Program of the Seventy-First Annual Meeting of the American Association of Physical Anthropologists

to be held at
The Adam's Mark Hotel
Buffalo, New York
April 10 to April 13, 2002

AAPA Scientific Program Committee:

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Local Arrangements Committee:

Ted Steegmann

and many student volunteers

Message from the Program Committee Chair

The 2002 AAPA meeting, our seventy-first annual gathering, will be held at the Adam's Mark Hotel in Buffalo, New York. There will be more than 560 podium and poster contributions, distributed among 29 sessions with a total of more than 1,000 authors participating. We have scheduled an interesting series of symposia on topics such as biocultural diversity in Northeast Africa; nutritional status, physical activity and productivity; forensic anthropology; modern morphometric techniques; South African paleoanthropology; and primate cognitive ecology.

The trend toward our meetings becoming truly international in scope is continuing. This year, almost a quarter of the people who will present papers live outside of the United States. In addition to a large contingent of attendees from Canada and the United Kingdom, there are also substantial numbers of participants from Austria, France, Germany, Italy, Japan, and South Africa.

This year we completed the process of bringing our meeting registration process into the digital age by creating an online system for submitting abstracts and the payment of registration fees. This has had a number of benefits, not the least of which is saving us thousands of dollars in registration processing costs and relieving you of the annual ritual of figuring out how to make your printer place your abstract within the boundaries of the infamous "blue line" abstract submission form that we used in the past. Another is the searchable on-line database of the abstracts in this volume that is available at the AAPA web site: 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 Human Biology Association, the Paleopathology Association, the Primate Biology and Behavior Interest Group, the American Dermatoglyphics Association, the American Association of Anthropological Genetics, and the Dental Anthropology Association. As usual, the Paleopathology Association meeting will begin on the Tuesday before the AAPA meeting (April 9). The Human Biology Association, in contrast, has changed its meeting schedule this year. Instead of meeting before the AAPA, as it has done in the past, this year the HBA will hold its sessions on Saturday, April 13, and Sunday, April 14.

The following pages provide a summary table of conference events; a map of the third floor of the Adam's Mark Hotel showing the locations of meeting rooms; a day-by-day conference schedule, including meetings of affiliated societies, editorial boards, workshops, and various business meetings; a detailed listing of AAPA podium and poster sessions; the abstracts of presentations; and indexes of authors showing the session numbers of their presentations and the page numbers where their abstracts can be found.

AAPA activities commence on Wednesday evening, April 10, with a panel discussion organized by our Career Development Committee titled "Ask the Editors: The Dos and Don'ts of Journal Publishing," followed by our annual reception. Poster and podium sessions begin Thursday morning and continue through Saturday evening. Plan on attending the annual plenary session and luncheon on Thursday and Friday, respectively. For the plenary session, we will have a special theatrical performance, "Charles Darwin: Live and In Concert," by Richard Milner. The luncheon speaker will be Karen Strier. Join the association's continuing discussion of eth-

ics in biological anthropology at a roundtable on Thursday from 12:30 – 2:00 pm. Invited participants include Linda Wolfe, Susan Anton, and Andrew Merriwether among others. Attendees are encouraged to bring with them case study material for discussion. Also, keep in mind the business meeting for Friday evening, and the award reception on Saturday evening.

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

Phillip L. Walker

AAPA Vice President and
Program Committee Chair

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The Conference at a Glance

	Tue Morning	Tue Afternoon	Tue Evening	Wed Morning	Wed Afternoon	Wed Evening	Thur Morning
Grand Hall	PPA Registration. 8 am-6 pm		PPA Reception, 5:45-7:45 pm	PPA Registration PPA Poster Sessions	PPA Registration PPA Poster Sessions AAPA Registration, 1-8 pm		AAPA Registration, starts 8:00 am
Grand Pavilion							Session 1. Dental Anthro. & Paleopath. Posters. 8 am-noon
Grand Ballroom A	PPA Podium Sessions	PPA Podium Sessions		PPA Podium Session	PPA Podium Sessions	AAPA Reception & Cash Bar, 8-11 pm	Session 2. Symposium: Recent Research in Forensic Anthro. 8-11:45 am.
Grand Ballroom B							Session 3. Human Bio. I: Human Repro., Growth & Develop. 8-11:45 am
Grand Ballroom C							
Grand Ballroom D							Session 4. Symposium: Primate Cognitive Ecology. 8 am-noon
Grand Ballroom E						Student Concerns Panel: Ask the Editors, 6:30-7:45 pm	Session 5. Hominid Evolution I. 8 am-noon
Richardson			PPA Dinner and Business Meeting, 7:30-10 pm		AAAG Symposium, 1-5:30 pm	AJHB Edit. Board Dinner, 6:30-8 pm	AAPA Educ. Comm Wkshp, 8 am-noon
Wright							AAPA Book Exhibit
Sullivan				PPA Podium Sessions	AJPA Edit. Board Lunch, noon-2 pm		AAPA Book Exhibit
Olmsted				AAPA Exec. Comm. Meeting. 8 am-5 pm			
Executive Board	LAC. 7 am-10 pm daily	LAC	LAC	LAC	LAC	LAC	LAC
Dr III						PPA Student Concerns Wkshp, 6-9 pm	AAPA Interview
Dr IV	PPA Slide Preview	PPA Slide Preview		PPA Slide Preview	PPA Slide Preview		AAPA Slides Press

Monday: Paleopathology Association Registration, 4-8pm, *Grand Hall*.
Saturday American Association of Physiical Anthropologists Student Awards Reception, 6-7pm , *Olmstead Room.*
Sunday: Human Biology Association Registration and Workshop, 8 am-noon.

For a schedule of all conference events, see page 7.
For a detailed listing of individual AAPA poster and podium presentations, see page 11.

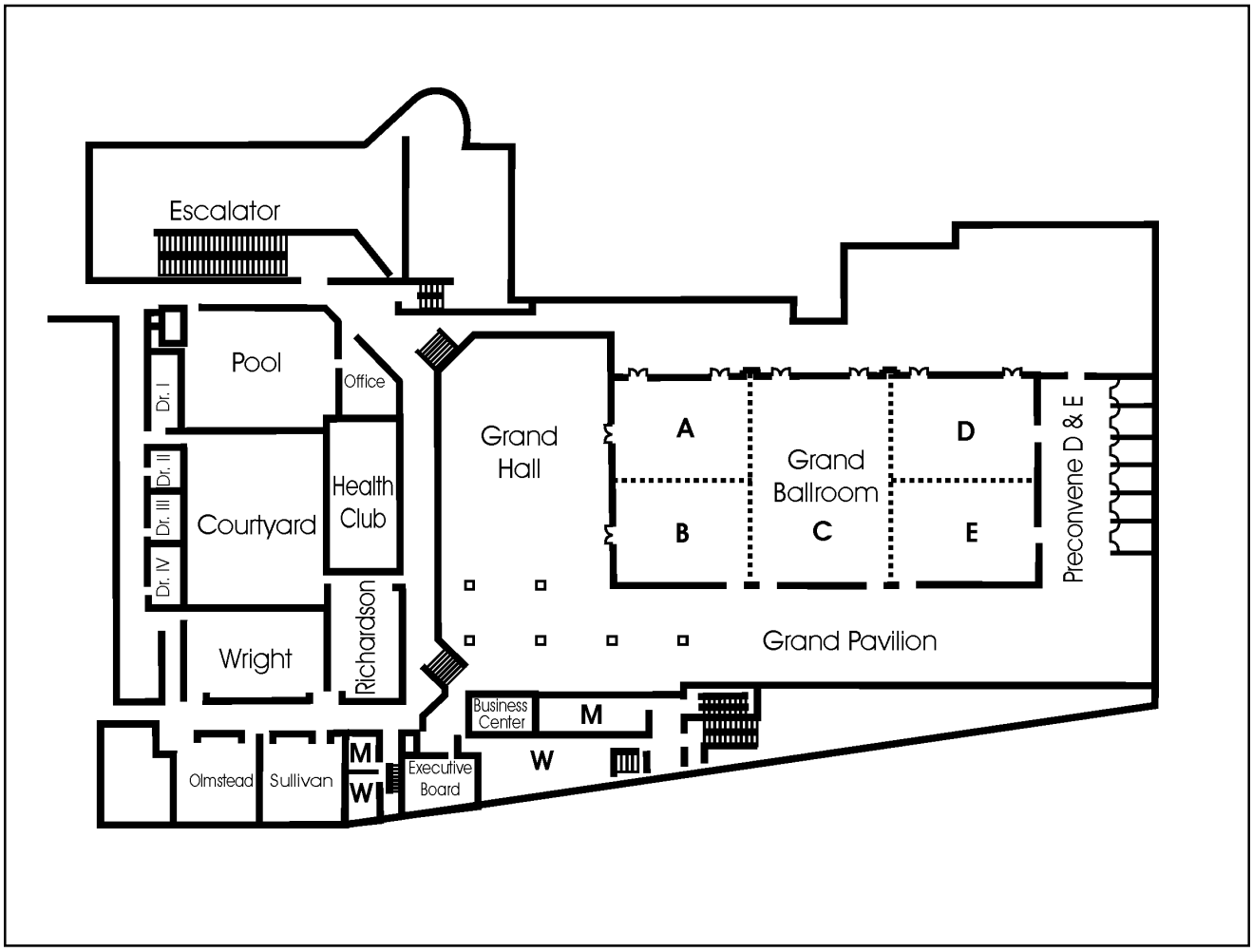
Thur Afternoon	Thur Evening	Fri Morning	Fri Afternoon	Fri Evening	Sat Morning	Sat Afternoon
AAPA Registration, ends 5:00 pm	AAPA Registration	AAPA Registration	AAPA Registration		AAPA Registration	AAPA Registration
Session 6. Skeletal Bio. Posters. 1:30 pm-5 pm		Session 11. Hominid & Primate Evolution. Posters. 8:30 am-noon	Session 16. Human Bio./Genetics/Forensics. Posters. 2-5 pm HBA Poster Sessions, noon-5 pm		Session 21. Primate Behavior & Bio. Contributed Posters. 8:30 am-noon HBA Poster Sessions	HBA Poster Sessions
Session 7. Symposium: Northeast African Biocultural Diversity. 1:30-4:30 pm	AAPA Plenary Session, 5:30-6:30 pm	Session 12. Paleopathology. 8 am-noon	Session 17. Skeletal Bio. I: 2:00-6:00 pm		Session 22. Skeletal Bio. II. 8 am-noon	Session 26. Skeletal Bio. III. 1-4:45 pm
Session 8. Human Bio. II: Evolution & Adaptation. 1-2:15 pm; Symposium: Constraints on the Human Brain. 2:30-5 pm	AAPA Plenary Session, 5:30-6:30 pm	Session 13. Human Bio. III: Demography, Health & Disease. 8-11:45 am	Session 18. Symposium: Nutrition, Activity & Productivity. 2-5:30 pm	HBA Reception, 6:30-8:30 pm	Session 23. Primate Evolution. 8 am-noon	Session 27. Genetics. 1-5 pm
	Primate Biol. Group, 5-6 pm		AAPA Annual Luncheon. Noon-2 pm			
Session 9. Primate Behavior I: Socioecology & Conservation. 1-5:30 pm	DAA, 5-6 pm	Session 14. Primate Behavior II: Social & Repro. Behavior. 8:30 am-noon	Session 19. Primate Bio. I: Anatomy & Functional Morphology. 2-6 pm	AAPA Business Meeting, 8-11 pm	Session 24. Primate Bio. II: Molecules & Biomechanics. 8 am-12:15 pm	Session 28. Symposium: Modern Morphometrics. 1-5 pm
Session 10. Symposium: Australopithecines to AMHS. 1-5 pm		Session 15. Hominid Evolution II. 8 am-noon	Session 20. Symposium: Dr. Livingstone, We Presume. 2-6 pm		Session 25. Hominid Evolution III. 8 am-noon	
AAPA Ethics Roundtable, 12:30-2 pm		HBA Registration (in hall)	HBA Registration (in hall) HBA Podium Sessions, 2-5 pm	ADA Business Meeting, 6-7 pm AAAG Business Meeting, 7-8 pm	HBA Registration HBA Plenary Session, Podium Sessions, 8-11:30 pm	HBA Registration HBA Plenary, Podium Sessions, 1-3:30 pm Pearl Lecture, 3:30-4:30 pm HBA Business Meeting, 5-6 pm
AAPA Book Exhibit		AAPA Book Exhibit	AAPA Book Exhibit		AAPA Book Exhibit	AAPA Book Exhibit
AAPA Book Exhibit		AAPA Book Exhibit	AAPA Book Exhibit		AAPA Book Exhibit	AAPA Book Exhibit
	HBA Exec. Comm. Dinner, 6-10 pm	AJHB Edit. Board Breakfast, 7:30-9 am				
LAC	LAC	LAC	LAC	LAC	LAC	LAC
AAPA Interviews		AAPA Interviews	AAPA Interviews		AAPA Interviews	AAPA Interviews
AAPA Slides Press		AAPA Slides Press	AAPA Slides Press		AAPA Slides Press	AAPA Slides Press

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 Anthroplogy Association
HBA Human Biology Association
LAC Local Arrangements Committee
PPA Paleopathology Association

Adam's Mark Hotel

Third Floor Meeting Rooms



Conference Schedule

For a schedule of individual AAPA poster and podium presentations, see page 11.

Monday, April 8, 2002

Paleopathology Association

4:00 pm – 8:00 pm	Registration. *Grand Hall.*

Tuesday, April 9, 2002

Paleopathology Association

8:00 am – 12:00 noon	Registration, *Grand Hall.* Workshops, Scientific Sessions. *Grand Ballroom A.*
7:30 pm – 10:00 pm	Dinner, Business Meeting. *Richardson.*

Wednesday, April 10, 2002

Paleopathology Association

8:00 am – 12:00 noon	Registration. *Grand Hall.* Workshops, Scientific Sessions. *Grand Ballroom A.*

American Association of Physical Anthropologists

1:00 pm – 8:00 pm	Registration. *Grand Hall.*
8:00 am – 5:00 pm	Executive Committee Meeting. *Olmstead.*
12:00 noon – 2:00 pm	*American Journal of Physical Anthropology* Editorial Board Luncheon. *Sullivan.*
6:30 pm – 7:45 pm	Student Concerns Panel: "Ask the Editors: The Dos and Don'ts of Journal Publishing." *Grand Ballroom E.*
8:00 pm – 10:00 pm	Reception & Cash Bar. *Grand Ballroom C.*

Human Biology Association

6:30 pm – 8:00 pm	*American Journal of Human Biology* Editorial Board Dinner. *Richardson.*

Thursday, April 11, 2002

American Association of Physical Anthropologists

8:00 am – 5:00 pm	Registration. *Grand Ballroom.*
8:00 am – 12:00 noon	Education Committee Workshop. *Richardson.*
8:00 am – 12:00 noon	**Session 1. Dental Anthropology/Paleopathology.** Contributed Posters. *Grand Pavilion.*
8:00 am – 11:45 am	**Session 2. Recent Research in Forensic Anthropology.** Symposium. *Grand Ballroom A.*

8:00 am – 11:45 am	**Session 3. Human Biology I: Human Reproduction, Growth & Development.** Contributed Papers. *Grand Ballroom B.*
8:00 am – 12:00 noon	**Session 4. Primate Cognitive Ecology.** Symposium. *Grand Ballroom D.*
8:00 am – 12:00 noon	**Session 5. Hominid Evolution I: Neandertals/Modern Human Origins.** Contributed Papers. *Grand Ballroom E.*
8:00 am – 12:00 noon	Education Committee Workshop . *Richardson.*
1:30 pm – 5:00 pm	**Session 6. Skeletal Biology.** Contributed Posters. *Grand Pavilion.*
1:30 pm – 4:30 pm	**Session 7. Biocultural Diversity and History in Early Northeast Africa: Issues and Interpretations.** Symposium. *Grand Ballroom A.*
1:00 pm – 2:15 pm	**Session 8. Human Biology II: Evolution and Adaptation. Contributed Papers.** *Grand Ballroom B.*
2:30 pm – 5:00 pm	**Session 8. Evolution and Nutritional Constraints on the Human Brain.** Symposium. *Grand Ballroom B.*
1:00 pm – 5:30 pm	**Session 9. Grand Ballroom D Primate Behavior I: Socioecology and Conservation.** Contributed Papers. *Grand Ballroom D.*
1:00 pm – 5:00 pm	**Session 10. Australopithecines to AMHS: Current Paleoanthropological Research in South Africa.** Symposium. *Grand Ballroom E.*
12:30 pm – 2:00 pm	Ethics Roundtable. *Richardson.*
	Join the continuing discussion of ethics in biological anthropology. Trudy Turner, Organizer.
5:30 pm – 6:30 pm	Plenary Session. *Grand Ballroom B.*
	Speaker: Richard Milner, “Darwin Live and in Concert”
6:30 pm – 8:30 pm	Wiley-Liss Reception. *Grand Ballroom C.*

Dental Anthropology Association

5:00 pm – 6:00 pm	Business Meeting. *Grand Ballroom E.*

Primate Biology & Behavior Interest Group

5:00 pm – 6:00 pm	Business Meeting. *Grand Ballroom D.*

Human Biology Association

6:00 pm – 10:00 pm	Executive Committee Meeting and Dinner. *Olmstead.*

Friday, April 12, 2002

American Association of Physical Anthropologists

8:00 am – 5:00 pm	Registration. *Grand Hall.*

8:30 pm – 12:00 noon	**Session 11. Hominid Evolution and Primate Evolution.** Contributed Posters. *Grand Pavilion.*
8:00 am – 12:00 noon	**Session 12. Paleopathology.** Contributed Papers. *Grand Ballroom A.*
8:00 am – 11:45 am	**Session 13. Human Biology III: Demography, Health and Disease.** Contributed Papers. *Grand Ballroom B.*
8:30 am – 12:00 noon	**Session 14. Primate Behavior II: Social and Reproductive Behavior.** Contributed Papers. *Grand Ballroom D.*
8:00 am – 12:00 noon	**Session 15. Hominid Evolution II.** Contributed Papers. *Grand Ballroom E.*
12 noon – 2:00 pm	AAPA Luncheon. *Grand Ballroom C.*
	Speaker. Karen Strier
2:00 pm – 5:30 pm	**Session 16. Human Biology/Genetics/Forensics.** Contributed Posters. *Grand Pavilion.*
2:00 pm – 6:00 pm	**Session 17. Skeletal Biology I.** Contributed Papers. *Grand Ballroom A.*
2:00 pm – 5:30 pm	**Session 18. Understanding the Linkages Between Nutritional Status, Physical Activity, and Productivity.** Symposium. *Grand Ballroom B.*
2:00 pm – 6:00 pm	**Session 19. Primate Biology I: Anatomy and Functional Morphology.** Contributed Papers. *Grand Ballroom D.*
2:00 pm – 6:00 pm	**Session 20. "Dr. Livingstone, We Presume." Evolutionary Views of Human Variation and Hominid History.** Symposium. *Grand Ballroom E.*
8:00 pm – 11:00 pm	Annual Business Meeting. *Grand Ballroom D.*

American Dermatoglyphics Association

6:00 pm – 7:00 pm	Annual Business Meeting. *Richardson.*

American Association of Anthropological Genetics

7:00 pm – 8:30 pm	Business Meeting. *Richardson.*

Human Biology Association

8:00 am – 5:00 pm	Registration. *Olmstead.*
7:30 am – 9:00 am	*American Journal of Physical Anthropology* Editorial Board Breakfast. *Olmstead.*
1:00 pm – 5:00 pm	Scientific Program. *Olmstead.*
6:30 pm – 8:30 pm	Reception. *Grand Ballroom B.*

Saturday, April 13, 2002

American Association of Physical Anthropologists

8:00 am – noon	Registration. *Grand Hall.*

8:30 am – 12:00 noon	**Session 21. Primate Behavior and Biology.** Contributed Posters. *Grand Pavilion.*
8:00 am – 12:00 noon	**Session 22. Skeletal Biology II.** Contributed Papers. *Grand Ballroom A.*
8:00 am – 12:00 noon	**Session 23. Primate Evolution.** Contributed Papers. *Grand Ballroom B.*
8:00 am – 12:15 pm	**Session 24. Primate Biology II: Molecules And Biomechanics.** Contributed Papers. *Grand Ballroom D.*
8:00 am – 12:00 noon	**Session 25. Hominid Evolution III.** Contributed Papers. *Grand Ballroom E.*
1:00 pm – 4:45 pm	**Session 26. Skeletal Biology III.** Contributed Papers. *Grand Ballroom A.*
1:00 pm – 5:00 pm	**Session 27. Genetics.** Contributed Papers. *Grand Ballroom B.*
1:00 pm – 5:00 pm	**Session 28. Modern Morphometrics in Physical Anthropology.** Symposium. *Grand Ballroom D.*
6:00 pm – 7:30 pm	Awards Reception and Cash Bar. *Olmstead.*

Human Biology Association

8:00 am – 6:00 pm	Registration, Scientific Sessions. *Richardson.*
8:00 am – 11:30 am	Plenary Session. *Richardson.*
11:30 am – 1:00 pm	HBA Luncheon. *Grand Ballroom C.*
1:00 pm – 3:30 pm	Plenary Session. *Richardson.*
3:30 pm – 6:00 pm	Pearl Lecture and Business Meeting. *Richardson.*

Sunday, April 14, 2002

Human Biology Association

8:00 am – 12:00 noon	Registration. *Richardson.* Scientific Sessions, *Richardson.*

AAPA Poster and Podium Presentation Schedule

For a schedule of all conference events, see page 7.

Thursday Morning – April 11, 2002

Session 1. Dental Anthropology/Paleopathology. Contributed Posters. *Grand Pavilion.*
Chair: D. GANTT, U.S. Army Medical Department Center and School.

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 Dental Paleopathology of a Late Prehistoric Mortuary from Indiana. T. GREENE.

2 LSAMAT in a Caribbean Slave Population. L. ATZ.

3 Dental Macrowear Analysis of the late Prehistoric Ray Site, Warrick County, Indiana. M. HILL, C. SCHMIDT.

4 The Ancient Neolithic People of Ukraine, Osteological and Dental Considerations. A.M. HAEÜSSLER, I. POTEKHINA.

5 Intertooth and intrafacet dental microwear variation in archaeological humans: implications for dietary research. P. MAHONEY.

6 Dental anthropology, settlement pattern, and social structure at the Maya site of Xcambó, Yucatán. A. CUCINA, V. TIESLER BLOS.

7 Patterns through time: a comparison of dental pathology between the Late Woodland, Illinois Bluff burial mounds and Spiro Mounds, Oklahoma, based on changes in subsistence economy. A.T. MAYES.

8 The Impact of Acetic Acid Pretreatment on Apatite Carbonate. S. GARVIE-LOK, T.L. VARNEY.

9 Distribution of linear enamel hypoplasia in Ceboidea. E.A. NEWELL, D. GUATELLI-STEINBERG.

10 A worldwide survey of deciduous tooth size distributions in recent humans. L. HARRIS, L. LEASE.

11 A comparison of relative enamel thickness of deciduous and permanent teeth in *Pan troglodytes*. A. OLEJNICZAK, L. MARTIN.

12 Histologically derived canine crown formation times from a medieval Danish sample. D. REID, R. FERRELL, P. WALTON.

13 Incremental features of pre- and post-natal enamel microstructure in pigtailed macaques (*Macaca nemestrina*). T. SMITH, L. MARTIN, J. SIRIANNI.

14 A Dental Reconstruction of Biological Relationships in the Late Bronze and Early Iron Ages of the Southern Levant. J. ULLINGER.

15 Patterns of Dental Wear and Disease in the Middle Archaic of the Texas Gulf Coastal Plain: An Example from the Ernest Witte Site. M.S. TAYLOR

16 Quantification of tooth crown shape by dental topographic analysis. P. UNGAR, J. DENNIS.

17 A Study of Linear Enamel Hypoplasia in a Middle Mississippian Population. J. WILSON, D. WOLFE STEADMAN.

18 Intertrait association: measuring correlations among dental discrete traits within and between tooth classes in a Maya skeletal collection. G.D. WROBEL.

19 The double child burial from Sunghir (Russia): pathology and inferences for Upper Palaeolithic funerary practices. V. FORMICOLA, A. BUZHILOVA.

20 Is Pastoralism a Pain in the . . . ? Palaeopathology in Early Neolithic Iran. D.C. MERRETT.

21 The Samnites of Alfedena Iron Age Burials: An Assessment of inter-personal cranial trauma. D. MANCINELLI, R. PAINE, M. RUGGIERI, A. COPPA.

22 Osteological Markers and Habitual Behaviors, Assessing the Connection at Hierakonpolis, Egypt. N. DENTON.

Thursday Morning – April 11, 2002 (continued)

23 Health in Predynastic Egypt: Using Skeletal Stress Markers to Assess the Overall Health of a Working Class Population in Hierakonpolis. J. MATOVICH.

24 Counting the Children: Demography and Health of Subadults from a Collective Bronze Age Tomb, Tell Abraq, United Arab Emirates. P. STONE, J. RHODES, D. MARTIN, D. POTTS.

25 A Paleopathological Assessment of Early Medieval Subadults from English and German Skeletal Populations. B. JAKOB.

26 Evidence for dental hygiene in early medieval Northern Germany: Traces of tooth picks. W-R. TEEGEN, M. SCHULTZ.

27 Evidence for clubfoot (*talipes equinovarus*) from a Laurel Period site (ca. 2000 BP) in southern Manitoba. T. GARLIE, D.C. MERRETT, C. MEIKLEJOHN, D. FINCH, B. WADDELL.

28 Cranial trauma as evidence of violence in a native Alaskan skeletal sample from Nunivak Island, Alaska. S.S. LEGGE.

29 A Demographic Profile of Porotic Hyperostosis in an Ancient Native American Sample. J. BAUDER, D. WOLFE STEADMAN.

30 Life and Death in Kentucky: A Bioarchaeological View from the Revolution Era to the Progressive Era. S. PHILLIPS.

31 Infectious disease in enslaved Africans from Newton Plantation, Barbados: Bioarchaeology and Ethnohistory. K. SHULER.

32 Activity Related Pathology in the Albany County Almshouse Cemetery, Albany, NY. M. SOLANO.

33 The Frequency and Chronological Distribution of Linear Enamel Hypoplasia in a 19th Century Almshouse Population. J.L. MULLER, P.M. WILLIAMS, J.E. SIRIANNI.

34 Resolving cultural affiliation through multiple methods: a case study. J.T. ENG, P.L. WALKER.

35 Differential Diagnosis of Sirenomelia: A Case Study. J. FILDES.

Session 2. Recent Research in Forensic Anthropology. Symposium. *Grand Ballroom A.*

Organizers and Chairs: L. MEADOWS JANTZ and L. W. KONIGSBERG, University of Tennessee.

Forensic anthropology is often misconstrued as being entirely an applied pursuit that uses methods expropriated from human skeletal biology/physical anthropology. As such, the notion of "forensic anthropology research" would be considered by some as oxymoronic. To the contrary, the papers in this symposium demonstrate that physical anthropologists are indeed engaged in research contributions to the field of forensic anthropology, and that the methods being developed are uniquely suited to the applied nature of forensic anthropology.

8:00 am Introduction. L. MEADOWS JANTZ.

8:15 am DNA sexing from hair shaft samples. L.E. BAKER, J. MILSAPS, K. MATTESON.

8:30 am Further analysis of utilizing the human patella to determine sex in forensic contexts. N.E. TATAREK, L.R. LEASE.

8:45 am Logic processing of expert knowledge: A formal alternative to quantitative approaches to sex and age estimation. D.G. McBRIDE, R.A. BENFER, N.L. FURBEE.

9:00 am Investigating long-bone growth retardation in the Forensic Data Bank subadults. K. SPRADLEY.

9:15 am Advances in estimating age-at-death from cementum annulations and tooth root translucency. D.A. PRINCE, U. WITTWER-BACKOFEN.

9:30 am A comparison of neural networks and traditional linear models in skeletal estimation of ancestry, sex and secular change. S. BELL, R.L. JANTZ.

9:45 am Break

10:00 am Social Races and Human Populations: Why Forensic Anthropologists are Good at Identifying Races. S. OUSLEY.

10:15 am Mixture analysis as an alternative to 'determination of ancestry.' L.W. KONIGSBERG, R.L. JANTZ.

10:30 am Cranial variation in the American white population: a temporal and geographic perspective. C. SPARKS, K. SPRADLEY, R.L. JANTZ.

10:45 am The statistical basis for positive identifications in forensic anthropology. D. WOLFE STEADMAN, L.W. KONIGSBERG.

Thursday Morning – April 11, 2002 (continued)

11:00 am New morphometric approaches to positive identification from frontal sinuses. A.M. CHRISTENSEN, D.E. SLICE.

11:15 am Evaluation of computer enhanced facial reproduction at the National Center for Missing and Exploited Children using Terry Collection death masks and photographs. G. MILLER, D.R. HUNT, S. LOFTON, J. MULLINS.

11:30 am Discussant. D. UBELAKER.

Session 3. Human Biology I: Human Reproduction, Growth, and Development. Contributed Papers. *Grand Ballroom B.*

Chair: J. RICHTSMEIER, Pennsylvania State University.

8:00 am Food shortages and the omnivore's dilemma. D. SMAY.

8:15 am The Reproductive Ecology of High Pastoralist Fertility. S. JOSEPH.

8:30 am The Sea Hunters of Lamalera, Indonesia: Do Marriage Alliances Explain Crew Formation? E. FINK, M. ALVARD.

8:45 am Age at menopause in Puebla, Mexico: methodological considerations. L. SIEVERT, S. HAUTANIEMI.

9:00 am Adaptive fertility behavior in an agricultural population. B. STRASSMANN, B. GILLESPIE.

9:15 am Maternal nutritional status and diet during pregnancy and offspring lipid metabolism in Filipino adolescents. C. KUZAWA, L. ADAIR.

9:30 am The negative impact of family size on nutrition and development in a Shuar village: evidence of a quantity-quality tradeoff. E.H. HAGEN, H.C. BARRETT, M.E. PRICE.

9:45 am Growth and physiological adaptation in Chinese children of three ethnic groups at 3200 m. S. BAILEY, J. XU, X. FENG, X. HU, C. ZHANG, S. QIU.

10:00 am Break

10:15 am Physical activity, body size, and body proportions of Portuguese and Cape Verdean-Portuguese pre-menarcheal girls. M. VARELA SILVA, B. BOGIN.

10:30 am Growth of Akwesasne Mohawk adolescents and environmental contaminants. M. GALLO, J. RAVENSCROFT, L. SCHELL, A. DeCAPRIO, M. DENHAM, AKWESASNE TASK FORCE ON THE ENVIRONMENT.

10:45 am The relative fatness of street children in Guatemala. T. SULLIVAN.

11:00 am Genetic Architecture of the Timing of the Pubertal Growth Spurt and Skeletal Maturity During Puberty. B. TOWNE, D. DUREN, S. CZERWINSKI, E. DEMERATH, A. ROCHE, J. BLANGERO, J. PARKS, M. BROWN, R. SIERVOGEL.

11:15 am Childhood Developmental Trajectory of Attention and Impulse Control. A. BREWIS, K. SCHMIDT.

11:30 am Head shape of adult males as a possible indicator of economic changes in northern Jordan (1900-1978). A. ABU DALOU.

Session 4. Primate Cognitive Ecology. Symposium. *Grand Ballroom D.*

Organizer and Chair: P.A. GARBER, University of Illinois, Urbana.

Compared to many groups of animals, primates are characterized by large brain size, enhanced manipulative abilities, and complex cognitive skills. In this symposium we examine primate cognitive ecology. Our goals are to examine evidence for major taxonomic differences in primate cognition, and whether a theory that combines causal knowledge of both social and ecological information offers a clearer understanding of decision-making and cognition in human and nonhuman primates. Emphases will be placed on problem-solving strategies in natural field settings. Research on primate cognition in captive environments, and studies of learning and neural development also are included.

8:00 am Introductory Remarks: Decision-making in primates. P.A. GARBER.

8:15 am Brain growth, life histories, and cognition in primate and human evolution. S.R. LEIGH.

8:30 am Less is more: why simple rules are adaptive solutions to complex foraging problems. C. JANSON.

Thursday Morning – April 11, 2002 (continued)

8:45 am The use of visual, olfactory, and spatial information during foraging in wild nocturnal and diurnal anthropoids: A comparison between *Aotus*, *Callicebu*s, and *Saguinus*. J.C. BICCA-MARQUES, P.A. GARBER.

9:00 am The sensual side of primate food choice. N.J. DOMINY, P.W. LUCUS.

9:30 am Variation in Foraging and Food Processing Techniques Among White-faced Capuchins (*Cebus capucinus*) in Santa Rosa National Park, Costa Rica. R. O'MALLEY, L.M. FEDIGAN.

9:45 am Break

10:00 am Experimental field study of tool use in wild capuchins (*Cebus capucinus*): learning by association or learning by insight? P.A. GARBER, E. BROWN.

10:15 am What does the ability to use tools tell us about 'cognition'? M.A. PANGER.

10:30 am Paleoenvironmental basis of cognitive evolution in great apes. R. POTTS.

10:45 am The evolutionary foundations of learning by imitation in chimpanzees. K.A. BARD.

11:00 am Spatial cognition and memory in a symbol-using chimpanzee. C. MENZEL.

11:15 am Human Cognition and Tool Use: Inspiration for Primate Studies. J. DIXON KELLER.

11:30 am Discussion.

Session 5. Hominid Evolution I: Neandertals/Modern Human Origins. Contributed Papers.

Grand Ballroom E.

Chair: S. C. ANTÓN, Rutgers University.

8:00 am Paleoanthropology of the Kibish Formation, Ethiopia. J. FLEAGLE, Z. ASSEFA, F. BROWN, I. McDOUGALL, S. YIRGA.

8:15 am Reexamining Variation in Early Pleistocene Fossils from East Africa. J. WILSON, A. VAN ARSDALE.

8:30 am The Mauer Mandible. A Paleopathological Analysis. A. CZARNETZKI, B. JAKOB, C.M. PUSCH.

8:45 am Human Evolution: A Neanderthal Skeleton in a *sapiens* Closet. C.L. BRACE, N. SEGUCHI, C. QUINTYN.

9:00 am Dental Reduction in Late Pleistocene and Early Holocene Hominids. C. FITZGERALD, S. HILLSON.

9:15 am Approximate age at death of fragmentary fossils in the modern human origins debate. J. AHERN, F.H. SMITH.

9:30 am Evidence for summer rains during Neandertal occupation at Amud Cave, Israel: the stable isotope data. K. HALLIN, M. SCHOENINGER, H. SCHWARCZ.

9:45 am Break

10:00 am Were Neanderthals full of "NO" gas? The relationship between paranasal sinus morphology and nitric oxide production. S. MARQUEZ, P.J. GANNON, W. LAWSON, J.S. REIDENBERG, J.T. LAITMAN.

10:15 am Revisiting human cold adaptation—craniofacial shape assessed by 3D laser scanning. M. FRIESS.

10:30 am New human remains from the Neander Valley, Germany. F. SMITH, R. SCHMITZ.

10:45 am Clavicle morphology and Neandertal shoulder architecture. J-L. VOISIN.

11:00 am Archaic and Modern Human Distal Humeral Morphology. T.R. YOKLEY, S.E. CHURCHILL.

11:15 am Pulsatile hormone secretion, episodic growth patterning, heterochrony, and punctuated equilibria: A unifying model. N. MINUGH-PURVIS, S. CROCKFORD.

