replicate this method. Why has there been so little success? This paper outlines work performed at the McMaster Palaeogenetics Institute on the analysis of human remains with putative syphilis from around the world and different time periods including the American Civil War, historic Canada, medieval England and historic Chile.

**The semicircular canals of subfossil lemurs and their functional significance.**

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The radii of curvature of semicircular canals of extant primates are correlated with locomotion. Large radii are found in species that have fast and frequent changes in angular motion, while small radii are found in those that are slow climbing or less jerky in their locomotion. It follows that semicircular canal morphology can be used to retrodict the locomotion of extinct species. Petrous bones from six subfossil lemur species were scanned using ultra-high resolution X-ray computed tomography (uhrCT). The resulting uhrCT data were then re-sliced digitally to image the semicircular canals. The canal radii were used in a regression analysis with body mass and the results compared with a database of extant primates of known locomotion

*Paleopropithecus ingens* is retrodicted as the extreme slowest of the indrisine sloth lemurs, and has canals that are relatively smaller by far than those of any living primate. Two smaller sloth lemurs, *Babakotia radofilai* and *Mesopropithecus pithecoides*, were also very slow moving relative to extant primates, having canals as small as those of slow climbing modern lorises. *Archaeolemur*, another indrisine subfossil lemur, has been reconstructed as a digitigrade monkey-like animal. The relative size of its canals confirms this assessment and indicates that it was relatively fast moving. Species of *Megaladapis*, the "koala" lemurs of debatable phylogenetic affinity, have much smaller canals than any living primate of their body mass, concordant with slow climbing locomotion with little proclivity, if any, to make even short leaps.

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**Bioarchaeological evidence for the health status of an early Icelandic population.**

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Recent excavations at Hrisbrú in the Mosfell Valley of Iceland have revealed a church and cemetery as well as domestic and ceremonial structures spanning the pagan and early conversion periods in the 10th and 11th Centuries. The skeletal remains of thirteen people buried at Hrisbrú provide new evidence of the health status and living conditions of Iceland's early inhabitants. The economic life of these people centered on sailing, fishing, and stock-raising in a challenging marginal environment. Traumatic injuries appear to have been common. One person buried in the cemetery is an apparent homicide victim with massive head injuries. Another has a healed leg fracture. In addition to traumatic injuries, skeletal lesions associated with heavy labor and infectious diseases are also common in this conversion period population. Several individuals, including an adolescent, show evidence of strenuous physical activity involving the hands and arms and osteoarthritis is prevalent. One young man from this cemetery is of special interest owing to the presence of lesions associated with a chronic ear infection that resulted in a brain abscess. Another adolescent male has lesions on the pleural surfaces of his ribs. Although other diagnoses are possible, the lesions in both of these cases suggest that tuberculosis was present in the Hrisbrú population. Stature comparisons with the early conversion period burials at Hrisbrú and contemporaneous skeletal remains from Norway provide additional data on the living conditions of these people. These data suggest that stressful living conditions and heavy labor were common among early Icelanders.

**Intraspecific differences in positional behavior of the white-faced saki, *Pithecia pithecia*, and the influence of habitat characteristics.**

S.E. Walker. Dept. of Sociology and Anthropology, Southwest Missouri State University.

Positional behavior ultimately depends on habitat structure; by demonstrating that some positions appear to be more efficient for use in certain habitats, or on particular supports, the selective advantage for these behaviors might be inferred. Of great usefulness to this end are intraspecific comparisons, which allow us to hold constant the effects of anatomy and phylogeny and assume that the observed variation is due to differences in use of available habitat.

As part of a long-term study on positional behavior and associated habitat

characteristics in pitheciin primates, two different groups of *Pithecia pithecia* (the white-faced saki) were observed on separate islands in eastern Venezuela for 15 months. Focal animal instantaneous sampling at two-minute intervals was used for behavioral data collection, and habitat analyses were conducted using plots and strip sampling to gauge the availability of various habitat types and supports. Significant differences in positional behavior, use of tree portions, and heights in trees are apparent between the two *Pithecia* groups during feeding, traveling, and resting. The most striking differences occur during feeding. Habitat differences were noted in terms of tree density, liana density and tree size. Differences in positional behavior between the two *Pithecia* groups are discussed in terms of support preferences and availability. I suggest that differences between the groups in positional behavior during feeding are greater than for other activities due to the importance of lability in feeding behavior for coping with environmental change.

#### **Variations in cortical material properties of baboon mandibles.**

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Understanding mechanical behavior of cortical bone and its variations plays an important role in our ability to interpret craniofacial architecture and its link to function. We assessed the material properties of cortical bones of eight baboon mandibles in different sex-age groups by using ultrasonic techniques. Results showed that, overall, cortical bone from baboon mandibles can be modeled as an orthotropic elastic solid. This bone has material properties comparable to that of human mandibles but also has some unique features due to specific anatomical specializations. There are significant differences in direction of maximum stiffness, thickness, density, and material stiffness throughout each mandible. The symphyseal area is high in thickness and low in density and stiffness. The corpus is low in thickness and high in density and stiffness. The ramus resembles the symphyseal area in material properties in juveniles, while it resembles the corpus in adults. There is a significant increase in material stiffness during growth. There are differences in material properties at the corpus and ramus between male and female mandibles which are not detectable in human mandibles and might be explained by the sexual dimorphism.

There are also correlations among the directions of maximum stiffness and bone axes, and among cortical thicknesses, densities, and mandibular transverse widths. Those relationships among growth, anatomical features and material properties bring us insights into the processes of development and adaptation, and the interface between form and function in mandibular form. Supported by NSF BCS-0240865.

#### **The uplift of the Qinghai-Xizang plateau and its effects on human evolution in East Asia.**

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Recent developments in research on the uplift of the Qinghai-Xizang plateau and its effect on the environment of surrounding areas have provided much more new information for understanding the human biological and cultural evolution in East Asia as well as the Old World. The strong uplift of the Qinghai-Xizang plateau, especially from the late Lower Pleistocene to early Middle Pleistocene, created a high physical barrier, and changed the global climate system, which obviously interrupted the genetic and cultural exchange between East Asia and the west of the Old World. This paper will discuss the relationship between the uplift of the Qinghai-Xizang plateau and the process of human evolution in East Asia, and its significance on the human biological and cultural evolution in the Old World.

#### **Canine dimorphism in *Australopithecus anamensis*.**

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While canine tooth size variation of *A. anamensis* is similar to that of *A. afarensis*, the large size of the canine alveolus of the KNM-KP 29287 *A. anamensis* mandible suggests substantial canine dimorphism existed in this species, exceeding that of other hominins. Even so, potential canine dimorphism in this species has not been quantified. We therefore evaluated canine crown, root and alveolar dimensions in a series of anthropoid primates in order to assess the potential magnitude of canine size variation in *A. anamensis*.

As well known, all hominins including *A. anamensis* show reduced canine crown height dimorphism. Among extant pri-

mates, canine crown height is only moderately correlated with dimorphism of the basal crown. This suggests that changes in canine crown height can occur independent of changes in basal crown or root dimensions. When the alveolus of KNM-KP 29287 is considered, variation in *A. anamensis* root and basal canine size is as great as that of chimpanzees. In contrast, *A. afarensis* is more like bonobos with less size variation.

Hence, the earliest *Australopithecus* retained substantial dimorphism in the canine basal dimensions, but had reduced dimorphism in canine crown height. Only later did basal canine dimorphism reduce to the same degree seen in crown height. Because canine crown height is the strongest correlate of social behavior among extant primates, assessments of the behavioral/ecological significance of dimorphism in early hominids should focus on the pattern of canine crown height reduction, rather than proportional differences in canine basal dimensions.

#### **Lytic lesions of the cranial vault: Differential diagnosis in dry bone.**

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Tumors involving the bones of the cranium are relatively common and most elicit some type of bony response resulting in productive periosteal reaction such as lamellated or spiculated bone growth. Purely osteolytic lesions of the vault-lesions that exhibit no sclerosis or osteoblastic response at all-are less common and are one of three general types: Histiocytosis X lesions, plasma cell tumors, and occasionally, a lytic metastasis from a primary carcinoma.

Histiocytosis X includes three non-neoplastic lesions that are clinically distinct, but may be impossible to differentially diagnose in dry bone. The three lesions, Letterer-Siwe's disease, eosinophilic granuloma, and Schüller-Christian's disease are most commonly found in children and adolescents and very rarely affect adults over 45 years of age. Multiple myeloma can present with a solitary cranial lesion and several lesser lesions in the axial skeleton that are difficult to locate without MRI or CT imaging. Solitary plasmacytoma, a plasma cell tumor related to multiple myeloma, produces lytic lesions and occurs with higher frequency in males of advanced age. Metastatic carcinomas usually elicit an osteoblastic response, but cannot be ruled

out. A finding of additional tumors in the skeleton can help confirm this diagnosis.

In this presentation, we present a series of lytic cranial vault lesions from documented collections, clinical practice, and forensic cases. We argue that, based solely on the appearance of a single cranial lesion, a differential diagnosis between these three general types of lytic lesions may not be possible from examination of skeletal remains alone.

**The effects of growth velocity on stable nitrogen isotope ratios in subadult long bones.**

A.L. Waters, M.A. Katzenberg. Archaeology Department, University of Calgary.

Stable nitrogen isotope ratios ( $\delta^{15}\text{N}$ ) are used by paleodiet researchers to reconstruct the breastfeeding and weaning practices of past populations, since elevated  $\delta^{15}\text{N}$  in infants has been attributed to the ingestion of breast milk. This research examines an alternate hypothesis for the elevated  $\delta^{15}\text{N}$  seen in infants. It is proposed that fluctuations in growth velocity may be responsible for the elevated  $\delta^{15}\text{N}$ . The relationship between growth velocity and  $\delta^{15}\text{N}$  is investigated in a sample of 19 subadult long bones from an ossuary sample from southern Ontario. A multiple, intra-individual (within-bone) sampling methodology was used on subadult long bones from individuals ranging in age from fetal to twenty-four years. It is concluded that growth velocity does not affect nitrogen isotope ratios, because (1)  $\delta^{15}\text{N}$  values are not significantly different among the metaphyses and diaphysis of a growing long bone, and (2)  $\delta^{15}\text{N}$  values are not significantly different between bones (or areas of a bone) that are still undergoing longitudinal growth, versus bones that have ceased growing. This research supports the use of stable nitrogen isotopes for reconstructing diet and breastfeeding practices in past populations.