11:30 am Morphological Integration 2: Developmental Interactions during Ontogeny and Phylogeny in the Human Cranium. H. SEIDLER, K. SCHAEFER, H. PROSSINGER, P. MITTERÖCKER, P. GUNZ, G.W. WEBER, F.L. BOOKSTEIN.

11:45 am Human remains from the initial Upper Paleolithic of Üçagizli Cave, South Central Anatolia, and implications for the evolution of the genus *Homo* in Turkey. E. GÜLEÇ.

Thursday Afternoon – April 11, 2002

Session 6. Skeletal Biology. Contributed Posters. *Grand Pavilion.*

Chair: R. PASTOR, University of Bradford.

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 Histologic Examination of Age in Chimpanzees. D. MULHERN, D. UBELAKER.

2 Scanning electron microscopic analysis of regional histomorphological variation within the physis of the primate proximal femur. P.L. RENO, M.A. KRIZ, M.A. McCOLLUM, C.O. LOVEJOY.

3 Accurately estimating areal measures of thin-walled cortical bone from conventional CT data using a sub-voxel algorithm. M. BLACK.

4 The Application of 3D æCT to the Analysis of Cortical Bone Porosity. D. COOPER, B. HALLGRIMSSON.

5 Accuracy and precision of body size estimation using the W. Montague Cobb Collection. C. TERRANOVA.

6 Quantification of anisotropy in trabecular bone fabrics. R. KETCHAM, T. RYAN, M. MAGA, A. GORDON.

7 Relationship between collagen fiber orientation, age and mechanical adaptation of the human mid-shaft femur. H.M. GOLDMAN, T.G. BROMAGE, J.G. CLEMENT, C.D.L. THOMAS.

8 Effects of experimental intrauterine stress on postnatal growth of the skeleton. M.C. FUCINI, A.B. ORDEN, L.M. GUIMAREY, F.A. QUINTERO, E.E. OYHENART.

9 Digital image analysis for osteological aging: a preliminary assessment. M. SITCHON, R. HOPPA.

10 Using Semilandmarks on surfaces to analyze a Neolithic hydrocephalus. P. GUNZ, P. MITTERÖCKER, M. TESCHLER-NIKOLA, H. SEIDLER.

11 Brain growth in rabbits with delayed onset craniosynostosis. A.M. KREITHEN, S.M. WEINBERG, G.M. COOPER, A.M. BURROWS, T.D. SMITH, H.W. LOSKEN, M.P. MOONEY, M.I. SIEGEL.

12 Complexity of Human Cranial Sutures: Are They Fractal? R. WRIGHT, M. WILLIAMSON, J. YU, J. BRASELTON.

13 Asymmetrical angular rotation of the femur; divergence between prehistoric and modern American populations. D.R. HUNT, H. WILLIAMS.

14 Directional asymmetry in joint surface size in a Mississippian sample. J. PLOCHOCKI.

15 A Humerus Tale: Humeral Torsion and Activity-Related Change in the Upper Limb. J. RHODES.

16 Structure-Based Prediction of Joint Motion. T. MASTERSON, P. LOUBERT, A. SALTARELLI.

17 Chest Shape in Human Skeletons from High and Low Altitudes. K. WEINSTEIN.

18 Effect of moderate undernutrition on the functional components of the axial skeleton. A.B. ORDEN, E.E. OYHENART, M.F. CESANI, M. ZUCCHI, M.C. MUÑE, M.E. VILLANUEVA, R.R. RODRIGUEZ, E.R. PONS, H.M. PUCCIARELLI.

19 Three-Dimensional Anthropometry: Reliability and Error. D. FEATHERS.

20 Nonmetric Traits of the Cervical Vertebrae: Methods for Data Collection and Comparison. M. AUBIN.

21 From Heels to Height: Estimating Stature Based on the Talus at Tell Abraq, U.A.E., B. TURNER, A. GOODMAN, D. MARTIN, D.T. POTTS.

22 Sex Determination from the Adult Clavicle in a South Asian Sample. C. KATZMARZYK.

23 The Mystery of Muscle Markers: Aggregation and Construct Validity. E. WEISS.

24 Upper limb morphology and the division of labor among southern African Holocene foragers. S. PFEIFFER, J. STOCK.

25 An Investigation of Habitual Activity Patterns at the Historic Period Maya Site of Tipu, Belize, Using Musculoskeletal Stress Markers (MSM). K. HARTNETT.

Thursday Afternoon – April 11, 2002 (continued)

26 Terrain and Subsistence Strategy Effects on Long Bone Diaphyseal Structure. D. WESCOTT.

27 Morphometric Analysis of Northwestern Plains Amerindian Crania. L.J. STUART, R.L. JANTZ.

28 Kennewick Man Revisited: Group Affiliation and Native American Origins. R.A. GONZALEZ.

29 Human population size as a predictor of threatened species. C.D. FOOCE, J.K. McKEE.

30 Context and Burial Rescue in Northern Sonora, Mexico. J. WATSON.

31 The prehistoric burials of Shum Laka rockshelter (North-West Cameroon): funerary practices, biological affinities, health status. I. RIBOT, R. ORBAN, P. DeMARET.

32 Dynastic funerary ritual and body treatments of sacrificial companions among the Classic Maya. A case study from the sarcophagus tomb of Temple XIII, Palenque, Mexico. V. TIESLER BLOS, A. CUCINA, A. ROMANO PACHECO.

33 Demographic and health reconstruction of the Santa Catalina de Guale Ossuary, Amelia Island, Florida. C. SCHMIDT, C.S. LARSEN.

34 Population and Migration: The Nile Valley During the Predynastic and Early Dynastic Periods. S. ZAKRZEWSKI.

35 Bioarchaeological Investigations of a 2700 BP Cemetery, Republic of Palau, Micronesia. G.C. NELSON, S.M. FITZPATRICK, J.M. McLAUGHLIN.

36 The Old Ladies of Black Mesa: A 900-Year Chronicle of Diet and Health Recorded in Bone and Teeth. D. MARTIN, J. FAN, M. SANDERS, R. WHITE.

37 The Cremated Infant Remains from Carthage: Skeletal and Dental Evidence For and Against Human Sacrifice. G. AVISHAI, P. SMITH.

38 The Fetal Skeletons of Kellis: The Isotopic, Fluorescent Microscopic, and Osteometric Evidence. T. DUPRAS, M. TOCHERI, C. MAGGIANO, E. MOLTO.

39 Thermic Exposure of The Burials from Cuicuilco, Mexico. C. PIJOAN, J. MANSILLA, G. VALENZUELA.

Session 7. Biocultural Diversity and History in Early Northeast Africa: Issues and Interpretations. Symposium. *Grand Ballroom A.*

Organizers: S.O.Y. KEITA, Department of Anthropology, The Field Museum, and A.J. BOYCE, Institute of Biological Anthropology, Oxford University.

The northeast quadrant of Africa (including the Horn) traditionally has been a place of great interest to anthropologists, and provided rich materials with which to explore the past and build hypotheses. This region and its subareas have also been the focus of various controversies. This symposium will present and explore issues of population and culture history in early northeast Africa using data from archaeology, historical linguistics, genetics and skeletal biology. The purpose is to examine old and new ideas, and show the usefulness of a biocultural approach in exploring population history and affinities, and received models of interpretation, including categorical thinking. Hopefully this will provide stimulation to consider whether or not it is important to develop criteria for reconciling evidence from different disciplines.

1:30 pm Human Genetic Diversity in East Africa: Implications for Modern Human Origins and Recent Biocultural History. S. TISHKOFF, A. KNIGHT, J.L. MOUNTAIN.

1:45 pm The Nile Valley route Out-of-Africa further considered: An examination of the Late Pleistocene archaeology of northeast Africa and the Levant. A. HAWKINS.

2:00 pm Late Pleistocene and Early Holocene Archaeology of the Nile Corridor: Implications for the Spread of Malaria. A.S. BROOKS, J.E. YELLEN.

2:15 pm Locating a Phylum in Time and Space: the Case of the Afrasian [Afroasiatic Language Family]. H. FLEMING.

2:30 pm Populations and Languages in the Expansion of the Afroasiatic Language Family. C. EHRET.

2:45 pm Break

3:00 pm The Role of Neolithic People in Northeast African Prehistory: A Biocultural Perspective from Nabta Playa, Egypt. J. IRISH, R. SCHILD, A. FROMENT, F. WENDORF.

3:15 pm Evaluation of the Genetics of the Nile Corridor in the Context of African Diversity, Geographic Distances and Language Families. R. KITTLES, S.O.Y. KEITA.

3:30 pm Changes in Nubian Craniofacial Morphology and Dentition: Evaluating the Case For Population Discontinuity. G.J. ARMELAGOS, J. CALCAGNO, A. COPPA, R. VARGIU.

Thursday Afternoon – April 11, 2002 (continued)

3:45 pm Morphological Micro-evolution of Nubian Populations from A-Group to Christian Epochs: Gene Flow, Not Local Adaptation. A. FROMENT.

4:00 pm Mapping Diversity: Craniofacial Affinities in the Mid-Holocene Nile Valley Considered With Archaeological and Linguistic Data. S.O.Y. KEITA, A.J. BOYCE.

4:15 pm Discussant. A.J. BOYCE.

Session 8. *Grand Ballroom B.*

Human Biology II: Evolution and Adaptation. Contributed Papers.

Chair: R. FRISANCHO, University of Michigan.

1:00 pm Relationship of nasal morphology to metabolic performance during nose-breathing and mouth-breathing. R. HALL.

1:15 pm Climate, Body Size Allometry and the Effect on Craniofacial Measurements. P. KILLORAN.

1:30 pm Environmental Correlates of Human Skin Color, Revisited. G. CHAPLIN, N. JABLONSKI.

1:45 pm Evolutionary diversification processes in Paleoamericans and Amerindians. H.M. PUCCIARELLI, M.L. SARDI, W.A. NEVES, J. JIMENEZ LOPEZ, C. SERRANO.

2:00 pm Microevolution of the central European human vertebral column since the Neolithic: preliminary osteometric assessment and interpretations. F. J. RÜHLI, M. SCHULTZ, M. HENNEBERG.

2:15 pm Break

Evolution and Nutritional Constraints on the Human Brain. Symposium.

Organizers and Chairs: J.H. LANGDON, University of Indianapolis, and S.C. CUNNANE, University of Toronto.

The hominid brain has overcome physiological limitations of nutrition, energy, birthing complications, and thermoregulation in order to expand to its present size. New interest has focused on the role that specific diets, including essential fatty acids and micronutrients, might have played. Some of the recently published nutritional models have arisen from clinical and nutritional sciences and have not received much notice among physical anthropologists. Similarly, arguments published by anthropologists are not necessarily communicated well outside our community. This symposium offers an opportunity to bring these divergent approaches together and facilitate the exchange of ideas and perspectives.

2:30 pm Metabolic correlates of hominid brain evolution. M.L. ROBERTSON, W.R. LEONARD, J. SNODGRASS.

2:45 pm Fatty Acid Composition and Energy Density of Foods Available to Hominids: Implications for Encephalization. L. CORDAIN.

3:00 pm Docosahexaenoic Acid and Cerebral Evolution. C.L. BROADHURST, M.A. CRAWFORD, S.C. CUNNANE, H. HOLMSEN, K. GHEBREMESKEL, J. PARKINGTON, W.F. SCHMIDT, M. BLOOM.

3:15 pm Neonatal Body Fat: A Uniquely Human Attribute Essential for Brain Expansion. S. CUNNANE.

3:30 pm Fishy diets?: Isotopic and chemical methods for testing. H. SCHWARCZ.

3:45 pm Darwin meets DHA: Natural selection, diet, and brain evolution. J. LANGDON.

4:00 pm The role of phospholipid metabolism and mental illness in the late stages of human evolution. D. HORROBIN.

4:15 Isotopic information about early hominid diets in southern Africa: implications for ecological niche and brain expansion. J. LEE-THORP, M. SPONHEIMER.

4:30 pm The Iodine Imperative. J.E. DOBSON.

4:45 pm Discussion.

Session 9. Primate Behavior I: Socioecology and Conservation. Contributed Papers. *Grand Ballroom D.*

Chair: D. WATTS, Yale University.

Thursday Afternoon – April 11, 2002 (continued)

1:00 pm More Evidence for Visual Predation in the Slender Loris. K.A.I. NEKARIS.

1:15 pm Does group size reflect a trade-off between predation risk and within-group food competition? S. BOINSKI

1:30 pm Ranging Behavior of Nicaraguan Howling Monkeys (*Alouatta palliata*) as Evidence for Within-Group Competition. K. WILLIAMS-GUILLEN, C.M. McCANN.

1:45 pm The influence of a large home range on the social structure of free ranging spider monkeys (*Ateles geoffroyi*) on BCI, Panama. C. CAMPBELL.

2:00 pm Inter-group variation in ranging patterns in golden-mantled tamarins, *Saguinus tripartitus*. C. KOSTRUB.

2:15 pm Changes in Visibility Affect Ranging Behavior and Vigilance in Vervet Monkeys (*Cercopithecus aethiops*). K. ENSTAM, L. ISBELL.

2:30 pm The influence of swamp use and fruit consumption on western gorilla (*Gorilla gorilla gorilla*) ranging behavior at Mondika Research Center. D. DORAN, D. GREER.

2:45 pm How specialized are ripe-fruit specialists? Dietary selection in the face of sympatric competitors and shifting fruit abundance. J.L. DEW.

3:00 pm Break

3:15 pm The response of white-bellied spider monkeys to the vocalizations of sympatric frugivores. S. SUAREZ.

3:30 pm Experimental evidence of long-term memory for resource locations in *Pithecia pithecia*. E. CUNNINGHAM, K. SWARTZ, C. JANSON.

3:45 pm Seasonal variations in nutritional components of diet in two lemur species in Madagascar. N. YAMASHITA.

4:00 pm Patterns of use in leaf source species by mantled howler monkeys (*Alouatta palliata*). B. WELKER.

4:15 pm Percussive Technology: Wild Chimpanzees Pound Open Baobab Fruits. L. MARCHANT, W. McGREW.

4:30 pm Ethno-archaeology of unhabituated chimpanzees at Mont Assirik, Senegal, West Africa. W. McGREW, P. BALDWIN, L. MARCHANT, J. PRUETZ, S. SCOTT, C. TUTIN.

4:45 pm Experimental evidence for the effects of reduced ground predator pressure on the habitat use of arboreal monkeys in the Tai Forest, Ivory Coast. W. McGRAW, R. BSHARY.

5:00 pm Conservation of lemurs in the Onive-Vohidahy region of eastern Madagascar. S. LEHMAN.

5:15 pm Recent forest destruction and its impacts on critically endangered primates in the lower Tana River, Kenya. J. WIECZKOWSKI, D.N.M. MBORA.

Session 10. Australopithecines to AMHS: Current Paleoanthropological Research in South Africa. Symposium. *Grand Ballroom E.*

Organizers and Chairs: R. R. ACKERMANN, University of Cape Town and K. KUYKENDALL, University of the Witwatersrand.

For a number of reasons – some political, some geographical, some historical – paleoanthropological research in South Africa has suffered from fragmentation. The goal of this seminar is to pull together this disparate body of work, through an exploration of the breadth of the research (and researchers) in South Africa. The papers in this seminar will draw from paleoanthropological research broadly construed – investigations into taxonomy and morphology, life history and development, diet and paleo-environments, site formation and taphonomy are all included. South Africa has a unique fossil record that reflects important events both ancient and recent, and therefore the temporal range of the seminar is also broad – from Pliocene to late Pleistocene. Such an approach will provide a framework for understanding the state of the science generally, and will provide unity and clarification to benefit researchers both locally (SA) and abroad.

1:00 pm What can morphological variation tell us about phylogenetic divergence? R.R. ACKERMANN

1:15 pm Strategies to cope with the lack of a clear boundary between *Australopithecus* and *Homo*. F. THACKERAY.

1:30 pm The hominid species of Sterkfontein through time. R.J. CLARKE.

1:45 pm The elusive 'second species' at the Sterkfontein fossil site: the dental evidence. J. MOGGI-CECCHI.

2:00 pm Human incisors and molars from the Late Pleistocene hominid locality of Hoedjiespunt, South Africa. D. STYNDER, J. MOGGI-CECCHI, L. BERGER, J. PARKINGTON.

2:15 pm Early modern humans and the formation of Middle Stone Age shell middens along the Cape west coast. J.E. PARKINGTON.

Thursday Afternoon – April 11, 2002 (continued)

2:30 pm New human and chimpanzee models to interpret early hominid dental development. J. BRAGA.

2:45 pm A comparative analysis of tooth mineralisation and paranasal sinus development in the Taung child. L. KUYKENDALL, J. BOZIC, G.C. CONROY.

3:00 pm Break

3:15 pm What do we really know about the early hominid diet? M. SPONHEIMER.

3:30 pm Reassessing evolution of open environments associated with the early South African hominids, using a Carbon13-based index. J. LUYT, J. LEE-THORP, M. SPONHEIMER.

3:45 pm Middle Pleistocene paleoenvironments of hominid sites in the Western Cape. K. CRUZ-URIBE, R. KLEIN.

4:00 pm Dating the depositional sequence and Australopithecine "Grey Breccia" of Makapansgat Limeworks using magnetostratigraphy. A.I.R. HERRIES, A.G. LATHAM.

4:15 pm Site formation in the early hominid sites of Gauteng (SA) and its influence on the archaeological record. K. KUMAN.

4:30 pm Taphonomic summary of Middle Pleistocene hominid sites in the Western Cape. R. MILO.

4:45 pm Discussion

Friday Morning – April 12, 2002

Session 11. Hominid Evolution and Primate Evolution. Contributed Posters. *Grand Pavilion.*
Chair: M. TEAFORD, Johns Hopkins 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 Please don't throw the baby out with the bath water: Skeletal characters in cladistic analyses of hominoid evolution. A. DEANE, D. BEGUN.

2 My data are better than yours: Comparing the relative utility of data partitions in reconstructing evolutionary history. B. WILLIAMS.

3 Phalanges of *Omomys carteri* from the Eocene of North America and the morphology of early primate grasping digits. M. HAMRICK, H. COVERT.

4 Paleocene and Eocene primate-bearing faunas from the Great Divide Basin, SW Wyoming. R. ANEMONE.

5 Analysis of trabecular bone structure in the femoral heads of two Omomyid primates. T. RYAN, R. KETCHAM.

6 The effect of time on levels of variation in Eocene primates. J. SCOTT.

7 Biogeography of platyrrhine communities across the northern tier of South America. S.M. FORD.

8 Morphology of frontal bone of *Amphipithecus*. M. TAKAI, N. SHIGEHARA, N. EGI, T. TSUBAMOTO.

9 Problems in body mass estimation for primitive anthropoids. N. EGI, M. TAKAI, N. SHIGEHARA, T. TSUBAMOTO.

10 Discriminant function analysis of distal humeral morphology and locomotor adaptations in extant and fossil primates. W. SWEITZER.

11 Patterns of craniofacial variation in primates. J.M. PLAVCAN.

12 Paleoenvironmental reconstructions with respect to the extinction of *Sivapithecus* in Pakistan. S. NELSON.

13 East African cercopithecid fossil record and its relationship to global climatic change. S. FROST.

14 Canine sexual dimorphism in four middle Miocene catarrhines from Maboko Island, Kenya. B. BENEFIT, M. McCROSSIN.

15 Dietary adaptations of late Miocene Colobinae. J. REITZ.

16 Estimation of body mass and diet for fossil cercopithecids from the Asbole area of the Afar, Ethiopia. C. ORR, Z. ALEMSEGED.

17 Measuring enamel thickness in papionins. L. HLUSKO, G. SUWA.

Friday Morning – April 12, 2002 (continued)

18 In vivo bone strain and finite-element modeling of the anterior root of the zygoma of Macaca. C. ROSS, D. STRAIT, B. RICHMOND, M. SPENCER.

19 Behavioral Comparisons of Primate Audiograms. M. COLEMAN.

20 Giant lemurs were hunted and eaten in Madagascar. V. PEREZ, L. GODFREY, M. ATKINSON.

21 Activity patterns of subfossil lemurs: evidence based on the relative size of the optic canal. E.C. KIRK, R.F. KAY, W. L. JUNGERS.

22 Variation in the face of *Australopithecus robustus*. C. STEININGER.

23 A Note on the Relative Minimum Frontal Breadth with Special Reference to the Taxonomic Status of *Homo erectus*. Q. WANG, P. TOBIAS.

24 Earliest Pleistocene Homo in Asia: craniodental comparisons of Dmanisi and Sangiran. S.C. ANTÓN, E. INDRIATI.

25 The Human Fossils of La Chaise, Bougeois-Delaunay. S. CONDEMI.

26 Possible evidence of deliberate shaping on the Swartkrans early hominin bone tools. L. BACKWELL, F. d'ERRICO.

27 Mode and tempo of the hominid pelvis evolution. F. MARCHAL.

28 The Comparative Morphology of the Hominoid Fibula. T.M. GREINER.

29 New hominid distal humeral material from Sterkfontein, Swartkrans and Drimolen. C. MENTER, L.R. BERGER.

30 The comparative morphology of hominin postcranial remains from the Kapthurin Formation, Baringo District, Kenya. R. FISHER, S. McBREARTY.

31 Direct Three Dimensional Morphometric Analysis of Calcanei of Some Catarrhines. M. MAGA.

32 Niche differentiation in forest primates and origins of hominid bipedalism. P. RODMAN.

33 Midtarsal flexibility, footprints, and the evolution of bipedalism. J. MELDRUM.

34 Missing Mammals: The effects of simulated fossil preservation biases on the paleoenvironmental reconstruction of hominid sites. C. ROBB.

35 Patterns of faunal and environmental change in the Hadar Formation, Ethiopia. R. BOBE, G. ECK.

36 Parameterized reference models for morphological comparison of fossil and modern skulls. J. KIM, G. WEBER, A. NEUMAIER.

37 Consideration of Fatness in Body Mass Estimation from Skeletal Indicators. P. STUBBLEFIELD.

38 Comparison of impression materials used on fossil teeth. D. GUATELLI-STEINBERG, J. MITCHELL.

39 Lateralization of minicolumns in human planun temporale is absent in nonhuman primate cortex. D. BUXHOEVEDEN, K. SEMENDEFERI, M. CASANOVA.

40 Computerized shape analysis of hominid endocasts. C. MacLEOD, D. FALK, H. MOHLBER, J. SHAH, K. ZILLES.

41 Analysis of cerebellar shape and asymmetry in extant primate and African fossil hominid endocasts using 3d digitizing technology. D. WHITE, D. FALK.

42 Ontogenetic development of the axillary border of the scapula in Neandertals. A. BUSBY.

43 Neandertal Facial Morphology and Cold Adaptation: A Comparative Approach. J. BLUMENFELD.

44 The Paranasal Sinuses: An Active Residual System. R. KORITZER, G. HACK.

45 Anterior dental dimensions and the evolution of human facial form in the Middle and Late Pleistocene. R. DeROBERTIS,

46 The Kebara 2 Neandertal hyoid and speech capacity revisited: size and shape relative to mandibular dimensions. C. TOLL, R. FRANCISCUS.

47 A Reanalysis of the Tabun C2 Mandible. N.E. HOLTON.

48 A preliminary re-evaluation of the mylohyoid groove of Gran Dolina specimen ATD6-5. A.J. NEVGLOSKI.

49 Posterior migration of the mental foramen during Neandertal and modern human mandibular growth. F.L. WILLIAMS, G. E. KROVITZ.

50 Morphogenetic determinants of the mandibular ramus breadth: A test in modern human populations. M. BASTIR, A. ROSAS, K. KUROE.

Friday Morning – April 12, 2002 (continued)

51 Using Singular Warps to Study Morphological Integration. F. BOOKSTEIN, P. GUNZ, H. INGEBORG, P. MITTERÖCKER, H. PROSSINGER, K. SCHAEFER, C. UNTERREGGER, B. WIMMER, H. SEIDLER.

52 Testing caliper and wire frame measures against positional measures. J.H. PROST.

53 Allometric departures of the human brain: some methodological considerations. J. RILLING.

54 The first documented occurrence of spondylosis deformens in an early hominin. D. STAPS.

55 Early Hominids from South Africa: Will Trabecular Densities reveal different kinds of Bipedalism? V. GALICHON

Session 12. Paleopathology. Contributed Papers. *Grand Ballroom A*

Chair: A. L. GRAUER, Loyola University of Chicago.

8:00 am Pandemic TB or not TB? B. ROTHSCHILD, M. HWLBLING II.

8:15 am Tuberculosis in 20th century Britain: a preliminary study of the demographic profile of children admitted to Stannington sanatorium. M-C. BERNARD, C. ROBERTS.

8:30 am The Medieval leprosy epidemic in Southern Scandinavia. J.L. BOLDSEN.

8:45 am A contribution to health and disease in the pre-Columbian North American Southwest: The children from the Grasshopper Pueblo. M. SCHULTZ, T. SCHMIDT-SCHULTZ.

9:00 am Skeletal Pathologies Associated with Pellagra Mortality: Implications for Interpreting the Paleopathology of Maize-Dependent Populations. B. BRENTON, R. PAINE.

9:15 am Skeletal Pathologies Associated with Malnutrition Mortality: Implications for Interpreting the Paleopathology of Nutritional Deficiencies. R. PAINE, B. BRENTON.

9:30 am Prehistoric health and social status in a population from the Moche Valley, Peru. B.Y. YOSHIDA.

9:45 am How did they fight over scarce resources? The frequency of fractures in the Julio C. Tello skeletal collection from Nasca, Peru. C.M. KELLNER.

10:00 am Break

10:15 am Human Sacrifice at Punic Carthage? J. SCHWARTZ, F. HOUGHTON, L. BONDIOLI, R. MACCHIARELLI.

10:30 am A Western Hemisphere Perspective on the History of Violence. P.L. WALKER, R. STECKEL.

10:45 am Application of the Poisson Model to the Analysis of Fracture Data. B. GLENCROSS, L. SAWCHUK.

11:00 am Incidence of Osteoarthritis at the Trapeziometacarpal Joint from the Tomb at Tell Abraq, United Arab Emirates. J. COPE, A. BERRYMAN, D.L. MARTIN, D. POTTS.

11:15 am A study of the human skeletal remains of the Mycenaean tombs from Bronze Age Sykia, Lakonia, Greece. A. PAPATHANASIOU.

11:30 am Enamel Defects, Well-Being and Mortality in a Medieval Danish Village. R. FERRELL.

11:45 am The Paleoepidemiology of Celiac Disease: Osteological Evidence from Prehistoric Europe. L. JOHNSON-KELLY.

Session 13. Human Biology III: Demography, Health and Disease. Contributed Papers. *Grand Ballroom B.*

Chair: C. BEALL, Case Western Reserve University.

8:00 am Subsistence patterns and seasonality of vital events in historical times in Central Apennines (Abruzzo, Italy). M.E. DANUBIO, A. COPPA, G. GRUPPIONI.

8:15 am Overcoming biases in the paleodemographic record: Estimating adult skeletal age and population growth, with an example from the Archaic of the eastern woodlands. R. MEINDL, R. MENSFORTH, H. YORK.

8:30 am Morphological and molecular variation in ancient and modern Sudan. L.J. MOORE.

8:45 am Weight for Trunk Frame Size: An Alternative Index of Fatness in Populations of Varying Body Proportions. C. RUFF, P. JAMISON.

9:00 am Historical population structure of North Yorkshire coastal populations: the effects of distance and occupation on mobility. M. SMITH, S. SHERREN, R. WILLIAMS.

Friday Morning – April 12, 2002 (continued)

9:15 am Biodemographic Structure of An Ancient Population: The Cholera Epidemic of 1837 in Alia (Palermo, Sicily). S. TULUMELLO, R. BIGAZZI, S. DeIASIO.

9:30 am Evaluation of low dietary iron as a nutritional adaptation to infectious disease. B. SHELL-DUNCAN, T. McDADE.

9:45 am Break

10:00 am Food Insecurity and Nutritional Status Among Low-Income Hispanic Children. D. HIMMELGREEN, R. PÉREZ-ESCAMILLA, Y. PENG, A. BRETNALL.

10:15 am Yuendumu Childhoods: Political Economy and Enamel Hypoplasia. J. LITTLETON.

10:30 am Associations of changes in mood with changes in blood pressure and total cholesterol levels during a 17-month study: understanding the mechanisms linking psychosocial risk factors with cardiovascular disease. T. POLLARD, J. SCHWARTZ.

10:45 am Social Support and its Relations to Blood Pressure in Kuwaiti Family. Y. AL-KANDARI.

11:00 am Thyroid function and polychlorinated biphenyls (PCBs) in adolescents of the Akwesasne Mohawk Nation. L. SCHELL, A. DeCAPRIO, M. GALLO, AKWESASNE TASK FORCE ON THE ENVIRONMENT.

11:15 am Age-based anthropometric standards for protective respiratory equipment: a community-based study of at-risk children. K.M. KELLY, S.R. REYNOLDS, G. MOORE, A.M. STROMQUIST, J.A. MERCHANT.

11:30 am Quantifying the colonised/colonist relationship: Suicide as a proxy measure for population stress. L.A. SAWCHUK, J. PADIAK, J. PURCELL.

Session 14. Primate Behavior II: Social and Reproductive Behavior. Contributed Papers. *Grand Ballroom D.*

Chair: S. LEIGH, University of Illinois, Urbana-Champaign.

8:30 am Causes for primate sociality: Inferences from other mammals. A. MUELLER, C. SOLIGO.

8:45 am Assessing behavioral style in chimpanzees: methods and preliminary results. S.F. ANESTIS.

9:00 am Demographic and social constraints on male chimpanzee behavior. J. MITANI, D. WATTS, J. PEPPER, D.A. MERRIWETHER.

9:15 am Interchange of Grooming and Coalitionary Support by Wild Male Chimpanzees. D. WATTS.

9:30 am Hunting Behavior of Adolescent Male Chimpanzees at Ngogo, Kibale National Park, Uganda. H. SHERROW, D. WATTS, J. MITANI.

9:45 am Female Reproductive Strategies in Chimpanzees of the Taï Forest, Côte d'Ivoire: Do Females Exhibit Preferences for Particular Males? R. STUMPF, C. BOESCH.

10:00 am Reproductive seasonality in wild chimpanzees: A new method of analysis from Kibale, Uganda. D. SHERRY.

10:15 am Break

10:30 am Sex differences in chimpanzee and orangutan diet and the sexual division of labor of humans. S. PANDOLFI, C.P. VAN SCHAIK, A.E. PUSEY.

10:45 am Play behavior in infant western lowland gorillas at the Lincoln Park Zoo. S. MALLAVARAPU.

11:00 am Patterns of subgrouping, social affiliation and social networks in Nicaraguan mantled howler monkeys (*Alouatta palliata*). M. BEZANSON, P. GARBER, J. RUTHERFORD, A. CLEVELAND.

11:15 am Life history of male white-faced capuchins (*Cebus capucinus*), Santa Rosa National Park, Costa Rica. K. JACK, L. FEDIGAN.

11:30 am Behavior and demography of a semi-free ranging population of long-tailed macaques (*Macaca fascicularis*) at Padangtegal, Bali, Indonesia. A. FUENTES, K.G. SUARYANA, A.L.T. ROMPIS, I.G.A. ARTA PUTRA, I.N. WANDIA, I.G. SOMA, N.L. WATINIASI, N. SUARTHA, I.D.K. HARYA PUTRA, G. EMEL.

11:45 am Reproductive Parameters and Asynchronous Reproduction in Wild Hamadryas Baboons. L. SWEDELL.

Session 15. Hominid Evolution II. Contributed Papers. *Grand Ballroom E.*

Chair: B. WOOD, George Washington University.

Friday Morning April 12, 2002 (continued)

8:00 am The first record of fossil hominins from the Ndolanya Beds, Laetoli, Tanzania. T. HARRISON.

8:15 am A comparative study of Pliocene hominin fossils from Lomekwi, west of Lake Turkana (Kenya). F. SPOOR, L. LEAKEY, M. LEAKEY.

8:30 am New fossil hominin and faunal discoveries from Coopers Site, South Africa. L. BERGER, C. STEININGER, D. deRUITER.

8:45 am Auditory Ossicles of *Paranthropus robustus* from Swartkrans, South Africa. D. deRUITER, J. MOGGI-CECCHI, M. MASALI.

9:00 am Stand and Be Counted: A History of Bipedalism as a Marker of the Human Lineage. T. GUNDLING.

9:15 am Arm Swing and Thermoregulation of Early Hominids. A. CROSS.

9:30 am Break

9:45 am Functional morphology of the *Australopithecus afarensis* partial upper limb skeleton A.L. 438-1. M.S. DRAPEAU.

10:00 am From Lucy to Littlefoot: a three dimensional analysis of Plio-Pleistocene hominin tarsal remains. W. HARCOURT-SMITH, P. O'HIGGINS, L. AIELLO.

10:15 am The pelvis of Stw 431 (*Australopithecus africanus*): New indications for differences in locomotion to *A. afarensis*. M. HAÜSLER

10:30 am Testing the Energetics Hypothesis for the Origins of Hominid Bipedalism. M. SOCKOL.

10:45 am Limb proportions, body mass and joint postures in *Homo* and australopithecines. J. POLK.

11:00 am Vertebrae numbers of the early hominid lumbar spine. S. MARTELLI, M. HAÜSLER.

11:15 am The Identity of the Chemeron Temporal. H. DUNSWORTH.

11:30 am Brain endocast reconstructions of *A. boisei* (Konso) and *A. garhi* (BOU-VP-12/130): some contrasts. R.L. HOLLOWAY.

11:45 am Evidence for a major faunal turnover at around 2.3 Ma in the Shungura Formation, Ethiopia. Z. ALEMSEGED.

Friday Afternoon – April 12, 2002

Session 16. Human Biology/Genetics/Forensics. Contributed Posters. *Grand Pavilion.*

Chair: P. STUBBLEFIELD, University of Florida.

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.

1 Overview of the International Union of Biological Sciences (IUBS). C. BEALL.

2 Ecogeographical Patterning in the Human Fetus. M. WARREN, T.W. HOLLIDAY, T.M. COLE.

3 The Influence of Maternal Diet on Prenatally-Forming Enamel Zinc Concentrations of Children from the Solis Valley, Mexico. A.E. DOLPHIN, A.H. GOODMAN, D. AMARASIRIWARDENA, J. BACKSTRAND.

4 Handedness and directional dermatoglyphic asymmetry in individuals exposed to alcohol prenatally. C. KUEHN, L. NEWELL-MORRIS, D. HOLMAN, A. STREISSGUTH.

5 The consistency of ethnic differences in diurnal blood pressure variation in employed women. G.D. JAMES, J.M. GAINES, H.B. VALDIMARSDOTTIS, G.H. MONTGOMERY, D.H. BOVBJERG

6 Associations with blood pressure in Blackfeet women. S.L. JOHNSTON.

7 Within-individual variation in heart rate and energy expenditure at rest. M. JENIKE.

8 Nitric oxide exhalation is elevated upon acute exposure to high altitude hypoxia and is related to individual distress. D. BROWN, P. MILLS, K. STROHL, C. BEALL.

9 Defining Relationships between Native American Groups: A Biodistance Study of the North Carolina Coastal Plain. K. KILLGROVE.

Friday Afternoon – April 12, 2002 (continued)

10 Populations in Island Melanesia provide evidence for non-selection based variation in skin pigmentation. H. NORTON, J. FRIEDLANDER, D.A. MERRIWETHER, G. KOKI, C. MGONE, M. SHRIVER.