**The Middle Miocene Maboko Island primate locality: New data and the integration and reinterpretation of existing data suggest the paleoenvironment was lacustrine.**

B. Watkins. Dept. of Geology, University of Liverpool.

Maboko Island is recognized for the wealth of primate fossils its sediments have produced. The primary fossiliferous beds occur in the lower part of the sequence. Essentially, since calcrete has been identified in sections of the forma-

tion, the paleoenvironment has been interpreted as a semi-arid floodplain. However, new and the integration and reinterpretation of existing data suggest an alternative environment. The lowermost Bed 3, colloquially known as greensand, has been particularly productive. This bed displays characteristics known to develop in a lacustrine environment. Sedimentologic examination shows that a fundamental component of this bed is sub-rounded sand-sized grains known as ooids. Ooids are formed in bodies of water that has sufficient energy to maintain grains in suspension. These suspended grains are eventually coated with concentric layers of calcium carbonate. Thin sections of the ooids show that these layers of  $\text{CaCO}_3$  are symmetric and resemble tree rings. Further, fragments of stromatolites are found, which occasionally function as nuclei for the ooids. Kent (1944) proposed that the Maboko area was the site of a vast Miocene lake, but his hypothesis was later discounted. However, sedimentological and non-mammalian paleontological material as well as research concerning the evolution of the basin appears to suggest that the tectonic and volcanic history of the region, and therefore the geomorphological and fluvial prerequisites required to form a lacustrine environment appear prearranged. Indeed, since the Maboko Formation represents more than a million years of sedimentation, it appears unlikely that a single depositional regime could account for its entire construction.

**Meat sharing by chimpanzees at Ngogo, Kibale National Park.**

D.P. Watts<sup>1</sup>, J.C. Mitani<sup>2</sup>. <sup>1</sup>Yale University, <sup>2</sup>University of Michigan.

Chimpanzees hunt a variety of prey species and commonly share meat after successful hunts. Hunters expend energy and often risk injury. This raises a question general to food sharing in animals: why would individuals share the nutritionally valuable resources gained from successful hunts? Proposed answers include the possibilities that sharers: gain indirect fitness benefits; avoid costs of harassment; gain mating opportunities; advertise, enhance, or maintain status; improve their foraging efficiency; improve survivorship by augmenting group size; and/or gain future benefits either in kind (reciprocity) or in other currencies (e.g., "interchange" food for grooming). Several of these explanations, notably reciprocity, status enhancement (political maneuvering), and mating success, have been invoked for chimpanzee meat sharing. Our

previous work has supported the hypotheses that males in an unusually large chimpanzee community at Ngogo, Kibale National Park, share meat reciprocally and exchange meat for grooming and agonistic support, but not the hypothesis that sharing increases mating success. Still, questions about whether apparent reciprocity and interchange are byproducts of other factors remain. Here, we use more extensive data on meat sharing to show that reciprocity and interchange are not statistical artifacts of association patterns. We reconfirm the hypothesis that males use meat as a political tool, and show that active sharing is notably common between allies. However, we also show that the frequency of passive sharing (tolerated theft) and the number of sharers vary with carcass size and with the number of beggars in ways that support the "harassment" hypothesis.

**The Upper Paleolithic Mladec assemblage: Cranial geometry compared with anatomically modern humans and Neanderthals.**

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The Mladec human remains from northern Moravia, Czech Republic play a central role in the discussion of modern human origins. Although generally accepted as modern *Homo sapiens*, some distinctiveness of the cranial morphology stimulated speculations about possible anatomical links to the preceding Neanderthals. We therefore investigate and compare the cranial geometry of the most complete four specimens (Mladec 1, 2, 5 & 6) with geometrical and statistical techniques. Size and shape differences of the Mladec assemblage vs. modern *Homo sapiens* of both sexes, Late Pleistocene anatomically modern *Homo sapiens* (AMHS), and classic Neanderthals are based on a dataset of Cartesian coordinates. In contrast to other studies, the cranial surface is recorded here by various anatomical landmarks as well as several hundred semilandmarks in previously unquantified regions.

Analysis of the Procrustes coordinate data was done by principal components and principal coordinates in size-shape space and shape space. With respect to shape alone and considering shape and size we observe three distinct groups: Modern *H. sapiens*, Late Pleistocene AMHS, and Neanderthals. The Mladec

crania are part of the Pleistocene AMHS cluster, which lies on the fringe of modern *H. sapiens* variability, while the Neanderthals are distinctly separate. We describe detailed findings for the braincase and the face (if extant), including supraciliary morphology and occipital protrusion, and discuss considerations towards a possible ancestry of Neanderthals.

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### **Evidence of biomechanical stress in a Middle Mississippian skeletal population.**

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Skeletal remains and funerary objects from the MacDuffee Site in northeastern Arkansas are being analyzed at the request of the Quapaw Tribe, the most likely affiliated descendants. Archaeological evidence indicates a Late Woodland/Middle Mississippian origin for the site. Sex and age could be reliably determined for only 44 (27 males, 27 females) of 112 adults. In addition to disease indicators and trauma, the presence and severity of degenerative pathologies were described for each of these 44 skeletons. Forty-three of the MacDuffee adults had hypertrophic muscle attachment sites. Seventy-seven percent of the individuals exhibited osteoarthritic changes on four or more joints. Osteophytosis was present in 44% and 65% of the adult males and females respectively, and disk herniations were observed in 12 males and nine females.

In this paper, evidence of biomechanical stress among the adult skeletal remains is considered by sex and age category. Patterns of hypertrophy and arthritis possibly attributable to sexual divisions of labor are discussed. The MacDuffee material is compared with other contemporaneous Mississippian sites, including Dickson Mounds. In general, the prevalence of muscular hypertrophy was greater in young females (16-25, 26-35 year categories) than young males for the shoulder, elbow, hip, and knee joints, whereas a greater percentage of older males (36-45, 46-55 years) than females was affected by muscular hypertrophy in those same joints. Males exhibited osteoarthritic changes more often than females in all joints except the jaw. The incidence of arthritis increased with age in most joints. The MacDuffee population exhibited more degenerative pathologies than Dickson Mounds individuals in all age categories.

### **The post-cranial functional morphology of Javanese bovids as an indicator of paleoenvironment.**

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The vertebrate paleontological scheme currently utilized for Java, while useful for examining broad evolutionary trends, lacks the resolution necessary to address questions of local environmental change and early hominid behavior. An increasing number of studies indicate that the environment plays a key role in understanding hominid morphological and behavioral adaptations. For Java, environmental reconstructions have been limited primarily to comparisons of overall faunal compositions within the current biostratigraphic framework. While this method is useful, it relies on an assumption of temporal stasis in habitat preference in addition to requiring taxonomic and phylogenetic robusticity. Studies of African bovids have shown that a more effective way of examining past environments is through the study of morphological traits that are characteristic of functional adaptations to different environmental conditions. Before morphological traits characteristic of function could be discerned for Javanese bovids, identification criteria for the post-cranial bones of the two most common large bodied genera, *Bibos* and *Bubalus*, had to be constructed. Based on the examination of modern representatives of these genera, 32 qualitative characters for 14 skeletal elements have been identified. Additionally, based on ecomorphological characters of the femur, the work indicates that these two genera are morphologically adapted to two different environments. Ultimately, the study provides an empirical means by which the paleontological record can be examined and may provide insight into environmental preferences of early hominids on Java.

### **Age estimation of human skeletal remains - A comparison of methods from Lauchheim, Germany.**

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Basel, <sup>6</sup>Dept. of Anthropology, Ohio State University, <sup>7</sup>Inst. for Anthropology, Univ. of Mainz, <sup>8</sup>Dept. of Anthropology, University of Tennessee, <sup>9</sup>Landesdenkmalamt Baden-Württemberg, <sup>10</sup>Inst. for Human Genetics and Anthropology, Univ. of Freiburg.

A wide variety of methods for estimation of age-at-death from human skeletal remains are now available, reflecting a long history of interest in the subject. These methods rely largely on morphological changes in the maturing dentition and skeleton. The diversity of methods results in a diversity of reliability, rendering comparisons between methods insecure. The present study applies various methods of adult age estimation by independent investigators (the coauthors of this study) in order to document and interpret reliability and applicability.

Each observer applied a specific age estimation method to the same subsample (n=121) of a large early medieval (A.D. 550-750) cemetery at Lauchheim, Germany (n=1400). Previously, the tooth cementum annulation and Complex Method employing a range of methods recommended by the European Anthropological Association were used (Kunter, Wittwer-Backofen). For the present study, the following methods were used and compared to the results of the previous study: transitional method (Boldsen), auricular surface (Buckberry), suture closure (Larsen, Wahl), tooth root translucency (Prince), and osteon density (Doppler, Grupe). In addition, two observers (Hotz, Kemkes-Grottenthaler) applied a combined spectrum of different methods.

The results of this study reveal a general consistency of adult age-at-death, but with a high degree of variation. The study suggests that use of multiple age indicators is important for reconstruction of demographic profiles in archaeological settings.

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### **A modern revision of E. Hooton's study on the Indians of Pecos Pueblo.**

K.E. Weisensee. University of Tennessee, Knoxville.