11 Orbicularis oris muscle morphology in individuals with cleft lip with or without cleft palate and their relatives. M. MOONEY, S. WEINBERG, K. NEISWANGER, R. FAIX, D.A. RICHARDSON, S.S. PETIPRIN, K.M. BARDI, R.F. GILES, E.S. CARTER, A. BOWEN, M.L. MAZARITA.

12 Cyclical and non-cyclical mortality in two Hungarian villages. L. MADRIGAL, T. KOERTVELYESSY, B. WARE, T. CUEVAS.

13 Mutation Accumulation and Reduced Mortality in Human Populations. R. D. HOPPA, S. PLETCHER, K. BOS.

14 The Influence of Socio-Economic Status on Stature and Body Proportions in European Archaeological Populations. M. SCHWEICH.

15 Human Skeletal Indications of the Emergence of Chronic Infectious Disease in Northern Viet Nam. M. OXENHAM.

16 Height and SES in the 19th Century. G. GUTHRIE, S. JENKINS.

17 From behind bars: new anthropometric history data from Ohio Penitentiary records. J. STEWART, N.E. TATAREK, M.P. MASTERS.

18 Mathematical Analysis of Trabecular Trajectories in Apparent Trajectorial Structures: The Unfortunate Historical Emphasis on the Human Proximal Femur. J. SKEDROS, J. BRADY, C. SYBROWSKY.

19 The 1999 Status of the Race Concept in Physical Anthropology: Two Studies Converge. L. LIEBERMAN, R.C. KIRK.

20 New mtDNA Haplogroups in Melanesia. D.A. MERRIWETHER, J. FRIEDLANDER.

21 Functional Genetic Differences Among Humans, Chimpanzees, and Their Closest Relatives. D. WILDMAN, L. GROSSMAN, M. GOODMAN.

22 Morphologic and Genetic Evidence for the Kinship of Juvenile Skeletal Specimens from a 2,000 year-old Double Burial at the Usu-Moshiri Site, Hokkaido, Japan. N. ADACHI, Y. DODO, N. DOI.

23 A 9.1kb insertion/deletion polymorphism with an ancestral origin: a study on Melanesian populations. R. ROBLEDO, L. SCHEINFELDT, M. SINISCALCO, D.A. MERRIWETHER, J. FRIEDLANDER.

24 *COX8H* is expressed in strepsirrhine and platyrrhine primates, but not in humans. A. GOLDBERG, D. WILDMAN, T. SCHMIDT, M. HUTTEMANN, M. GOODMAN, L. GROSSMAN.

25 Strategies for analysis of DNA extracted from skeletal material. S. SMALLWOOD, N. TUROSS, J. MILANICH, C. MULLIGAN.

26 Identification of Species-Specific Maternal Lineage in Spider Monkeys. A. COLLINS.

27 Can we determine kinship systems? Testing models of genetic patterns for cemetery analysis. B. USHER, J. WEETS, C. WANGLUND.

28 A cluster of Alu repeats within the gene encoding the L1 cell adhesion molecule may have acquired a regulatory role in the course of hominoid evolution. D. EDELMAN, F. JONES.

29 Mitochondrial DNA analysis of a small sample of prehistoric and protohistoric human skeletal material from northern Baja: Is there genetic continuity? A. POTTER, P.S. WHITE.

30 Nuclear gene phylogenies from Old World monkeys. R. RAAUM, K. STERNER, C. NOVIELLO, T. DISOTELL, P. KARANTH, A.P.J. deKONING, C-B. STEWART.

31 First mtDNA sequences from prehistoric people buried in the mound CH2D01-A, Rocha, Uruguay. M. SANS, B. BERTONI, J. McDONOUGH, C. BLUTEAU, G. CABANA, D. A. MERRIWETHER.

32 A reference distribution of Fst values for SNPs. A.J. PAKSTIS, J.R. KIDD, K.K. KIDD.

33 Contemporary mtDNAs reveal pre-Columbian migrations to Puerto Rico. P. VALENCIA-RIVERA, E. GONZÁLEZ-BONILLA, J. STARTEK, M. RIVERA-VEGA, A. ROMÁN-COLÓN, J.S. RAMÍREZ-LUGO, J.C. MARTÍNEZ-CRUZADO.

34 Relationship by Isonymy in Sixteenth-Century Yucatan. A. CHRISTENSEN.

35 Misidentification of Meroitic Nubians using Fordisc 2.0. R. BELCHER, F. WILLIAMS, G.J. ARMELAGOS.

36 A Histological Study of Comparative Mammalian Cortical Bone. H. HORNI, R.R. PAINE.

37 Assessment of classification of crania using Fordisc 2.0: Nubian X-Group Test. A. LEATHERS, J. EDWARDS, G.J. ARMELAGOS.

38 Forensic Facial Reconstructions: A Test of Two Methods. J. SMART.

Friday Afternoon – April 12, 2002 (continued)

39 Fracture patterns in a large contemporary skeletal sample: 30 years of casework at the C.A. Pound Human Identification Laboratory. S. COYLE, K. JEMMOTT, H. WALSH-HANEY, A. FALSETTI.

40 Disease as Detective: An analysis of severe skeletal pathology in a modern forensic case. K.E. SHERIDAN, A. MUNDORFF.

41 Nonmetric population variation in perinatal human skulls. S. WEINBERG, D. A. PUTZ, M.P. MOONEY, M.I. SIEGEL.

42 An analysis of a quantitative method for rib seriation using the Spitalfields documented skeletal collection. R. PASTOR, S. OWERS.

43 Subadult Sex Determination from the Skeleton. S. JOHNSON.

Session 17. Skeletal Biology I. Contributed Papers. *Grand Ballroom A.*

Chair: D. WESCOTT, University of Tennessee.

2:00 pm Artificial Cranial Modification as a Social Marker in the Jequetepeque Valley, Peru. M. LICHTENFELD.

2:15 pm Ethnicity and the Ancestors: A Bioarchaeological Investigation of Ethnic Boundaries. K.C. NYSTROM.

2:30 pm Skeletal and Mortuary Evidence for Cultural Diversity in the Late Intermediate Period Chilean Atacama. C. TORRES-ROUFF.

2:45 pm Health, Labor, and Political Economy in Provincial Arabia. M. PERRY.

3:00 pm Late Woodland/early Mississippian period evidence of intergroup violence: emerging temporal and spatial patterning. M. SMITH.

3:15 pm Summary of Brazilian Human Remains Dating from 8,000 to 13,000 Years Before Present. K. REINHARD, S. MENDONÇA DE SOUZA, A. LESSA.

3:30 pm Cranial Deformation and Measurement Stability among Prehistoric South Central Andean Populations. M. RHODE.

3:45 pm Break

4:00 pm Analysis of Easter Island cranial collections: Museum sample variation. V. STEFAN.

4:15 pm Modeling the ecology of subsistence change. H. SCHUTKOWSKI.

4:30 pm Trophic Level and Macronutrient Shift Effects Associated with the Weaning Process in the Maya Postclassic. J. WILLIAMS, C.D. WHITE, F.J. LONGSTAFFE.

4:45 pm Foreign relations and economics at Teotihuacan: Isotopic evidence from the Merchant's Barrio. C.D. WHITE, M. SPENCE, F.J. LONGSTAFFE.

5:00 pm Tetracycline in a Meroitic Population (0 CE-350 CE) from Sudanese Nubia. T. STOKOL, G.J. ARMELAGOS.

5:15 pm Maize and the Emergence of the Tarascan State. L. CAHUE.

5:30 pm Prehistoric population movements in southern coastal and highland Peru: Bone isotopic evidence. P. TOMCZAK, S. AMBROSE, D. BLOM.

5:45 pm Dietary Analysis of Inhabitants of Southern Coastal Peru. R.A. BERGFIELD, M.J. DIETZ.

Session 18. Understanding the Linkages Between Nutritional Status, Physical Activity and Productivity. Symposium. *Grand Ballroom B.*

Organizer and Chair: D.L. DUFOUR, University of Colorado, Boulder.

The purpose of this symposium is to provide a coherent picture of our current understanding of the linkages between nutritional status, physical activity, and work productivity. Presentations will cover methodological issues as well as recent progress in understanding changes in nutritional status and physical activity level in modernizing societies, work pace regulation as an adaptive strategy, and the influence of micronutrient status on work capacity. The symposium honors the significant and fundamental contributions of G.B. Spurr to defining the effects of undernutrition on physical activity and work capacity.

2:00 pm Introduction. D.L. DUFOUR.

2:15 pm Measuring human energy expenditure: What have we learned from the flex-HR method? W. LEONARD.

2:30 pm Habitual physical activity of Senegalese adolescent girls: influence of nutritional status on work produc-

Friday Afternoon April 12, 2002 (continued)

tivity. E. BENEFICE, G. NDIAYE, D. GARNIER.

2:45 pm Energy and effort in Papua New Guinea. S. ULIJASZEK.

3:00 pm Physical activity of poor urban women: A comparison of women working and women at home in Cali, Colombia. D. L. DUFOUR.

3:15 pm Obesity an upcoming problem in the developing nations: Links to physical activity and birth weight. A.R. FRISANCHO.

3:30 pm Break

3:45 pm Tortoises and hares: Management of pace in relation to work intensity and sustainability. C. PANTER-BRICK.

4:00 pm Iron depletion increases the energy cost of work in non-anemic Mexican women. J. HAAS, J. SEYMOUR, S. HERNANDEZ-CORDERO, J. deHAENE, S. VILLALPANDO, J. RIVERA.

4:15 pm Progressive muscle fatigue during dynamic work in iron deficient Mexican women. T. BRUTSAERT, S. HERNANDEZ-CORDERO, J. RIVERA, T. VIOLA, G. HUGHES, J. HAAS.

4:30 pm Reported levels of Physical Activity, Fitness and Fatness in Kuwait. M. BARAC-NIETO, J. RAMADAN.

4:45 pm Secular changes in physical activity levels in Canada: Implications for the obesity epidemic. P. KATZMARZYK, M. BRUCE.

5:00 pm Discussant: R.M. MALINA.

5:15 pm Discussant: A.T. STEEGMANN.

Session 19. Primate Biology I: Anatomy and Functional Morphology. Contributed Papers. *Grand Ballroom D.*

Chair: W. HYLANDER, Duke University Primate Center.

2:00 pm Incongruence and homoplasy in the mammalian skeleton. M. ALLARD, R.C. McCARTHY, B WOOD.

2:15 pm Bootstrap-based methods for comparing morphological integration patterns. T. COLE, S. LELE.

2:30 pm Increasing population sample sizes using global skeletal size variables. A.D. GORDON.

2:45 pm Finite element analysis of a macaque skull: applications for functional morphology. D. STRAIT, B. RICHMOND, C. ROSS, M. SPENCER.

3:00 pm Sexual Dimorphism and Testicle Size in White-collared Lemurs. S. JOHNSON, A. GORDON, R. STUMPF.

3:15 pm Anatomical Comparison of Male Orangutans and Gorillas. R. McFARLAND, J. GURCHE, A. ZIHLMAN.

3:30 pm Timing Differences in Male versus Female Ontogenies. S. KING.

3:45 pm The ontogeny of form variation in the African ape facial skeleton: a hierarchical approach to the interspecific comparison of ontogenetic trajectories. S. COBB, P. O'HIGGINS.

4:00 pm Break

4:15 pm Ontogenetic variation in forelimb postcranial morphology of Gorilla. S. INOUYE.

4:30 pm Ontogeny of paranasal sinuses in the Platyrrhini. J. ROSSIE.

4:45 pm Dental development in hylobatids, or how to get to the same place in the same time on a different road. W. DIRKS.

5:00 pm Phylogenetic Distribution of Craniofacial Traits in Papionin Primates. M. SINGLETON.

5:15 pm Gross, histological, and CT scan investigation of the maxillary-premaxillary suture and upper incisors in primates. T. SMITH, A. BURROWS, E. DUMONT, C. BONAR.

5:30 pm More on the three-dimensional trabecular architecture of anthropoid primates: *Macaca fascicularis* and *Symphalangus syndactylus*. R. FAJARDO, R. MÜLLER.

5:45 pm Morphometric variation in proximal femoral development in primates and mammals. M.A. KRIZ,

Friday Afternoon April 12, 2002 (continued)

P.L. RENO, C.O. LOVEJOY.

Session 20. "Dr. Livingstone, We Presume." Evolutionary Views of Human Variation and Hominid History. Symposium. *Grand Ballroom E.*

Organizer and Chair: V.J. VITZTHUM, SUNY Binghamton.

This symposium honors Frank B. Livingstone for a lifetime of exemplary scholarship. His groundbreaking work on sickle cell anemia ranks among the first documented cases of "evolutionary medicine." Backed by sophisticated evolutionary theory and empirical evidence, Livingstone declared "There are no races, there are only clines," disputed Neanderthal extinction and typologically-grounded propagations of hominid paleospecies, and battled genetic determinism. Livingstone's work is characterized by conceptual and quantitative rigor, a willingness to challenge the status quo if the data and evolutionary theory warrant it, and a capacity to demand, without rancor or disrespect, the same high standards from his colleagues and students.

2:00 pm Scientific Discipline and Intellectual Freedom: Michigan in the Late 1950s. A.T. STEEGMANN.

2:15 pm Simulating Hemoglobin History. A. FIX.

2:30 pm The role of infectious disease in human populations: New findings from the Black Death. J. WOOD, R. FERRELL, S. DeWITTE-AVINA.

2:45 pm Testing the Malaria Hypothesis for the Case of Thailand: A Genetic Appraisal. S. POOLSUWAN.

3:00 pm Hemoglobin and HLA: Patterns of Molecular Evolution. R.C. WILLIAMS.

3:15 pm Down's Syndrome: An Example of the Interaction between Culture, Demography, and Biology in Determining the Prevalence of a Genetic Trait. C. OLSEN, P. CROSS, L. GENSBURG, J. HUGHES.

3:30 pm Break

3:45 pm The Evolution of Human Plasticity: Age and Size at Maturity. T. GAGE.

4:00 pm Polymorphisms Past and Present. R.B. ECKHARDT.

4:15 pm The Single Species Hypothesis: Truly Dead and Pushing Up Bushes, or Still Twitching and Ripe for Resurrection? K. HUNT.

4:30 pm Did the Australopithecines Speak? Hypotheses and Hypoglossals. W. JUNGERS, A.A. POKEMPNER.

4:45 pm Did the Australopithecines Crawl? D. TRACER.

5:00 pm Genetic diversity and the non-existence of human races. J. LONG, R. KITTLES.

5:15 pm A Number No Greater than the Sum of its Parts: The Use and Abuse of Heritability. V. J. VITZTHUM.

5:30 pm On Critical Thinking in Science or 'Did you see what they said in the *Times*!?' K. WEISS.

5:45 pm Closing Remarks. F.B. LIVINGSTONE.

Saturday Morning – April 13, 2002

Session 21. Primate Behavior and Biology. Contributed Posters. *Grand Pavilion.*

Chair: P. RODMAN, University of California, Davis.

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 A New Resource of Chimpanzee Biomaterials. J. BECK, C. BEISWANGER, R. ROBLEDO, W. BOGGS, J. LEAONARD, P. BENDER.

2 Foraging and patch use in white-handed gibbons. T.Q. BARTLETT, W.Y. BROCKELMAN.

3 Hormonal Assessment of Sexual Maturation in Three Captive Lowland Gorilla Males (*Gorilla gorilla gorilla*). A. BELLISARI, J. FRENCH.

4 Natal dispersal of titi monkeys (*Callicebus moloch*) at Cocha Cashu, Manu National Park, Peru. F. BOSSUYT.

5 Growth and development in body tissues and proportions of African apes (*Gorilla gorilla* and *Pan troglodytes*): a

Saturday Morning – April 13, 2002 (continued)

preliminary report. D. BOLTER, A. ZIHLMAN.

6 Female Immigration Patterns in Mantled Howling Monkeys (*Alouatta palliata*) on La Pacifica, Guanacaste, Costa Rica. M. CLARKE, K. GLANDER.

7 Growth spurts in linear dimensions in *Pan troglodytes*. L.S. BUCHANAN

8 Reaction to Novel Objects by Captive Slender Lorises: Implications for Behavior in the Wild. C. CROZIER.

9 Contribution of central nervous system characters to hominoid phylogenetics. A. deSOUSA, B. WOOD.

10 Rates of agonism by lemurid primates: Implications for establishing female dominance. E. ERHART, D. OVERDORFF, T. MUTSCHLER.

11 Dental monomorphism in a wild population of *Propithecus verreauxi* from Beza Mahafaly, Southwestern Madagascar. L. GODFREY, J.C. RAZAFIMAHAZO, M. SCHWARTZ.

12 Food selection by black and white colobus monkeys (*Colobus guereza*) in relation to plant chemistry in the Kakamega Forest, Kenya. P.J. FASHING, C.B. MOWRY, E.S. DIERENFELD.

13 Pattern of Morphologic variation among Living Hominoids. F. GUY.

14 To what extent are male-male relationships dependent on mother-son relationships in bonobos (*Pan paniscus*)? A case study on a captive alpha male bonobo. M. FORTUNATO, C. BERMAN.

15 Craniofacial form comparison between Bornean and Sumatran orang-utans. S. HENS.

16 Maintenance of spatial proximity in red-fronted brown lemurs *Eulemur fulvus rufus*. J. GERSON.

17 Kinematics of Bipedal Locomotion in Bipedally-Trained Japanese Macaques (Monkey Performance Monkeys). E. HIRASAKI, N. OGIHARA, Y. HAMADA, M. NAKATSUKASA.

18 Loud calls in adult male mona monkeys on the island of Grenada, West Indies. M. GLENN.

19 Serotonin transporter promoter length variants among the Cercopithecinae. J. LORENZ, K. SMITH, J. VIRAY, P. BENDER, J. BECK, D. SMITH.

20 Spatial and genetic differentiation in an isolated tropical tree population: reconstructing primate seed dispersal. B. GRAFTON, M. NORCONK.

21 Stable isotope composition in *Propithecus diadema edwardsi* from Talatakely and Vatoharanana in Ranomafana National Park, Madagascar. E. McGEE, S. VAUGHN, P. WRIGHT.

22 Infanticide and subsequent mating behavior in a black and white colobus monkey group. T. HARRIS.

23 Anatomical Correlates to Nectar Feeding Among the Strepsirrhines of Madagascar. M. MUCHLINSKI.

24 Limb preference in the lowland gorilla (*Gorilla gorilla gorilla*). R. HARRISON, P. NYSTROM.

25 Leptin and Reproductive Function in Captive Male Macaques and Baboons. M. MUEHLENBEIN, B. CAMPBELL, R. RICHARDS, F. SVEC, K. PHILLIPPI, M. MURCHISON, L.A. MYERS.

26 Cultural Transmission of a Communicative Gesture in a Captive Group of Bonobos (*Pan paniscus*). E. INGMANSON.

27 Energetics of bipedal and quadrupedal walking in Japanese macaques. M. NAKATSUKASA, E. HIRASAKI, N. OGIHARA, Y. HAMADA.

28 A Preliminary study of positional behavior in *Alouatta caraya* in northern Argentina. M. KOWALEWSKI, C. ALVAREZ, D. PEREYRA, E. VIOLI, G. ZUNINO.

29 Dental microwear pattern in hamadryas and anubis baboons. P. NYSTROM, L. SWEDELL, J.E. PHILLIPS-CONROY, C.J. JOLLY.

30 The Wild Chimpanzee's Working Day: Activity Budget at Gombe National Park, Tanzania. J. LODWICK, W. McGREW.

31 An interactive database for primate morphometric studies. D. REDDY, S. FROST, M. FRIESS, L. MARCUS, E. DELSON.

32 Shifting Status: Four years of adult male hierarchy in *Macaca fascicularis* at Padangtegal, Ubud, Bali, Indonesia. J. LOUDON, A. FUENTES, A. WELCH.

33 Geometric morphometric analysis of extant hominoid mandibles—using mandibular morphology to differentiate hominoid species. C. ROBINSON.

34 Effect of Ecological Conditions on the Daily Activity Budget of Adult Male Mantled Howler Monkeys (*Alouatta palliata*) Living in a Forest Fragment at Bocas del Toro Province, Republic of Panama. K. MELTZ.

35 Ontogeny and allometry of mandibular fossa placement in African apes. R.J. ROWLEY.

Saturday Morning – April 13, 2002 (continued)

36 Adaptive strategies and resource utilization of the mantled howling monkey (*Alouatta palliata*) in a small forest fragment in Nicaragua. K. MITCHELL, J. FLOYD, L. WINKLER.

37 Effects of branch orientation on quadrupedal walking in *Loris tardigradus*. N.J. STEVENS.

38 Male dominance rank reversals during the breeding season in ringtailed lemurs (*Lemur catta*): changes resulting from female mate choice. J. PARGA.

39 Evaluation of bone mineral density in Great Ape mandibles using high-resolution computed tomography. A. TAYLOR, D. DAEGLING.

40 Competition between savanna chimpanzees and humans in southeastern Senegal. J. PRUETZ.

41 Locomotion dependent variation in the trabecular pattern of the hominoid proximal femur. T.B. VIOLA.

42 Land use histories of rural landscapes in Japanese macaque habitats. D. SPRAGUE

43 Foot use in *Propithecus verreauxi* during bipedalism. R. WUNDERLICH, M. SINOPOLI, J. SCHAUM, P. KILKENNY.

44 Raymond Dart as a primatologist. G. STRKALJ, P. TOBIAS.

45 Growth and development of the fetal craniofacial complex in humans (*Homo sapiens*) and pigtailed macaques (*Macaca nemestrina*). M. ZUMPANO, J. RICHTSMEIER.

46 Monkey See Monkey Learn: Macaques learn 3-item lists by observing experienced subjects. F. SUBIAUL, J. CANTLON, R.L. HOLLOWAY, H. TERRACE.

47 Neural substrates of cognition in monkeys and apes: preliminary observations. K. SEMENDEFERI, N. SCHENKER, H. POJE.

48 Social Behavior and Aggression among Ringtailed Lemurs. R. SUSSMAN, O. ANDRIANASOLONDRAIBE, T. SOMA, S. ICHINO.

49 Lateralized Behaviors in *Lemur catta*. M. SHAW.

50 Object manipulation in a population of semi-free ranging *Macaca fascicularis* in Bali, Indonesia. W. TRUCE, A. FUENTES.

51 Diet of a 300-member Angolan colobus monkey (*Colobus angolensis*) supergroup in the Nyungwe Forest, Rwanda. A. VEDDER, P.J. FASHING.

52 The role of the accessory olfactory bulb in nocturnal mating systems. L. ALPORT, D. OVERDORFF.

53 Female chimpanzee allogrooming behavior at Ngogo, Kibale National Park, Uganda. M. WAKEFIELD.

54 A comparison of fission-fusion patterns in two communities of mantled howling monkeys (*Alouatta palliata*). L.A. WINKLER, E. JANNEY, G. PETER, R. SOHN, J. CROSKEY.

55 Parity Initially Mitigates the Effects of Aging on Bone Mineral Density (BMD) in the Spine of Rhesus Macaques. A. CERRONI, M. GRYNPAS, J. TURNQUIST.

56 *In vivo* masticatory strains in a regracted face. F. YATES, D. LIEBERMAN.

Session 22. Skeletal Biology II. Contributed Papers. *Grand Ballroom A.*

Chair: H. SCHUTKOWSKI, University of Bradford.

8:00 am Individuation of Human Remains From Historic Cemeteries. D.C. BOYD, C. BOYD.

8:15 am Age, Sex, and Race-Related Patterns of Skeletal Osteomalacia in the Hamann-Todd Collection. R. MENSFORTH.

8:30 am Short backs and small pelves in modern females. R. TAGUE.

8:45 am Three Dimensional Quantitative Analyses of Human Pubic Symphyseal Morphology: Can Current Limitations of Skeletal Aging Methods Be Resolved? M. TOCHERI, A. RAZDAN, T. DUPRAS, M.S. BAE, D. LIU.

9:00 am Effects of age and exercise on long bone modeling and remodeling. O. PEARSON, D. LIEBERMAN.

9:15 am Influence of Skin Pigmentation as a Risk Factor for Osteoporosis. S.J. SHAH, G.J. ARMELAGOS.

9:30 am Changes in Phenotypic Variability during the Mission Period of Florida. C. STOJANOWSKI.

9:45 am Developmental stress in a Post-Medieval Population of Londoners. T. KING, L. HUMPHREY, S. HILLSON.

Saturday Morning – April 13, 2002 (continued)

10:00 am Break

10:15 am The populations in the circum-Caribbean area from the 4th millennium b.C to the conquest: the biological relationships according to possible migratory patterns. A. COPPA, A. CUCINA, M. LUCCI, A. PELLEGRINI, R. VARGIU.

10:30 am Dental Morphology and Biological Affiliation—A population study. L. MATZKE, C. STRONG.

10:45 am Dental Morphology and Pathology of Prehistoric Canary Island Populations: A New Perspective. L. OWENS.

11:00 am 3D Reconstruction of Enamel Volume in Human and Gorilla Molars. D. GANTT, J. KAPPELMAN, R. KETCHAM, M. COLBERT.

11:15 am Dental microwear of canines and M1s of late stone age compared with those of the modern age of Western Japan. T. HOJO.

11:30 am The Anthropology of Malocclusion: Crowding and Anomalies in the Japanese. N. SEGUCHI, H. OE.

11:45 am Masticatory performance, posterior occlusal contacts, and malocclusion. P. BUSCHANG, G. THROCKMORTON, S. OWENS, J. ENGLISH.

Session 23. Primate Evolution. Contributed Papers. *Grand Ballroom B.*

Chair: J. M. PLAVCAN, University of Arkansas.

8:00 am Primate Phylogeny Based on Complete Mitochondrial Genome Sequences. D. DeGUSTA, H.M. FOURCADE, J.L. BOORE.

8:15 am Primate Origins: Disruption of Eye Position and Oculomotor Coordination by the Masticatory Muscles in Otolemur and Felis. C. HEESY, C. ROSS, B. DEMES.

8:30 am Phylogenetic utility of papionin postcranial morphology. M. COLLARD, S. ELTON.

8:45 am Morphology as a key to evolutionary change in the primate brain. K. ALDRIDGE.

9:00 am The phylogeny and taxonomy of plesiadapiforms. M. SILCOX.

9:15 am A New Skeleton of *Theropithecus brumpti* (Primates: Cercopithecidae) from Lomekwi, West Turkana, Kenya. N. JABLONSKI, M. LEAKEY, C. KIARIE, M. ANTON.

9:30 am Break

9:45 am First primate postcrania from the Eocene of Myanmar casts doubt on anthropoid origins in Asia. R. CIOCHON, G.F. GUNNELL.

10:00 am *Pondaungia cotteri*, a slow-moving primate seed predator from the Eocene of South Asia. R. KAY, D. SCHMITT, C. VINYARD.

10:15 am Dental variation in *Arapahovius gazini* with comments on the early Eocene (Wasatchian) community ecology of the Washakie Basin, WY. F. CUOZZO.

10:30 am A Lower Miocene Lorid femur from Napak, Uganda. L. MacLATCHY, R. KITYO.

10:45 am Postcranial anatomy of *Ankarapithecus meteai* and the origin of the great ape and human locomotor skeleton. B. RICHMOND, J. KAPPELMAN, M. MAGA.

11:00 am Chimpanzee walking. B. DEMES, J. POLK, W. JUNGERS.

11:15 am Galloping kinetics of primates vs. non-primates: implications for understanding primate locomotor evolution. J. HANNA, D. SCHMITT.

11:30 am Gait mechanics in the common marmoset: Implications for the origin of primate locomotion. D. SCHMITT.

11:45 am Morphological Correlates of Forelimb Protraction in Primates. S. LARSON.

Session 24. Primate Biology II: Molecules And Biomechanics. Contributed Papers. *Grand Ballroom D.*

Chair: W. JUNGERS, State University of New York, Stony Brook.

8:00 am Molecular Perspectives on Dispersal in Lowland Woolly Monkeys (*Lagothrix lagotricha poeppigii*). A. DiFIORE.

Saturday Morning – April 13, 2002 (continued)

8:15 am Comparative analyses of genetic social structure in wild gorillas (*Gorilla gorilla*) using DNA from feces and hair. B.J. BRADLEY, D. DORAN, M.M. ROBBINS, E. WILLIAMSON, C. BOESCH, L. VIGILANT.

8:30 am Within group relatedness and genetic mating systems in white-handed gibbons (*Hylobates lar*). K. CHAMBERS, L. VIGILANT, C. BOESCH, U. REICHARD.

8:45 am Quantifying inhibition using real time-PCR in DNA extracted from the feces of wild savannah baboons. K. SMITH, J. ALTMANN, S. ALBERTS, P. BENDER, J. BECK.

9:00 am IGF-I bioavailability and patterns of body size variation. R. BERNSTEIN, S. LEIGH, M. SIEGEL, S. DONOVAN.

9:15 am Testosterone and Reproductive Aggression in Wild Chimpanzees. M. MULLER.

9:30 am CSF 5-HIAA, life history and aggression in captive female macaques (*Macaca mulatta*). A. CLEVELAND, M.K. TRENKLE, I. LUSSIER, J.D. HIGLEY, G.C. WESTERGAARD.

9:45 am Soft tissue constraints on basicranial flexion and length. R. McCARTHY, D. STRAIT, C. KIRK.

10:00 am Break

10:15 am Recruitment and firing patterns of jaw muscles during mastication in ring-tailed lemurs. W. HYLANDER, C. VINYARD, C. WALL, S. WILLIAMS, K. JOHNSON.

10:30 am Functional morphology of the mandible in *Otolemur spp*. A. BURROWS, T. SMITH.

10:45 am Analysis of phase II movements during the power stroke of chewing in Papio. C. WALL, C. VINYARD, K. JOHNSON, S. WILLIAMS.

11:00 am Biomechanical Investigation of African Apes and Influences of Positional Behavior. K. CARLSON.

11:15 am The positional behavior of douc langurs, Delacours' langurs, and white-cheeked gibbons at the Endangered Primate Rescue Center, Cuc Phuong National Park, Vietnam. C. BYRON, H. COVERT, T. NADLER, H.T. LONG.

11:30 am The origins of diagonal-sequence walking gaits in primates: an experimental test involving two didelphid marsupials. P. LEMELIN, D. SCHMITT, M. CARTMILL.

11:45 am Swing phase and the use of diagonal sequence gait in primates. D. RAICHLEN, L. SHAPIRO.

12:00 pm A new theory concerning the adaptive value and evolution of diagonal-sequence gaits in primates and marsupials. M. CARTMILL, P. LEMELIN, D. SCHMITT.

Session 25. Hominid Evolution III. Contributed Papers. *Grand Ballroom E*

Chair: F. SPOOR, University College, London.

8:00 am Paleoanthropological Survey of the Lake Rukwa Basin, Tanzania. R.J. SHERWOOD, J.D. KINGSTON.

8:15 am Lemudong'o: a late Miocene fossil site in southern Kenya. S. AMBROSE, L. HLUSKO, M. KYULE, A. DEINO, M. WILLIAM.

8:30 am Hominid Diagnosis in Late Miocene and Plio-pleistocene Fossils. E. STINER, E.E. SARMIENTO.

8:45 am Adaptationism and Cladism in Human Evolutionary Studies. R. DELISLE.

9:00 am Norma lateralis in one early great ape species. D. BEGUN, L. KORDOS.

9:15 am Molar growth in the late Miocene hominoid *Dryopithecus laietanus*. J. KELLEY, C. DEAN, D. REID.

9:30 am Phylogenetic utility of higher primate craniodental morphology: an assessment using population genetic techniques. D. SERDOZ, M. COLLARD.

9:45 am Break

10:00 am Comparative context of radicular variation in fossil hominins: methodology and variation in premolar root form. B. WOOD, S. ABBOTT.

10:15 am Functional morphology of the metacarpophalangeal joints of Kenyapithecus and Australopithecus: Implications for the adaptive history of locomotion among African apes and humans. M. McCROSSIN.

10:30 am Molar microwear and diet of *Praeanthropus afarensis*: preliminary results from the Denan Dora Member, Hadar Formation, Ethiopia. M. TEAFORD, P. UNGAR, F. GRINE.

10:45 am Brain reorganization in hominid evolution: histological confirmation in chimpanzee. M. YUAN, D. BROADFIELD, R. HOLLOWAY.

11:00 am Estimating hyoid bone morphology in earlier hominin species. M. CLEGG, L. AIELLO.

11:15 am Assessment of quantitative characters in the distal humerus among hominids (great apes and hominins). E. DELSON, M. FRIESS, L.F. MARCUS, D.P. REDDY.

Saturday Afternoon – April 13, 2002

11:30 am Assessing the utility of incisor morphology for discriminating fossil species. V. PILBROW.

11:45 am Univariate and Multivariate scaling of epiphyseal and diaphyseal dimensions in extant and extinct hominids. A. GALLAGHER.

Saturday Afternoon – April 13, 2002

Session 26. Skeletal Biology III. Contributed Papers. *Grand Ballroom A.*

Chair: S. PFEIFFER, University of Toronto.

1:00 pm The Use of Skeletal Data for the Study of Secular Change: Methodological Implication of Combining Data from Different Sources. J. ALBANESE.

1:15 pm Reconstructing the Grauballe Man: A Danish Bog Body, CAT-scan and 3-D visualization. N. LYNNERUP, M. DALSTRA, A. JURIK, P. ASINGH.

1:30 pm Climate, terrestrial mobility and the patterning of lower limb robusticity among Holocene foragers. J. STOCK.

1:45 pm Human Migration in the Archaic. N. TUROSS.

2:00 pm Age-related bone loss and intraskeletal variability in the Imperial Romans. H. CHO, S. STOUT.

2:15 pm Stereotypical bone distribution in the mandibular corpus of anthropoid primates. D.J. DAEGLING, J.L. HOTZMAN.

2:30 pm Experimental test of the effects of masticatory forces on facial growth. M. DEVLIN, D. LIEBERMAN, G. KROVITZ.

2:45 pm Break

3:00 pm Going beyond non-human primates to answer questions of human parturition. A. GRAY.

3:15 pm Modularity within and among limbs: Implications for evolutionary divergence in fore- and hind limb morphology in primates. B. HALLGRIMSSON, B.K. HALL.

3:30 pm Morphometric shape variations associated with retroflexion of the human fetal midline cranial base. N. JEFFERY, F. SPOOR.

3:45 pm Canalization and developmental stability in craniofacial development in the Brachyrrhine mouse. K. WILLMORE, S. LOZANOFF, B. HALLGRIMSSON.

4:00 pm Growth versus repair responses to loading in the limb. D. LIEBERMAN.

4:15 pm Developmental Field Fluctuation: a potential basis for skeletal morphological variation. C.O. LOVEJOY, P. L. RENO, M.A. KRIZ, B.A. ROSENMAN

4:30 pm Does Dental Arch Asymmetry in Adriatic Island Populations reflect Developmental Instability? K. SCHAEFER, T. LAUC, P. MITTERÖCKER, P. GUNZ.

Session 27. Genetics. Contributed Papers. *Grand Ballroom B.*

Chair: D. WILDMAN, Wayne State University.

1:00 pm Proteomic analysis of extracellular matrix proteins from ancient bones. T. SCHMIDT-SCHULTZ, M. SCHULTZ.

1:15 pm Differences in DNA Preservation in Skeletal Remains. C. KUBA.