Earnest Hooton recorded metric and nonmetric data from more than 450 individuals for his study, "The Indians of Pecos Pueblo". The focus of this research is a re-analysis of Hooton's original data using a modern conceptual and statistical framework. Although the skeletons from the Pecos site have been reburied, there is still a great deal of research potential

from this large, well-documented sample, due to Hooton's thorough data collection. First, a discriminant function was constructed in order to examine the highly male-biased sex ratio reported for the sample. The results of this analysis suggest that Hooton relied too heavily on the cranium, particularly when innominates were absent. Following a discussion of the sex estimation, the biological variation within the series is considered. The variation within the sample is examined using both the craniometric and cranial nonmetric data. The biological variation of the craniometric data is analyzed using RMET, and the resulting distance matrix is compared with the distance matrix obtained from an analysis of the nonmetric data. The distance matrices are used to assess changes that occurred at the pueblo over time, from the initial occupation to European contact. Finally, an analysis of the overall variation within the Pecos sample is assessed in order to determine changes in the level of variation of the entire Pecos site and between the sexes and time periods within the site. By examining the variation present at the site, questions regarding migration and marital pattern can be addressed.

**When size does not matter: An examination of aggregate osteoarthritis.**

E. Weiss. Archaeological Survey of Canada, Canadian Museum of Civilization.

Osteoarthritis, like musculoskeletal markers, is frequently used to reconstruct activity patterns. However, recent studies show that muscle markers are confounded by body size. The same concerns are raised concerning osteoarthritis. This study uses an aggregate osteoarthritis variable based on six sites (shoulder, elbow, wrist, hip, knee, and ankle) to examine effects of size (an aggregate of upper and lower limb size measurements), age, sex, and cross-sectional properties (an aggregate of humeral areas and inertias) to improve activity pattern reconstructions.

Seventy-seven (57 males, 20 females) British Columbians (3500 – 1500 yrs BP) and 18th Century Quebec Prisoners from the Canadian Museum of Civilization are analyzed. Osteoarthritis and size are measured using *Standards for Data Collection from Human Skeletal Remains* (Buikstra and Ubelaker, 1994); age and sex are determined through pelvic, cranial, and dental morphology; and, cross-sectional properties are calculated from humeral radiographs using Biknevicius and Ruff's (1992) formulae.

Using nonparametric Spearman correlations, osteoarthritis correlates with age,  $r = 0.61$ ,  $P < 0.001$  and cross-sections,  $r = 0.25$ ;  $P < 0.05$ , but not with size,  $r = -0.08$ , n.s. or sex,  $r = -0.07$ , n.s. Using a partial correlation to control for age, osteoarthritis no longer correlates with cross-sections,  $r = 0.15$ , n.s., which is expected due to age-related changes in cross-sections. Results do not change when examining upper and lower limbs separately. Osteoarthritis increases in older individuals. Thus, according to this study, age, but not size, is a factor that needs to be controlled for when using osteoarthritis to reconstruct activity patterns.

**Examination of the mortuary use of fire as a taphonomic process.**

M. Weitzel. Dept. of Anthropology, University of Alberta.

The association of fire with mortuary activity is widespread in the archaeological record. Research regarding the mortuary use of fire in detail is limited, however, with regard to both the material and technology used as well its potential taphonomic implications. This study is a comprehensive examination of mortuary fire use as a cultural taphonomic factor. In the first part of the study, eighteen charred burials were analyzed from the Late Neolithic/Early Bronze Age cemetery Khuzhir-Nuge XIV in the Lake Baikal region of Siberia. Each grave, individual, and skeletal element was examined in detail. Observation of the charred remains and their context reveals information about processes involved and subsequent impact the processes have on the bone. The second part of this study applies what was learned at Khuzhir-Nuge XIV to the development of six experiments using fire in a mortuary context. Experimental graves were constructed using domestic pigs as human analogues and burned under various circumstances (temperatures, durations, source of fuel, etc.). The results from experimental projects help to further explain this mortuary activity at Khuzhir-Nuge XIV and are applicable to other sites with evidence of fire usage.

**Toward a phylogenetic classification of late Pleistocene Homo in Africa, the Levant, and Australasia and its implications for the biological origins of the first Australians.**

M.C. Westaway. School of Archaeology and Anthropology, Australian National University.

Debate continues to focus on the human palaeontological record in the Australasian region as a means of testing the origins of modern humans. Opinion ranges between complete replacement of archaic humans by moderns to an ancestor/descendant relationship of indigenous populations east of Wallacea from Asian *Homo erectus*.

Examination of the (bio)stratigraphy and taphonomy of the hominin sites of Ngandong (Indonesia) and the Willandra Lakes (Australia) provide an indication of the likely minimum age of important taxa such as WLH 50 and the Ngandong site 1 specimens. Analysis of fauna from these localities also hints at the palaeoclimate and hence the likely environmental conditions that may have influenced their morphology. Positioning these specimens into their correct chronological and environmental context is critical to determine their phylogenetic relevance/significance to modern human origins in Australasia.

With reference to the prevailing environmental variables in late Pleistocene Australasia, parsimony and logistic discrimination analyses are applied to fossil hominin crania from Africa (Jebel Irhoud, Laetoli, Herto, Omo and Singa), the Levant (Skhul and Qafzeh), Java (Ngandong, Ngawi, and Sambungmacan) and Australia (Willandra Lakes, Kow Swamp, Nacurrie, and Coobool Creek) to determine the phylogenetic relationship between these specimens. The results of the analysis are considered in determining if the biological origins of the first Australians involves an Asian *Homo erectus* component or if cranial form indeed shares plesiomorphic conditions with the earliest anatomically moderns represented by specimens such as Herto, Omo, Skhul and Qafzeh.

**Wide faces or large canines? The attractive versus the aggressive primate.**

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The importance of sexual selection in the evolution of the hominid lineage is much debated. Hominids display marked body size dimorphism, suggestive of strong sexual selection; at the same time, they lack the significant sex differences in canine size that are commonly associated with intrasexual competition in primates. Here, we resolve this paradox by examining sex differences in facial morphology. We show that chimpanzees exhibit clear sexual dimorphism in face width, over and

above that expected on the basis of sex differences in body size. Furthermore, such facial dimorphism is negatively correlated with canine dimorphism among anthropoid primates. Our findings thus suggest that the lack of canine dimorphism in hominids is not due to weak sexual selection, but rather is associated with strong sexual selection for broader face width. In light of existing data linking enlarged cheekbones with attractiveness in humans, we propose that the evolution of a broad face in hominid males results from inter-sexual selection (mate choice), as opposed to intra-sexual competition.

**Mitochondrial DNA analysis for the study of variation and determination of geographic identity of indigenous human skeletal remains.**

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Mitochondrial DNA has played a major role in human population studies over the past 20 years, due its maternal inheritance and non-recombination (Macaulay, 1999). The mtDNA control region has been the focus of studies due to the highly polymorphic nature of this non-coding region. Forensic scientists also use mtDNA to determine identity of missing persons when nuclear DNA degrades. However, when skeletal remains are unclaimed, no comparison for identification exists. Therefore, using mtDNA in this context is not helpful. For population genetics, however, hypervariable regions in the mtDNA are useful in identification of population affiliations, especially in conjunction with morphological analyses.

The Hillsborough County ME Office provided 20 skeletons for this study. Mitochondrial DNA was extracted, amplified, and sequenced from the bones to determine polymorphisms in the HVR I region. These sequences will be aligned and compared to sequences from a human mtDNA control region database using several systematics programs (Handt, 1998). The skeletal remains have been osteologically measured for a similar morphological assessment using PAUP. Conclusions should reveal two systematic relationships: 1. a molecular cladogram establishing the relationships between different geographical groups and the unknown sequences; 2. a morphological cladogram showing relationships between the unknown skeletal samples and individuals of established geographical backgrounds. The importance of this study will deter-

mine whether systematic analysis is a legitimate way to determine population affiliation of unknown individuals, thereby benefiting future forensic studies.

**Adaptive regimes and genus designations of Plio-Pleistocene hominins: a multivariate approach.**

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While there is considerable dispute among biologists concerning what constitutes a species, genera have proven even harder to define. It has been proposed that a genus is a monophyletic group characterized by a single adaptive regime. This definition has been used to argue that the genus *Homo* is too inclusive because its earliest members occupied a different adaptive niche than later species of the genus. On the other hand, the species assigned to the genus *Australopithecus* are done so based on their similar adaptive grade, despite little evidence of monophyly. Prior attempts to demonstrate either that species assigned to *Australopithecus* form an adaptive grade or that early members of *Homo* are characterized by this grade have been largely qualitative. This study takes a quantitative, multivariate approach to test whether *Australopithecus* truly forms an adaptive grade and whether some members of *Homo* are characterized by this grade. Fifteen variables relating to diet, locomotion, body size, and brain size were analyzed using hierarchical cluster analysis. Results indicate that australopithecids form an ecological grade and that *H. habilis* is characterized by this grade. The placement of *H. rudolfensis* with the australopithecids, however, is equivocal. The species assigned to *Paranthropus* form a sub-grade in several analyses, indicating that they likely meet the above definition of genus. *H. sapiens* and *H. neanderthalensis* clustered closely in all analyses, while *H. erectus* clustered with later *Homo* in less than two-thirds of the analyses, indicating it may not meet the above criteria for membership in *Homo*.

**Fetal load in bipeds: Selection pressure for female lumbopelvic adaptation.**

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Prior to delivery of the neonate and its placenta, a protracted period of fetal growth occurs. Orthograde pregnancy characterized by habitual verticality ex-

erts marked biomechanical stress on the maternal lumbopelvic complex, yet the impact of fetal load on the primate skeleton has not been quantitatively investigated. In humans spinal loading is markedly complex due to lumbar lordosis and pelvic anterior tilt. These bipedal traits distribute load differentially along the vertebral column, particularly in response to fetal mass.