1:30 pm Expansion of ALFRED, the ALlele FREquency Database. K. KIDD, M.V. OSIER, H. RAJEEVAN, L. DRUSKIN, N.P. TOSCHES, A.J. PAKSTIS, J.R. KIDD, K-H. CHEUNG, P.L. MILLER.

1:45 pm Old World monkey mitochondrial DNA evolution. T. DISOTELL, R. RAAUM, K. STERNER, C. NOVIELLO, C-B. STEWART.

2:00 pm Elevated sequence divergence of baboon endogenous virus (BaEV) in a natural population of hybrid anubis and hamadryas baboons. M. UDDIN, J. PHILLIPS-CONROY, C. JOLLY.

2:15 pm Phylogeography and genetic diversity of wild bonobos (*Pan paniscus*). J. ERIKSSON, G. HOHMANN, C. BOESCH, L. VIGILANT

2:30 pm MtDNA HV1 Relationships of the Ancash: an Ordination and Phylogenetic Investigation. C. LEWIS, B. LIZARRAGA, R. TITO, A. STONE.

Saturday Afternoon – April 13, 2002 (continued)

2:45 pm Phylogeographic patterns of mtDNA reflect the population history of Puerto Rico. J. MARTÍNEZ-CRUZADO, G. TORO-LABRADOR, J. VIERA-VERA, M. RIVERA-VEGA, J. STARTEK, M. LaTORRE-ESTEVES, A. ROMÁN-COLÓN, R. RIVERA-TORRES, I.Y. NAVARRO-MILLÁN, E. GÓMEZ-SÁNCHEZ.

3:00 pm Break

3:15 pm MtDNA and Population Movements in Prehistoric Western North America. J. ESHLEMAN.

3:30 pm Regional patterns of sex-specific geneflow among the prehistoric Tewa Indians of north-central New Mexico. M. SCHILLACI, C. STOJANOWSKI.

3:45 pm Investigating the spread of the Uto-Aztecan language family and maize cultivation in North America using mtDNA. R. MALHI, D. SMITH.

4:00 pm Evidence of Y Chromosome Clines in Europe: Post-glacial re-colonization from Upper Paleolithic refugia? C. TILLQUIST, M. KAPLAN, F. BLACKMER, T. KARAFET, H. JARJANAZI, M-S. REMIGEREAU, E. ARNASON, H. SIGURGISLASON, M. HAMMER.

4:15 pm Apportionment of human genetic diversity using quantitative traits. J. RELETHFORD.

4:30 pm A method for understanding the causes of patterns of genetic diversity in human populations. K. HUNLEY, D.A. MERRIWETHER.

4:45 pm Race and Athletic Ability. R.A. BROWN, G.J. ARMELAGOS.

Session 28. Modern Morphometrics in Physical Anthropology. Symposium. *Grand Ballroom D.*

Organizer and Chair: D. E. SLICE, SUNY Stony Brook

Morphometrics has undergone a revolutionary transformation in the past two decades as methods have been developed to address shortcomings in the traditional multivariate analysis of linear distances, angles, and indices. While there is much active research in the field, the new approaches to shape analysis are already making significant and ever-increasing contributions to biological research, including physical anthropology. This symposium includes presentations explaining the basic machinery of the most important methods, introductions of novel extensions to these methods to address new types of questions, and expositions of how new methods provide enhanced results compared to more traditional approaches.

1:00 pm Introduction. D. E SLICE.

1:15 pm Comparing traditional craniometric and non-traditional landmark based methods for investigating cranial variation. A.H. McKEOWN, R.L. JANTZ.

1:30 pm A morphometric approach to quantifying between-sample differences in joint shapes. W. NIEWOEHNER.

1:45 pm Craniofaciometric diversity in Iraqi Males. W. GHARIABEH.

2:00 pm Consistency and bias in morphometric methods. F.J. ROHLF.

2:15 pm Applications of geometric morphometrics to the study of growth in the facial skeleton: partial and full faces. U. STRAND VIDARSDOTTIR, P. O'HIGGINS.

2:30 pm Geometric morphometric approaches to the study of soft tissue growth and expression in the human face. P. O'HIGGINS, N. JONES, A. GHATTAURA, P. HAMMOND, T. HUTTON, M. CARR.

2:45 pm Break

3:00 pm Semilandmarks on Curves and Surfaces in Three Dimensions. P. MITTERÖCKER, P. GUNZ.

3:15 pm Studying asymmetry with Euclidean Distance Matrix Analysis (EDMA). J.T. RICHTSMEIER, T.M. COLE III, E. LINDSAY, C.D. KREGER, V.B. DELEON, K. ALDRIDGE, S. LELE.

3:30 pm The Limitations of landmark-based morphometrics: fractal models of frontal sinus ontogeny. H. PROSSINGER.

3:45 pm Assessing craniofacial secular change in American whites and blacks using geometric morphometry. R.L. JANTZ, D. WESCOTT.

4:00 pm Combining Procrustes Superimposition and Fourier descriptors: Analysis of midsagittal cranial outlines. M. BAYLAC, M. FRIESS.

4:15 pm Secular change in craniofacial asymmetry studied by geometric morphometry and procrustes methods. E. KIMMERLE, R.L. JANTZ.

Saturday Afternoon – April 13, 2002 (continued)

4:30 pm Analysis of the posterior cranial profile morphology in Neanderthals and modern humans using geometric morphometrics. K. HARVATI, D. REDDY, L. MARCUS.

4:45 pm Discussion.

Session 29. Hominid Evolution IV. Contributed Papers. *Grand Ballroom E*

Chair: F. SMITH, Northern Illinois University.

1:00 pm Isotopically based reconstructions of early to middle Pliocene paleohabitats at Laetoli, Tanzania. J. KINGSTON, T. HARRISON.

1:15 pm Taphonomic Analysis of Butchered Chimpanzee Skulls from Liberia. T. PICKERING, R. CLARKE, R. PROTSCH VON ZIETEN.

1:30 pm Craniofacial Variation in *Homo habilis* compared to modern chimpanzees. J.M.A. MILLER, G.H. ALBRECHT, B.R. GELVIN.

1:45 pm From functional interpretation to taxonomic attribution. The OH8 issue. G. BERILLON, F. MARCHAL.

2:00 pm A multivariate examination of the Hexian *Homo erectus* calvarium. A. DURBAND, J. KIDDER, R.L. JANTZ.

2:15 pm The evolution of brain shape in hominids. D. FALK, C. MacLEOD, H. MOHLBERG, K. ZILLES.

2:30 pm Interpretations of biostratigraphy, dating and faunal changes in the Pleistocene-aged hominin bearing deposits of Gladysvale Cave, South Africa. R. LaCRUZ, L. BERGER.

2:45 pm Break

3:00 pm Evolutionary patterns in Pleistocene human brain size. S-H. LEE, M. WOLPOFF.

3:15 pm Temporal bone morphology and earliest Homo. C. LOCKWOOD, W. KIMBEL, J. LYNCH.

3:30 pm The one-million-year-old human remains from the Danakil (Afar) Depression of Eritrea. R. MACCHIARELLI, L. BONDIOLI, A. COPPA, Y. LIBSEKAL, L. ROOK, E. ABATE.

3:45 pm Bone remodeling in the Atapuerca-sh mandibles: Implications for growth patterns in middle pleistocene hominids. Preliminary report. C. MARTÍNEZ MAZA, A. ROSAS.

4:00 pm The Species of Humans at Dmanisi. M. WOLPOFF.

4:15 pm Asymmetry of the frontal endocranium in modern humans: Implications for interpretation of fossil endocasts. D. BROADFIELD, R.L. HOLLOWAY.

4:30 pm Everyday US sign language: A new look at Hewes' hypothesis for a gestural origin of spoken language. P. GANNON, N. KHECK, S. GOLDIN-MEADOW, A-M. VALACHOVIC, A. BRAUN.

4:45 pm Glasnost for paleoanthropology. G. WEBER, H. SEIDLER.

Abstracts of AAPA Poster and Podium Presentations

Head shape of adult males as a possible indicator of economic changes in northern Jordan (1900-1978).

A. Abu Dalou. Dept. of Anthropology, University of Missouri-Columbia, Columbia, MO, 65211, USA.

There are several anthropometric measurements used by health workers to evaluate nutritional status. These include stature, sitting height, stature by weight, and head circumference. This study associates head size but also shape in adults with changing economic conditions during early childhood. Pohlandt (1994) pointed out that there are two causes for long and narrow head: decreased mineralization rate and low ratio of bone mineral content. The hypothesis of this study is that adult head shape, as well as size, is influenced by changes in childhood nutrition. When economic conditions are very bad, nutrition and health suffer and will result in dolichocephaly. To test this hypothesis, I measured head length, width, and circumference of 398 adult males in Jordan. Fifty-four per cent are Jordanians, while 46% are Palestinians. I divided the modern history of Jordan and West Bank into four economic periods. The results of the study show that the Cephalic Index (CI) among Jordanians increases with economic improvement except that CI decreased during the last economic period. A different pattern is observed among Palestinians. The pattern among Jordanians can be explained in terms of maternal environment and early childhood malnutrition. When economic conditions were bad, mothers and infants suffered from malnutrition and deficits in health care services during prenatal and postnatal periods. Infants were born with very low birth weights and longer heads. However, the highest mean value of head circumference among Jordanians and Palestinians is obtained from those who lived their childhood during bad economic periods, an unexpected result.

What can morphological variation tell us about phylogenetic divergence?

R.R. Ackermann. Dept. of Archaeology, University of Cape Town, Rondebosch, Cape Town, 7701, South Africa.

When living species are used as analogues for fossil ones, the assumption is made that the fossil and the living species vary in the same way. Implicit in this assumption is the idea that closely-related living species themselves vary in the same way. These assumptions underlie many analyses, despite growing understanding that they are inaccurate. There is also an increasing awareness that many of the characters used for phylogenetic inquiry may contain no phylogenetic signal. Together, these two issues pose some serious challenges for those trying to interpret the phylogenetic relationships among fossil hominids.

In this paper, I first illustrate differences among patterns of inter-specific phenotypic facial variation within two living primate clades: 1) New World tamarins, and 2) African apes and humans. By comparing correlation and covariance matrices, I show that morphological variation is not constant among the species. In fact, the differences among variation patterns generally correspond to the phylogenetic relationships among these species, suggesting that patterns of variation have diverged through time in both clades. Based on the assumption that fossils and their analogue species do NOT vary in the same way, I then address the implications of this for analysis of fossil data, focusing on the relationships among early fossil members of the genus *Homo*.

The interpretation of phylogenetic relationships in the fossil record is confounded by a lack of understanding of how variation changes through time, and incorporating an understanding of time-related divergence in patterns of variation into our models can alter our understanding of human evolution.

Morphologic and genetic evidence for the kinship of juvenile skeletal specimens from a 2,000 year-old double burial at the Usu-Moshiri Site, Hokkaido, Japan.

N. Adachi[1], Y. Dodo[1], N. Doi[2]. [1]Dept. of Anatomy and Anthropology, Tohoku University School of Medicine, Sendai, Miyagi, 980-8575, Japan, [2]Dept. of Anatomy, University of the Ryukyus Faculty of Medicine, Nishihara-cho, Okinawa, 903-0215, Japan.

DNA analyses of ancient populations are mostly based on mitochondrial DNA because of its accessibility in decayed specimens. However, since the analysis of mitochondrial DNA can only provide information on the maternal line, detailed kinship between individuals who belong to the same maternal line has hardly been clarified. In this study, we examined two 2,000-year-old juvenile skeletal specimens from a double burial of the Usu-Moshiri site, Hokkaido, Japan based on the mitochondrial DNA analysis combined with the similarity analysis of tooth size proportion that reflects the hereditary background of both parents. The result of the mitochondrial DNA analysis strongly suggested the existence of maternal kinship between these specimens. The similarity of tooth size proportions between these specimens was extraordinary high even compared with a true consanguineous human group. Taking the frequency of the pairs that showed this level of similarity in related and unrelated Japanese populations and the specimens' estimated ages into account, these two specimens were considered more likely to be siblings than other maternal relatives.

Approximate age at death of fragmentary fossils in the modern human origins debate.

J. Ahern[1], F.H. Smith[2]. [1]Dept. of Anthropology, University of Wyoming, Laramie, WY, 82071-3431, USA, [2]Dept. of Anthropology, Northern Illinois University.

Since subadults tend not to exhibit robust superstructures such as large brow ridges, it is possible to mistake adolescent anatomy for more modern-like anatomy. In the modern human origins debate, replacement proponents have accused supporters of continuity of this very mistake and vice versa. Accusations have focused upon two samples of Late Pleistocene hominids, those from Vindija Cave and Klasies River Mouth. Specifically, it has been suggested that the modern-like aspects of the supraorbital fossils from these sites are a function of age rather than evolution. Since Le Moustier 1 Neandertal is one of the few Late Pleistocene adolescents that can be given a dental age, it may shed some light upon the debate surrounding these fragmentary fossils.

This study documents Le Moustier 1's anatomy and uses it to help distinguish adolescent from adult anatomy in the cases of the fragmentary Vindija and Klasies supraorbital fossils. Although Le Moustier 1's anatomy does indicate that two of the Vindija fossils are adolescent, these two fossils have already been excluded in studies that dem-

onstrate transitional aspects of the Vindija supraorbitals. Results of an analysis of the Klasies fossil KRM 16425 in light of Le Moustier 1 are ambiguous and highlight the need to be wary of confusing adolescent anatomy with modernity.

The use of skeletal data for the study of secular change: methodological implication of combining data from different sources.

J. Albanese. Dept. of Anthropology, McMaster University, Hamilton, Ontario, L8S 4L9, Canada, Toronto, Ontario, M6G 2S4, Canada.

Previous research by Meadows Jantz and Jantz (1999, *American Journal of Physical Anthropology* 110:57-67) has shown that skeletal measurements may be useful for the study of secular change in size and proportion. Combining data from several different sources, Meadows Jantz and Jantz found that secular change was greater in males than females, greater in the lower limb bones than the upper limb bones, and greater in "Whites" than "Blacks" but not at a statistically significant level.

The purpose of this research is to determine whether it is methodologically sound to combine data from different sources into racial categories for an analysis of secular change. Change in the femur length in the Terry Collection and the Coimbra Collection were examined. It was found that the results from an analysis of secular change can be very misleading when the samples from different collections are combined. No significant secular change was found in males or females in either the Terry Collection or the Coimbra Collection regardless of "race" when each collection was analyzed separately. When data from both collections was combined and analyzed, secular change was visible in males and statistically significant in females. The secular change in males and females in the combined-collections analysis is a result of the source of the data and the combination of the data from different collections, and not any measurable secular changes in each sample. It is concluded that the source of the data (the collection) is a more important consideration than dividing a sample into biologically meaningless racial categories when investigating human skeletal variation.

Morphology as a key to evolutionary change in the primate brain.

K. Aldridge. Johns Hopkins University School of Medicine and Pennsylvania State University, State College, PA, 16803, USA.

The aim of this study is to determine whether there are specific suites of features which characterize distinct patterns of organization between humans, apes, and monkeys.

The study sample consisted of whole brain magnetic resonance images (MRIs) of live, adult individuals of 10 anthropoid species: capuchins (N = 3), Rhesus macaques (N = 2), mangabeys (N = 3), baboons (N = 2), gibbons (N = 3), orangutans (N = 4), gorillas (N = 2), chimpanzees (N = 6), bonobos (N = 4), and humans (N = 37). Three-dimensional landmarks defined on the surface and on subcortical structures of the brain were located on 3-D MRI reconstructions of each individual using MEASURE software. The landmark coordinate data were scaled for differences in size and analyzed using a principal coordinates analysis application of Euclidean Distance Matrix Analysis (EDMA). This method defines clusters of individuals and identifies specific linear distances that are influential in defining those clusters.

First, analysis of cortical surface landmarks alone does not produce taxonomically relevant clusters of individuals. When subcortical structures are included in the analysis, a unique pattern defines the human brain, including the relative positions of subcortical frontal and temporal structures. In contrast, analysis of only non-human anthropoids indicates that cortical surface landmarks are influential in distinguishing ape from monkey taxa. Thus, patterns of neuroanatomical organization differ in monkeys as compared to apes, as well as in non-human anthropoids as compared to humans. However, the patterns distinguishing these groups are defined by different suites of characters. These results suggest that two adaptations potentially associated with varying biological processes may have been responsible for these two evolutionary divergences.

Evidence for a major faunal turnover at around 2.3 ma in the Shungura Formation, Ethiopia.

Z. Alemseged. IHO/Arizona State University, Tempe, AZ, 85281, USA.

It has widely been suggested that the environment in the Plio-Pleistocene of Africa became increasingly dry and open through time, which in turn affected fauna. However, there are discrepancies among researchers as far as the timing of the major change. For Vrba (1995), the major faunal turnover is situated in the interval 2.8-2.5 Ma. Behrensmeyer et al. (1997) suggest that the most important faunal change and a marked variability (Potts 1996) occurred after 2.5 Ma, whereas Bobe and Eck (2000) indicate a rapid change in taxonomic abundance at around 2.8 Ma. In this paper a multivariate method is used to discriminate localities of the Shungura Formation based on their taxonomic composition. The dependability of the method used was first tested by applying it to modern bovids from African game parks. An attempt was made to reach isotaphonomy by using skeletal elements of similar behavior only, and by considering localities that are characterized by similar depositional conditions. The row and column profiles of this analysis point to a major faunal change at the base of Member G, dated to around 2.3 Ma. This change is interpreted to have been caused by environmental transformation that occurred around that time period, probably the appearance of an open environment that dominated the Shungura Sequence for the first time. The same environmental change correlates in time with the dental and mandibular transformations within the East African robust lineage, perhaps suggesting environmental causes for the appearance of *Australopithecus boisei*.

Social support and its relations to blood pressure in Kuwaiti Family.

Y. Al-Kandari. Kuwait Univ, 71926, Kuwait.

High Blood Pressure (BP) is a major health problem world-wide. Many factors affect blood pressure, particularly stress. The main goal of this study is to examine sociocultural changes within the Kuwaiti family structure and their relationship to systolic blood pressure (SBP) and diastolic blood pressure (DBP) levels. 373 married women and men were examined in major hospitals throughout Kuwait. Sociocultural and physical information was requested from participants through a questionnaire. Data were entered in a SPSS program: t-tests and correlations were the major statistical analysis. The more social support a person receives, the lower is his/her SBP and DBP. Because of the support received within the extended family from relatives, members of such families had a lower BP. Family size is also important in maintaining a lower BP. The more people in the household, the lower the level of BP compared to people living alone in the same household. Some significant differences have found between males and females. More studies are needed to examine other variables.

Incongruence and homoplasy in the mammalian skeleton.

M. Allard, R. McCarthy, B. Wood. The George Washington University, Washington, DC, 20052, USA.

Characters from the postcranium are often underrepresented in mammalian systematic studies, largely due to the perception that postcranial elements are too functionally labile to be of use for phylogeny reconstruction. However, it is unknown how ex-

clusion of these characters influences hypotheses of mammalian phylogeny.

This study analyzes data from forty previously-published mammalian phylogenetic studies to test the hypothesis that postcranial and craniodental data reconstruct phylogeny differently. Two sets of analyses were carried out. First, the incongruence length difference (ILD) and local incongruence length difference (LILD) tests were used to assess character conflict between craniodental and postcranial data partitions, both globally and at specific nodes. Second, partitioned Bremer support was used to assess the relative contribution of craniodental and postcranial data to the total evidence tree. Data were treated as unweighted and unordered in all analyses.

Incongruence between craniodental and postcranial data partitions was present in ten datasets, but was generally localized to a few taxa rather than globally distributed on any given tree. In general, phylogenies reconstructed from postcranial data were remarkably consistent with those from craniodental data. Finally, partitioned Bremer support results indicate that postcranial data add resolution to the total evidence tree. Taken together, these results suggest that the postcranial skeleton is not simply "overwritten" by a functional signal and that characters from the postcranium should not be excluded from phylogenetic analyses a priori. Instead, the inclusion of postcranial characters in mammalian systematic studies can significantly contribute to hypotheses of phylogenetic history.

The role of the accessory olfactory bulb in nocturnal mating systems.

L. Alport, D. Overdorff. University of Texas at Austin, Austin, TX, 78703, USA.

Olfaction plays an important role in the mammalian reproductive process, but its exact function is not fully understood. Nocturnal prosimians may serve as a good model to study the role of olfaction in primate reproduction because they rely heavily on olfaction and have varied social systems. Given that the accessory olfactory bulb (AOB) is essential to the reproductive cycle in nocturnal prosimians, we predicted that among the night-active prosimians, relative AOB size would be correlated with social organization and mating system. Specifically, we predicted that AOB size would increase with the number of males a female mates with as polygamous females use olfaction to instigate and intensify precopulatory male-male competition (Perret, 1995). To test these predictions, the relative size of the AOB was compared with several reproductive variables in 14 nocturnal species. Relative AOB sizes ranged from 2.26 to 41.65. No relationship was found between the AOB and social organization, however a trend was found when AOB was compared with mating system. All monogamous or polygynous species have medium- to small-sized AOBs which fall below the mean index (mean = 9.91). Although not conclusive, the smaller AOBs of single-male mating systems affirms nocturnal primates may indeed be informative in understanding the evolution of mating behavior. Certainly the wide range of relative AOB sizes among this group suggests that further investigation is warranted.

Lemudong'o: a late Miocene fossil site in southern Kenya.

S. Ambrose[1], L. Hlusko[1], M. Kyule[1], A. Deino[2], M. William[3]. [1]Dept. of Anthropology, University of Illinois, Urbana, IL, 61801, USA, [2]Berkeley Geochronology Center, [3]Geographical and Environmental Studies, University of Adelaide.

Lemudong'o (GvJh15) is a new terminal Miocene fossil locality located in Narok District of Kenya, on the west margin of the Gregory Rift Valley. This site was first discovered in 1994, and over 600 diagnostic fossils were collected during five one-day visits between 1995 and 2000. Total surface collection and selective sieving were conducted in July 2001. Over 800 fossil bones and teeth identifiable to family level were collected from a fining-upward sequence of alluvial gravels, sands, and overbank silts and clays with intercalated paleosols, overlying a lacustrine diatomaceous silt. The site has excellent chronometric control. A fossiliferous volcanic ash in the overbank silty clays dates to 6.04 ± 0.019 myr by Single Crystal Laser Fusion (SCLF) $^{40}Ar/^{39}Ar$ (Deino et al. 1998). Three stratified tephra immediately below the lacustrine silt have statistically indistinguishable dates of 6.108 ± 0.018, 6.087 ± 0.015 and 6.11 ± 0.04 myr.

Identifiable taxa include Hystricidae, Lagomorpha, Cercopithecidae, Viverridae, Mustelidae, Hyaenidae, Ursidae, Machairodontidae, Hyracoidea, Equidae, Bovidae, Rhinocerotidae, Proboscidea (*Anancus*), Suidae, Hippopotamidae, and numerous micromammals. The diagnostic suid species *Nyanzachoerus syrticus* (= *N. tulotos*) suggests an age greater than 5.6 ma, consistent with SCLF dates. Many bones show evidence of carnivore ravaging, and breakage when fresh. Seeds of *Celtis zenkeri*, a widely dispersed African forest and woodland tree, were also recovered.

The fossils indicate a closed habitat, like most other hominid-bearing late Miocene sites. Lemudong'o has potential to yield hominids and to refine our understanding of the habitat preferences of our earliest ancestors.

Paleocene and Eocene primate-bearing faunas from the Great Divide Basin, SW Wyoming.

R. Anemone. Western Michigan University, Kalamazoo, MI, 49008, USA.

Seven field seasons of paleontological investigations in early Tertiary sediments of the Great Divide Basin have yielded 6500 catalogued mammalian specimens (including 500 Primates) from more than fifty localities across the Paleocene-Eocene boundary. Here we review early Eocene faunas from three collecting areas and provide information on the local stratigraphy and biostratigraphy of these deposits. Euprimates (Adapidae and Omomyidae) and Plesiadapiformes (Microsyopidae and Plesiadapidae) are important components of each of these faunas.

The Red Desert fauna comprises 400 mammalian specimens from an isolated eroded sandstone locality with a taxonomically diverse fauna that includes five different primate genera (N = 50). While Gazin suggested an early Wasatchian age for his small fauna from the same locality, our larger sample suggests a middle Wasatchian age.

The Tipton Buttes assemblage is from the upper part of the Main Body of the Wasatch Formation and is probably middle Wasatchian in age. The great majority of these fossils come from a set of very productive anthills at the base of the Buttes. At least five primate taxa are included among the 150 primate specimens: a total of 1600 mammals have been catalogued.

The Freighter Gap assemblage comes from both the Main Body and the Niland Tongue of the Wasatch Formation and has yielded 1500 mammalian specimens (including over 200 primates representing five taxa). The presence of the perissodactyl index fossils *Heptodon* and *Lambdotherium* at different stratigraphic levels suggests the presence of 2 distinct late Wasatchian faunas.

Assessing behavioral style in chimpanzees: methods and preliminary results.

S.F. Anestis. Yale University, Dept. of Anthropology, New Haven, CT, 06511, USA.

Many primatologists have remarked on individual differences in their study subjects for which the term personality is appropriate. One notable example in some species (e.g., chimpanzees) is that some individuals seem more concerned with obtaining high rank than are others. Personality variables could influence not only dominance rank, but also the relationship between rank and reproductive success. However, research on dominance relationships has focused mostly on the patterning and outcome of agonistic interactions, with little consideration of the

possible consequences of personality variation. This may be partially because personality is difficult to quantify. In this report I present one method to assess and quantify behavioral style and test its utility in the chimpanzee.

I observed 35 young (ages 4-8), peer-housed chimpanzees at the New Iberia Research Center in New Iberia, Louisiana during four months of research in 2000-2001. I created behavioral style categories using a chimpanzee ethogram, and then ranked individuals in these categories based on social behavior data. These categories take into account such factors as the likelihood that an individual wins an agonistic interaction that it initiates and the likelihood that it redirects aggression to unretaliating victims. The data reveal individual differences not directly related to rank and support the argument that behavioral style is an important source of variation in social behavior that could be under the influence of natural selection. They also support the argument that more attention to behavioral style would enrich our understanding of primate socioecology.

Earliest Pleistocene Homo in Asia: craniodental comparisons of Dmanisi and Sangiran.

S.C. Antón[1], E. Indriati[2]. [1]Rutgers University, New Brunswick, NJ, 08901, USA, [2]Gadjah Mada, University.

Recent hominid discoveries and geochronological studies appear to place *Homo erectus (sensu lato)* well outside of Africa by the early Pleistocene. Among these, the Dmanisi remains from the Republic of Georgia, are dated to about 1.7 Ma and the oldest hominids from the Sangiran Formation of Java, Indonesia (Sg 4, 27) are dated between 1.5 Ma and 1.7 Ma. These ages are comparable to the earliest *H. erectus* cranial remains from Koobi Fora and West Turkana, Kenya. Although arguments have been made that the Asian *H. erectus* morphotype is specifically different than early African forms, the earliest Southeast Asian fossils have not been fully described nor directly compared with their Western Asian or African contemporaries, particularly with respect to their dental anatomy. Thus, relationships among these early dispersers remain unclear.

We compare the craniodental morphology of the Dmanisi, Sangiran and Kenyan fossils using metric and nonmetric traits of the vault, face, and dentition.

Despite similar geologic age, the earliest Indonesian and Georgian hominids differ substantially. We concur that the Dmanisi hominids exhibit strong affinities with early African *H. erectus*. Early Sangiran fossils, however, exhibit regional Asian characters. Nonetheless, the Dmanisi and Sangiran fossils are similar in aspects of the dentition, particularly accessory cusp complexes of the molars, but arcade shape is more similar between Sangiran and Kenyan fossils. It is possible that hominids like those from Dmanisi played an important role in the peopling of Eastern Asia. However, regional characteristics of the Eastern Asian morphotype were also quickly established.

Changes in Nubian craniofacial morphology and dentition: evaluating the case for population discontinuity.

G.J. Armelagos[1], J. Calcagno[2], A. Coppa[3], R. Vargiu[3]. [1]Dept. of Anthropology, Emory University, Atlanta, Georgia 30320, Atlanta, Georgia, 30309, USA, [2]Loyola University, Chicago, [3]University of Rome, Rome, 185, Italy.

The racial models have traditionally been used to interpret the culture history of the Nile Valley. Archaeologists assumed that "foreign" intrusions in the area were responsible for the major cultural disruptions. The "cause" of the collapse of the "Caucasian" Meroitic empire (the presence of a great civilization was *prima facie* evidence that the cultural bearers were white) was attributed to the X-Group who were assumed to be a Negroid population. To the archeologist of the period, the decline of such a great civilization could only have occurred by invasion and displacement. After racist underpinnings of this approach were discarded, the multiple migration model became the preeminent perspective. In this model, the each of the defined archeological horizons (A-Group, C-Group, Meroitic, X-Group and Christians were thought to represent new populations who were the bearers of distinct cultures. Following the work of Carlson, Greene, Calgagno, and Van Gerven, a model of *in situ* evolution was proposed that fit with the archeological transition. *In situ* evolution considered changes in subsistence that led to the reduction of craniofacial dimensions and dentition. The most recent incarnation of the population replacement model is based on statistical comparisons of discrete dental traits suggesting that Late Paleolithic Nubians (LPN) were not predecessors of Holocene Nubians. Rather, the LPN were ancestors to West African Holocene populations. The Nubians, based on the analysis of discrete dental traits, are descendent from populations from the north who migrated into the region. We challenge this interpretation on the basis of their statistical analysis and assumptions of genetic independence of dental traits.

LSAMAT in a Caribbean slave population.

L. Atz. Brockington and Associates, Inc., Norcross, Georgia, 30071, USA.

Lingual Surface Attrition of the Maxillary Anterior Teeth (LSAMAT) was observed in individuals from Newton Plantation, an historic slave cemetery in Barbados. Macroscopic and microscopic wear was used to determine the etiology of the observed LSAMAT. An additional goal was to determine the usefulness of microwear analysis for this type of study. LSAMAT has been observed in populations in both the New World and the Old World (Alt and Pichler, 1985; Irish and Turner, 1987, 1997; Larsen et al., 1998; Turner and Machado, 1983). Most researchers agree that chewing on a fibrous, gritty root (specifically manioc), between the tongue and anterior teeth is the most likely etiology of LSAMAT (Irish and Turner, 1987, 1997; Larsen et al., 1998; Turner and Machado, 1983). That theory could not be disputed in this study. Toothtool use was ruled out as a possible cause of LSAMAT at Newton because the wear occurs equally in males and females with no corresponding anterior mandibular wear (Larsen et al., 1998; Lukacs and Pastor, 1988). Manioc is also unlikely to be the cause of LSAMAT in the Newton population due to the danger of eating/preparing raw manioc, sweet or bitter. Chewing on sugarcane between the tongue and anterior teeth, or ingestion of a large amount of dietary acid are suggested as possible causes. Microwear analysis provided little new information. Considering the time and expense involved in microwear analysis, it is a marginally useful research tool for the type of study attempted here.

Nonmetric traits of the cervical vertebrae: methods for data collection and comparison.

M. Aubin. Dept. of Anthropology, Arizona State University, Tempe, AZ, 85008, USA.

Nonmetric skeletal traits occur both cranially and postcranially and have been postulated to be useful biological distance indicators. However, relatively few studies have been conducted using postcranial nonmetric traits as opposed to those using cranial traits. Unlike dental traits, skeletal nonmetrics have few standards for measure and evaluation beyond simple presence/absence data; however, previous research indicates that, like dental traits, these postcranial traits are quasi-continuous. While some researchers count partial presence of a trait, others do not, and formal standards for partial presence are lacking. Moreover, traits such as different types of atlas bridging are sometimes collapsed into one category rather than two or three separate ones, making comparison of results from one study to another difficult. Not only are standards for data collec-

tion and reporting needed for comparison now but also for study in the future. With the repatriation of many skeletal collections in the United States, future study will depend on detailed recording and reporting of osteological data.

This study utilizes a sample of Meroitic Nubians to examine the occurrence of hyperostotic cervical nonmetric traits and to compare those results with previously published results for other population samples. Preliminary results suggest that specified atlas traits could be used as population discriminators for this sample of Nubians. However, comparison with other published data is difficult/impossible due to lack of standard methods for data collection and reporting. A standardized method of observation and documentation of vertebral nonmetric traits is proposed that will facilitate comparisons of skeletal nonmetrics between samples.

The cremated infant remains from Carthage: skeletal and dental evidence for and against human sacrifice.

G. Avishai, P. Smith. Laboratory of Bio-Anthropology and Ancient DNA, Faculty of Dental Medicine, Hebrew University-Hadassah, Jerusalem, Israel, Jerusalem, 92623, ISRAEL.

This study uses dental and skeletal growth standards to examine claims that the Punic "Tophet" at Carthage, Northern Africa, represents a human sacrificial site. These claims are based on the presence of thousands of urns containing the cremated remains of infants and immature animals, found under monuments, some with Punic inscriptions. The study sample consists of the contents of 459 ceramic urns excavated at Carthage and dated to the first millenium BCE. The main findings are 1275 tooth germs and 382 petrous portions of temporal bones. They show a varying degree of burning, with color ranging from yellowish brown to black and whitish gray. Most of the teeth are primary teeth in early stages of development. In order to establish the extent of shrinkage caused by cremation the dental remains from Carthage were compared with unburnt teeth from archaeological assemblages. This was performed using Mesio-Distal and Bucco-Lingual lengths for 100 teeth of the sample group and a control group that were plotted against total tooth length. Size and shape in the Carthage sample was similar to that of the control group, therefore shrinkage was considered to be minimal. The Carthage remains were aged in three independent ways: a. comparison with tooth length in samples of known chronological age, b. measurement of prenatal enamel thickness in histologic sections, c. using skeletal growth standards for the petrous portion of the temporal bone. In the Carthage sample 95% were aged one year or less, with 51% of these dying between birth and one month. This is strikingly different to what is known for other populations where infant death has been recorded. We conclude that the significant differences found between the observed age distribution and that expected strengthens the claim that infants at Carthage were indeed sacrificed.

Possible evidence of deliberate shaping on the Swartkrans early hominin bone tools.

L. Backwell[1], F. d'Errico[2]. [1]University of the Witwatersrand, Johannesburg, Gauteng, 2050, South Africa, [2]CNRS, Institut de Prehistoire et de Geologie du Quaternaire.

Recent research has confirmed earlier suggestions that certain fossil bone fragments found at the Swartkrans and Sterkfontein sites were used by early hominins. In contrast to earlier studies that predicted that the use of the tools was for digging roots and tubers, new research suggests that the unique wear patterns on the tools were created during termite foraging in epigeal mounds. This work also suggests that only weathered bones were used by early hominins to dig into the colony. Here we present possible evidence of bone tool shaping from Swartkrans Members 1-3 (ca. 1.8-1 Mya), as recorded on facets covered by parallel fusiform striations characteristic of grinding. Identification of these traces as possibly resulting from deliberate shaping by grinding is based on microscopic analysis of diagnostic traces and other taphonomic modifications observed on the bone tools, as well as a study of the remainder of the horncores from Swartkrans. We have also used comparative microscopic analysis of naturally weathered horncores, horncores from other southern African Plio-Pleistocene sites (Sterkfontein, Makapansgat, Gondolin), Later Stone Age and Iron Age bone tools shaped by grinding, and experimental manufacture of bone and horn. Morphometric analysis of Swartkrans long bone shaft fragments used as tools in comparison with unused bone fragments, indicates that early hominins selected for heavily weathered, longer, wider and more robust pieces. We conclude that early hominins had the cognitive ability to modify the functional area of bone implements to achieve optimal efficiency.