To test the hypothesis that lumbopelvic shape sexual dimorphism is greater in humans than in other orthograde primates five vertebral and innominate variables in humans (N= 65m/65f) were measured, tested and compared with similar data for two nonhuman orthograde primates, *Hylobates lar* (N= 24m/22f) and *Propithecus verreauxi* (N= 6m/7f). While dissimilar in positional repertoires, each taxon similarly maintains truncal verticality relative to the body line of gravity sharing directionality of key biomechanical forces.

Analyses of lumbopelvic sexual dimorphism in body size-adjusted variates using principal components and Welch's approximate *t*-test indicate that while pelvic canal shape significantly differs by sex in all three taxa, humans are distinct in lumbar vertebral sexual dimorphism. Females have relatively robust zygapophyses and laminar structures. Sexual dimorphism in the lumbopelvic complex of bipeds is examined as an adaptation to spinal loading patterns introduced by fetal load. Although pregnancy is intermittent, duration and recurrence of this obstetric load exert marked stress on the bipedal skeleton, suggesting an early emergence of lumbopelvic sexual dimorphism in the hominid lineage.

**Variation of the mandibular molars in extant lemuriform primates: A qualitative and quantitative study.**

J.L. White. Department of Anthropology, University of Iowa.

Comparative morphology remains a useful method in reconstruction of fossil taxa. When combined with morphometric techniques, it has proven valuable at elucidating small scale changes amongst taxa. Several studies have addressed the correlation between size and shape of the mandibular dentition and diet. The aim of this project is to identify metric variation among lemuriform primates between homologous points, as well as classify character states in order to more precisely define correlations between morphology varieties and diet. This study adds to past research by addressing metric variation between homologous landmarks on the

first and second lower molars and evaluates the utility of such data in reconstructing fossil primate behavior. As the long term goal of this project is to reconstruct fossil primate dietary behavior, it is crucial to understand variation among extant strepsirhine primates. This project investigates the dietary implications of mandibular dentition morphology by combining traditional measurements of molar shape with analyses of changes in the distribution of seven homologous landmarks. By means of fifteen linear distance measurements between homologous structures of the first two molars of the mandibular dentition, this study tests the utility of principal components analysis in positively identifying significant differences among extant lemuriform primates. Preliminary data indicate that extant lemuriform primates differ in the orientation of their homologous points and in the distribution of non-metric character states (e.g., talonid basin shape, presence of cingulid notches, entoconid position, and orientation of the cristid obliqua).

**Population Viability Analysis of ring-tailed lemurs (*Lemur catta*) of the Beza-Mahafaly Special Reserve, Madagascar.**

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Population Viability Analyses (PVAs) refer to the study of how habitat loss, environmental uncertainty, demographic stochasticity, and genetic factors contribute to the future success or decline of populations (Meffe et al. 1997). Recently, PVAs have been used to predict the ability of large mammal populations to persist in the wild, but have seldom been applied to populations of wild primates (Armbruster and Lande 1993, Marmontel et al. 1997, Penn et al. 2000, Strier 2000). In order to assess the utility of PVAs as an instrument of primate conservation, we tested the accuracy and predictive power of 2 types of PVA software. We used demographic data collected between 1987-2003 on a population of wild ring-tailed lemurs (*Lemur catta*) in the Beza Mahafaly Reserve to assess the predictive power of both types of software.

The results indicate that PVAs can be helpful and accurate in predicting primate persistence in the wild. Moreover, simulating stochastic events, such as drought, can provide insight regarding the survivability of a population when faced with

natural disasters. In addition, we discuss the types of data that will be necessary for primatologists to collect in order to conduct PVAs for other populations of wild primates as well as the benefits and drawbacks of each type of software

**Serum leptin reflects ecological differences in vervet monkey (*Cercopithecus aethiops*) populations.**

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Intra-specific variation in wild primates is a rich resource for investigating the physiological and ecological bases of life history evolution. Nutritional status is a key variable linking ecology to resource allocation, but its contributions to life history variation in natural primate populations are not well understood. We have previously reported differences in morphology, demography, and life history among natural vervet monkey (*Cercopithecus aethiops*) populations in Kenya. This study tested the hypothesis that observed population differences were linked to nutritional status, as measured by serum leptin. Leptin is a hormone produced in adipocytes that reflects and regulates body fat and may help to regulate reproduction.

Data were obtained from populations of vervet monkeys at four widely separated sites in Kenya, East Africa. The sites differed in altitude, temperature, rainfall, and access to human foods. Blood, hair, dental casts, and morphological measurements were collected from 367 wild-trapped individuals. Leptin was measured in 58 adult males for which both serum and morphometric measurements were available. Leptin was measured by radioimmunoassay using a kit for nonhuman primate leptin (Linco).

Body mass differed significantly across populations. Males in the driest site were significantly heavier than males in the wettest site. Serum leptin also differed significantly across populations with significantly higher levels in the two sites with higher annual rainfall. There was a significant positive correlation of leptin with serum testosterone. These findings show that leptin links ecology and reproductive function in natural primate populations.

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**Habitat structure of a non-forest corridor used by a group of Tana mangabeys (*Cercocebus galeritus*).**

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The Tana mangabey (*Cercocebus galeritus*) is endemic to fragmented forest habitat along the lower Tana River in southeastern Kenya. Although a forest primate, the Tana mangabey is able to use non-forest corridors to move between forests. Considering the mangabey is critically endangered due to habitat loss and degradation, this ability may prove critical to its survival. Utilizing data from an 810-meter long belt transect, I characterized the habitat of a one-kilometer non-forest corridor a mangabey group used to move between two forests. The majority (77.6%) of shrubs and trees in the non-forest corridor was 1-4.9 meters tall; vegetation of this height was found at a density of 2320 individuals per hectare. No individuals of the mangabey's top 15 diet species were present in the corridor. In addition, habitat structural data collected in three belt and line transects in each forest were compared to the corridor data to illustrate the differences between the forest and non-forest habitats. For trees 10 meters or taller, the non-forest corridor had a significantly lower mean height, a significantly smaller mean percentage canopy cover, and a lower percentage of trees that size than either forest. The corridor also had a smaller basal area per hectare of trees with a diameter at breast height of 10cm or greater. These habitat structural data can be applied to management plans for corridor establishment within the habitat of this critically endangered primate. Funded by Wildlife Conservation Society, Margot Marsh Biodiversity Foundation, Conservation International's Primate Action Fund, and Primate Conservation, Inc.

**Testing for hyperpaedomorphosis in southern African Plio-Pleistocene baboons.**

F.L. Williams. Georgia State University.

Vrba's hyperpaedomorphosis model suggests that cooler, drier Pleistocene climates may have selected for larger, paedomorphic descendants of warmer- and wetter-adapted ancestral Pliocene forms. These predictions are examined with respect to Plio-Pleistocene baboon genera. *Parapapio*, known primarily from the Pliocene-aged sites of Makapansgat, Sterkfontein and Taung, is widely considered to be ancestral to other baboon genera. Fossil *Papio* and *Dinopithecus* are largely known from Pleistocene sites such as Swartkrans, while *Simopithecus* (cf. *Theropithecus*), deriving from Makapans-



gat and Swartkrans, may cross the Plio-Pleistocene boundary. To examine ontogenetic patterns in the data, five dental-based life cycle stages were identified. Means for each life cycle stage per genus were calculated for the nine facial linear distances most frequently preserved across taxa. Shape indices were constructed for each life cycle stage of each genus and then subjected to principal components analysis. In particular, I examined the degree to which adults of the Pleistocene forms were similar in shape to juveniles, but larger in size than adults, of the Pliocene species.

There is much variation in shape and size among Plio-Pleistocene baboons. *Parapapio* is paedomorphic compared to all other taxa, but particularly to relatively prognathic fossil *Papio* adults. While some aspects of muzzle morphology in *Dinopithecus* and *Simopithecus* are peramorphic compared to *Parapapio*, the relatively broad and tall snouts of adult *Simopithecus* distinguish it from other taxa. Although an increase in size over time generally characterizes Plio-Pleistocene baboon genera, Pleistocene forms are peramorphic compared to their Pliocene counterparts, contradicting Vrba's hyperpaedomorphosis model.

**Inca-period diet for the central coast of Peru: A preliminary report on the isotopic analysis of human bone collagen from Puruchuco-Huaquerones.**

J.S. Williams. Department of Archaeology, The University of Calgary.

Puruchuco-Huaquerones is an Inca-period cemetery located near Lima, Peru in the Rimac river valley. This cemetery was excavated from 1999-2001 with the recovery of 1286 burials representing 2200-2400 individuals. Various preserved tissues (skin, muscle, tendon, nail, hair, bone and tooth) were sampled to investigate diet and dietary change over an individual's lifetime. The purpose of this paper is to present preliminary results of the stable carbon and nitrogen isotopic analysis of bone collagen from 53 individuals. The average  $\delta^{13}\text{C}$  value is  $-11.2 \pm 1.3$  ‰ indicating a diet composed primarily of C4 plants, C4 consuming animals and/or seafood. The average  $\delta^{15}\text{N}$  value is  $10.8 \pm 1.4$  ‰ indicating that the animal component of the diet did not include high level carnivores, offshore/reef fish or sea mammals. Based on these results we can propose that the individuals sampled from this cemetery spent at least the last 10-15 years of their life along the coast, since highland diet is generally based primarily on C3 resources such as potatoes, yucca

and animals consuming C3 grasses. This is important for understanding the political organization of the area represented by this cemetery since the Inca often moved individuals (called mitimas) from previously conquered areas into newly conquered territories. If mitimas were present in the Rimac valley, they do not appear to have originated from the highlands. These analyses represent the first isotopic investigation of diet within the Rimac valley during the Inca-period and provide important data for reconstructing social and political organization.

**Dental asymmetry through time in coastal Florida and Georgia populations.**

S.E. Williams, M.W. Warren. Department of Anthropology, University of Florida.