Growth and physiological adaptation in Chinese children of three ethnic groups at 3200 m.

S. Bailey[1], J. Xu[2], H. Feng[2], X. Hu[3], C. Zhang[2], S. Qiu[2]. [1]Tufts University, Medford, MA, 2155, US, [2]Sichuan University, [3]South China Normal University.

Children's growth responses to high altitude stress differ by population. Hypoxic stress, however, has been inferred from indirect measures. We collected anthropometric and physiological variables, including blood oxygen saturation, on 161 children aged 8 to 11 living at 3200 m northwest of Songpan, Sichuan, PRC. Han, Tibetan, and Hui ethnic groups are represented. Results indicate that Tibetan children at all ages are significantly taller, heavier, more muscular, and more skeletally robust, the latter measured by arm muscle, lean body mass, ankle breadth, and biacromial and chest circumferences. Hui children tended to be the smallest and lightest. Body fatness, as measured by bioelectric impedance, BMI, and summed skinfold thickness, did not differ significantly among the three groups. Tibetan children had significantly greater forced vital capacity and diastolic blood pressure, while Han had greater resting heart rates. Boys were significantly larger and heavier than girls at most ages. Size differences were significantly associated with ratio of lower leg length to projected upper leg length or height. Relative lower limb growth, in turn, increased significantly with increasing blood oxygen saturation for Tibetan and Han, but not Hui children. Tibetan children, moreover, showed significantly higher oxygen saturation at each lower leg length quartile than Han or Hui peers. These results corroborate earlier indications that Tibetan children have superior growth performance under hypoxic stress, and demonstrate for the first time that tibial growth is directly associated with blood oxygen levels.

DNA sexing from hair shaft samples.

L. Baker[1], J. Milsaps[2], K. Matteson[1]. [1]Dept. of Medical Genetics, UT Medical Center, Knoxville, TN, 37920, USA, [2]University of Tennessee.

Hair is the most common form of biological evidence found at forensic crime scenes. The ability to genetically determine the sex of these samples is extremely useful in forensic situations. To date, genetic sexing has been performed on both ancient and skeletal remains using the amelogenin gene, which relies on the identification of a 6 bp deletion of intron one of the amelogenin of the X homologue. This results in 106 bp and 112 bp amplicons from the X and Y-chromosomes, respectively. Traditionally, genetic hair analysis could only be performed on samples containing a hair bulb; however, recent work has shown the extraction of useful genetic material (mainly mitochondrial DNA) from hair shafts as well. The purpose of this research is to extend the genetic analysis of hair shaft samples to include not

only mtDNA analysis but also sexing analysis using the amelogenin gene.

DNA was extracted from twenty forensic hair shaft samples using a silica/guanidine thiocyanate method. Each sample was then amplified with primers specific for the amelogenin gene and the sexing results were compared with the known sex of each of the individuals. The success rate for the amplification of samples will be presented along with the percentage of correctly typed individuals. The optimization of these methods specifically for hair shaft analysis will also be addressed.

Reported levels of physical activity, fitness and fatness in Kuwait.

M. Barac-Nieto[1], J. Ramadan[2]. [1]Dept. of physiology, School of Medicine, Kuwait University, Kuwait City, Kuwait, POB 24923 Safat 13110, Kuwait, [2]Dept. of Physiology, School of Medicine, Kuwait University.

We studied the relationships between reported physical activity, fitness and body composition in healthy adult office-working Kuwaiti males (n = 45) and females (n = 67). None of the subjects reported dieting. Reported level of physical activity (gr 0 = no routine exercise, gr 1 = routine exercise sessions of at least 30 min once or twice a week for the last 6 months, gr 2 = routine exercise sessions three or more times per week) was determined from recall questionnaires. Fitness levels were assessed from resting heart rates and measurement of maximal oxygen uptake (treadmill exercise, Bruce protocol). Body composition was estimated from body weight, body height and seven skin-folds. Among males, in spite of no differences ($P>0.1$) in resting heart rates, VO_2max, VO_2max per Kg weight and per Kg lean, the sedentary group (gr 0) had higher (12-14 kg, $P<0.05$) average body weight and higher (12-13 kg, $P<0.05$) body fat than the physically active gr 1 and 2. Male gr 1 and 2 did not differ ($P>0.1$) from each other with regard to fitness and body composition. Among females, resting heart rates were higher ($P<0.05$), VO_2 max, VO_2max/Kg weight or per Kg leant were lower ($P<0.05$) in sedentary than in physically active females (gr 1 and 2); body and fat weights were lower (5-4 Kg, $P<0.05$) only in gr 3 females. Thus threshold frequency of routine physical activity for aerobic conditioning was lower in Kuwaiti females than in males while that for reduced body weight and fat was lower in Kuwaiti males than in females. These data may reflect a natural tendency to retain fat and a generally low level of physical fitness in these females.

The evolutionary foundations of learning by imitation in chimpanzees.

K. Bard. Psychology, University of Portsmouth, Portsmouth, Hants, PO1 2DY, United Kingdom.

Primate species differ in capacity for imitation and in imitative performance. Typically, we judge imitative ability in its most complex form, that is, imitative copying of both the actions used in manipulating a tool and the actions of the tool to obtain a goal object. I will argue that we should look at imitative capacity within a developmental perspective. That is, we should first consider imitation of activities that are simpler than tool-use, and that are socially-based rather than object-based. In human developmental psychology, it is recognized that neonatal imitation may be the earliest form of communicative expression. Imitation of facial actions and some vocalizations in face-to-face interaction with socially competent adults indicates a capacity for primary intersubjectivity which is the foundation for social cognition. In this study, we assessed the ability of chimpanzee newborns to imitate facial and vocal actions, in order to document one aspect of primary intersubjectivity. Subjects were 5 chimpanzees (*Pan troglodytes*), 7-11 days of age. All 5 chimpanzee newborns imitated at least one modelled action. Performance was better for chimpanzees tested using a more relaxed, interactive procedure (compared with a rigidly structured procedure) suggesting that imitation serves a communicative function in chimpanzees as it does in humans. The early capacity for imitation of socially-based actions indicates that chimpanzees, at birth, have imitative abilities comparable to those of human newborns. The social environment after birth, therefore, can act either to foster the development of more complex imitative abilities or to allow early imitative abilities to atrophy.

Foraging and patch use in white-handed gibbons.

T.Q. Bartlett[1], W.Y. Brockelman[2]. [1]Dept. of Anthropology, University of Texas at San Antonio, San Antonio, TX, 78249, USA, [2]Mahidol University, Bangkok, Thailand.

Gibbons have been characterized as being both uniquely adapted to small, scatter resources and seasonally reliant on large fruiting figs. In order to reconcile these conflicting views we present an analysis of patch use by white-handed gibbons. Our findings suggest that the characterization of gibbons as small-patch specialists is unwarranted.

From February 1994 to January 1995 the feeding and ranging behavior of two gibbon social groups was studied as part of long-term research on plant-animal relations on the Mo Singto Forest Dynamics Plot. Individual feeding trees used continuously for at least 5 minutes were marked, mapped, measured for diameter at breast height (DBH), and identified to species when possible.

Over the 12-month period of the study 38 species accounted for at least 1% of annual feeding time, including 13 species of *Ficus*. Excluding figs, the contribution of major fruiting species to the gibbon diet correlates positively with their abundance. Recurrent visits to large fruiting trees were typical of gibbon foraging during all months. The mean DBH for all measured feeding trees was 47.8 cm (N = 269; Range 5.7-129.9). This places the *average gibbon feeding tree* in the 90th percentile of all trees measured in the botanical plot.

We conclude that future studies on gibbon foraging should focus on the spatial knowledge of the animals rather than patch size.

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Morphogenetic determinants of the mandibular ramus breadth: a test in modern human populations.

M. Bastir[1], A. Rosas[1], K. Kuroe[2]. [1]Atapuerca Research Team, Museo Nacional de Ciencias Naturales, Madrid, 28006, Spain, [2]Dept. of Orthodontics, Kagoshima University.

The breadth of the mandibular ramus (MR) displays geographic and phylogenetic variation. According to Enlow et al. [1982, Angle Orthod.: 52:279-287] the MR forms a part-counterpart system - the "posterior face" - together with the middle cranial fossa (MCF) and the pharynx. Their counterpart principles predict that the anterior limit of the MR depends on the anterior limit of the MCF. Analyzing lateral radiographs of Black and White Americans they confirmed their hypothesis and related the increased Black American ramus breadth to the forward rotation of their MCF.

Because of its potential interest in human evolution, we explore the spatial configurations of the "postero-facial" subunits by geometric morphometric methods and analyze their shape covariation patterns by relative warps. Twenty-nine 2D landmarks were digitized in lateral radiographs of African, European and Asian samples of modern humans ($N_{total} = 146$).

We found that the hypothesis of Enlow and coworkers should be refined: 1) The

anterior limit of the MR is set geometrically by the cribriform plate - not by the MCF. 2) Variability is located at the posterior border of the MR. 3) There is a systemic covariation pattern within a region, best described as "posterior facial block."

Our results strengthen a basicranial morphogenetic influence on the mandible. We confirm the mentioned forward rotation of the MCF but further suggest that it is localized at its posterior part. These results have important morphogenetic and systematic implications. They indicate that variation in one character (MCF-configuration) may underlie an epigenetic cascade of traits covariation.

A demographic profile of porotic hyperostosis in a ancient Native American sample.

J. Bauder, D. Wolfe Steadman. Binghamton University, Binghamton, NY, 13902, USA.

This study formulates a demographic profile of porotic hyperostosis (including cribra orbitalia) in the Orendorf skeletal sample, a Middle Mississippian (~AD 1150) site from the central Illinois valley. It has been proposed that porotic hyperostosis is representative of a childhood episode of iron deficiency anemia and, when seen in adults, represents incomplete remodeling of lesions. Anemia leads to an increased demand for hematopoietic marrow in the diploe which, during childhood, is already filled to capacity placing pressure on the external table and causing lesions. In adults, the hematopoetic marrow does not occupy the entire cavity and an increased demand can be met without diploic expansion. While this concept is generally accepted, the minimum and maximum ages at which porotic hyperostosis is active is not fully understood. The ages in which subadult lesions occur may provide information as to whether maternal iron stores, pathogen load, or weaning stress is a primary cause of iron deficiency. This study also gives insight as to whether the age in which iron deficiency anemia no longer impacts the skeleton in a paleopopulation is consistent with the age expected based on clinical data showing when marrow is reduced to the adult volume.

To determine the age range in which porotic hyperostosis is active, 180 crania of subadults and adults of both sexes are examined for the presence, degree, activity and location of lesions. Important differences exist in the frequency and distribution of anemic lesions and the ages in which lesions are active between Orendorf and other Mississippian samples.

Combining Procrustes Superimposition and Fourier descriptors: Analysis of midsagittal cranial outlines.

M. Baylac[1], M. Friess[2]. [1]Museum National d'Histoire Naturelle, Groupe de travail Morphométrie, Paris, France, F-75005, France, [2]American Museum of Natural History, Division of Paleontology New York.

The use of geometric morphometric techniques for the purpose of quantifying variations of biological shape has become more common recently. Within this approach, especially in its applications to anthropology, landmark based analyses are among the methods most frequently used in order to analyze shape differences. However, in many cases relevant biological information may be located in the space between landmarks, requiring the statistical analysis of outlines by techniques such as Elliptical Fourier Analysis. We propose to use Generalized Procrustes Analysis, the standard landmark oriented approach, in order to perform standardization and size correction of outline data prior to Elliptical Fourier Analysis. We defined a series of landmarks on cranial outline, called control points. Control points and outlines were digitized using the same pictures and normalized for size. Procrustes Superimposition was performed for control points, and the superimposition parameters (translation and rotation) were applied to the corresponding outlines. Finally, we calculated Elliptical Fourier coefficients, which were analyzed statistically.

Comparisons of this combined approach to analyses of the same data set using landmarks only reveals an increase in statistical power as well as in the resolution of the observed variation. The statistical separation of groups is improved, and it can be demonstrated that additional information is gained from the outlines.

We therefore encourage the combined use of Generalized Procrustes and Elliptical Fourier analyses whenever outlines are expected to carry significant biological information.

Overview of the International Union of Biological Sciences (IUBS).

C. Beall. Case Western Reserve University, Cleveland, OH, 44106, USA.

The International Union of Biological Sciences (IUBS) is a non-governmental, nonprofit scientific network founded in 1919 to promote the study of biological sciences and international collaboration in the biological sciences. The American Association of Physical Anthropologists and the Human Biology Association are among the 83 Scientific Members; the National Academy of Sciences is the U.S. National Member. Some past activities of the IUBS are known to physical anthropologists, for example it sponsored the International Biological Programme of multidisciplinary studies of major human ecosystems during the 1960s-70s and the Decade of the Tropics during the 1980s. Several current activities of the IUBS are relevant to physical anthropologists. These include programs promoting research in biodiversity, integrative biology, ethics in biological research, taxonomy and systematics.

The purpose of this poster is to introduce the IUBS to members of the American Association of Physical Anthropologists. It will describe current IUBS initiatives and events. It will indicate how to become involved in national and international IUBS activities by participating in ongoing programs or helping to identify scientific efforts worthy of international support and credibility.

Sponsored by the U.S. National Committee for the International Union of Biological Sciences.

A new resource of chimpanzee biomaterials.

J. Beck, C. Beiswanger, R. Robledo, W. Beggs, J. Leonard, P. Bender. Coriell Institute for Medical Research, Camden, NJ, 8103, USA.

Recognizing the need for resources to permit genetic comparisons of species closely related humans, the Coriell Cell Repositories, in collaboration with the Yerkes Regional Primate Research Center, have begun the establishment of a collection of biomaterials from chimpanzees (*Pan troglodytes*). Lymphoblastoid cell lines were established from blood collected in ACD tubes using standard protocols with Epstein-Barr virus and phytohemagglutinin (PHA). Fibroblast cell lines were established from skin biopsies. All established lines are viable and contaminant-free. Karyotype analyses confirm that the lines are chimpanzee. In addition, the chimpanzees were genotyped using primers from the ABI PRISM Linkage Mapping Set, version 2 and probes discriminating gender based on X chromosome amelogenin alleles. Even though the markers tested were developed for analysis of human loci, all markers successfully amplified chimpanzee DNA. Some markers show no overlap in allele size between chimpanzees and humans, while others show a substantial overlap with humans tending to have larger allele sizes than chimpanzees. The amelogenin probes correctly identified the

gender of all samples and the microsatellite data are consistent with the proposed pedigrees derived from behavioral studies. Detailed information about these samples, including ordering instructions, is available in an electronic catalog (http://locus.umdnj.edu/ccr).

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Norma lateralis in one early great ape species.

D. Begun[1], L. Kordos[2]. [1]Dept. of Anthropology, University of Toronto, Toronto, Ontario, M5S 3G3, Canada, [2]The Geological Museum of Hungary.

Cranial architecture is poorly understood in great ape evolution due mostly to the dearth of relatively complete fossil specimens. For the fossil great ape *Dryopithecus* this has led to hypotheses of klinorhinchy (African ape-like ventral deflection of the face) based on incomplete specimens (Kordos, 1987; Kordos and Begun, 1997) or airorhinchy (Asian ape-like dorsal deflection of the face) based on a composite from 3 species and both sexes (Moyà-Solà et al., 2001). Here we present new evidence of cranio-facial hafting from the most complete cranium of *Dryopithecus*.

RUD 200 preserves a connection between the face and neurocranium via the lateral orbital pillar, showing that *Dryopithecus brancoi* is klinorhnych. Damage to the temporal bone precludes an unambiguous determination of the Frankfurt Horizontal, so the amount of klinorhynchy cannot be measured by traditional means. Several anatomical clues to cranial orientation (lateral orbital pillar, superior orbital plates, palatal axis) show that the face must have been klinorhych and could not have been oriented as is the multispecies-bisexual composite of *Dryopithecus* proposed by Moyà-Solà et al. (2001), based largely on an outdated reconstruction of another *D. brancoi* specimen (RUD 77). We note that cranial organization in hominids, and indeed in many tetrapods, is highly complex and caution against reconstructions based on combinations of casts and originals of multiple species and both sexes.

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Misidentification of Meroitic Nubians using Fordisc 2.0.

R. Belcher[1], F. Williams[1], G.J. Armelagos[2]. [1]Dept. of Anthropology and Geography, Georgia State University, Atlanta, GA, 30303, USA, [2]Dept. of Anthropology, Emory University.

The biological affinity of the peoples of the Nile Valley is currently a topic of debate. The identity of the Meroitic Nubians plays a crucial role in understanding the peopling of the Nile Valley, and the interrelationships of populations that form the core of ancient Nubia. To address this issue, we examined a sample of 47 adult Meroitic Nubian crania (0-350 B.C.E.) from Wadi Halfa within the program Fordisc 2.0 (a forensic computer application that uses weighted discriminant functions and reference populations to ascribe unknown individuals' biological affinity and sex). Meroitic Nubians were compared to two populations within Fordisc 2.0: Howells' worldwide data set and the Forensic Data Bank series from Ousley and Jantz (1996) Fordisc 2.0. The University of Tennessee, Knoxville. Our results indicate that Fordisc 2.0 identifies gracile individuals (either male or female) as female, and robust individuals (either male or female) as male unless the sex is constrained by the program. Howells' data attribute the Nubian specimens to populations on several continents, whereas the Forensic Data Bank series provides no explainable pattern of population attribution. These results suggest that Fordisc 2.0 cannot accurately identify the biological affinity of ancient Nubian crania. We question the utility of any forensic application that attempts to constrain worldwide human cranial variability into discrete biological groupings, or races.

A comparison of neural networks and genetic algorithms to traditional linear models in skeletal estimation of ancestry, sex and secular change.

S. Bell[1], R.L. Jantz[2]. [1]Eastern Washington University, Dept. of Chemistry and Biochemistry, Cheney, WA, 99004-2431, USA, [2]University of Tennessee, Knoxville.

Neural networks are data analysis tools well suited to forensic anthropology. With both supervised and unsupervised architectures available, networks are versatile, flexible, and complement existing multivariate analytical techniques. With the integration of genetic algorithms, the once daunting tasks of network optimization and variable selection have become manageable, greatly enhancing the utility of neural networks for forensic applications. In the present study, networks were used to classify skeletal remains and to predict age-at-death and secular change patterns based on common osteological measurements. Osteometric data for recent crania were obtained from the Forensic Anthropology data bank at the University of Tennessee. Data from 19th century crania were obtained from the Terry and Hamman-Todd anatomical collection. Analyses were conducted with 15 standard measurements. Several different network topologies were compared, including back propagation, radial basis function, and Bayesian networks. The strengths and limitations of the network models were evaluated, and relative uncertainties of estimates and probabilities of classifications were generated. Genetic algorithms and variable contribution measures were employed to study importance and predictive power of variables. Results were compared with multivariate statistical techniques previously applied to the data. In general, network predictions of year of birth showed similar average errors to statistical models but smaller uncertainties, while classification by ancestry and sex were comparable. Importantly, network models identified osteological measurements not heavily weighted in regression studies, illustrating the utility of networks as complementary tools.

Hormonal assessment of sexual maturation in three captive lowland gorilla males (*Gorilla gorilla gorilla*).

A. Bellisari[1], J. French[2]. [1]Dept. of Sociology/Anthropology and Lifespan Health Research Center, Wright State University, Kettering, OH, 45420, USA, [2]Dept. of Psychology, University of Nebraska Omaha.

Monozygotic twin male gorillas born in the Columbus (Ohio) Zoo in 1983 have lived in separate zoos since they were 7 years old. Although their growth indicators were virtually identical the first year, Mosuba now has the appearance of a fully mature male, while Macombo is not completely developed. Mosuba lives in an all-male group and sired an infant through artificial insemination. Macombo lives in a mixed group led by a 34-year old silverback, but has not copulated with any of the five females. Because of his apparent delayed maturation relative to his twin, we conducted analyses of urinary testosterone and cortisol, indicators of sexual maturity and stress. First void morning urine samples were collected from Macombo, Mumbah and Nkosi, an adolescent male in the same group. Samples were frozen, stored at –15C°, and analyzed at the University of Nebraska Omaha Endocrine Laboratory, using enzyme immunoassay.

Macombo's mean testosterone (221.82 $\pm$ 28.11 ng/mg CR) and cortisol (153.90 $\pm$ 9.90 ng/mg Cr) levels were not significantly different from Mumbah's (266.28 $\pm$ 32.70 and 173.40 $\pm$ 40.1). Consistent with his developmental stage, however, Nkosi had significantly lower testosterone levels (147.41 $\pm$ 24.64) and significantly higher cortisol levels (342.30 $\pm$ 49.80) ($p<0.05$) than Macombo and Mumbah. Therefore, although Macombo is of adult age and his hormonal profile is similar to a proven fertile adult male, his appearance and behavior are those

of a maturing male. The delay in somatic and behavioral maturation appears to be independent of gonadal suppression and/or stress-induced hypercortisolism.

Habitual physical activity of Senegalese adolescent girls: influence of nutritional status on work productivity.

E. Benefice[1], G. Ndiaye[2], D. Garnier[1]. [1]Institut Français de Recherche pour le développement, (IRD), MONTPELLIER, Hérault, 34032, France, [2]Université de Dakar (Sénégal).

The relationships between low nutritional status, low physical working capacity and productivity have economic implications in developing countries because of the high prevalence of malnutrition. This study investigates habitual activity of rural Senegalese adolescent girls who work to contribute to household subsistence, and addresses the following question: Are malnourished girls less active and productive than normal girls? Subgroups of 40 girls (13-15 years of age) were selected for in-depth studies of activities within a total sample of 390 adolescent girls followed since 1995. Physical activity was assessed quantitatively using direct observations and accelerometers, and qualitatively by questionnaires. Anthropometric measurements were also taken and sexual maturity status was assessed. The Senegalese girls were shorter, leaner and less mature than girls from industrialized countries. However, they had higher levels of physical activity, ranging between 1.70 and 1.85 METS. There was a significant decrease in intensity of activity with age and sexual maturity. Girls were more active during the rainy season than during the dry season, and also were more active when they migrated to work in cities than in the villages. Malnourished girls did not reduce their activities compared with normal girls. However, the body mass index was positively associated with intensity of activity. At younger ages, girls spent less time in discretional tasks and more in domestic tasks. The results suggest that more mature and heavier girls were more productive and efficient in terms of work output, than younger, unskilled girls.

Canine sexual dimorphism in four middle Miocene catarrhines from Maboko Island Kenya.

B. Benefit[1], M. McCrossin[2]. [1]Dept. of Anthropology, Carbondale, IL, 62901-4503, USA, [2]Dept. of Sociology and Anthropology, New Mexico State University, Las Cruces, NM, 88003-8001, USA.

Levels of canine sexual dimorphism in four catarrhines from middle Miocene Maboko deposits are compared with each other and to extant species. Problems encountered sorting canines into species and sex are discussed.

Lengths and breadths were taken on unbroken specimens and crown height only on unworn canines. Average (male mean/female mean), maximum (largest male value/smallest male value) and minimum (largest male value/smallest female value) levels of dimorphism are calculated. Extant comparative data are taken from published literature including Plavcan and van Schaik (1992).

Within the Maboko community, maxillary canines of *Kenyapithecus africanus* are the most dimorphic for crown height, its index of 1.64 being similar to that of *Pongo* (1.69), greater than *Pan* (1.35) and slightly less than for *Gorilla* (1.73). *Kenyapithecus* mandibular canine height dimorphism (1.5) is similar to *Pongo* (1.55) and *Gorilla* (1.53).

Victoriapithecus and *Simiolus* are unusual among catarrhines because their mandibular canines are more dimorphic than their maxillary canines. For both species maxillary crown height dimorphism, 1.37 for *Victoriapithecus* and 1.38 for *Simiolus*, resembles *Pan* and is lower than that found among extant Old World monkeys. Mandibular canine height dimorphism for *Victoriapithecus* (1.6) is slightly lower than *Gorilla* and within the cercopithecoid range, but *Simiolus* shows even greater dimorphism (1.85) with levels similar to *Nasalis* (1.89), *Colobus verus* (1.81), and *Cercocebus* (2.0). Mandibular canine height dimorphism in *Mabokopithecus* (1.66) resembles *Victoriapithecus*, but could not be estimated for maxillary canines.

Implications for interpreting the behavior of these species and the evolution of canine sexual dimorphism are discussed.

New fossil hominin and faunal discoveries from Coopers Site, South Africa.

L. Berger, C. Steininger, D. De Ruiter. University of the Witwatersrand, Johannesburg, Gauteng, 2050, South Africa.

A series of associated cave infills, referred to as Coopers A – D, have been recognized as potential hominin-bearing deposits since 1937. These deposits, located between the well-known hominin sites of Kromdraai and Sterkfontein, have been cursorily examined in the past, and 3 unprovenienced hominin specimens have been recovered which are most likely derived from Coopers. However, the unprovenienced nature of these fossils has hampered direct association of the hominins and the recovered fauna from Coopers.

Recently opened excavations in a new area of the site (Coopers D) has resulted in the recovery of the first *in situ* hominin specimens from this locality, as well as stone tools and a diverse faunal assemblage. The cranial and post-cranial hominin material has been tentatively referred to *Australopithecus* cf. *robustus*, although the morphology of the dental specimens suggests variability not yet observed in samples of this taxon from other South African sites. The recovered tools are primitive and largely comprised of quartz flakes and cores.

Biostratigraphic evidence suggests that the Coopers D deposit may be older than the classical robust australopithecine sites of Swartkrans, Kromdraai and Drimolen. Additionally, the Coopers D deposit has yielded an abundant suid fauna, which is unusual for the Witwatersrand cave sites.

Dietary Analysis of Inhabitants of Southern Coastal Peru.

R. Bergfield, M. Dietz. University of Missouri - Columbia, Columbia, Missouri, 65211, USA.

It is widely accepted that agricultural dependence occurred along the southern Peruvian coast by the beginning of the Early Intermediate Period (EIP), approximately 2200-1400 B.P. This paper explores the influence of an early agricultural economy on the health of an EIP skeletal population from the southern coast of Peru.

Chongos is one of the major archaeological sites in the lower Pisco Valley. Ceramic sequences support two occupations, dating to the EIP and the Late Intermediate Period. A previous study has discussed a skeletal series from the EIP occupation (Dietz 2000). Dental Health and phytolith analysis indicated reliance on maize.

This study utilized Neutron Activation Analysis to analyze trace element content in skeletal hair samples from this population. Hair functions as an excretory organ for minerals. Diagenesis is present at Chongos for some elements but not others. However, physiological activity for these minerals can be demonstrated when concentration is observed to vary as a function of distance form the scalp. The observed relations between trace element content and diet by sex and age are complex in any coastal site, but supporting archaeological dietary data make interpretation possible.

In addition, I discuss results of using another procedure, Inductively Coupled Plasma - Mass Spectrometry, with the same samples. Both similarities and differences in results using the two methods are evaluated. Rinsate collected from the hair samples remains to be studied in order to learn whether any pollen or particulate remains are found there.

From functional interpretation to taxonomic attribution: the OH8 issue.

G. Berillon, F. Marchal. CNRS, France, Paris, Paris, 75016, France.

In 1999, Wood & Collard presented a proposal for a redefinition of the genus *Homo* in which the functional interpretation has a key role. The functional interpretation of the *Homo habilis* OH62 postcrania shows some climbing abilities and is from that point of view *Australopithecus afarensis*-like. For this reason Wood & Collard proposed to remove *Homo habilis* from the genus *Homo* and provisionally allocate it to the genus *Australopithecus*. How far can we extend to an individual or a species the functional interpretation of a partial skeleton? More widely speaking, to what extent can we use the functional interpretation as criteria for a taxonomic attribution?

The bearing of the OH8 foot appears crucial to this issue, historically, as being originally allocated to the paratype of the *Homo habilis* species, and functionally, because it is nearly complete.

The whole OH8 foot is compared to a sample of australopithecine specimens and other early hominids, as well as extant species. Both architectural and morphological analyses are undertaken on dislocated skeletons. Results argue that OH8 has a *Homo*-like pattern of architecture that clearly differs from the *Australopithecus afarensis* one. From that point of view, strictly applying the criteria of functional interpretation would lead to place OH8 and OH62 in two different taxa. OH8 should then be something else than *habilis*. This point is more widely discussed, considering further postcranial fossil data.

Tuberculosis in 20th century Britain: a preliminary study of the demographic profile of children admitted to Stannington sanatorium.

M. Bernard, C. Roberts. University of Durham, Durham, DH1 3HN, UK.

Tuberculosis (TB), once thought to be conquered, is again becoming a problem for today's society. The aim of this study was to determine the demographic profile of the children admitted to a North East England sanatorium between the years of 1937 and 1953.

Data from the medical files (n = 605) of children who were patients at the Stannington sanatorium, near Morpeth, Northumberland were entered into a database. The information provided data on age, sex, origin of the child (whether rural or urban), family and personal history of the disease, type of TB, bones affected, treatment given, and finally the radiological report when bones were affected.

Results showed that there were slightly more female than males admitted (326 [54%] and 279 [46%] respectively). The average time of stay was under 12 months with 67% of children staying for that period of time (n = 406). The majority of children suffered from pulmonary TB (330, or 54.5%). There were also 84 cases where the children suffered from bone and joint TB (14%). The age range for the children varied between one and 16 years, and the majority came from urban backgrounds (n = 502, or 83%). Contacts were found for 267 children (44%) with a possible 18 more (3%). This study is preliminary in nature and forms part of a PhD project. Continuing work on further medical files will provide data to predict patterns of past populations infected with TB and also provide a greater understanding of childhood tuberculosis in the past.

IGF-I bioavailability and patterns of body size variation.

R. Bernstein[1], S. Leigh[1], M. Siegel[2], S. Donovan[2]. [1]Dept. of Anthropology, University of Illinois at Urbana-Champaign, Urbana, IL, 61801, USA, [2]Dept. of Food Science and Human Nutrition, University of Illinois.

Somatomedins (IGF-I and IGF-II), hormones involved in somatic growth, vary in their concentration and pattern of secretion among primates. It remains unclear whether there is a direct relationship between absolute IGF-I levels and body size. Among the papionins in particular, small-bodied mangabeys share high levels of IGF-I with large mandrills, to the exclusion of larger-bodied baboons. Changes in circulating IGFBP-3, the major binding protein of IGF-I, play a major role in determining the concentration and bioavailability of IGF-I. This interaction may be assessed by comparing changes in the IGF-I:IGFBP-3 molar ratio during growth.

This study investigates the extent to which a change in bioavailable IGF-I, as evidenced by a shift in the IGF-I:IGFBP-3 molar ratio, contributes to a period of peak body mass growth in baboons and mangabeys. Large longitudinal samples are analyzed for serum levels of IGF-I and IGFBP-3 using standard assay techniques, and molar ratios are calculated using standard molecular weights. Profiles of hormone secretion are evaluated using nonparametric regression techniques, with bootstrapping to determine confidence intervals.

Both baboons and mangabeys peak in the secretion of IGF-I and IGFBP-3 at puberty. While both also show a twofold increase in the molar IGF-I:IGFBP-3 ratio from very young ages to puberty, the IGF-I:IGFBP-3 molar ratio is greater in mangabeys than in baboons. This supports the conclusion that the higher IGF-I levels in mangabeys are indicative of increased IGF-I availability. The implications of these results are discussed with respect to the evolution of body size differences, both within and between species.

Patterns of subgrouping, social affiliation and social networks in Nicaraguan mantled howler monkeys (Alouatta palliata).

M. Bezanson[1], P.A. Garber[2], J. Rutherford[3], A. Cleveland[2]. [1]Dept. of Anthropology, University of Arizona, Tucson, Arizona, 85721, *USA*, [2]Dept. of Anthropology, University of Illinois, Urbana, [3]Dept. of Anthropology, Indiana University.

Studies of social affiliation and social spacing offer important insight into the dynamics of subgroup formation and social strategies in living primates. In the genus Alouatta, 5 of 6 species are reported to live in relatively small harem groups composed of one or two adult males. In mantled howlers (Alouatta palliata), however, group size may exceed 25 individuals, and groups commonly contain 4-8 adult males and from 4-12 adult females. In this paper, we examine patterns of subgrouping, activity, and partner preferences in a troop of wild mantled howler monkeys.

From May through June 2001, 150 hours of quantitative data were collected on the activity budget, social spacing, and subgroup size, composition, and distribution of a troop of 25-28 mantled howlers inhabiting Estacion Biologica de Ometepe, Nicaragua. Data were collected using a 5-min scan sampling technique. During each sampling period, two or three different howler subgroups were monitored simultaneously.

The results indicate that our howler study troop fragmented into subgroups of from 1-13 individuals. Mean subgroup size was 5.5 and consisted of 2 adult males, 2.5 adult females, and their young. Although lone animals tended to be adult males, 86% of subgroups composed of two individuals were male-female pairs, and subgroups of three commonly contained 2 adult males and 1 adult female (47.2%). Based on the number of howlers simultaneously feeding or resting in the same tree, there was little evidence that competition over food resources was an important factor in determining the size of subgroups. Rather, it appeared that subgroup size and composition reflected individual patterns of social affiliation and social tolerance. Additional relationships concerning social networks within subgroups, and long-term partner preferences are discussed.

The use of visual, olfactory, and spatial information during foraging in wild nocturnal and diurnal anthropoids: A comparison among *Aotus*, *Callicebus*, and *Saguinus*.

J.C. Bicca-Marques[1], P.A. Garber[2]. [1]Faculdade de Biociencias, Pontificia Universidade Catolica do Rio Grande do Sul, Porto Alegre, RS, 90619-900, Brazil, [2]Dept. of Anthropology/ UIUC.

Early in their evolution, the ancestors of anthropoid primates radiated from a nocturnal to a diurnal niche. Foraging during the night differs from foraging during the day in terms of the availability of light and color cues, and in the movement of odor molecules through the canopy. In this study, we compared the ability of nocturnal (*Aotus nigriceps*), and diurnal New World monkeys *Callicebus cupreus cupreus*, *Saguinus imperator imperator,* and *S. fuscicollis weddelli*) to use perceptual cues (sight or smell of food) and spatial information (place predictability) in within-patch foraging decisions.

An experimental field study was conducted on one group of night monkeys and two groups each of emperor tamarins, saddleback tamarins, and titi monkeys at the Parque Zoobotânico/UFAC, Rio Branco, State of Acre, Brazil. Our research design included the construction of feeding stations (FS) located in the home range of the study groups. Each FS consisted of eight visually identical feeding platforms located in a circular arrangement. In all test settings, two platforms at each feeding station contained a food reward (banana) and the remaining six platforms contained a sham reward (plastic or inaccessible banana). Data are presented on 2203 visits to feeding platforms by individuals of these species.

When the location of reward sites was predictable over time, individuals in all four species successfully relocated food rewards based solely on spatial information ($P<.05$). Each species also was successful in using visual information to distinguish real from sham food rewards. However, when only visual cues were available, night monkeys required longer exposure to the test setting in order to solve the foraging task than did either tamarins or titi monkeys. In addition, only night monkeys and one group of emperor tamarins used olfactory information alone to locate food rewards. Overall, compared to the diurnal primates, night monkeys relied more on olfactory information than on visual cues in making within-patch foraging decisions. Additional information concerning patterns of learning and evidence of rule-based foraging are discussed. Research supported by CAPES, FBPN, WWF-Brazil, Wenner-Gren, ASP, CLACS/UIUC, UFAC, and S.O.S. Amazonia.

Accurately estimating areal measures of thin-walled cortical bone from conventional CT data using a sub-voxel algorithm.

M. Black. Dept. of Biological Anthropology and Anatomy, Duke University, Durham, NC, 27708-0383, USA.

Micro-CT technology, while offering high spatial resolution, has drawbacks which limit its wider use within paleoanthropology: limited availability outside the U.S., inherent limitations in discriminating fossil bone from adherent matrix, and strict limits on specimen size.

Conventional CT technology, on the other hand, is more widely available and has excellent contrast resolution, but previous research has repeatedly documented a critical minimum distance (CMD) of 1.0 - 1.1mm, below which measurements are increasingly inaccurate and are consistently overestimated, due to the blurring effects of partial volume averaging.

The combined effect of these constraints makes it seem impossible to (non-invasively) get accurate linear and areal measures for thin-walled cortical structures on some larger fossil elements, such as hominid *os coxa*.

On closer examination, a CMD of 1mm is found not to be an inherent limitation of conventional CT data, but instead is specific to the image analysis protocol used by the majority of medical and anthropological researchers; namely, the whole-pixel thresholding of CT attenuation coefficients according to the half maximum height criterion. Using an alternate approach may decrease the CMD.

A Bayesian probability algorithm, recently developed for sub-voxel segmentation of MRI images, is here adapted to the comparatively simple analysis of 2-state (bone, air), 2-dimensional CT images. Partial volume averaging is treated not as a problem, but as a potentially rich source of spatial information. Preliminary results obtained on simulated CT images are promising: on a section of thin cortex of varying thickness (0.6 – 0.7 mm), the algorithm calculates a total cortical area which is 99.7% of the true area of 1.48 mm^2. Thus, this new method is capable of calculating cross-sectional areas of thin cortical walls which have dimensions well below the 1mm CMD, actually *under*-estimating cortical area, and by only 0.3% (0.0046 mm^2).

Neandertal facial morphology and cold adaptation: a comparative approach.

J. Blumenfeld. University of Illinois, Urbana-Champaign, Champaign, Illinois, 61820, USA.

Characteristic Neandertal facial features have been hypothesized to represent adaptations to the cold climate in which Neandertals lived. Alternatively, these features could reflect biomechanical adaptations related to intense anterior tooth use. In this study, three characteristic Neandertal facial features were examined in relation to a climatologically diverse comparative sample of both fossil and recent humans. These features are: pronounced midfacial prognathism, elongated and elevated nasal apertures that are quite broad relative to facial breadth and swept-back zygomatic regions.

If these distinctive features are, in fact, related to cold adaptation it was expected that they would also be present in anatomically modern cold adapted populations. The null hypothesis examined in this study was that the Neandertal face contains elements that can clearly be identified as adaptations to a cold climate. The alternative hypothesis was that these features do not reflect an adaptation to a cold climate, but are biomechanical adaptations.

A variety of statistical analyses were applied to the data. In the first instance, this analysis did not find these features to sort consistently with climate in anatomically modern cold populations. In the second instance, when classified with any modern human group, the Neandertals were placed with those from warm climates. Therefore, the null hypothesis was rejected. It is concluded that these features are not indicative of cold adaptation, but rather are biomechanical adaptations most likely inherited from an ancestral *Homo heidelbergensis* population, as well as due to heavy anterior dental loading which occurred through the practice of both masticatory and paramasticatory activities practiced by the Neandertals.

Patterns of faunal and environmental change in the Hadar Formation, Ethiopia.

R. Bobe[1], G. Eck[2]. [1]Smithsonian Institution, Washington, DC, 20560, USA, [2]University of Washington.

The Hadar Formation (Ethiopia) provides a record of faunal change spanning much of the late Pliocene. The Hadar sample consists mostly of fossil mammals collected during the 1970s, but more recent fieldwork between 1990 and 2000 has added significant new specimens to the collection. The complete Hadar faunal catalog consists of nearly 8,000 records. Here we provide new analyses of the Hadar collections, and compare our results with patterns documented elsewhere in East Africa. We use abundance data to document faunal changes through the late Pliocene, and we discuss the environmental implications of these changes. Our results show that the Sidi Hakoma Member (3.4-3.22 Ma) represents woodland and dry bush habi-

tats, and the Denen Dora Member (3.22-3.18 Ma) represents a well-watered interval with edaphic grasslands and riverine forests. The lower Kada Hadar Member (3.18-2.95 Ma) shows a significant increase in the abundance of alcelaphine bovids, indicating the onset of drier and more open conditions in the region, conditions that continue to prevail in the upper Kada Hadar Member (younger than 2.35 Ma). In the context of other East African localities, the increase in aridity in the Hadar region appears earlier than in the Omo region of southern Ethiopia, suggesting that different factors may have influenced the onset of aridity in each region. A comparative approach to the analysis of the Hadar fauna provides key evidence of hominid environments and of how these environments changed through time.

Does group size reflect a trade-off between predation risk and within-group food competition?

S. Boinski. Dept. of Anthropology, University of Florida, Gainesville, FL, 32611-7305, USA.

The arsenal of spatial and social strategies that appear to counter predation risk and enhance success in within-group food competition among primates is extensive. Nevertheless, group size is widely considered to be a particularly useful dependent variable to evaluate the tradeoffs in the costs and benefits of these two selective regimes. In theory, larger group size affords greater efficiency in detecting and deterring predators. But as group size increases, the benefits of reduced predation risk are offset by exacerbated within-group food competition for finite resources. Also, in practical application, for comparative analyses with broad phylogenetic scope, few alternative proxy measures are as sensitive to both selective regimes as group size. To date, however, scant evidence directly supports the putative effects of predation risk and food competition on group size.

Here I exploit long-term field data from three species of squirrel monkey (*Saimiri oerstedii* - Costa Rica; *S. boliviensis* - Peru; and *S. sciureus* - Suriname) for a comparative analysis of how group size covaries across different combinations of predation risk and food competition. Each field site is typical of the habitat within the range of each species and is nearly untouched by human disturbance. Considered separately, each field study provides an interesting and plausible scenario as to the optimal solution for the interaction of these two selective regimes. Yet couched within a comparative framework, this study system affords strong evidence that species-typical group sizes represent a balance between the risks of predation and the costs of within-group food competition.

The Medieval leprosy epidemic in Southern Scandinavia.

J.L. Boldsen. ADBOU, SDU-Odense University, Odense M, Denmark, DK 5230, Denmark.

Leprosy was a well recognized and dreaded disease in northern Europe in the Middle Ages. Resent research has shown that this disease affected a substantial portion of the population - perhaps as many as one third of the adult population - and led to seclusion of the victims. Leprosy is a debilitating but not a highly deadly disease. It could be a major load on the productive capability of the population.

Close to two thousand skeletons of adult people from the collections of the Anthropological Data Base Odense University (ADBOU) from excavations covering most of Medieval Denmark and dating from alle phases of the Medieval period have been registered for leprosy related skeletal conditions. Seven different skeletal conditions associated with leprosy are studied. These conditions all meet the criterion that they occur more frequently among lepers than among non lepers. The sensitivities and specificities are generally quite low so on an individual level this battery of tests provide poor diagnoses. However, using powerful and newly developed statistical tools it is shown that the prevalence of the leprosy in the once living, adult population changed substantially over the five Medieval centuries and that the clinical image created by the disease was dependent on time, place and structure of the population giving origin to the skeletal samples.

The fact that the osteological and clinical image created by an infectious disease like leprosy depends on the host (human beings), det pathogen (*Mycobacterium leprae*) and the environment makes palaeopathological diagnosis quite difficult. This paper concludes that it in spite of variability of clinical images and interactions with other conditions is possible to analyze the leprosy epidemic and get an idea of the impact the disease had on society from observations made on large skeletal samples.

Growth and development in body tissues and proportions of African apes (*Gorilla gorilla* and *Pan troglodytes*): a preliminary report.

D. Bolter, A. Zihlman. University of California, Santa Cruz, Santa Cruz, CA, 95064, USA.

During primate growth, body parts reach maturity at different rates, for example, brain size peaks early, and body mass and proportions later. Little information is available on proportions of soft tissue and distribution of body mass at different life stages. This study focuses on soft as well as hard tissue of 4 African apes (gorillas, age 3 months and 3 years; chimpanzees, 1 day old and 3 years). Through dissection we collected quantitative data on body tissues (muscle, bone, skin, fat) within each body segment (e.g. forelimbs, hindlimbs, trunk and head). We recorded linear dimensions prior to dissection and measured cranial capacities later.

We found that body tissues develop in a mosaic fashion. In the two youngest apes, muscle tissue comprised a similar percentage of total body mass (25-30%). Although the same dental age, two three year olds differ in relative amount of muscle: the 3 year old gorilla has 42% of total body mass, the chimpanzee has 32%. Body proportions also differ. Limb mass (forelimbs plus hindlimbs) is similar for the youngest apes and 3 year old chimpanzee (29.8%, 31.1% and 32.5% respectively), whereas the 3 year old gorilla's limbs are 38% of body mass – compared to adult gorillas' 34%. This may indicate genetic variation in rates of growth, as also suggested by the dentition. Gorillas may accumulate muscle tissue and limb mass early, with body fat and adult limb proportions developing later. Investigation of soft tissue can contribute further detail to our understanding of African ape growth.

Using singular warps to study morphological integration.

F. Bookstein[1], P. Gunz[2], H. Ingeborg[2], P. Mitteroecker[2], H. Prossinger[2], K. Schaefer[2], C. Unteregger[2], B. Wimmer[2], H. Seidler. [1]Institute of Gerontology, University of Michigan, Ann Arbor, MI, 48109-2007, USA, [2]Institute for Anthropology, University of Vienna, Austria.

Today many morphometric studies concern the integration of an organism's various parts over the course of ontogenetic or evolutionary change. This paper introduces a new method for studying relationships of spatially distinct parts of the organism over these two processes when studied together in mixed growth samples.

Our method of singular warps is a variant of Partial Least Squares modified for application to landmark coordinates. The technique centers around the singular value decomposition of the cross-covariance matrix between the shape coordinates corresponding to two sublists of landmarks in a common Procrustes registration. The singular vectors can be interpreted as saliences (weighting factors) of landmark location for either block in the task of optimally predicting the other. Combined in one single thin-plate spline, the set of singular vectors shows correlated shape changes, relative sizes, relative positions, and relative orientations of parts for the integrated process as a whole. The corresponding singular warp scores, which are linear combinations of the shape

coordinates weighted by the singular vectors, supply a useful ordination indicating whether particular dimensions represent ontogeny, phylogeny, or a combination.

Easily generalized for studies involving more than two blocks of landmarks, these singular warp strategies seem especially suited for determining whether the principal dimensions of shape variation among fossils submit to familiar heterochronic explanations.

Natal dispersal of titi monkeys (*Callicebus moloch*) at Cocha Cashu, Manu National Park, Peru.

F. Bossuyt. Graduate Group in Animal Behavior/Dept. of Anthropology, University of California, Davis, Davis, CA, 95616, USA.

Titi monkeys live in monogamous family groups (mean 4.0, range 2 to 7 family members at Cocha Cashu) in small territories (mean 11.5 ha, range 6 to 18 ha), and exhibit both intense paternal care and cooperative alloparental care. This study documented temporal changes in relationships of sub-adults to adult family members and to their natal territories and documented the behavior of sub-adults as they dispersed and acquired territories. Stable groups retained up to 7 members. Low average group size resulted largely from low birth rates (<1.0 per year per group) and high juvenile mortality. Sub-adults dispersed at ages 3 to 4 years or older without obvious social pressure from other group members. Sub-adult males first remain in their natal groups, advertise vocally, and explore nearby mating opportunities. Eventually they may wander away, advertising, and may displace a weakened resident male from his mate. Females appear to disperse and become vagrants earlier than males. Male calls attract them, and they will compete for a mated male that appears ambivalent towards its mate. Sub-adults may delay dispersing because of few mating opportunities, or because they provide critical aid to siblings that are at risk of predation. Sub-adults' aid to sibs may explain both protracted residence in the natal group and absence of pressure from adults for sub-adults to disperse.

Francis Bossuyt tragically disappeared at Cocha Cashu on April 27, 2000. This abstract was prepared from his notes, with great admiration for his exceptional dedication and remarkably rich field research. PSR.

Individuation of human remains from historic cemeteries.

D.C. Boyd, C. Boyd. Radford University, Radford, Virginia, 24142, USA.

A current phenomenon in applied physical anthropology is the legal (contract-driven) archaeological exhumation and analysis of historic cemeteries, often with significant descendant involvement. Physical anthropologists are routinely being solicited to provide precise identification of exhumed ancestors by their descendants.

A comparison of three recently completed historic cemetery projects in Virginia (Jones, Marshall Tract and West cemeteries) illustrates complexities in the integration of skeletal biological, forensic and historic data in the identification of interred individuals. Three Anglo-American cemeteries dating from the late 17th to the late 19th centuries in eastern Virginia contained a total of 52 individuals; a major goal of these projects was to link recovered human remains with the names of individuals that historic records and oral history indicated were buried at these sites. Poor bone preservation limited the range of forensic identification methods which could be used. Concordance of genealogical and skeletal data, however, led to the individuation of at least 9 of these individuals from the Jones cemetery. Identification of one individual at the Marshall Tract Burial Ground permitted demographic assessment of others through seriation of dental wear. Finally, at the West family cemetery in Alexandria, no positive individuation could occur in spite of detailed information from descendants. These cases illustrate how variability in preservation, contextual integrity, and quality of historic and skeletal data can affect efforts at individuation.

Human evolution: a Neanderthal skeleton in a *sapiens* closet.

C.L. Brace[1], N. Seguchi[1], C. Quintyn[2]. [1]Museum of Anthropology, University of Michigan, Ann Arbor, 48109, Ann Arbor, MI, 48109, USA, [2]Central Identification Laboratory, 310 Worchester Avenue Blgd 45, Hickam Air Force Base, Honolulu, Hawaii 96853-5530.

The press and the profession speak of the "extinction" of European Neanderthals and the immigration of "modern" humans as though they were givens. The categorical typological distinction and the suddenness of "replacement" are assumed without any attempt at documentation. Use of the available data demonstrates a very different picture. Cranial contours of living Europeans, early "moderns" and "classic" Neanderthals demonstrate that the main proportions of the skull are identical.

The obvious difference is in the facial skeleton when individuals such as La Ferrassie I, Predmostí 3 and a recent European male are superimposed. This is reinforced by a comparison of the dental dimensions of "Classic" Neanderthals, Early "moderns" and living Europeans. The regression line slope does not change from the Early Neanderthals until the end of the Pleistocene. The change from Late Neanderthal to Early "modern" is so gradual that there is no way to tell the difference between them.

Published assessments of the archaeological record from Europe to Siberia document the view that the Upper Paleolithic develops *in situ* from the Mousterian. This also documents the nature of the selective force change that produced "modern" human form in place without needing to postulate migration from "elsewhere."

The persisting enthusiasm for Neanderthal "extinction" and "replacement" is a reflection of the lingering reluctance of paleoanthropology to accept the basic outlook of evolutionary biology.

Comparative analyses of genetic social structure in wild gorillas (*Gorilla gorilla*) using DNA from feces and hair.

B.J. Bradley[1], D. Doran[2], M.M. Robbins[3], E. Williamson[4], C. Boesch[3], L. Vigilant[3]. [1]Anthropological Sciences, SUNY at Stony Brook, Max Planck Institute for Evolutionary Anthropology, Leipzig, Leipzig,, D-04103, Germany, [2]Anthropological Sciences, SUNY at Stony Brook, [3]Max Planck Institute for Evolutionary Anthropology, Leipzig, Germany, [4]Dian Fossey Gorilla Fund International, PO Box 1321, Kigali, Rwanda.

Genetic analysis provides a powerful means to examine whether ecological differences observed between mountain (*G. g. beringei*) and western lowland (*G. g. gorilla*) gorillas correspond to differences in genetic social structure (e.g. inter-individual relatedness, dispersal patterns, mating success). We are employing DNA analysis within a comparative framework to evaluate the extent to which group males monopolize reproduction of group females as well as to investigate the degree of relatedness between adults in social groups. Hair and fecal samples were collected from some 90 individually recognized mountain gorillas at Karisoke Research Center, Rwanda for which long-term behavioral data have been collected, and from approximately 75 unhabituated western lowland gorillas at Mondika Research Center on the border of Central African Republic and Republic of Congo (Brazzaville). DNA extracted from the noninvasive samples was genotyped using a set of 10 microsatellite loci, resulting in a unique genetic profile for each individual (Probability of individual identity >0.99). These loci exhibit a sufficient amount of variability in both populations for statistically significant determinations of paternity (P>0.95) and accurate assessment of genetic relatedness among individuals. Preliminary results reveal a high degree of reproductive skew

among gorilla males of both subspecies, although western gorilla males are apparently able to monopolize group reproduction to a greater degree than mountain gorillas. These results, however, need to be evaluated within the context of demographic differences between the subspecies as well as differences in male-male relatedness within groups.

New human and chimpanzees models to interpret early hominid dental development.

J. Braga. Université Bordeaux 1, Laboratoire d'Anthropologie, Talence Cedex, France, 33405, France.

Development patterns of permanent teeth of 26 Plio-Pleistocene hominids, mainly from South Africa (N = 18), are re-examined using simulated sampling distributions of Bayesian posterior probabilities and biological models not investigated so far. In this approach, 3584 posterior probabilities can be theoretically calculated to assess the overall dental development pattern represented in a sample. The prior probabilities are chosen to be similar between all the samples in order to allow direct comparisons of posterior probabilities. A comparison is made between: (1) the two genetically distinct chimpanzee species (*Pan troglodytes* and *Pan paniscus*); (2) two non-European extant human samples from Iran and Ivory Coast; (3) extant humans and chimpanzees; (4) extant species and fossil taxa. It is concluded that the chimpanzees and human dental development patterns are highly polymorphic and overlap, even for some features classically considered as distinct. If we consider some of these features (for example canine delay vs. incisors, premolars and second permanent molars), it may be sometimes (i.e., for some comparisons) difficult to contrast developmental patterns because the polymorphism observed among extant humans or early hominids can be accommodated within the one seen among chimpanzees. Moreover, the simulations show that only a limited number of fossil specimens (mainly from Swartkrans) offer the possibility of observing dental development patterns distinctive between *A. (P.) robustus* and *A. africanus*. When removing these specimens from the samples to be compared, the posterior probabilities are often very close, if not identical.

Skeletal pathologies associated with pellagra mortality: implications for interpreting the paleopathology of maize-dependent populations.

B. Brenton[1], P. Robert[2]. [1]Dept of Soc/Anth, St. John's University, Jamaica, NY, 11439, U.S.A., [2]Texas Tech U.

This presentation reports on an analysis of skeletal pathologies from 15 individuals known to have died from pellagra. These pellagrins are part of the extensive "Raymond Dart" skeletal collection, housed at the University of Witwatersrand Medical School, Johannesburg, South Africa. The collection provides an unique research opportunity. Most of the individuals have been autopsied and a biological profile including age, sex, height, weight, ethnicity, and cause of death is available for them.

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. These pellagrins were found to exhibit considerable periostitic lesions of the lower limbs, and showed a high incidence of alveolar bone loss and dental caries. This corresponds to regions where soft tissue is known to be affected by pellagra. The following pathologies were also noted in some individuals: osteomyelitis, cribra orbitalia, cranial pitting, and enamel hypoplasias.

These findings offer new insights into skeletal-based interpretations of nutrition-related health problems, and for the paleopathology of maize dependent prehistoric and historic populations. Future research for this group will include the histological examination of ribs to determine microstructural patterns specific to pellagra victims.

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Childhood developmental trajectory of attention and impulse control.

A. Brewis[1], K. Schmidt[2]. [1]University of Georgia, Athens, GA, 30602-1619, USA, [2]University of Pittsburgh.

The maturation lag model of attention and impulse control development in boys and girls explains inattention and impulsivity in Attention Deficit Hyperactivity Disorder (ADHD) as delayed development along a normal developmental trajectory. The concept of a cross-culturally uniform developmental trajectory is tested by a comparison of the performance of 212 Mexican school children on the Test of Variable Attention (TOVA) with the performance of populations previously studied. An observed pattern of decreasing errors of omission (indicating improving attention) with increasing age did confirm the predictions of the existing developmental trajectory model, although the shape of this change was linear rather than curvilinear. A predicted age-related decrease in errors of commission (indicating improving impulse control) was not observed. Gender differences in attention and impulse control measures among Mexican children, ages 6-12 years, were not significant, in contrast to the findings of previous US studies. Mexican children made significantly more errors of omission and commission than American children, indicating greater degrees of characteristic inattentive and impulsive behaviors in childhood. These results indicate that the assumption of a uniform developmental trajectory of these behaviors should be carefully considered before it is applied to understanding children's behavior in culturally diverse settings.

Asymmetry of the frontal endocranium in modern humans: Implications for interpretation of fossil endocasts.

D. Broadfield[1], R.L. Holloway[2]. [1]Dept. of Anthropology, Florida Atlantic University, Boca Raton, FL, 33431, USA, [2]Dept. of Anthropology, Columbia University.

A hallmark of the modern human brain is physical asymmetry of the cerebral cortices. In addition, these morphological asymmetries have been implicated in the functional lateralization of cognitive processes. While endocasts do not present direct evidence of the lateralization of cerebral function, they do provide physical evidence indicating aspects of brain size and asymmetry. One area of interest is the frontal region, since it is this area that has been implicated in language functions. While it is not prudent to assign cognitive ability to features of endocasts, it is possible to determine anatomic asymmetries in them.

In a preliminary study we demonstrated the relationship between endocranial asymmetries and cerebral asymmetries (Broadfield et al., 2001). In order to elucidate the relationship between frontal petalial patterns and asymmetries in frontal features such as the orbital or Brocas cap, we examined the presence and degree of asymmetry of these features in modern human skulls that possess a left occipital right frontal petalial pattern (n = 28).

Preliminary analysis suggests that 90% of the individuals in this sample exhibit asymmetry in the frontal region and orbital cap. While this information does not unequivocally demonstrate lateralization of cognitive functions such as language in the individuals sampled, it does provide provocative evidence for interpreting the fossil record. If asymmetry in endocranial features is present in a group that exhibits lateralization of cognitive function such as modern humans, then one can postulate that other hominin groups that demonstrate similar asymmetries may have exhibited lateralization of cerebral functions.

Docosahexaenoic Acid and Cerebral Evolution

C.L. Broadhurst[1], M.A. Crawford[2], S.C. Cunnane[3], H. Holmsen[4], K. Ghebremeskel[2], J. Parkington[5], W.F. Schmidt[1], M. Bloom[6]. [1]Environmental Quality Laboratory U.S. Department of Agriculture Agricultural Research Service, Beltsville, MD USA. [2]Institute of Brain Chemistry and Human Nutrition, University of North London, UK. [3]Dept. of Nutritional Sciences, University of Toronto, Ontario, Canada. [4]Dept. of Biochemistry and Molecular Biology, University of Bergen, Norway. [5]Archaeology Department, University of Capetown, South Africa. [6]Dept. of Physics, University of British Columbia, Vancouver, Canada.

Docosahexaenoic acid (DHA, 22:6n-3) accounts for high percentage of the fatty acids in the retina and brain. DHA is concentrated in human fetal plasma by the placenta to support fetal brain growth. Fetal/neonatal DHA deficiency has been shown to impair cognitive and visual development. In theory, DHA can be synthesized from a precursor fatty acid (a-linolenic acid, 18:3n-3) found in vegetation, but in practice conversion is slow or nonexistent.

DHA is specifically and selectively incorporated into photoreception and neural cell membranes at a rate 20-40 times greater than the rate of synthesis from a-linolenic acid. Apparently, involvement of DHA in photoreceptor and synaptic membranes has been conserved throughout advanced evolution, similar to the conservation of key membrane proteins. Conservation dates to the origin of the visual system and brain in the marine environment ca. 600 mya.

This biochemical evidence is relevant to the origins of *H. sapiens*. DHA is found in abundance only in animal food resources of marine, littoral, and lacustrine environments. Savanna resources are relatively poor in DHA with the minor exceptions of organ meats and bone marrow. Since DHA is essential for brain expansion and the development of complex synaptic interconnections, consistent access to coastal food resources could have provided significant competitive evolutionary advantages. Foods such as shellfish and marine bird eggs require no sophistication to collect and utilize, yet readily provide the raw materials for neural construction. Early *H. sapiens* remains dating to ca. 100 kya from coastal South African sites support this hypothesis.

Late Pleistocene and Early Holocene archaeology of the Nile Corridor: implications for the spread of malaria.

A.S. Brooks[1], J.E. Yellen[2]. [1]Dept. of Anthropology, George Washington University, Washington, DC, 20052, USA, [2]Archaeology Program, National Science Foundation.

Archaeological evidence from 25,000 to ca. 8,000 BP suggests a spread of subsistence technology from Central Africa into the Sahara, primarily, but not exclusively, via the Nile Corridor. Phytolith, pollen and macrobotanical evidence from Central Africa suggests that some Central African populations already were altering vegetation patterns through fire management and forest clearance. Grindstones at sites like Ishango (D.R. Congo) and Wadi Kubbaniya (Egypt), and storage pits at Nabta Playa (Egypt) and other sites indicate increasing intensification of plant food use, along with a more sedentary lifestyle. In addition, there is increasing evidence for incipient domestication of cattle in the Sahara during the early Holocene. Contact with populations from Europe and/or the Near East is suggested by anomalous bone harpoon styles at Taforalt (Morocco) and the Fayum (Egypt). We argue that all of these developments created zones of opportunity for the spread of malaria parasites among human populations, which were both more concentrated on lakeshores and more sedentary for at least part of every year. In addition, the cattle themselves would have altered lakeshore environments to increase the prevalence of mosquitoes and mosquito-borne parasites. In addition to archaeological data, the paper will also present data on malaria prevalence and resistance in modern African cattle pastoralists. These data are in accord with recent evidence (Tischkoff et al. 2001) for an early- to middle-Holocene expansion of G6PD variants in humans.

Nitric oxide exhalation is elevated upon acute exposure to high altitude hypoxia and is related to individual distress.

D. Brown[1], P. Mills[1], K. Strohl[2], C. Beall[2]. [1]Dept. of Anthropology, University of Hawaii at Hilo, Hilo, HI, 96720-4091, USA, [2]Dept. of Anthropology, Case Western University.

The enzyme nitric oxide (NO) synthase is usually downregulated under hypoxic conditions. Sympathetic nervous system activity has been shown to increase pulmonary NO production in animal models. To test the effects of acute exposure to hypoxia on NO exhalation levels, a sample of 47 sea level residents, all healthy adult non-smokers, were observed at sea level, 2700 m and at 0, 2 and 3 hr exposure times at 4000 m altitude on Mauna Kea, Hawaii. Measurements were made of reported symptoms of acute mountain sickness (AMS), pulse oximetry, and NO exhalation. NO exhalation was significantly elevated at both 2700 m and 4000 m (paired t-tests, $p < 0.001$) relative to sea level values, peaking at 4000 m. There was no significant change in NO exhalation levels over the three hour exposure at 4000 m (repeated measures ANOVA, $F = 2.0$, ns). Upon return to sea level NO exhalation returned to pre-exposure values. The mean increase in NO exhalation level upon initial exposure to 4000 m was significantly positively correlated with reported symptomology of AMS later in the exposure period at 4000 m (at hour 2: $r = 0.31$, $p < 0.05$; at hour 3: $r = 0.35$, $p < 0.05$) and was significantly negatively correlated with O saturation upon initial exposure ($r = -0.33$, $p < 0.05$). In summary, NO exhalation is elevated upon acute exposure to high altitude hypoxia. The amount of elevation is related to the degree of distress experienced by the individual as measured by O_2 saturation and reported symptoms of AMS, with this relationship possibly mediated by sympathetic nervous system activity.

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Race and athletic ability.

R.A. Brown, G.J. Armelagos. Dept. of Anthropology, Emory University, Atlanta, Georgia, 30320, USA.

The use of race as an explanatory tool is severely hampered by the role that it plays in understanding human variability. Richard Lewontin's seminal paper (1972) showed the limits of race in the apportionment of human variability. Many anthropologists and geneticists have resisted these findings, claiming that once "appropriate" genes were found, the validity of race would become firmly established. Data accumulated in the last 3 decades that includes the most recent genomic analysis confirms Lewontin's initial assessment that less then 10% of human variability is explained by race. Not withstanding this evidence, genetically based racial biological explanations are presented to explain athletic ability. Beginning with Jon Entine's *Taboo: Why Black Athletes Dominate Sports and Why We're Afraid to Talk About It*, we examine the arguments that are used to dismiss the racial apportionment data and the evidence that is used to support their position. Entine is so effective that his web site highlights a review in the *AJPA* that heralds *Taboo* as "… an important book for biological anthropologists." We will also examine the purported phenotypic differences such as 'fast twitch" muscle fibers, racial differences in muscle mass and other alleged racial features that are said to provide superior athletic ability. These arguments can be traced to century old myths that suggest a trade off between physical ability and intelligence that now misapplies evolutionary concepts such as r/K selection. A century of misapplication of anthological concepts by others is enough. Anthropologists should reclaim misapplied concepts that define our field.

Progressive muscle fatigue during dynamic work in iron deficient, Mexican women.

T. Brutsaert[1], S. Hernandez-Cordero[2], J. Rivera[3], T.B. Viola[4], G. Hughes[4], J. Haas[2]. [1]The University at Albany, SUNY, Albany, NY, 12222, USA, [2]Cornell University, [3]National Institute of Public Health, Mexico, Cuernavaca, Mexico, [4]The University at Albany, SUNY.

The objective of this study was to investigate the effects of tissue level iron depletion on the progressive fatigue of muscle during dynamic endurance-type exercise. We used a novel fatigue protocol of about 8 minutes duration that integrates 2-3 second maximal voluntary static contractions (MVC) of knee extensor muscles with dynamic knee extension exercise until subject exhaustion. Twenty iron-depleted (serum ferritin <16 μg.l-1), non anemic (hemoglobin >12 g.dl-1) women (29.1±1.2 yrs old) received 100 mg of ferrous sulfate (S) or placebo (P) per day in a randomized, double blind trial (n = 10 per group). There were no group differences in measures of iron status or muscle fatigue at baseline, including MVC at rest (MVC_{rest}), the overall rate of MVC decline, or in the MVC at the end of the test (MVC_{end}). Iron supplementation increased serum ferritin, serum iron, and transferrin saturation, and decreased transferrin receptors in the S compared to P-group. Individual measurements of MVC_{rest} did not differ between groups post-treatment. MVC_{end} was higher (22.3%) post-treatment in the S but not P-group (p = 0.007). The rate of MVC decline was attenuated after supplementation in the S but not P-group, especially during the latter minutes of the fatigue protocol where MVC (kg) was 10-15% higher post-supplementation (p = 0.012). These results indicate that iron deficiency without anemia impairs the fatigue resistance of muscle during dynamic exercise, and this may have implications for the performance of endurance type work.

Growth spurts in linear dimensions in *Pan troglodytes* .

L. Buchanan. University of Illinois, Urbana-Champaign, Champaign, IL, 61822, USA.

This analysis investigates growth rates of linear dimensions in *Pan troglodytes*. Specific attention is given to the identification of growth spurts using contemporary regression methods. Such analyses suggest whether or not the human adolescent growth spurt is uniquely derived, and thus have important implications for human evolution.

Data for this project consist of Gavan's longitudinal ontogenetic series of 9 male and 7 female chimpanzees. Linear dimensions of all limb segments and trunk height are utilized. Data are smoothed using loess and spline regression techniques. Bootstrapped curves are constructed to create plots of growth velocity by age. Longitudinal analyses allow for inspection of within species variation. Comparative data for humans are derived from literature sources.

Cross sectional analyses indicate no late spurts in linear dimensions for either male or female *Pan troglodytes*. However, slight spurts are found in both sexes at earlier ages. Individual variation complicates interpretations of growth patterns, but confirms spurts in some individuals.

Pan appears to employ a skeletal growth strategy that differs both from the human condition as well as from that of some other primates. Thus, skeletal growth patterns may vary among primates. While a growth strategy that employs skeletal growth spurts may not be unique to humans, a nearly universal skeletal growth spurt at adolescence may be a derived human characteristic.

Data supplied by B. Gelvin and the J.A. Gavan collection.

Functional morphology of the mandible in *Otolemur* spp.

A. Burrows[1], T. Smith[2]. [1]Dept. of Physical Therapy, John G. Rangos, Sr. School of Health Sciences, Duquesne University,, Pittsburgh, PA, 15282, USA, [2]School of Physical Therapy, Slippery Rock University.

Ultimate mandibular form reflects a variety of factors including masticatory forces, ontogeny, and ecological influences such as diet. As such, it may be expected that primates with varying diets would display different mandibular morphology and form. While this has been demonstrated in some primate taxa, prosimian functional mandibular morphology is not as clearly understood. As part of a larger cross-taxonomic study on prosimian mandibular functional morphology, both three-dimensional landmark coordinate data and two-dimensional linear distances were collected directly from the cleaned and dried mandibles of *Otolemur crassicaudatus* and *O. garnettii*. The following landmarks were digitized for three-dimensional coordinates: infradentale, lateral edge of mandibular third molar, coronoid process, condylion, medial pole of mandibular condyle, gonion, and menton. The following distances were measured using digital sliding calipers: infradentale-lateral edge of mandibular third molar, lateral edge of mandibular third molar-coronoid process, condylar width, coronoid process-condylion, medial pole of condyle-gonion, condylion-gonion, gonion-menton, menton-infradentale, ramus height, and ramus height v. mandibular body length. Statistically significant ($p<0.05$) differences between species were found in a variety of regions including distances associated with the coronoid process, the mandibular condyle, and gonion. These preliminary findings suggest greater differences between species in regions associated with muscular attachments and condylar function than in other regions associated with the dentition, which may be under more genetic control. While these results may reflect differences between the greater reliance on a frugivorous vs. a carnivorous diet between these species of *Otolemur*, definitive statements await a greater cross-taxonomic sampling using species that exploit various diets.

Ontogenetic development of the axillary border of the scapula in Neandertals.

A. Busby. Northern Illinois University, DeKalb, Illinois, 60115, USA.

The morphological patterning of the axillary border of the scapula in Neandertals is often cited as a distinguishing feature from modern human populations. Although well-documented variation is recognized for adults, the variability in development of the axillary border at various ontogenetic stages has thus far been un-documented. Such documentation would provide insight on the involvement of genetic patterning in axillary border development.

Developmental patterning in Neandertal juveniles was examined using the Krapina hominid remains. This sample was recovered from the Husnjakovo rock shelter near Zagreb, Croatia. Although co-mingled and fragmentary, the Krapina collection presents a large sample of scapulae from both adult and juvenile remains. The juvenile scapulae in the sample were analyzed using both metric and non-metric methods. Some of the juvenile scapulae of the sample exhibited traits typical of Neandertals.

The Krapina juveniles were then compared with 80 juveniles (age 1-19) from the Hamann-Todd Osteological Collection. Correlations between the two samples were assessed to determine developmental stages in both groups. Comparison between the two samples revealed that differences in morphology appear relatively late in ontogeny. Results indicate that the axillary border of the scapula is highly mechanically influenced and that ontogenetically the developmental sequence is very similar in both samples. Therefore, this trait is not a good indicator that Neandertals and modern humans should be considered separate species.

Masticatory performance, posterior occlusal contacts, and malocclusion.