In the last three decades, investigations have shown that non-genetic, environmental factors can adversely affect dental growth, resulting in bilateral asymmetry in tooth size. Generally, odontometric studies describe two types of asymmetry: directional, where crown size is consistently larger on one side, and fluctuating, wherein the largest side varies between individuals of a given population. These two forms of asymmetry have been shown to vary in magnitude between groups of the same time period, as well as between groups over time. These differences have been primarily attributed to non-specific environmental stressors. Studies have revealed a pattern that indicates asymmetry is greatest in populations with the highest incidences of sub-optimal levels of health and nutrition. These studies suggest that modern populations should display the least degree of asymmetry. Few of these studies, however, have examined asymmetry in skeletal populations or have compared diverse populations over time within the same geographic region.

This study examines mesio-distal and bucco-lingual diameters in order to quantify asymmetry. Data were collected from skeletal collections at the Florida Museum of Natural History and Forensic Research Laboratory at the University of Florida, and include indigenous populations of the Atlantic coasts of Florida and Georgia dating from the late archaic period to a forensic sample. Examination of this topic using materials which represent individuals existing in the same geographic region over time will assist in further elucidating the relationship between asymmetry and stress.

**Seasonality of health measures of urban Bhutia women in Sikkim, India.**

S.R. Williams. Department of Anthropology, Northwestern University.

Health is a construct interpreted on many levels, including physical, mental and social well-being. Humans are plastic, able to respond both behaviorally and biologically when factors threaten their well-being, creating stressors. Seasonal changes in climate such as temperature and rainfall may result in significant changes in health status. The purpose of this study is to examine the relationship between seasonal climatic variation and women's health in an urban environment.

The Bhutia are one of two scheduled tribes inhabiting the small state of Sikkim in the Himalayan Mountains of north-eastern India. The climate in Sikkim is distinctly seasonal with well-defined patterns of rainfall and temperature. A total of 238 Bhutia women between the ages of twenty-five to thirty-five were included in this study. Survey questionnaires were administered and anthropometric and physiological data was collected for each participant on a seasonal basis. Results of survey questionnaires and physiological measures show that seasonal patterns in health status are present in this population. Significant seasonal variation ( $p < 0.05$ ) was found in number of health recall items, hemoglobin levels, and systolic blood pressure but not in C-reactive protein or diastolic blood pressure. However, measures of health status exhibiting significant seasonal variation did not all follow the same seasonal pattern.

**Quantitative trait linkage mapping studies in the Jirels of Nepal.**

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Human isolate populations offer many advantages for genetic research. Large pedigrees can be constructed easily in small geographically restricted populations with low rates of migration. The Jirel population is an ethnic group consisting of approximately 4200 individuals who are residents of nine villages in the Jiri region of Nepal. Information collected through house-to-house surveys enabled construction of a single pedigree consisting of 2000 living individuals. The pedigree has been well characterized and

markers at 375 loci spaced evenly across the autosomes have been generated for almost all pedigree members as part of an ongoing genome scan. The wealth of genetic data available for the pedigree has made it invaluable for research on a broad range of physiological traits. The initial work on susceptibility to helminthic infection yielded the localization of the first two genes known to influence susceptibility to *Ascaris lumbricoides* as part of the Jiri Helminth Project. The Jiri Growth Study was recently established to initiate a genetic epidemiological study of growth and development in a parasitized population by generating new morphological data to be analyzed in conjunction with the existing genetic data. A newly developed project will collect phenotypes related to psychiatric disease in the same pedigree as part of an effort to identify genes related to depression and other disorders. This paper reviews the studies that have utilized the single Jirel pedigree, and emphasizes the importance of long-term genetic studies of isolate populations for elucidating the genetic determinants of a broad range of normal and disease-related phenotypes.

**Are all the Neandertal males really male?**

J.W. Wilson, M.H. Wolpoff. University of Michigan, Department of Anthropology.

The European Neandertal sample of complete crania has an unequal sex ratio with an over-representation of males. It is not clear whether more males than females have been discovered thus far, or if some existing specimens have been incorrectly classified. In this study, we tested a null hypothesis of same sex for 10 Neandertal crania that were previously classified as male, female, or uncertain sex, based on morphology. We used a morphometric statistical technique to examine current sex classification in the European Neandertal fossil sample.

Crania in which 40 of the same measurements could be obtained were used to test our hypothesis. Measurements included those that reflect brain size in order to add 2 juvenile crania to our sample, assuming most brain growth had been completed by death.

We examined the distance of each measurement on each Neandertal specimen from a reference cranium and obtained the slope value of the regression line. Previous research has demonstrated that the slope of the regression line based on these comparisons provides a successful tool for sexing individual samples when this slope

is compared to a bimodal distribution of slope values from a comparative sample.

A human reference sample was used as a known model of sexual dimorphism to generate a distribution of slope values through resampling. By comparing the slope value of the Neandertal samples to this distribution, we predicted the sex of each cranium.

**Western research in a non Western world: HIV in rural Tanzania.**

L.A. Winkler, N. Darity, J. Huff, J. Miley, V. Hess, F. Brebnor. University of Pittsburgh.

Medical anthropologists bring valuable skills to global medicine due to their understanding of the important interplay between culture and biology and their exposure to non-Western ideology. This study examines the incidence and epidemiology of HIV in northwestern Tanzania, a rural area where lack of western diagnostic tools and western technology limit traditional western analysis of HIV incidence. This may contribute to the perception of HIV as a disease of urbanization and displacement.

The research team worked with the staff and records of the Karagwe district hospital and AIDS control program during the summers of 2002-3, examining and comparing different programs and measures of HIV incidence and progression in this area bordering Rwanda, Uganda, and Burundi in order to assess the demographics of HIV here. HIV infection rates are available from hospital testing programs and range from 16% to 36% over the last five years. Due to a number of cultural factors that influence testing, the accuracy of each of the testing programs varies. However, the upper percentage which is based on testing of blood donors is a more accurate indicator of population incidence than the lower figure (premarital testing). In addition, many HIV+ individuals who receive treatment here are diagnosed symptomatically and are not tested for confirmation of HIV status for a number of cultural and logistical reasons that may contribute to under-reporting of HIV. Our analysis indicates that HIV levels are as high in this rural area as reported in urban areas.

**Tooth cementum annulations in paleodemography – The exemplary case of Lauchheim.**

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In a recent validation study, Tooth Cementum Annulations (TCA) have proved to be a reliable method for age estimation (Wittwer-Backofen et al., in press). It opens the field for paleodemographic applications in unknown skeletons. A major problem up to now has been the broad confidence intervals in individual age estimations based on morphological changes during adulthood. This led to age distributions, which do not show the real mortality peaks. The TCA method is expected to produce more realistic age patterns.

The early medieval cemetery of Lauchheim was selected as an exemplary case to provide TCA data from all adult skeletons with available teeth. The main reasons for the selection of Lauchheim were the large number of individuals (over 1300 graves), the well-defined chronology covering the settlement period, the clear social stratigraphy, and the availability of a large number of anthropological data for all skeletons.

The TCA method has been applied to more than 800 skeletons. Major results show a clearly defined mortality peak for males and a broad distribution of mortality risks for females, including fertility risks. Of major importance are also the highest ages at death, as they significantly influence paleodemographic parameters in life tables. Among the oldest individuals are mainly women.

The study also represents the basis for a wider methodological project on the comparison of age indicators (see contribution Weise et al., AAPA annual meeting 2004).

**African Y-chromosome haplotypes strongly correlate with linguistic groups.**

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Variation at 48 bi-allelic markers on the non-recombining portion of the Y-chromosome was surveyed in 1330 males from 49 African populations to examine the nature of subdivision and the relationships among paternal genetics, language classification, and geographic location. This study revealed 36 haplotypes that were unevenly distributed across the continent. Analysis of Molecular Variance (AMOVA) detected a high degree of population structure ( $\Phi_{ST}=0.31$ ). The amount of among-group variation ( $\Phi_{CT}$ ) increases substantially when populations were grouped by language family (0.23) compared with geographic location (0.07). Mantel tests also show a higher correlation between language and genetics ( $r=0.41$ ,  $p<0.000$ ) than between geography and genetics ( $r=-0.02$ ,  $p>0.10$ ). This strong relationship between linguistic affiliation and paternal genetics remains when geography is held constant ( $r=0.42$ ,  $p<0.00$ ). An analysis of a subset of language families reveals that the language-genetics relationship is primarily due to the inclusion of populations from the Niger-Congo family. The large effect on the among-group variation of the E-P1\* haplotype data suggests that the spread of this mutation via the Bantu expansion acted to homogenize geographically subdivided populations. These subdivided populations likely were the earliest speakers of the Niger-Congo, Khoisan, and Afro-Asiatic language families.

#### **Creating the collection: Ontogeny of locomotion in Vietnamese colobines.**

C. Workman. University of Colorado-Boulder, Department of Anthropology.

The range and timing of pre-adult locomotor and postural behaviors contribute a substantial component to a species growth and development. For this reason, studies on the ontogeny of locomotion are essential to understanding the complete profile of a species, and yet detailed research of the ontogenetic positional behavior for monkeys is scarce. This paper presents longitudinal data on the positional behavior of red-shanked douc (*Pygathrix nemaeus*), Delacour's (*Trachypithecus delacouri*) and Hatinh (*Trachypithecus hatinhensis*) langurs. 207 hours of data collected on young and adult animals ( $n=31$ ) at the Endangered Primate Rescue Center in Cuc Phuong National Park, Vietnam, during January-March 2002 are supplemented with an additional 116 hours collected in June-July 2003 on both the same individuals (including subadults) and new animals born since the end of the first study ( $n=35$ ). Although housed in similar

enclosures, these species show differences in the range, timing, and relative speed of developing their positional behavior repertoires. Results are discussed in terms of the eventual locomotor differences of adults (a mostly quadrupedal pattern for *Trachypithecus* versus a higher degree of suspensory behavior for *Pygathrix*) social factors affecting locomotor development in young animals (i.e., play and exploration), and the implications of these results for ecological resource partitioning of sympatric species (*P. nemaeus* and *T. hatinhensis*). The applications of these results to free-ranging conditions are discussed, both the expected modifications in complex environments, and especially the conservation impacts for locomotor ontogeny in increasingly shrinking and anthropogenically disturbed habitats.

#### **Character analysis of hominoid trunk and forelimb morphology: synapomorphy or homoplasy?**

S. Worthington. Dept. of Anthropology, University of Durham.

The extent of homoplasy in the trunk and forelimb morphology of the Hominoidea has long been a subject of contention. This study tests whether characters from the trunk and forelimb are: (1) hominoid synapomorphies; (2) hominid synapomorphies; (3) African ape/human synapomorphies; or, (4) homoplasies. Hypotheses are evaluated using character state analysis, performed on eight metric characters, derived from trunk and forelimb data collected from ten extant anthropoid and nine fossil catarrhine genera. Computer based analyses (MacClade) are used to reconstruct the hypothetical ancestral conditions of characters on published topologies. Ancestral morphotypes are then compared with conditions exhibited in terminal taxa to determine synapomorphy or homoplasy. Results suggest that four of the eight characters examined are hominoid synapomorphies. Of the remaining traits, one is an equivocal hominoid or hominid synapomorphy, one is shared derived for hominids, one is a synapomorphy of the African ape/human clade and one is not diagnostic for apes at all. Three traits exhibit homoplasy, in the form of convergence or reversal, though not between hominoid taxa. It is therefore unlikely that hylobatids, pongines or African apes/humans evolved these traits independently of each other. Three main conclusions may be drawn from this study: (1) there is no homoplasy between extant hominoid genera in the features examined; (2) some of the characters previously interpreted as synapomorphic for

extant and stem hominoids are not shared derived for this clade; and, (3) the association of these traits with forelimb suspensory locomotion is unlikely.

#### **What's stress got to do with it? The social ecology of immune function.**

C.M. Worthman. Anthropology, Emory University.

Recognition of interactions between immune function and psychosocial factors has opened a new window onto biosocial dynamics in differential well-being. As anthropologists apply the paradigms of psychoneuroimmunology in widely differing physical and social ecologies expanded to include the entire lifespan, and subject empirical models to theoretical treatment from developmental, adaptationist, and comparative perspectives, they inevitably uncover dynamics that challenge established views.

These issues are illuminated by data from a population-based longitudinal study of the ecology of stress-related immune function in adolescents of the eleven counties of western North Carolina. The sample comprises three annual waves of data collection from youth initially ages 9, 11, and 13 years old [n of observations: 3692]. Household, experiential, and psychobehavioral assessments were collected along with fingerprick samples during annual in-home interviews. Samples were assayed for antibodies to Epstein Barr virus (EBV), a biomarker for chronic stress. Predictably, EBV showed strong positive associations with ten of sixteen previously-identified psychiatric risk factors. Both boys and girls living with chronic ecologic stressors exhibited elevated EBV, but girls also manifested additional effects of domestic dynamics and boys exhibited impact of structural factors. Less predictably, viral load differed by ethnicity, contributing to apparent persistent population differences in rates of seropositivity established by age 9 years. Indeed, rates of seropositivity did not change with age in either population. Implications of these data for current models of the developmental ecology of immune function and of psychoneuroimmunology in general will be considered.

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#### **Chimpanzee juveniles constrain their mothers' gregariousness.**

R.W. Wrangham, H. Pontzer. Dept. of Anthropology, Harvard University.

Why are mothers less gregarious than other adult chimpanzees? The Scramble Competition Hypothesis (Wrangham 2000) proposes mothers (adult females with clinging infants) prefer to travel in small parties to avoid the extra travel costs (time and energy) and increased scramble competition for food associated with larger groups. To test this hypothesis, we analyzed day ranges from 200 nest-to-nest group follows of chimpanzees in the Kanyawara community of Kibale National Park, Uganda. As expected, day range was significantly correlated with group size for all sex-age classes, suggesting larger groups do incur greater travel costs. However, mean day range for mothers was not significantly less than other adult females, and paired comparisons of first-time mothers reveal no difference between nulliparous and parous conditions for day range or average party size. This suggests the presence of a clinging infant is not the primary factor affecting grouping behavior. Instead, day range for mothers and adult females was significantly correlated with the age of their youngest non-clinging juvenile, and juvenile day range was positively correlated with age. Further, maximum recorded day range was highly correlated with age for juveniles, suggesting smaller body size may limit their ability to travel long distances. These results suggest mothers are kept from foraging in large groups in part due to ranging constraints imposed by their non-clinging offspring.

#### **Food mechanical properties and niche partitioning in a community of Neotropical primates.**

B.W. Wright. Department of Anthropology and Center for the Advanced Study of Human Paleobiology, George Washington University.

This study compares the mechanical properties of foods processed by six species of New World monkey in the Iwokrama Reserve, Guyana, S.A. These data help to clarify how these primarily frugivorous primates presently partition and exploit resources within the same ecological community. Data were collected on foods processed by *Alouatta seniculus*, *Ateles paniscus*, *Cebus apella*, *C. olivaceus*, *Chiropotes satanas* and *Pithecia pithecia* with a portable tester designed by Lucas et al. (2001).

It was found that *A. seniculus* (683.0 J m<sup>-2</sup>) and *C. apella* (508.0 J m<sup>-2</sup>) comminute or macerate the toughest tissues on average. This includes items such as the leaf lamina of *Inga* spp. (2034.0 J m<sup>-2</sup>) and the leaf base of *Astrocaryum vulgare* (6268.0 J m<sup>-2</sup>). The pitheciines masticated the

weakest tissues on average (not exceeding 325.0 J m<sup>-2</sup>). The toughness of plant tissues breached by primates in this community reveals that *Chiropotes satanas* (2826.0 J m<sup>-2</sup>) and *C. apella* (1860.0 J m<sup>-2</sup>) open the most demanding tissues on average. These include the pods of *Eperua grandiflora* (5384.0 J m<sup>-2</sup>) and the pods of *Dimorphandra conjugata* (9953.0 J m<sup>-2</sup>). *C. olivaceus* and *A. paniscus* breached the weakest tissues on average (not exceeding 1223.0 J m<sup>-2</sup>).

The major subfamilies of New World primates appear to have radiated into distinct dietary niches early in their evolutionary history. Although these dietary differences provide useful insight into the divergence of platyrrhine subfamilies, the findings from this study reveal ecological and morphological overlap among more distantly related species.

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#### **Vertebrate taphonomy and geochronology of Initial Upper Paleolithic occupation horizons at Obi-Rakhmat Grotto, Uzbekistan.**

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Uzbekistan has recently attracted attention due to its geographic placement between northern and western Eurasia, areas where researchers have noted the closely timed (ca. 50-40,000 BP) appearance of Levallois-leptolithic Initial Upper Paleolithic (IUP) technological entities. The Central Asian "corridor" zone, where Paleolithic research has been limited, may shed important light on the adaptations and spread of hominids bearing IUP technology. Since 1998, an interdisciplinary Russian-Uzbek-American team has conducted excavations at Obi-Rakhmat Grotto, northwestern Uzbekistan. Tens of thousands of stone artifacts, as well as numerous animal bones and several hominid teeth and cranial fragments, have been recovered from stratified IUP and Levallois-Mousterian contexts.

In this study, we concentrate on the faunal and geochronological data gathered to date. Taphonomic methods have been employed in the analysis of animal bones from Obi-Rakhmat to address (1) the agencies responsible for accumulating the bone fragments, (2) the effects of hominid foraging strategies on prey taxonomic

representation, and (3) the role of butchery practices in hominid use of the site over time. Bone fragments were sorted by element and taxonomic category and data on surface modification, fragmentation, and age-at-death were collected. There is a remarkable consistency in the dominant represented taxa (*Capra sibirica* and *Cervus elaphus*) throughout the strata, and taphonomic data indicate that hominids were the principal generators of the faunal assemblages. Carnivore remains are rare, and the site appears to have been used as a short-term butchery station. Current results of a comprehensive dating programme (AMS, Th/U, ESR, OSL) are also presented.

#### **An odontometric reduction trend among ancient Maya populations from northern Belize.**

G.D. Wrobel. Dept. of Sociology and Anthropology, University of Mississippi.

An odontometric analysis of 361 individuals from the northern Belize sites of Altun Ha, Chau Hiix and Lamanai shows a significant reduction in the dimensions of posterior teeth from the Preclassic (400 BC) to the Late Postclassic (AD 1500) period. Comparisons to published data from the Colonial site of Tipu, Belize (Jacobi 2000) shows a continuation of this reduction trend. In distance analyses comparing the northern Belize group to other precolumbian Maya, as well as to a variety of other Amerindian skeletal samples, contemporaneous groups tended to cluster together regardless of their geographic proximity, suggesting that this trend is not unique to the Maya. Other factors potentially contributing to variation within and between these groups, such as age and sex, were found to vary substantially, likely as the result of biocultural and taphonomic differences between the groups, as well as interobserver error. Explanations for the reduction trend among the Maya include selection for smaller teeth as the result of their heavy dependence on agriculture, though this phenomenon also may be the result of a general reduction in body size noted in both ancient and modern groups. The results of this study demonstrate that odontometric variation is primarily affected by a long-term dental reduction trend rather than patterns of population interaction and thus these data are not appropriate for genetic distance analyses.

#### **Human chemical communication: Should we fear amone?**

C. J. Wysocki. Monell Chemical Senses Center.

In the academic and biomedical communities, mention of human pheromones brings forth mixed reactions. To some the concept is foreign to the extreme. Arguments akin to the following can be heard: Microsmatic humans have advanced well beyond reliance upon chemical communication for social order. Insects, yes, that's where it all began; vertebrates, including some mammals, yes, because chemicals have been identified for pigs, mice and elephants; but not for humans. Furthermore (the argument continues), humans do not have a functioning vomeronasal organ (VNO) and a VNO is necessary to detect pheromones (a non sequitur). Others embrace the concept to the extreme and the identification of VNO receptor genes in the human genome has lead others to argue that since humans have intact VIR-like receptor genes, they must use them to detect pheromones.