P. Buschang[1], G. Throckmorton[2], S. Owens[1], J. English[2]. [1]Baylor College of Dentistry, The Texas A&M University Health Science Center,

Dallas, Texas, 75246, USA, [2]University of Texas Southwestern Health Science Center.

This preliminary study evaluated the relationships between masticatory performance and areas of interoccclusal-distance contact (<50 μm) and near contact (50-350 μm) of the buccal segments during maximum intercuspation. The sample included subjects with normal occlusion (N = 20), Class I (N = 20), Class II (N = 13) and Class III (N = 6) malocclusions. Chewing performance was evaluated based on the breakdown of CutterSil®; chewing ability was assessed based on the number of chews to swallow jerky and almonds. Impressions of the buccal segments, taken using Blu Mousse® impression material, were scanned, enlarged and each subject's first molars and both premolars were manually traced (bilaterally) to estimate the platform area (PA). The areas of contact and near contact (ACNC) between 0-350 μm thick were estimated optically based on the amount of light transmitted through the impression. The results showed no significant differences in PA between the right and left sides or between the malocclusion groups. ACNC were significantly related with median particle size and broadness of particle distribution. There were no correlations between areas of contact or near contact and the number of chews to swallow jerky or almond. Subjects with normal occlusion had significantly larger ACNC than individuals with Class I, Class II, and Class III malocclusions, in descending order with Class III malocclusions having the smallest areas of near contact <350 μm. We conclude that ACNC are similar on the right and left sides; that individuals with larger ACNC are better able to break down foods; and that individuals with malocclusions have smaller ACNC than individuals with normal occlusion.

Lateralization of minicolumns in human planun temporale is absent in nonhuman primate cortex.

D. Buxhoeveden[1], K. Semendeferi[2], M. Casanova[1]. [1]Medical College of Georgia, Augusta, Georgia, 30910, USA, [2]University of California, Dan Diego.

We compared area Tpt in nine human, eight chimpanzee, and seven rhesus monkey brains. Seven of the humans were adults ranging from 20 - 86 years old, and two were adolescents at 9-and 16-years of age. The chimpanzees ranged from 4 to 13 years of age. Minicolumns found in Nissl-stained slides were examined with a computerized imaging program based on cell density and the minimum spanning tree. Columns in human cortex were larger in the left hemisphere than the right, with an average width of 50.4μm for the left and 43.1μm for the right, measurements that were highly significant ($F_{[1, 25]} = 7.5864$, $p = 0.0107$). By contrast, the chimpanzee means for the left and right side were nearly identical (36.5/36.4 μm), with no evidence of left/side asymmetry ($F_{[1, 22]} = 0.0211$, $p = 0.8860$). The rhesus monkey displayed a mean left side column size of 35.9μm and slightly larger columns in the right hemisphere (36.9μm), but these measurements were not significant ($F_{[1, 18]} = 1.8769$, $p = .187$). Similar differences were found for neuropil space in the periphery, Gray Level Index, and RDR (a measure of cell column compactness). A pilot study was performed in which the same method was used to examine left-right differences in the minicolumn of selected sections of the posterior superior temporal gyrus in two gibbons, two bonobos, three orangutans, and one gorilla. All were adults. Preliminary results suggest that there is no evidence of lateralization and the size of the minicolumns is smaller than those in human planum temporale.

The positional behavior of douc langurs, Delacours' langurs, and white-cheeked gibbons at the Endangered Primate Rescue Center, Cuc Phuong National Park, Vietnam.

C. Byron[1], H. Covert[2], T. Nadler[3], H.T. Long[3]. [1]Dept. of Anthropology, Kent State University, Ravenna, OH, 44266, USA, [2]Dept. of Anthropology, University of Colorado at Boulder, [3]Endangered Primate Rescue Center, Cuc Phuong National Park, Vietnam.

Seventy hours of positional behavior on primates at the Endangered Primate Rescue Center of Cuc Phuong National Park, Vietnam were collected during January and February 2001. An equal amount of instantaneous and continuous bout data were collected on red-shanked douc langurs (*Pygathrix nemaeus*), Delacours' langur (*Trachypithecus delacouri*), and white-cheeked gibbons (*Nomascus leucogenys*). All animals were housed in enclosures of 10 meters by 5 meters by 3 meters and lived in small social groups.

The positional behavior of white-cheeked gibbons was as expected. Locomotion was dominated by brachiation, much of which was quite acrobatic in nature. Postures frequently included the use of at least one forelimb in suspensory support. The positional behavior of Delacours' langurs was similar to that of other arboreal colobines. Locomotion was dominated by quadrupedal walking, running, and bounding on tops of arboreal supports. Postures were dominated by sitting in and sitting out with only a modest amount of forelimb suspensory support. Interestingly, the positional behavior of douc langurs is intermediate in nature between these other two primates. Locomotion is nearly evenly divided between armswinging and quadrupedal walking and running bouts. Postures often included the use of at least one forelimb in suspensory support.

Maize and the emergence of the Tarascan state.

L. Cahue. Dept. of Anthropology, University of Notre Dame, South Bend, Indiana, 46616, USA.

The Tarascan state emerged in the Lake Pátzcuaro basin (LPB) during the Postclassic period (A.D. 900 - A.D. 1520), when the basin was unable to produce enough maize to feed its population. Ethnohistoric documents indicate that the Tarascan state was not an economically viable unit, and that it existed, and even thrived, only through the establishment of differential mechanisms of economic exchange (Pollard, 1982; Pollard, 1993). Non-elites obtained goods (including maize and beans) through the intensification of local and regional markets or subsistence activities, while the elites obtained most of their goods by outright ownership of local production or by tribute secured through militarism (Pollard, 1993). This differential adaptation of elites and non-elites (which excluded agricultural intensification and hydraulic works) would have buffered the elite population in the LPB from dietary change as the Tarascan state emerged.

The diets of Pre-Tarascan and Tarascan elites at two lake basins were compared. Stable carbon and nitrogen isotopes of bone collagen were used to assess temporal and spatial dietary variation.

The diet of elites in the Lake Pátzcuaro Basin did not change over time. Among Tarascan administrative centers, elites at higher ranked centers consumed relatively higher proportions of maize than those at lower ranked centers. Elites in the Lake Sayula Basin diets most closely resembling the diets of Tarascan elites at Tzintzuntzan, the capital of the Tarascan State.

The influence of a large home range on the social structure of free ranging spider monkeys (*Ateles geoffroyi*) on Barro Colorado Island, Panama.

C. Campbell. Dept. of Earth Sciences, Santa Monica College, Santa Monica, CA 90405, Los Angeles, CA, 90095, USA.

The spider monkeys (*Ateles geoffroyi*) of Barro Colorado Island (BCI), Panama were introduced in the late 1950s and early 1960s. Milton (1993) reports that data collected from the late 1970s and early 1980s show that the single group on the island was "normal" in every sense even though the surviving ani-

mals never had adults to learn from. Here I report results from a recent study, documenting changes in the social behavior of the current BCI spider monkeys. Data collected between October of 1997 and December of 1998 show that the social system of the BCI spider monkeys is more cohesive than that of groups studied elsewhere. Subgroup size is larger and females are more frequently observed in the presence of additional adult females and males than on their own. Smaller foraging units are formed, however this occurs only after the group as a whole moves to certain areas of the island in search of a particular food species. In addition, females and their associated offspring do not travel in core areas as reported by previous spider monkey researchers including Milton (1993). All of these differences are potentially related to the increase in the home range of the BCI spider monkey group. During my study the home range was more than 960 hectares, significantly larger than reported from other study sites. I suggest that this large home range size has resulted in a decrease in intragroup feeding competition, which has resulted in a more cohesive social structure.

Biomechanical investigation of African apes and influences of positional behavior.

K. Carlson. Dept. of Anthropology, Indiana University, Bloomington, IN, 47405, USA.

Bone responds to strains, which are engendered through body movements, by adapting its shape to maintain internal stresses below failure level. Using this as a basis, long bone morphology of African apes is investigated with available positional behavior data. Locomotor behaviors are emphasized, rather than postural behaviors, as the former are likely more responsible for adaptations in shaft cross-sectional geometry than the latter. Specifically, cross-sectional geometry of humeral and femoral shafts at 35%, 50%, and 65% lengths is examined across a comprehensive sample of commonly recognized *Gorilla* and *Pan* subspecies, as well as *P. paniscus*.

Hypotheses relating locomotor repertoire to cross-sectional geometry are investigated. Since the arboreal landscape has a higher degree of 3-D complexity relative to the terrestrial landscape, loads engendered during arboreal movement should be more variable in magnitude and orientation relative to those arising during terrestrial movement. Degree of arboreal locomotion, measured as the percentage of locomotor behavior that is arboreal versus terrestrial, correlates negatively with the circularity of the long bone shaft (i.e., the ratio of principal moments of area) at several locations. At a majority of locations, Theta, the angle between a principal moment of area, I_{max}, and a second moment of area, I_x, is more variable in subspecies exhibiting a higher degree of arboreal locomotion.

This research further clarifies links between morphology and behavior in extant African apes. Because the earliest hominids exhibit ape-like features, a more complete understanding of African ape long bone morphology will assist inferences of early hominid positional adaptations.

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A new theory concerning the adaptive value and evolution of diagonal-sequence gaits in primates and marsupials.

M. Cartmill, P. Lemelin, D. Schmitt. Duke University, Durham, North Carolina, 27710, USA.

Lateral-sequence walking gaits (in which each fore footfall follows the ipsilateral hind footfall) predominate among nonprimate mammals, whereas diagonal-sequence (DS) walks (fore footfall follows contralateral hind footfall) are the norm among primates. No satisfactory explanation of this difference has yet been offered. We conjecture that DS walking allows primates to support themselves with a protracted hind foot, placed on a proven support under the body's center of mass, before putting down a forefoot on a potentially precarious arboreal support. We tested this hypothesis by analyzing over 400 videotaped walking gaits of a wide variety of mammals. Our data corroborate this conjecture and show that DS walks are also prevalent among arboreal marsupials. In both primates and marsupials, this gait pattern is associated with increased loading and duty factors of the specialized grasping hind feet. These apomorphies define a complex of "hindlimb-based" locomotor behavior common to both groups and suggest parallels in their ancestral adaptations. We interpret the grasping hind feet and DS walks of both primates and marsupials as having evolved to facilitate locomotion on thin, flexible branches.

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Parity initially mitigates the effects of aging on bone mineral density (bmd) in the spine of rhesus macaques.

A. Cerroni[1], M. Grynpas[2], J. Turnquist[3]. [1]Dept. of Anthropology, University of Toronto at Mississauga, Mississauga, Ontario, Canada, L5L 1C6, Toronto, Ontario, M4C 5S7, Canada, [2]Dept. of Laboratory Medicine and Pathobiology, University of Toronto and Samuel Lunenfeld Research Institute, Mount Sinai Hospital, Toronto, Canada, [3]Caribbean Primate Research Center Museum and Dept. of Anatomy, University of Puerto Rico, Medical Sciences Campus, San Juan, PR 00936.

This cross-sectional study investigated the relationship between parity, bone mineral density (BMD), and spontaneous osteopenia/osteoporosis in a skeletal population of female rhesus macaques (*Macaca mulatta*) from the free-ranging colony of Cayo Santiago, Puerto Rico. BMD of the last lumbar vertebrae of 119 females between 4.0 and 22.2 years of age at the time of death were measured using dual-energy X-ray absorptiometry (DEXA), and analyzed for evidence of osteopenia/osteoporosis and the effects of parity and age.

Females with low parity have significantly lower mean BMD values than age-matched controls. Forty-three percent of the osteopenic/osteoporotic females in the sample were members of the low-parity group even though it composed only 13% (16/119) of the entire sample. After controlling for age, there is a significant ($p = 0.0006$) increase in BMD with increasing parity, up to a parity of 7 offspring. Thus, high parity initially has a positive effect on BMD in female rhesus monkeys, and appears to mitigate the effects of aging. After controlling for parity, however, age has a negative ($p = 0.015$) effect on BMD beginning several years after the attainment of peak BMD (10 years of age). Thus, the positive effect of parity on BMD is eventually overwhelmed by the aging process. There is also indirect evidence, from natal group membership data, for a genetic component to these observations.

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Within group relatedness and genetic mating systems in white-handed gibbons (*Hylobates lar*).

K. Chambers, L. Vigilant, C. Boesch, U. Reichard. Max Planck Institute for Evolutionary Anthropology, Leipzig, Sachsen, 4103, Germany.

Gibbons have long been termed the "monogamous ape" as the primary social unit has appeared to consist of a pair of adults in a presumably sexually exclusive relationship. Long-term observation of habituated groups of white-handed gibbons (*Hylobates lar*) in the Khao Yai Forest in Thailand, however, has indicated that extra-pair copulations may account for up to 10% or more of the copulations in some females.

Furthermore, polygynous and polyandrous gibbon social groups are not uncommon. In order to clarify the mating system in gibbons, we have determined the genetic relationship of some 60 individuals living in 12 social groups. Noninvasively collected fecal samples were used as the source of nuclear DNA for genotyping. Some samples were preserved in ethanol and others were dried on silica. Successful extractions were carried out in 23% of the ethanol samples and 50% of the silica samples. A total of 52 markers originally identified in humans were examined for variability in *H. lar*, and seven markers exhibiting high variability were typed in all individuals. Paternity assignment was done by exclusion, with assigned fathers sharing an allele with the offspring at all loci and other males excluded by mismatches. These genetic data in conjunction with the observational data allow a more accurate description of the range of variation in group structure and mating strategies within a single population of gibbons.

Environmental correlates of human skin color, revisited.

G. Chaplin, N. Jablonski. Dept. of Anthropology, California Academy of Sciences, San Francisco, CA, 94118-4599, USA.

Human skin color varies clinally, according to environmental factors. Previous workers have analyzed the relative contributions of environmental factors to constitutive skin color, and have emphasized the importance of latitude and ultraviolet radiation (UVR) in its evolution. We have extended previous studies by examining the relationship between skin reflectance measurements of indigenous human populations relative to environmental data (including UVR, temperature, and precipitation) gathered by remote sensing and direct measurement. These data were then statistically analyzed and visualized using a geographic information system (GIS). Skin reflectance was found to be most strongly correlated with variables representing UVR, with the highest correlation found between skin reflectance and Autumn UVR levels. Principal Component Analysis (PCA) revealed that most variables representing UVR and temperature were highly collinear. A multiple regression model applied to a subset of non-covarying environmental variables as revealed by PCA showed that skin reflectance was most highly correlated with Autumn UVR, followed by Maximum (Summer) UVR, Summer precipitation and Winter precipitation. The main finding of this study was that skin color could be almost fully modeled as a linear effect of Autumn UVR alone. Most of the departures from the linear model were minor, and could be accounted for by the nature and timing of human migrations. Our second major finding was that there appears to be a threshold effect of Maximum UVR on the evolution of skin coloration, past which no further skin darkening occurs. This finding suggests that in areas of high UVR, the rate of skin darkening may have slowed over time.

Age-related bone loss and intraskeletal variability in the Imperial Romans.

H. Cho, S. Stout. University of Missouri-Columbia, Columbia, MO, 65211, USA.

Bone mass varies within and among skeletal elements of the same individual and among individuals. Although a correlation between age-related bone loss among different skeletal elements has been noted, a lack of consensus exists as to the relative equivalence of bone loss among skeletal elements commonly affected with osteoporosis. The rate of cancellous bone loss is inconsistent with that of cortical bone loss, each leading to distinct fracture patterns among skeletal elements with differing proportions of these two kinds of bone.

Bone loss is a universal phenomenon, including in past populations. However, the incidence of bone fragility and fractures is relatively low in archaeological populations. An Imperial Roman sample from the Isola Sacra necropolis offers a unique opportunity to study age-associated bone loss and intraskeletal variability. The study sample is from an urban European archaeological population, distinct from previous bioarchaeological research based primarily on non-Western pre-industrial societies.

Multiple skeletal sites from the same individuals are available to address intraskeletal variability. The midshaft rib and femur (non-loadbearing and loadbearing cortical bone, respectively) and the anterior superior iliac crest (non-loadbearing trabecular bone) are examined for patterns of age-related bone loss and intraskeletal variability. Cortical bone samples are analyzed for static indices of bone remodeling and measures of bone mass (i.e., cortical area). Cortical thickness and trabecular bone volume are analyzed for the iliac crest bone samples. The patterns of age-associated bone loss in the ancient Romans are described and implications of these findings for understanding osteoporosis in modern populations are discussed.

Relationship by isonymy in sixteenth-century Yucatán.

A. Christensen. Rutgers University-Camden, Collingswood, NJ, 08107-2312, USA.

Surnames have been used to study population structure in many populations of European ancestry, but fewer indigenous ones. Unlike other Mesoamerican populations, the Yucatec Maya used indigenous surnames throughout the Colonial period, with males and females both keeping inherited patrilineal names after marriage. Analysis of these surnames using methods pioneered by Lasker, Relethford, and others provides a view of Maya population structure several decades after the Spanish Conquest. Two nominal censuses from 1583 were analyzed: One from the four *cahob*, or indigenous towns, congregated by Spanish authorities into the pueblo of Tizimin, and one from the three constituent barrios of the *cah* of Pencuyut. This illuminates three different scales of genetic distance: Between barrios, between *cahob*, and between regions. The greatest similarity was found between barrios; congregated *cahob* were slightly more distant from each other; and Pencuyut and Tizimin were further separated. At the same time, the barrios of Pencuyut had higher I_{ii} values (0.033-0.035) than the *cahob* of Tizimin (0.019-0.029). Thus individual barrios were more homogeneous than *cahob*. With sexes separated, males from different barrios were more divergent than females, indicating virilocal residence; the same pattern was less clear at the *cah* level. Within Tizimin, R_{ST} for males (0.00198) was slightly higher than that for females (0.00187); in Pencuyut, the male value (0.00301) was dramatically higher than the female (-0.00027). Combining males and females from both censuses, F_{ST} (0.00680) was dramatically higher than R_{ST} (0.000005).

New morphometric approaches to positive identification from frontal sinuses.

A. Christensen[1], D. Slice[2]. [1]Dept. of Anthropology, University of Tennessee, Knoxville, Knoxville, TN, 37996, USA, [2]State University of New York, Stony Brook.

Forensic anthropologists have, for years, been using frontal sinus radiographs in making positive identifications under the assumption that these structures are "as unique as fingerprints." While many studies confirm their uniqueness to the degree that two radiographs from a known individual can be correctly matched, few have pondered the probability of misidentification in a forensic context. Here, we explore the issue of assessing the potential error rate of objective sinus-based identification using parameterized sinus outlines.

Assertions of uniqueness should be given as the probability of a match given the correct identification versus the probability of a match from the population at large. These

probabilities can be obtained using measures of difference between coefficients from an Elliptic Fourier Analysis that describe sinus outlines while optionally controlling for variation in size, orientation, and location. Replicate radiographs of multiple individuals were scanned and stored as digital images. The outer borders of the sinuses in each image were outlined using Scion Image to obtain a series of x, y coordinates. The digitized outlines were parameterized using standard methods of Elliptic Fourier Analysis and between-radiograph distances computed in this multivariate parameter space. Individual uniqueness using this method is reported as the ratio of average distances between replicate radiographs and that between different individuals and the probability of correct identification is reported as the proportion of correct identifications based on the minimum distance between sinus outlines in EFA space. In addition, the effects of relative size, location, and orientation of the sinuses within individuals are considered.

First primate postcrania from the Eocene of Myanmar casts doubt on anthropoid origins in Asia.

R. Ciochon[1], G.F. Gunnell[2]. [1]University of Iowa, Iowa City, IA, 52242, USA, [2]Museum of Paleontology, University of Michigan, Ann Arbor, MI 48109.

Fossil primates have been known from the late middle Eocene Pondaung Formation of Myanmar since the first description of *Pondaungia cotteri* in 1927. All have been represented by fragmentary dental and cranial remains. Here we describe the first primate postcrania from Myanmar, including a complete left humerus, fragmentary right humerus, parts of both ulnae, and the distal half of a left calcaneum, all representing one individual. We assign this specimen to *Pondaungia* based on body size and known geographic distribution and diversity of Myanmar primates.

The humerus and ulna indicate that *Pondaungia* was capable of a wide variety of forelimb movements with great mobility at the shoulder joint. Morphology of the distal calcaneus indicates that the hind feet were mobile at the transverse tarsal joint. The postcrania of *Pondaungia* present a mosaic of features, many shared in common with a number of fossil and extant primates and some unique. Overall, *Pondaungia* humeral and calcaneal morphology is most consistent with that of other known adapiforms and does not support the inclusion of *Pondaungia* in Anthropoidea. Given that *Pondaungia* and *Amphipithecus* are closely related taxa that have been united in the "Amphipithecidae" on the basis of cranio-dental characters, this new postcranial evidence affords an independent view of their phylogenetic status. Neither cranio-dental nor postcranial evidence supports recognition of a larger-bodied anthropoid radiation in the Eocene of Asia. A possible explanation for the existence of these "anthropoid-like" taxa may be their opportunistic exploitation of open ecomorphospaces, otherwise occupied by true anthropoids in Africa.

Female immigration patterns in mantled howling monkeys (*Alouatta palliata*) on La Pacifica, Guanacaste, Costa Rica.

M. Clarke[1], K. Glander[2]. [1]Dept. of Anthropology, Tulane University, New Orleans, LA, 70118, USA, [2]Dept. of Biological Anthro. & Anatomy, Duke University.

While secondary transfer is not typical in mantled howler females, longterm records based on capture sessions and behavioral observations indicate that there are several situations where females do not stay in the first group they join after emigration from the natal groups. Between 1975 and 2001 there have been 70 documented cases of immigration by females over three years of age in two riparian and 3 upland habitat study groups. Of the 52 females under 6 years of age, 20 left in less than one year ("transients"), 5 left after three years("secondary emigrants"), and 27 remained in the group. Eighteen older females joined groups (age = 6 years with infant to 21 years), and 5 subsequently left ("multiple emigrants"). Permanent members vs. transients and later emigrants were compared by social factors (female age, group size, females in group, male takeover) and environmental factors (habitat, rainfall during joining year and previous year). When all animals were compared, there were no significant differences in any categories. When transients were eliminated, significantly more females of all ages remained in the group with increased rainfall the previous year, and left in the presence of a male takeover. When young immigrants were compared with older immigrants, older immigrants stayed when group size and resident females numbers were down, whereas young immigrants stayed when the group was larger. There was no significant effect of habitat, although there were more transients in the two riparian habitat groups, and older transients were more likely to stay in these groups.

The Sterkfontein Caves of South Africa are famous for the large number of fossil hominids attributed to *Australopithecus africanus*. Excavation and research in recent years has revealed that the cave breccias which span a time range from about 4 million years to over 100,000 years contain several hominid species. The well known member 4 breccia of 2.6 to 2.8 million years contains a second *Australopithecus* species in addition to *A africanus*.

The older deposits have another *Australopithecus* dating to 3.5 million years ago and the member 5 breccia contains *Paranthropus* at around 2 million years and *Homo ergaster* at about 1.7 million years.

These fossils are assessed within their temporal and environmental contexts.

The Hominid species of Sterkfontein through time

R.J. Clarke. Sterkfontein Research Unit, University of the Witwatersrand South Africa

The Sterkfontein Caves of South Africa are famous for the large number of fossil hominids attributed to Australopithecus africanus. Excavation and research in recent years has revealed that the cave breccias which span a time range from about 4 million years to over 100,000 years contain several hominid species. The well-known member 4 breccia of 2.6 to 2.8 million years contains a second Australopithecus species in addition to *A africanus*.

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These fossils are assessed within their temporal and environmental contexts.

Estimating hyoid bone morphology in earlier hominin species.

M. Clegg, L. Aiello. University College London, London, England, WC1E 6BT, United Kingdom.

Aspects of hyoid bone morphology are correlated with cranial morphology in modern humans and African Apes. Based on multiple regression analyses of associated crania and hyoid bones of modern humans (n = 56) and *Pan troglodytes* (n = 18) it is possible to predict hyoid morphology for humans and chimpanzees. The multiple regression equations for the two species are not interchangeable reflecting different anatomical relationships between hyoid bone and cranium in modern humans and chimpanzees.

This technique can be used to infer hyoid bone morphology for extinct hominins. When Neanderthal hyoid morphology is predicted using the La Chapelle-aux-Saints cranium with the human equations, the results are very similar to the observed proportions of the Kebara 2 hyoid. This is not the case when the chimpanzee equations are used. This is highly suggestive of a similar anatomical relationship between the hyoid bone and cranium in Neanderthals as is observed in modern humans with all of the implications for similar laryngeal position.

Four further hominin species are included in the analyses, *Paranthropus boisei, Australopithecus africanus, Homo sp.* and *Homo erectus.* The chimpanzee equations produce the only anatomically plausible hyoid results for *P. boisei* and *A. africanus*. Both the human and the chimpanzee equations produced plausible results for *Homo* sp. and the human equations the only plausible results for *H. erectus.* This suggests that major changes hyoid morphology, in the relationship of the hyoid to the cranium and, probably, to laryngeal position occurred much earlier in human evolution than many anthropologists have previously thought.

CSF 5-HIAA, life history and aggression in captive female rhesus macaques (*Macaca mulatta*).

A. Cleveland[1], M. Trenkle[1], I. Lussier[1], J. Higley[2], G. Westergaard[1]. [1]Labs of Virginia Inc., Division of Research, Charleston, SC, 29414, USA, [2]National Institute on Alcoholism and Alcohol Abuse.

Previous studies have documented the relationship between low CSF concentrations of the major serotonin metabolite 5-HIAA, severe aggression and increased risk of early mortality among male humans and non-human primates. Few studies however, have addressed similar questions for female primates. In this study, we present analyses of a longitudinal data set collected for a cohort of 45 female rhesus macaques (*Macaca mulatta*). Both physiological and behavioral data were collected across two housing conditions (single-cage and field cage). We tested the reliability of CSF 5-HIAA concentrations as predictors of both life history and behavioral variables. Specifically, we found: 1. The mean CSF 5-HIAA concentration among animals that had died was significantly lower than among living animals. Moreover, among animals that had died, females with the lowest CSF 5-HIAA levels died earlier than did females with higher CSF 5-HIAA concentrations. 2. A positive relationship existed between CSF 5-HIAA concentrations and infant survivorship. 3. An inverse relationship was found for CSF 5-HIAA concentration and number of medical treatments for illness. 4. Individuals with low CSF 5-HIAA concentrations were more often targets of aggressive bouts than were individuals with high concentrations of CSF 5-HIAA.

We conclude that low CSF 5-HIAA concentrations are correlated with early mortality, high incidence of illness, low offspring survivorship, and high rates of received aggression in female rhesus monkeys. These results suggest that negative life history consequences of impaired serotonergic functioning may generalize to both male and female rhesus macaques.

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The ontogeny of form variation in the African ape facial skeleton: a hierarchical approach to the interspecific comparison of ontogenetic trajectories.

S. Cobb, P. O'Higgins. Evolutionary Anatomy Unit, University College London, London, WC1E6JJ, United Kingdom.

Interspecific comparisons of the ontogenetic basis of form variation require a statistically satisfactory model of scaling for each species. Such models are typically linear descriptors of size correlated shape changes (ontogenetic scaling) across a pooled sample of juveniles and adults of both sexes. Recent intraspecific studies on the African apes demonstrate that, although the form of the facial skeleton of male and female juveniles within each species are satisfactorily explained by ontogenetic scaling, divergence from this juvenile trajectory plays a major role in intraspecific adult form variation. Thus a linear model for a combined sample of juveniles and adults can provide an inaccurate approximation. This paper tests the congruence of both types of trajectory amongst the African apes.

3D coordinates of 28 facial landmarks were collected from *Gorilla gorilla gorilla* (62 adults; 75 juveniles), *Pan paniscus* (34 adults; 61 juveniles) and *Pan troglodytes troglodytes* (58 adults; 57 juveniles). For each species: (a) juveniles and adults combined, and (b) juveniles only were registered using generalised Procrustes analysis and submitted to PCA. In each case the scaling trajectory for each of the two samples was determined as the size correlated PC, and their congruence from the significance of the angle between them.

Significant angles were determined for *P. paniscus* (13.9°; $p<0.036$) and *P. troglodytes* (21.3°; $p<0.001$), *G. gorilla* is insignificant (14.3°; $p<0.075$). Thus, to avoid potentially misleading approximations, scaling trajectories need to be confirmed by a hierarchical approach. Hypothetical ontogenetic trajectories of fossil species are discussed in light of these findings.

Bootstrap-based methods for comparing morphological integration patterns.

T. Cole[1], S. Lele[2]. [1]Dept. of Basic Medical Science, School of Medicine, University of Missouri - Kansas City, Kansas City, MO, 64108, USA, [2]Dept. of Mathematical Sciences, University of Alberta, Edmonton, Alberta T6G 2G1, Canada.

Matrix correlations and matrix permutation tests (MPTs) are often used to compare morphological integration patterns across samples. These patterns are described by either correlation or covariance matrices. The MPT evaluates the null hypothesis of a random association between matrices, where the expected matrix correlation is zero. The matrix correlation and its associated "p-value" are then interpreted as measures of matrix similarity. However, this approach has been questioned for several reasons: 1) it may not be a valid application of MPT, violating the exchangeability principle; 2) it does not consider sampling errors in the correlation or covariance estimates; and 3) it does not provide a way to "localize" differences between matrices.

This study introduces bootstrap-based methods that avoid many of the limitations of MPTs. We use the bootstrap to estimate marginal confidence intervals for the elementwise differences between matrices. The intervals contain information about the effects of sample variation on correlation/covariance estimates, and, most importantly, they provide a valid and effective way of localizing differences. We can optionally scale the matrices to examine differences in integration "intensity" and "pattern."

We demonstrate our method by studying phenotypic correlations using skeletal measurements for samples of newborn and adult rats. We find that the intensity of integration is generally higher in adults, but when the correlation matrices are scaled, subtle differences in integration patterns emerge. Specifically, we find a higher level of relative integration within the adult forelimb, while there is a higher level of relative integration within the infant hind limb.

Behavioral comparisons of primate audiograms.

M. Coleman. Stony Brook, Saint James, New York, 11780, USA.

Audiograms of 14 species of primates were gathered from the literature and statistically analyzed. Parameters examined included total area of the audible field, low frequency area, middle frequency area, high frequency area, sound pressure level (SPL) at 125 Hz, highest frequency at the 70 dB threshold, frequency of best sensitivity, and SPL of the most sensitive frequency. These variables were compared with behavioral data on activity cycle, substrate usage, and diet. Phylogenetic groupings were also considered.

The nocturnal primates examined have higher SPL's at 125 Hz than diurnal ones and they also show a trend for the most sensitive frequency to be higher, although not statistically significant ($p = .057$). Diurnal primates have significantly greater areal values for frequencies in the middle of the audible

field. Terrestrial species exhibit higher values than arboreal species for frequencies in both the low and middle ranges. The most sensitive frequency for insectivorous primates is considerably higher than for other dietary groups and they also have smaller areal values in both the low and middle ranges. Haplorhines hear more of the total, low, and middle areas of the audible field but Strepsirrhines show significantly higher frequencies at the 70 dB cut off. Although it appears that there may be a trade off for maximizing either the high or low end of the auditory spectrum, this negative correlation is not significant. Further research on hearing acuity combined with morphological data may shed light on the auditory environment and adaptations of extinct and extant primates.

Phylogenetic utility of papionin postcranial morphology.

M. Collard[1], S. Elton[2]. [1]Dept. of Anthropology, University College London, London, England, WC1E 6BT, United Kingdom, [2]Dept. of Anthropology, University of Kent at Canterbury.

Primate postcranial data are widely assumed to be less phylogenetically informative than their craniodental counterparts, but recent work has suggested that this does not hold true for the extant hominoids. Here, we shed further light on this issue by analysing data from the six extant papionin genera, whose relationships have been established using molecular techniques.

The data comprised size-corrected and coded values for 62 craniodental and 124 postcranial measurements. Two sets of analyses were performed. In the first, each data set was bootstrapped, and the resulting clades compared with the molecular phylogeny and with the clades yielded by the other data set. In the second, the data sets were subjected to parsimony analysis, and also fitted to a cladogram with the same topology as the molecular phylogeny. Thereafter, the percentage difference in length between the most parsimonious cladogram and the molecular-topology cladogram was computed. Lastly, the results of the craniodental and postcranial analyses were compared.

In the bootstrap analyses, the postcranial characters yielded a single clade, which was compatible with the molecular phylogeny. In contrast, the craniodental data yielded several clades, none of which was compatible with the molecular phylogeny. In the cladogram fitting analyses, the most parsimonious postcranial cladogram was only 3% shorter than the molecular-topology cladogram, whereas the most parsimonious craniodental cladogram was 18% shorter. These results indicate that papionin postcranial characters are more reliable for phylogenetic reconstruction than their craniodental characters.

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Identification of species-specific, maternal lineage in spider monkeys.

A. Collins. University of Wisconsin - Milwaukee, Milwaukee, Wisconsin, 53211, USA.

This paper reports a quick and easy method for the identification of the maternal, species-specific haplotype for spider monkeys (*Ateles*) using restriction fragment length polymorphism (RFLP) analysis. These RFLP markers were identified and tested on samples used in phylogenetic studies of mitochondrial DNA variation in *Ateles*. DNA was amplified using PCR for two mitochondrial regions; Cytochrome c Oxidase Subunit II (COII) and the Control Region in spider monkeys of known geographic origin throughout the Neotropics. Phylogenetic analysis of DNA sequences identified four distinct species of *Ateles*. These include *A. geoffroyi* in Central America and the Pacific coast of South America, *A. hybridus* in the Magdalena River valley of Colombia, *A. belzebuth* in the southern and western Amazon Basin, and *A. paniscus* in the northeastern Amazon River Basin.

Analysis of the DNA sequences with MacDNASIS software identified four restriction enzymes (AcyI, MboI, ScaI, and SSpI) that can be used on the more conserved COII amplicons to determine maternal species identity. These four enzymes will also differentiate between the subspecies of *A. geoffroyi*. A fifth enzyme (Tru9I) can be used to distinguish between two *A. belzebuth* subspecies. Analysis of the control region with the enzymes DraI and PstI can also provide identifications for two *Ateles* species.

Tests of these enzymes on animals from this study, as well as, zoo animals with known karyotypes were carried out in the lab and proved reliable. Thus, an effective, low-cost, quick method for maternal lineage analysis in *Ateles* is provided by this study.

The human fossils of La Chaise, Bougeois-Delaunay.

S. Condemi. CNRS - Centre de Recherche Français de Jérusalem, Jerusalem, 90041, Israel.

The theme of the present study is the human fossil remains found in the cave of La Chaise in Charente between 1967 and 1975 by André Debénath. According to this author (1974), most of the human bone remains found in the abri Bourgeois-Delaunay were imbedded in the stalagmite floor corresponding to level 11. This stalagmite floor was dated by U/Th. The date established for this level 11 is 151 000 +/- 15 000 (Schwarcz et al., ,1969, Debénath et al, 1979; Blackwell et al., 1990, 1992). This date is in agreement with palynological analysis of the stalagmite floor.

The human fossils originating in abri Bourgeois-Delaunay include 23 fossil remains belonging both to adults and to children. In this study, we have studied only the adult remains. These human fossils include a calvarium, a zygomatic bone, a temporal and an occipital bone, a jaw with a complete set of teeth, a fragment of the maxillary with three molars, a scapula, a femoral diaphysis and rib fragments. It is interesting to recall that these fossils from abri Bourgeois-Delaunay were discovered in a small space. No other area that was excavated yielded human specimens. Found on a paleofloor that was without trace of tools, these fossils, according to A. Debénath, could not have been part of a dwelling area.