In another area, especially on the Internet, hawkers of "human pheromones" try to bring in big bucks. Herein may be the foundation for reasons why some in the academic and biomedical communities reject human pheromones. Many have been misinformed about the true nature of pheromones.

This presentation will A) define the various types of pheromones; B) discuss how pheromones function; C) explore the evidence for human responses to pheromones; D) introduce candidate human pheromones; E) briefly review the sensors in the nose that can detect pheromones, including those found in humans; F) argue that no single detection system is devoted to pheromones; and G) discuss the relationship between human pheromones and the VNO.

**Food properties and jaw performance in three sympatric species of *Haplemur simus* in Ranomafana National Park, Madagascar.**

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The feeding behaviors of three sympatric species of bamboo lemurs, *Haplemur simus*, *H. aureus*, and *H. g. griseus*, were studied during the austral winter (June-August). We hypothesized that interspecific feeding specializations on different bamboo parts were related to interactions between mechanical food properties and

biting performance of the masticatory apparatus. We performed *in situ* tests of mechanical properties of individual plant parts using a portable tester and recorded maximum jaw gapes and bite forces on anesthetized animals.

The lemur species primarily fed on two bamboo species during this season. *H. simus* concentrated on the culm pith and mature leaves of the giant bamboo, *Cathariostachys madagascariensis*, whereas *H. aureus* and *H. griseus* relied on branch shoots and young leaf bases of giant bamboo and a bamboo liana, *Cephalostachyum cf. perrieri*. Giant bamboo culm was the hardest, toughest, and stiffest food eaten. Jaw gape did not limit access to culm pith since *H. simus* first punctured the culm with an upper canine or lower premolar rather than biting it between the jaws. Once the outer surface was penetrated, *H. simus* then proceeded to strip the culm. Toughness values of culm sheath and pith were much lower in peeling and tearing than in cutting tests. Mechanical property and bite force data suggest that both *H. simus* and *H. aureus* can generate sufficient bite forces to penetrate and strip giant bamboo culm. The observation that *H. aureus* does not feed on culm pith cannot be explained by inadequate masticatory performance abilities alone. Supported by National Geographic Society and Zoological Society of San Diego.

**Does estradiol modulate sexual solicitations in the female Sichuan Golden Monkey (*Rhinopithecus roxellana*)?**

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Studies of the relationship between sexual behavior and reproductive endocrinology in females offer critical insight into questions of sexual selection, mate choice, and female reproductive strategies in primates. In this research we examine the relationship between sexual solicitations and urinary estradiol in female Sichuan golden monkeys (*Rhinopithecus roxellana*) living under semi-wild conditions at the Shanghai Wild Animal Park, China.

Data on the frequency of sexual solicitations and urinary samples were collected on four adult females during two mating seasons. Urinary estradiol levels were determined using radioimmunoassay methods. Our results indicate that during the estrus cycle, solicitation frequency varied systematically with changes in estradiol level (One-Way ANOVA,  $F_{1,25}=18.519$ ,  $p<0.001$ ). The frequency of female solicitations rose to a peak follow-

ing the peak of estradiol level, suggesting that ovarian steroids modulate sexual behavior during the fertile phase of the estrous cycle. Females also were found to frequently solicit matings during pregnancy. Most of those solicitations were accepted by the alpha male and resulted in copulations. During pregnancy, however, there was no significant relationship between sexual solicitation and urinary estradiol. In the Sichuan golden monkey, sexual behavior and estradiol production are decoupled during different parts of the reproductive cycle. Additional relationships between social interactions, dominance, sexual behavior and endocrine function are discussed.

**"Race" and anthropology's public face: Carleton S. Coon and the segregationists.**

K.A. Yelvington. Department of Anthropology, University of South Florida.

This paper traces the involvement of noted physical anthropologist Carleton S. Coon (1904-1981) with groups and personages seeking scientific justification for overturning the U.S. Supreme Court's 1954 *Brown v. Topeka* ruling that outlawed segregated schools. Segregationists, including Coon's distant cousin Carleton Putnam (1901-1998), academics, and members of the all-white Citizens' Councils which were active in the U.S. South, called upon Coon's work in their propaganda efforts and in their legal maneuverings to have *Brown* overturned, such as in *Stell v. Savannah-Chatham County Board of Education* (1963). In his book *The origin of races* (1962), Coon argued that *Homo erectus*, already divided into five geographic races or subspecies, evolved into *Homo sapiens* "not once but five times, as each subspecies, living in its own territory, passed a critical threshold from a more brutal to a more *sapient* state" (p. 657), with the ancestors of modern-day whites passing this threshold hundreds of thousands of years sooner than the ancestors of blacks; for Coon, this was significant because it meant whites and their ancestors were more culturally evolved than other "races." Coon denied links to Putnam and others — he stormed out of the 1962 AAPA meeting, which he presided over as president, to protest the accusations. However, as this paper shows, using Coon's correspondence now located in the National Anthropological Archives, Smithsonian Institution, Coon aided if not encouraged the segregationists.

### The functional correlates and consequences of Neandertal pelvic morphology.

J.W. Young. Stony Brook University, Interdepartmental Doctoral Program in Anthropological Sciences.

The Neandertal pelvis has long been acknowledged to exhibit a number of unusual features, including an anteriorly 'shifted' pelvic inlet and retroverted acetabula. The latter feature would force the foot into an abducted position if not counteracted by lower limb torsion with opposite rotatory effects. Furthermore, lack of such structural compensation can result in a reduced range of motion at the hip and even osteoarthritis. This study investigates the degree to which lower limb structural compensation might have taken place among Neandertals.

Pelves, femora, and tibiae were measured in a modern human sample of Inuit and Euro-American males and a Neandertal sample combining elements from several individuals. Using three-dimensional coordinates obtained with a Microscribe digitizer, six pelvic, femoral and tibial size and shape variables were computed.

Inuit pelves exhibit a more anteriorly placed pelvic inlet and greater acetabular retroversion than Euro-American pelves ( $p < .05$ ), indicating that the former are morphologically more similar to Neandertals. Results concerning structural interactions within the lower limb are inconclusive. Among the modern human sample, no consistent correlations exist between any of the elements. Although the Neandertal pelvis shows significantly greater acetabular retroversion than modern human pelves ( $p = .022$ ), Neandertal femoral and tibial torsion angles fell within the range of the modern human sample. These results might suggest that Neandertals walked differently from modern humans. However, given the composite nature of the Neandertal sample, such conclusions must be viewed with caution until a more complete postcranial skeleton can be found.

### A comparative three-dimensional geometric morphometric study of growth and similarity in the primate scapula.

N.M. Young. Department of Anthropology, Harvard University.

This study compares patterns of growth in the primate scapula using a geometric morphometric methodology, and tests whether multivariate allometric vector similarity is significantly correlated with

phylogenetic distance, adult morphological distance ( $D^2$ ), and/or functional/postcranial similarity (e.g., quadrupedalism vs. suspensory). X,Y,Z coordinates of twenty five landmarks were obtained for the following taxa: *Pan troglodytes*, *Pan paniscus*, *Gorilla gorilla*, *Pongo pygmaeus*, *Symphalangus syndactylus*, *Hylobates* sp., *Macaca* sp., *Papio* sp., *Cercocebus albigena*, *Cercopithecus aethiops*, *Presbytis cristatus*, *Nasalis larvatus*, *Colobus guereza*, *Ateles* sp., *Alouatta* sp., *Lagothrix lagothrica*, and *Saimiri sciureus* (Total Sample  $N=1173$ ). Patterns of growth were compared by performing a principal components analysis on pairs of taxa and examining variation significantly associated with log centroid size. Eigenvectors from taxon-specific covariance/variance matrices were also used to calculate an allometric similarity matrix. Hypotheses of pattern similarity were assessed using a matrix correlation followed by a Mantel's test, as well as cluster analysis.

Results from these analyses indicate that the scapulae of quadrupedal primates undergo much less shape change during ontogeny compared to suspensory primates, although overall change is similar. Suspensory primates exhibit pronounced changes in the shape and size of the acromion and coracoid not found in quadrupedal primates. Allometric similarity is significantly correlated with phylogenetic distance ( $r=-0.315$ ,  $p=0.008$ ), functional similarity ( $r=0.302$ ,  $p=0.004$ ), postcranial similarity ( $r=-0.348$ ,  $p=0.014$ ), and adult morphological distance ( $r=-0.471$ ,  $p=0.001$ ). These results suggest convergence in suspensory scapular form is associated with convergence in pattern of growth, and is partially due to a similar extended period of acromial growth.

### Dissection method in brain endocast reconstruction.

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Brain endocast reconstructions are often based on the cast molded from the internal table of the cranium or the fragments of such. If minimally distorted, the reconstructed endocast provides the most accurate assessment of endocranial capacity and morphological features present on the original portions. Severely distorted or damaged endocasts question the accuracy of the reconstruction, as these often require further adjustments in producing the final object for measurements.

In this study, we present a reconstruction methodology that tries to eliminate most of the distortion in the endocast. The cast from the original endocast or the mold from the original cranial fragment is dissected into segments, which are either minimally or not distorted. The detached segments are then reassembled, based on their anatomical relationships and morphological contours to rebuild a complete endocast. This dissection-reassembly reconstruction procedure is called the "Dissection Method"(DM).

The endocasts of *A. afarensis*, AL 444-2, *A. africanus* Type II, Type III, and Stw 505 are good examples in applying the DM. In A.L. 444-2, several endocast versions were reconstructed with the DM, including complete and hemi-endocast reconstructions with minimum and maximum capacity to provide a range of estimates (range:513-587 ml; best estimate:550 ml). In Type II, Type III, and Stw 505, the best estimates were 457, 286, and 550-560 ml respectively.

The DM in endocast reconstruction is meant to test and supplement computer-based reconstructions. In some cases, such as Stw 505, the DM may help to correct portions of reconstruction not immediately apparent on computer generated scans.

### Relative bone strength in the upper and lower limbs of a Predynastic Egyptian population.

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Measures of relative bone strength have been used profitably to differentiate human populations based on activity levels and subsistence strategies. While a number of studies have examined secular trends in Egyptian stature, little attention has been paid to differences in bone strength. The present study assesses social class, sex and population level differences in bone strength in the upper and lower limbs of a sample of Predynastic Egyptians from the site of Hierakonpolis, Egypt.

98 individuals were compared with pre-industrial Amerindian and early industrial East African population samples. Body mass was estimated using several regression equations. Cross-sectional geometric properties at 40% of humeral length from the distal end and at femoral midshaft were collected using latex cast molds combined with biplanar radiographs. Bone strength was evaluated in

terms of cortical areas (CA) and polar section moduli (Zp), standardized over body mass and/or bone length. Differences between the three populations and between the sexes were tested using *t* tests, ANOVAs and post-hoc comparisons.

Within the Egyptian sample, differences in CA and Zp were significant between the sexes ( $p < 0.01$ , *t* test), but not between the working and elite social classes. There were no significant differences between the three populations in femoral midshaft strength in either sex. However, there were significant differences in upper limb Zp within females, with the Egyptian sample having the relatively weakest humeri ( $p < 0.001$ , Tukey HSD). These results suggest a similar level of locomotor activity between the groups, but with a possibly increased sexual division of labor at Hierakonpolis.

#### **Intra-population and temporal variation in ancient Egyptian crania.**

S.R. Zakrzewski. Department of Archaeology, University of Southampton, UK.

The level of morphological variation within a population is the result of factors such as population expansion and movement. Traditionally Egyptologists have considered ancient Egypt to have a homogeneous population, with state formation occurring as a result of local processes without influence from migration. This paper tests this hypothesis by investigating the extent of biological relationships within a series of temporally successive Egyptian skeletal samples. Previous studies have compared biological relationships between Egyptians and other populations, mostly using the Howells global cranial data set. In the current study, by contrast, the biological relationships *within* a series of temporally-successive cranial samples are assessed.

The data consist of 55 cranio-facial variables from 418 adult Egyptian individuals, from six periods, ranging in date from c. 5000 to 1200 BC. These were compared with the 111 Late Period crania (c. 600-350 BC) from the Howells sample. Principal Component and Canonical Discriminant Function Analyses were undertaken, on both pooled and single sex samples.

The results suggest a level of local population continuity exists within the earlier Egyptian populations, but that this was in association with some change in population structure, reflecting small-scale immigration and admixture with new groups. Most dramatically, the results also indicate that the Egyptian series from Howells global data set are morphologically distinct from the Predynastic and

Early Dynastic Nile Valley samples (especially in cranial vault shape and height), and thus show that this sample cannot be considered to be a typical Egyptian series.

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#### **Placental adaptation to chronic hypoxia (high altitude residence) and pregnancy outcome.**

S. Zamudio, N.P. Illsley. New Jersey Medical School.

Pregnancy at high altitude (HA >2700 m) is associated with reduced birth weight and an increased incidence of pregnancy complications. Since not all babies are small, nor all pregnancies complicated, we tested the hypothesis that hypoxia-inducible membrane transport proteins, especially those related to nutrition, are increased in HA placentas, and that such changes may help to regulate fetal growth. The hypothesis was prompted by data from a number of cell systems indicating that hypoxia increases membrane glucose transporters and decreases amino acid transporters.

Syncytial microvillous (MVM, maternal facing) and basal membrane (BM, fetal facing) fractions were isolated from normal term placentas of women residing at 1600 m or 3100 m. Expression of MVM and BM GLUT-1 glucose transporter, the ATA2 isoform of the system A amino acid transporter, transferrin receptor (TfR), and erythropoietin receptor (EPO-R) were evaluated by immunoblotting and densitometry.

GLUT-1 expression was reduced in the BM but not MVM of HA placentas, and correlated positively with birth weight. ATA2 was reduced and EPO-R elevated in both MVM and BM at HA. Microvillous but not BM TfR expression was reduced at HA. In contrast to the hypothesis, nutrient transporters were down-regulated in the HA placentas, consistent with growth restriction and smaller fetal size. Such data are consistent with multiple regulatory pathways controlling the expression and function of nutrient transporters, some of which can clearly override the stimulus provided by hypoxia and potentially contribute to regulation of fetal growth in an oxygen poor environment. Support: Am. Heart Assoc., NIH DK55369

#### **The Paleolithic of southern Kyrgyzstan: New discoveries and revision.**

A.N. Zenin. Institute of Archaeology and Ethnography, Siberian Branch, Russian Academy of Sciences,

Almost a century of Paleolithic research within the vast territory of Central Asia has identified sites that span the Lower to Upper Paleolithic. Most of the best-studied and some of the only chronometrically dated sites are located within the Afghan-Tajik depression and along the western horn of the Tien Shan Mountains, in the countries of Tajikistan, Uzbekistan, and southern Kazakhstan. In comparison to the other Central Asian republics, the Paleolithic of Kyrgyzstan is relatively unknown. Moreover, stratified localities in the arid zone of Central Asia are exceptional. New data from the Kapchikai open-air workshop site, southern Kyrgyzstan, are presented in the context of an ongoing research program on the Paleolithic of Kyrgyzstan. Levallois point cores and Middle Paleolithic artifacts have been recovered from stratified deposits extending at least 1.3 m. in depth. These discoveries, in the context of research along Lake Issyk-Kul to the north, mark the beginning of a revision to conceptions of hominid occupation in the region.

#### **Skeletal and dental development in wild chimpanzees from Tai National Forest, Ivory Coast and Gombe Reserve, Tanzania.**

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The skeleto-dental remains of immature wild chimpanzees (*Pan troglodytes*) from Tai National Forest and Gombe Stream were investigated for species and population patterns of growth. Twenty individuals (16 Tai, 4 Gombe) constitute the sample of known chronological age, sex, and life history. Each was assessed for stages of dental eruption, epiphyseal union, limb bone lengths and cranial capacities. Data were compared with published research on captive chimpanzees.

Results demonstrate that the two wild populations grow similarly to each other, whereas captive populations have accelerated physical development. Epiphyseal closures of hip, knee, elbow and shoulder occur approximately two years earlier in captive chimpanzees. For dental development, the wild chimpanzees are at the late end of the captive age range or outside the range. For example, female M2s in captivity erupt through the gingiva around 5.4-6.3 years, but in the wild,

eruption through the alveolar bone is around 8.3 years. The cranial capacity for primates reaches about 90-95% of the adult mean at M1 eruption (Smith 1989), which implies that captive chimpanzees that are on a faster dental development track complete brain growth earlier than their wild cohorts. In all populations, females mature physically before males.

The wild pattern represents the normal mode of chimpanzee growth. These findings suggest a re-evaluation of age estimates of fossil immatures based on a captive chimpanzee model, which may underestimate the chronological age of extinct individuals.

**New data on early developmental differences between Neanderthals and modern humans.**

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Neanderthals assume a key role in the analysis of the developmental background of hominid phylogenetic diversification, since an important sample of both immature and adult fossil specimens is available. Until recently, however, the earliest phases of Neanderthal postnatal development have been only sparsely documented. – The cave site of Dederiyeh, Northern Syria, has yielded two well-preserved immature Neanderthal skeletons with estimated dental ages around two years. These specimens yield new comparative data on developmental differences between Neanderthals and modern humans and on early developmental variation within Neanderthals.

Computerized reconstruction of the skulls and subsequent landmark-based analysis of three-dimensional craniomandibular shape confirms earlier evidence that, at the age of two years, Neanderthals already had developed their taxon-specific morphology. The preserved basi-cranial anatomy of Dederiyeh1 permits first insights into the developmental dy-

namics of Neanderthal cranial base flexion in comparison to modern humans. Within this differential developmental framework, however, the Dederiyeh 1 and 2 specimens exhibit considerable variation. For example, Dederiyeh 2 is more advanced than Dederiyeh 1 with respect to dental eruption, but less advanced with respect to development of cranial bones. Moreover, significant differences exist between these individuals in relative sizes of cranial vault bones. To interpret these results in a wider evolutionary-developmental context, ontogenetic differences and commonalities between Neanderthals and modern humans are compared with new findings on the chimpanzee developmental dichotomy.

**A new method to quantify the 3D morphology of bone surfaces, with application to muscle entheses rugosity.**

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The morphology of muscle attachment sites may provide valuable insight into *in vivo* muscle use of ancient populations. In the past, studies of attachment site morphology have relied upon linear measurements of size and semi-quantitative assessments of rugosity. While informative, these methods do not assess variations in the complex 3D morphology of attachment sites in a repeatable, objective way.

A muscle's *in vivo* activity may theoretically increase the surface area, volume and rugosity of the bone to which it attaches. This paper presents a new method to test this theory that quantifies the 3D morphology of muscle and tendon attachment sites. This technique is validated with an error study and demonstrated in a study of seven muscle attachment sites in exercised and sedentary sheep. The attachment sites were scanned with a high-resolution laser scanner. The volume and 3D/2D surface area ratios of these scans were quantified using ArcView GIS 3.3 (ESRI). Additionally, the rugosity of the attachment sites were quantified via fractal analysis of profiles extracted from the laser scans at regular intervals along the primary anatomical axes of the attachment sites. Finally, the rate of bone growth at each of these attachment sites was quantified to correlate external morphological features with the underlying histological processes. These methods provide a new objective, repeatable way to assess the functional significance of muscle and tendon attachment sites.



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