On the basis of their morphological and metric features which are examined in the course of our study, the fossils of Bourgeois-Delaunay are to be grouped among the Neanderthals, from which they are only slightly differentiated. Certain bones are so similar to those of classic Neanderthals that, in absence of chronological and stratigraphic data, it would have been difficult to suppose a pre-Würmian age for these fossils.

The application of 3D μCT to the analysis of cortical bone porosity.

D. Cooper[1], B. Hallgrimsson[2]. [1]Dept. of Archaeology, University of Calgary, Calgary, Alberta, T2K 5C8, Canada, [2]Dept. of Cell Biology & Anatomy, Faculty of Medicine, University of Calgary.

Cortical porosity (CP), the area of pore spaces relative to the total sampled area of cortical bone, is a ratio that has been utilized to examine both the effects of normal age-related remodeling and pathological processes. To date, a great deal of variability in the regional distribution of CP between individuals, and indeed within individual bones, remains unexplained. This is despite many analyses considering factors such as age, gender, and body mass. A limitation of the traditional approach for measuring CP is the use of two-dimensional sections to sample the three-dimensional (3D) haversian system. Further, the model used for the examination of CP assumes that haversian canals are perfect cylinders, oriented parallel to the long axis of the bone, and sectioned for analysis perpendicular to this axis. This

model is susceptible to errors introduced both by the plane of sectioning and differences in haversian canal orientation. It can be mathematically demonstrated that sectioning a perfect cylinder at decreasing angles (<90°) produces ellipses of increasing area. Thus it is possible that apparent differences in CP are artifacts of sectioning and not indicative of overall porosity. Micro computed tomography (μCT) can be used to measure CP as a ratio of volumes through 3D reconstruction. We present a comparison of CP as a ratio of volumes versus a ratio of areas. We conclude that 3D μCT provides a better picture of CP at a single site within a bone and has the potential to examine other 3D characteristics of the haversian system.

Incidence of osteoarthritis at the trapeziometacarpal joint from the tomb at Tell Abraq, United Arab Emirates.

J. Cope[1], A. Berryman[2], D.L. Martin[3], D. Potts[4]. [1]Dept. of Anthropology, University of Massachusetts, Amherst, MA, 01003, USA, [2]Dept. of Occupational Therapy, Springfield College, Springfield, MA 01109-3797, [3]Natural Science, Hampshire College, Amherst, MA 01002, [4]Dept. of Archaeology, University of Sydney, Sydney, Australia.

An analysis of 646 metacarpal and carpal bones excavated from a large Umm an-Nar tomb at Tell Abraq, United Arab Emirates (ca. 2300 BCE) revealed a high incidence of osteoarthritis, a degenerative joint disease. Swanson (1995) reports that currently 37.4% of people aged 18 – 79 years experience osteoarthritis in their hands and/or feet. Waldron (1994) and Swanson (1995) also report that people who engage in physically-demanding occupations demonstrate a higher incidence of osteoarthritis at certain joints than people with more sedentary occupations

It is thought that the people of the Arabian Gulf of that time were agriculturists, herders and fishermen. In order to better understand who was buried in the tomb studies on individual bone elements are being conducted to calculate frequencies of occupationally related skeletal disorders including osteoarthritis. The demographic profile of the tomb by age categories suggests a well-represented Neolithic population. However, specific aging and sexing of the hand bones is not possible because of the disarticulated and commingled nature of the collection.

In this study, the trapeziometacarpal joint (TMJ) of the thumb was specifically evaluated, as it is one of the first to demonstrate signs of osteoarthritis in living populations. Over 55% of the TMJ facets showed signs of osteoarthritis, varying from mild to severe. Findings of osteoarthritis at this high a rate in the Tell Abraq specimens suggest that heavy labor was the norm.

The populations in the circum-Caribbean area from the 4th millennium B.C. to the conquest: the biological relationships according to possible migratory patterns.

A. Coppa[1], A. Cucina[2], M. Lucci[1], A. Pellegrini[1], R. Vargiu[1]. [1]University of Rome, Rome, 185, Italy, [2]University of Missouri - Columbia.

The migrations that led to the peopling of the Caribbean area took place beginning in the 4th millennium BC and originated from different continental neighbouring areas. By the time of the conquest, the islands were densely populated by what the chronicles reported as the Ciboney, Arawak (Tainos) and Carib cultures. This paper investigates the extent of biological relationship among various groups from the circum-Caribbean area through the analysis of dental morphological traits. Six different groups have been analyzed, identified according to their geographical location: Florida, Cuba, Santo Domingo, Virgin Island, Puerto Rico and Venezuela. The samples belong to different cultures and span wide chronological times. We tried to investigate the biological affinities of groups from the same and different migratory movements. Several multivariate statistical techniques have been applied: Maximum Likelihood, Principal Component Analysis, Multidimensional Scaling, Minimum Spanning Tree and Mean Measure of Divergence. A separation between cultural, even though coeval, groups arose, along with different relationships among island groups compared to the continental ones. The Tainos (from Santo Domingo, Virgin Islands and Puerto Rico) always clustered together and separated from the Ciboney of Cuba, the latter being considered the result of earlier migratory events. Interestingly, the preceramic sample of Cueva Roja (an earlier non-Taino group from Santo Domingo dated between the 3rd and 2nd millennium BC.) merges towards the Cuban Ciboneys, indicating its origin from one of the first migrations towards Hispaniola during the 4th millennium BC. Instead, no clear affinity of the samples from southern Florida and Venezuela emerges. The former ones, even the more ancient, do not seem to have any relationship with the Ciboneys. Their less distinct biological collocation related to the island groups could result from within the subcontinents demic movements and a higher gene flow, contrarily to what occurred to the geographically and genetically more closed island populations. Research granted by MURST COFIN1999, MAE and 60% Grant by the University of Rome “La Sapienza.”

Fatty acid composition and energy density of foods available to hominids: implications for encephalization.

L. Cordain. Colorado State University, Fort Collins, CO, 80523, USA.

With the emergence of *Homo* >2 MYA, brain/body mass (ENC) increased. Because brain is more metabolically active at rest than body resting metabolic rate (RMR), a rise in ENC requires that either RMR increases or that the size/metabolic rate of another tissue is reduced. Comparisons of human and primate gut mass and of RMR relative to the Klieber equation demonstrate that ENC increased via reductions in gut size/metabolic rate. To relax selective pressures that had selected a large gut to process largely vegetarian diets in earlier hominids, an increase in food energy density (FED) was necessary. Increasing meat consumption is frequently cited as the responsible element. Mammalian inter-species comparisons of brain docosahexaenoic acid (22:6n3) and arachidonic acid (20:4n6) reveal constant concentrations across species regardless of ENC. Because the chain elongation and desaturation of 18:2n6 to 20:4n6 and 18:3n3 to 22:6n3 are inefficient, ENC rises are constrained unless preformed dietary 20:4n6 and 22:6n3 are present. Hence, sizeable ENC rises require dietary increases in FED, 22:6n3 and 20:4n6. Muscle is rich in 20:4n6 but not 22:6n3 or FED. Marrow has high FED, but is devoid of 22:6n3 and 20:4n6. Subcutaneous fat has high FED but only traces of 20:4n6 and 22:6n3. Brain has a moderate FED but is rich in 22:6n3 and 20:4n6. Fish are rich in 22:6n3 and 20:4n6 but have low FED. Because early hominids likely were not successful big game hunters or fishers, then scavenged skulls (brain), represented the richest 22:6n3 and 20:4n6 source while scavenged long bones (marrow) were the primary high FED source allowing encephalization to proceed.

Fracture patterns in a large contemporary skeletal sample: 30 years of casework at the C.A. Pound Human Identification Laboratory.

S. Coyle, K. Jemmott, H. Walsh-Haney, A. Falsetti. C.A. Pound Human Identification Laboratory, University of Florida, Gainesville, Florida, 32611, USA.

Since its inception in 1972, the C.A. Pound Human Identification Laboratory has received nearly 1,600 forensic cases. Of this total, 382 individuals (24%) exhibited some type of ante/perimortem blunt force trauma. This poster will illustrate the demographics and fracture patterns of this large sample.

Of the 382 individuals, there are 233 males, 145 females, and 4 of unknown sex.

There are 19 subadults, 144 young adults, 110 middle adults, and 109 old adults. A total of 268 individuals are white, 75 are black, and 39 are of other ancestries. The majority of cases originated from medical examiners in the north Florida region (37.2%), followed by south Florida (27.3%), central Florida (23.8%), and the Panhandle (4.3%).

In both male and female antemortem trauma, fractures most often occurred on the nasal bones (19.1% and 21.3%, respectively) and thorax (15.7%, 20.6%). Male and female perimortem trauma was seen mostly on the cranium (23.5%, 14.4%) and thorax (12.2%, 12.4%). In both males and females, two-thirds more postcranial than cranial fractures occurred antemortem, while twice as many cranial than postcranial fractures occurred perimortem.

Significant differences ($p<.01$) were found between males and females, types of trauma, ancestry, and region of the state. There is also a significant correlation ($r = .4$, $p<.01$) between the dual occurrence of cranial and postcranial trauma, in both antemortem and postmortem circumstances. Our findings demonstrate the importance of examining the often-neglected postcranial skeleton in skeletal fracture pattern analyses.

Arm swing and thermoregulation of early hominids.

A. Cross. Dept. of Anthropology, University of Toronto, Toronto, Ontario M5S 3G3, Canada.

This paper reviews bipedal gait analysis with special consideration given to arm swing. The current total body surface area estimation methods fail to incorporate this variable which has limited our understanding of hominid thermoregulation. A new "ideal model" is presented. Future models should be judged by how completely they fulfill the requirements of the ideal model. The importance of analyzing thermoregulation as an efficiency modifier on moving, not standing, subjects is stressed. With this approach it can be seen that during a striding bipedal gait the arms traverse a greater amount of space than the rest of the moving body as a result of their swinging movement. Consequently, the arms are capable of dissipating heat through convective methods 13-36% more effectively than the rest of the hominid body, depending on the speed of walking. This suggests the possibility of travel even further away from water resources than what has been previously posited. It is also shown that the relatively longer arm length of the Australopithecines suggests that they would have benefited even more than *Homo* from convective thermoregulation resulting from arm swing. These thermoregulative benefits imply an evolutionary significance to this inevitable feature of a striding bipedal gait.

Reaction to novel objects by captive slender lorises: implications for behavior in the wild.

C. Crozier. Southern Illinois University-, Dept. of Anthropology, Carbondale, Illinois, 62901, US.

A number of studies on enrichment for captive animals have shown its value for anthropoid primates, but this contains little information for nocturnal primates. In addition, there are few data on the response of nocturnal primates to novel objects, either in captivity or in the wild. It can be very beneficial for a researcher to study an animal's behavior in captivity before going out into the field. This study examined the response of captive slender lorises (Loris tardigradus noriducus) to a variety of novel objects that could represent potential food items and predators.

Eleven different novel objects were presented to individual lorises, each independently. An instantaneous focal sampling was used to record the observations of 11 captive slender lorises in July 1996. The sex, exact behavior, positions, and height of animal in enclosure was noted every 30 seconds. A total of 2,518 observations were made over a period of approximately one-month. An ANOVA analysis was performed on this data.

Results show that the presence of a novel object lowered inactive stress levels and raised activity levels and locomotion of both the male and female subjects. ($X^2 = 21.994$, $df = 8$, $p<.0001$) Both sexes showed very significant reactions to the presence of a novel object. Although not much is known about slender lorises in the wild, it can be concluded that the lorises are displaying natural responses toward these novel objects. Understanding this natural response can be useful in studying lorises in the wild as well as improving their care in captive settings.

Middle Pleistocene paleoenvironments of hominid sites in the Western Cape.

K. Cruz-Uribe[1], R. Klein[2]. [1]Dept. of Anthropology, Northern Arizona University, Flagstaff, Arizona, 86011, USA, [2]Program in Human Biology, Stanford University.

This paper focuses on the paleoenvironmental implications of large mammal faunas from Middle Pleistocene sites in the Western Cape. Two of the most well known localities in this regard are the Elandsfontein Main site, which probably dates between 700,000 and 400,000 years ago, and Duinefontein 2, which probably dates between 400,000 and 200,000 years ago. The mammal remains from both sites suggest environments that were significantly different from that recorded historically. At both sites, grazing species are much more common than in the historic fynbos environment. Mean individual carnivore size provides another means of assessing ancient environments, and data from Elandsfontein Main suggests that temperatures during the time of bone accumulation were similar to those recorded historically.

Dental anthropology, settlement pattern, and social structure at the Maya site of Xcambó, Yucatán.

A. Cucina[1], V. Tiesler Blos[2], T. Sierra Sosa[3]. [1]University of Missouri at Columbia, Columbia, Missouri, 65211, USA, [2]Facultad de Ciencias Antropológicas, Universidad Autónoma de Yucatán, Mérida, [3]Centro INAH Yucatán, Instituto Nacional de Antropología e Historia, Mérida.

Dental anthropology, settlement pattern, and social structure at the ancient Maya coastal site of Xcambó, Yucatan, is a small settlement dated to the Classic Period. Its population subsisted on sea products, supplemented by agriculture, and was active in the production and trade of marine salt. Extensive excavations between 1996 and 2001 retrieved 514 skeletons from the site, constituting one of the largest and better-preserved prehispanic burial populations from the Yucatan peninsula. The individuals apparently lived in patio groups and compounds where they were also buried. Compounds were variable in number of individuals, ranging from few to about forty excavated individuals per residential group.

The present study describes and interprets the results obtained from the anthropological analysis of dental remains -nonmetric traits (ASU dental system), enamel defects and oral pathologies- of 250 adult and sub-adults skeletons. The data were investigated according to spatial distribution, especially relative to the domestic patio compounds, to gain new insights of Classic Maya filiation and kinship patterns, family organization, social dynamics, nutritional and pathological variability. Enamel defects and oral pathologies do not discriminate between different compounds, showing a high level of homogeneity within the population (i.e. general low frequencies of defects and relatively high frequency of oral pathologies also related to age at death). Non-metric traits also indicate a general level of homogeneity.

Multidimensional scaling and principal component analysis do not clearly cluster the compounds investigated, although adult females often separate from their compounds. Despite being a trade center the population

looks very homogeneous in terms of dental morphology and oral pathologies.

Neonatal body fat: a uniquely human attribute essential for brain expansion.

S. Cunnane. Dept. of Nutritional Sciences, Faculty of Medicine, University of Toronto, Toronto, Ontario, M5S 3E2, Canada.

Amongst terrestrial animals, humans are unique in having fat babies. There is normally about 500–600 g of fat (15% of body weight) at birth in humans; risk of sub–optimal neurological development increases markedly as body fat at birth decreases. At birth, the human brain consumes over 60% of the body's energy requirement so the energy reserve in fat is vital for the vulnerable and rapidly developing brain. The brain also requires certain fatty acids, i.e. docosahexaenoate (DHA), which are in short supply in the terrestrial diet. In healthy, term infants, sufficient DHA is present in body fat at birth for 3 months brain growth. Fetuses of macaques and humans have brains of similar size at 45–50 days old. Chimpanzees are born without body fat but with brains almost as large as human neonates. Therefore, before birth, the embryonic potential for brain expansion seems broadly similar across different primates but this potential was only fully exploited in humans. Why? The deposition of fetal fat in humans undoubtedly required a cluster of genetic mutations that promote fetal fatness, i.e. increased fat cell development, fat synthesis and/or fat transport. Sustained full expression (evolution) of such mutations probably depended not only on a high quality diet but also on a lifestyle sufficiently sedentary to permit maternal and fetal fat deposition. Shore–based subsistence would have provided the best opportunity to meet the exceptional metabolic demand of fetal fat deposition while simultaneously expanding the brain.

Experimental evidence of long-term memory for resource locations in *Pithecia pithecia* .

E. Cunningham[1], K. Swartz[2], C. Janson[3]. [1]City University of New York Graduate School/NYCEP, Brooklyn, New York, 11211, USA, [2]Lehman College of the City University of New York, [3]State University of New York - Stony Brook.

Observations of primates in nature suggest that they consider a number of variables when deciding on a travel route. A study we conducted of wild white-faced sakis (*Pithecia pithecia*) suggests that they learn the location of resources and consider their productivity when choosing sites to visit. To test our interpretations of the field data, it was necessary to conduct a series of experiments in more controlled conditions.

We report the results of experiments testing long-term memory, which were conducted at the Roger Williams Park Zoo in Rhode Island. Three groups and an individual saki were presented with up to eighteen closed containers, half of which were baited. Baited and empty containers were placed in the same locations in each trial. After the sakis reached criterion performance, we analyzed their ability to recall baited locations after delays of 1, 2, 4, 7, 14, 21, and 120 days.

The sakis opened 4.5 times as many baited containers as empty containers (Chi-square = 64.4, 1 df, $p < 0.000$). Although the sakis took numerous trials before they consistently opened the baited containers first, even the longest delay did not weaken their performance.

The results strongly support the hypothesis that sakis use long-term memory to locate resources. The sakis may have needed repeated exposures to develop an appropriate strategy for the experiments. The ability to remember where resources are located for long periods of time may be highly adaptive.

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Dental variation in *Arapahovius gazini* with comments on the early Eocene (Wasatchian) community ecology of the Washakie Basin, WY.

F. Cuozzo. Las Positas College, Livermore, CA, 94550, USA.

The early Eocene omomyoid primate *Arapahovius gazini* was first described by Savage and Waters (1978), based on material recovered from the Washakie Basin, WY. Because of its limited distribution (a 15 meter stratigraphic interval of the Washakie Basin), and as it is easily distinguished from sympatric primates based on its strongly crenulated enamel, *Arapahovius gazini* provides an excellent taxon with which to investigate dental variability in extinct primates. Here I present data on the patterns of dental variation in *Arapahovius gazini*, based on an analysis of previously described and newly recovered material from the Washakie Basin, WY.

A series of measurements was collected from a sample of 54 *Arapahovius gazini* dental specimens. A set of morphological traits was also scored for the sample. Despite a sample that spans several distinct strata within the overall stratigraphic interval, the degree of metric variation is quite limited, with lower molar length CVs of 3.04 for M_1 (mean = 2.30mm, n = 21), 3.56 for M_2 (mean = 2.25mm, n = 33), and 4.78 for M_3 (mean = 2.93mm, n = 23). There is also limited variation in several morphological traits previously described as being representative of the species, such as the absence of a P_3 metaconid in 22% (n = 9) of the specimens studied. As this species shows limited variability across its entire stratigraphic distribution, this pattern may be due, in part, to the ecological adaptations of *Arapahovius gazini*, which contrast to those of sympatric omomyoid primates (e.g., *Anemorhysis savagei*).

The Mauer mandible: a paleopathological analysis.

A. Czarnetzki[1], T. Jakob[2], C.M. Pusch[3]. [1]Institute of Anthropology and Human Genetics, Dept. of Paleoanthropology/Osteology, University of Tuebingen, Germany, Tuebingen, Germany, 72074, Germany, [2]Dept. of Archaeology, University of Durham, Durham, DH1 3LE, United Kindom, [3]Ophtalmological University Hospital, Molecular Genetics Lab., Div. II, Morgenstelle 15, D-72076 Tuebingen, Germany.

A new preparation of the Mauer mandible as well as specific conservatory treatments were conducted in 1996 and gave rise to the intense 2001 palaeopathological examination presented here. Based on comparative analyses, the breadth of the mandibular ramus, its flat intercondylar incision in conjunction with the flattening and broadening of the coronoid process tip results either from an idiosyncratic pattern of the course and insertion of the temporalis muscle on the coronoid process, or from an anatomical variant of temporalis possessing an accessory head. The incidence of periodontal pocketing, together with a vertical reduction of the alveolar margin to approximately 3.00 mm and a slight protuberance formed in the vicinity of the right M2 can safely be interpreted as pathognomonic indications of periodontitis. The small distance between the enamel-dentine-junction and the horizontal alveolar margins could either be an inherited variant or may result from incipient osteoporosis. Apart from an arthritic condition with slight osteophytic peripheral exostoses and an arthrolith on the right *condylus articularis* (i.e. an articular calculus), a depression in the medial part of the left mandibular condyle together with spreading into the inferior part of the ramus is obvious. These features are indicative of a trauma-induced *osteochondrosis dissecans*. The diagnosis therefore suggests that the observed depression results from an excellently healed fracture.

Stereotypical bone distribution in the mandibular corpus of anthropoid primates.

D.J. Daegling, J.L. Hotzman. Dept. of Anthropology, University of Florida, Gainesville, Florida, 32611-7305, USA.

The functional morphology of the primate mandible has been informed by comparative investigations of variation in cross-sectional geometry. Size and shape of the corpus is described in such studies by linear or areal measures from which second moments of area may be derived. While information on cortical bone thickness may be incorporated into such calculations, local differences in cortical thickness are not ordinarily the focus of investigation.

Existing data for anthropoids representing Platyrrhini (2 species) and Catarrhini (7 species) provide circumstantial evidence that cortical bone thickness is stereotypically asymmetric in both the molar region and in the anterior corpus. Specifically, the corpus under the molars is typified by lingually thin and basally thick compact bone. In midsagittal section, by contrast, both lingual and basal aspects of the corpus display relatively thick cortical bone.

We employ an experimental approach to examine the consequences of cortical thickness variation on the local stress environment. Using a sample of formalin-fixed human and nonhuman primate mandibles, we examine surface strain gradients *in vitro* under the combined effects of the major loading regimes known to occur during masticatory behaviors. These include torsion, parasagittal bending and direct shear in the postcanine corpus and coronal and transverse bending at the symphysis.

Experimental results are used to evaluate a series of hypotheses that local differences in cortical thickness are functionally linked to the masticatory strain environment. The validity of certain premises of the area-moment approach is also evaluated in light of our experiments.

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Subsistence patterns and seasonality of vital events in historical times in Central Apennines (Abruzzo, Italy).

M.E. Danubio[1], A. Coppa[2], G. Gruppioni[1]. [1]University of L'Aquila - Italy, L'Aquila, 20100, Italy, [2]University of Rome, Rome, 185, Italy [3].

Historical studies of isolated populations contribute to the maintenance of their cultural identity. The collection and analysis of archival data is a constructive way to conserve a cultural patrimony. The interpretation of indirect sources leads to an understanding of the factors that have directed the evolution of the single communities, determining their biocultural differentiation. Moreover, from an ecological viewpoint, the reconstruction of human ecosystems and their stability in time allows insight into the processes of adaptability developed by isolated communities. Within this frame, seasonality of vital events are good indicators of the effects of the different 'traditional' lifestyles, that are, in turn, the result of the ecological context in which a population developed specific subsistence modes. In fact, the time of wedding is influenced by cultural traditions, demographic structure, socio-economic and environmental conditions. Similarly, seasonality of births reflects the cultural attitude towards the best time to conceive in relation to working activities and loads, the latter limiting physiological fertility. The present research refers to gross natality rates and seasonality of births in pastoral and agricultural groups in historical times in Central-Southern Italy and correlates the monthly distribution of conceptions to that of marriages. Pastoral communities displayed natality rates that averaged 26 per 1000, and showed a marked pattern of seasonality of births: 80% occurred between February and July. The correlation (r = 0.86) between month of conception and month of marriage is high. This strict correlation was due to the absence of men during winter because of transhumance. In agricultural groups, on the contrary, natality rates were on average 35 per 1000, and the seasonal distribution of births shows the highest concentration (60%) between November and April. The correlation between month of conception and month of marriage is very low (r = 0.3). These findings suggest that pastoralism acted as a primary reproductive regulator.

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Auditory ossicles of *Paranthropus robustus* from Swartkrans, South Africa.

D. De Ruiter[1], J. Moggi-Cecchi[2], M. Masali[3]. [1]University of the Witwatersrand, Johannesburg, Gauteng, 2050, South Africa, [2]Universita' di Firenze, [3]Universita' di Torino.

Auditory ossicles are among the rarest of bones in the hominin fossil record of Africa. We report on the discovery of two ossicles recovered from a basicranium that has been attributed to *Paranthropus robustus* (SKW 18). The first specimen, an incus bone, provides comparison with a previously recovered *Paranthropus* incus from Swartkrans (SK 848). The second specimen, a malleus, is the first of its kind recovered for *Paranthropus*. Although the morphology of these ossicles is similar to that of humans, significant differences between the taxa are apparent.

The overall shape of the incus of SKW 18 is similar to SK 848 in that both display a bulbous, inflated body relative to humans. The processes of the *Paranthropus* incudes are narrow and curved, unlike humans. The articular surfaces of the incudomalleolar joint of the *Paranthropus* ossicles are deeper and not as medially rotated as is seen in humans. The malleal head of SKW 18 is large, bulbous and rounded. By comparison, the malleal head of humans, although rounded, is narrow and elongate. The manubrium of SKW 18 is straight and parallel-sided for most of its extent, with a slight lateral convexity towards the umbo.

A moderate amount of intra-specific variation is evident when the two incudes of *Paranthropus* now available from Swartkrans are compared. The new malleus provides anatomical data for a type of bone previously unknown in the australopithecine fossil record. The phylogenetic and functional implications of the morphology of these tiny bones are discussed.

Contribution of central nervous system characters to hominoid phylogenetics.

A. De Sousa[1], B. Wood[2]. [1]Doctoral Program in Hominid Paleobiology, The George Washington University, Washington, DC, 20052, USA, [2]CASHP and The Dept. of Anthropology.

A recent study by Gibbs et al. (2000) has suggested that soft tissue characters are more reliable for reconstructing hominoid phylogeny than hard tissue characters. A cladistic analysis involving exclusively soft tissue characters has yielded results consistent with the consensus molecular phylogeny for the Hominoidea, in which *Homo* is the sister taxon to *Pan*, to the exclusion of *Gorilla*. This contrasts with hard tissue based phylogenies, which have tended to support *Pan* and *Gorilla* as sister taxa, to the exclusion of *Homo*. It has been suggested that soft tissue characters are more phylogenetically useful than hard tissue characters because the latter are less susceptible to homoiologies. However, the Gibbs et al. (2000) soft tissue data set did not include any evidence from the central nervous system.

The current study is a continuation of the aforementioned research, in which the coverage of the soft tissue characters has been expanded to include the central nervous system (CNS). Published data on the CNS of five hominoid species (*Homo sapiens, Pan troglodytes, Pan paniscus, Gorilla gorilla, Pongo pygmaeus*) and one outgroup (*Hylobates*) have been used to generate CNS soft tissue characters. A preliminary cladistic analysis performed on a subset of these data has generated a single most parsimoni-

ous cladogram with the topology: (((((*Homo sapiens*, *Pan paniscus*) *Pan troglodytes*) *Gorilla gorilla*) *Pongo pygmaeus*) *Hylobates*). This is in broad agreement with the consensus molecular phylogeny, but differs from it in that the genus *Pan* is paraphyletic.

Please don't throw the baby out with the bath water: skeletal characters in cladistic analyses of hominoid evolution.

A. Deane, D. Begun. University of Toronto, Toronto, Ontario, M5S 3G3, Canada.

Although cladistics is widely accepted as the standard methodology for interpreting primate phylogeny, debate over its implementation remains. Specifically, Wood and Collard (2000, 2001) question the reliability of hominoid skeletal characters for phylogenetic reconstruction, based on their observations of widespread homoplasy and their inability to produce a tree topology congruent with accepted molecular phylogenies. In contrast, cladograms from Groves (1986), Begun (1992, 2001), Shoshoni et al. (1995), and Begun et al. (1997) are completely congruent with similar analyses of molecular data and suggest that skeletal morphology does contain a reliable phylogenetic signal. Examination of character lists from all studies identifies a significant degree of dissimilarity in the number and types of characters included (qualitative vs. quantitative), the anatomical regions sampled, the coding of individual characters, and the ingroup and outgroup taxa. We suspect that the discordant phylogenetic conclusions do not result from an intrinsic shortcoming in the skeletal evidence of hominoid phylogeny but instead from these methodological differences.

340 qualitative characters representing hominoid cranio-dental and post-cranial anatomy were analysed from recent data collected by the authors, and from all the sources listed above. The results unambiguously support an African ape - Human clade excluding Pongo, and a Pan - Human clade excluding Gorilla. This suggests that when large numbers of qualitative morphological characters representing cranio-dental and post-cranial anatomy are included in a carefully constructed character state analysis it is possible to accurately infer phylogenetic relationships among hominoids, and provides some reason for optimism in our ability to reliably classify most fossil hominids.

Primate phylogeny based on complete mitochondrial genome sequences.

D. DeGusta, H.M. Fourcade, J.L. Boore. Joint Genome Institute, U.S. Dept. of Energy; and Laboratory for Human Evolutionary Studies, University of California, Berkeley, Berkeley, CA, 94720-3160, USA.

Primate evolutionary relationships are not well characterized, even at higher taxonomic levels. This is a fundamental problem in biological anthropology, since a phylogenetic framework is required to understand an organism's biology, behavior, and ecology. While numerous studies of primate phylogeny have been conducted, they have generally focused on relationships within sub-families or genera. Morphological studies have often used characters of questionable validity. Molecular studies have been limited to only a few loci examined in relatively few taxa. In general, neither the various morphological or molecular studies have produced congruent, robust, well-resolved trees.

The solution to this problem is to use an expanded dataset, both in terms of characters and taxa sampled. For the problems at hand, molecular data is preferred over morphological data (though it is not without its problems). With the advent of the genomics era, we now have the ability to rapidly generate large DNA sequence datasets. We are using the production sequencing capabilities of the Joint Genome Institute (~28 million nucleotides per day) to sequence the complete mitochondrial genomes of a variety of primate genera.

With complete mitochondrial genome sequences, primate phylogeny can be reconstructed from multiple homologous loci. The most "clock-like" mitochondrial locus can be identified and used to provide estimates of relative and absolute divergence dates. The pattern of evolution of the mitochondrial genome within primates can be ascertained. In addition to clarifying key issues of primate evolution, such work brings molecular anthropology into the genomics era.

Adaptationism and cladism in human evolutionary studies.

R. Delisle. Dept. of Anthropology of both McGill University and the University of Montreal, Verdun, Québec, H3E-1J1, Canada.

The field of human evolution has been subjected to a number of theoretical changes in the past fifty years. This review will examine developments during the following periods : 1) 1950-1960 – the impact of the evolutionary synthesis on phylogenetic reconstructions; 2) 1960-1975 – the impact of the use of the concept of culture in conjunction with biological principles; 3) Post-1975 – the impact of cladistics and new developments in evolutionary biology. This review essay insists on the importance of historical analyses to get as better understanding of the progress of the field of paleoanthropology.

Assessment of quantitative characters in the distal humerus among hominids (great apes and hominins).

E. Delson[1], M. Friess[2], L.F. Marcus[3], D.P. Reddy[4]. [1]Dept. of Anthropology, Lehman College/CUNY, Bronx, NY 10468; Division of Paleontology, American Museum of Natural History, New York, NY 10024; NYCEP Morphometrics Group, New York Consortium in Evolutionary Primatology; Fort Lee, NJ, 7024, USA, [2]Division of Paleontology, American Museum of Natural History, New York, NY 10024; and NYCEP Morphometrics Group, New York Consortium in Evolutionary Primatology, [3]Division of Paleontology, American Museum of Natural History, New York, NY 10024; Dept. of Biology, Queens College/CUNY, Flushing, NY 11367; and, NYCEP Morphometrics Group, New York Consortium in Evolutionary Primatology, [4]Interdept. Laboratory, American Museum of Natural History, New York, NY 10024; and NYCEP Morphometrics Group, New York Consortium in Evolutionary Primatology.

The articular morphology of the distal humerus is known to reflect adaptation to patterns of locomotion in living primates. It has been argued that the more arboreal orangutans are characterized by relatively deep fossae, whereas large-bodied knuckle walkers have relatively larger articular surfaces than smaller-bodied ones. Numerous studies have provided comparisons based on conventional and landmark morphometrics, some of which are restricted to 2D. However, a three dimensional model of the humerus was expected to contain significantly more information about the functional variability of the distal articulation. We collected data with a Cyberware 3D laser surface scanner having a physical resolution of 0.1mm. We sampled articular surfaces of great apes (*Pongo, Pan, Gorilla*), as well as living and fossil humans. These data allow for a comparative analysis of terrestrial versus more arboreal quadrupedal locomotion, as well as the unique bipedal pattern of humans. Ultimately, one of the goals was to assess the morphometric affinities of hominin fossils whose phylogenetic position remains unclear, such as TM 1517 and KNM-ER 739. Area to volume ratios were determined for different functional components and compared across these taxa. Size-related variations, such as sexual dimorphism, were also taken into account for extant taxa. Major differences at the generic level can be seen in the size of the articular surface relative to the entire humerus, and in the relative size of the capitulum. Our results suggest different allometric patterns in chimpanzees compared to australopiths, contradicting previously claimed affinities.

Chimpanzee walking.

B. Demes[1], J. Polk[2], W. Jungers[3]. [1]Dept. of Anatomical Sciences, State University of New York at Stony Brook, Stony Brook, N.Y., 11794-8081, USA, [2]Harvard University, [3]SUNY Stony Brook.

When walking quadrupedally, the trunk of chimpanzees is angled obliquely relative to the direction of movement, and the hindlimbs pass the ipsilateral forelimbs; i.e., they overstride. We explored the kinematics of knuckle-walking and how they change with age and body mass. We recorded gait parameters, body mass and limb proportions in two male chimpanzees over a period of 4 years between 4 and 8 years of age, during which time their body mass nearly tripled. Markers were attached to the animals overlying all major limb joints, movements were recorded on video, and temporal and spatial gait parameters were calculated from marker coordinates digitized on sequences imported into Peak motion analysis software. Gaits were compared at equivalent Froude numbers to account for the change in mass. Over the age range covered, limb proportions changed little with mass. However, the animals walked with longer strides and lower stride frequency at older ages. Despite the geometric similarity of the animals at different age stages, their gaits are not dynamically similar. Whereas the decrease in stride frequency confirms predictions derived from allometric gait models, the increase in stride length does not. Angular excursions and knee and elbow angles are highly variable; i.e., the change in stride length is not achieved by a uniform pattern of angular changes. In comparison to our common chimpanzees, bonobos tend to walk with longer strides and lower stride frequencies (Aerts et al., 2000); i.e., they are more similar in gait to the older chimpanzees. Supported by NSF SBR-9806291.

Osteological markers and habitual behaviors, assessing the connection at Hierakonpolis, Egypt.

N. Denton. Dept. of Anthropology, University of Alaska Fairbanks, Fairbanks, AK, 99708, USA.

Reconstructing patterns of habitual behavior using skeletal material provides an independent line of evidence for archaeologists accustomed to working with material culture. This study examines MSM and osteoarthritic changes in the shoulder, elbow, hip and knee in a 5000-year-old agricultural population from the Nile River Valley. These markers are compared to hypothesized behavior patterns developed to identify specific activities.

The individuals examined were all members of the working-class population of Hierakonpolis. This city was one of the first in the region to be supported by intensive agriculture. This is a portion of the group of people who built the foundations for the elaborate political and religious structures that became Ancient Egypt.

Six hypothesized activities were selected for comparison. They are grinding grain, weaving, cultivation with a hoe, cultivation with a digging stick, shooting a bow and arrow, and irrigating using a shaduf. These activities were selected to represent work considered both male and female in various cultures, and alternate means of cultivation. The hypotheses were tested on the 37 individuals for which data were collected.

The results of these tests suggest that there are differences in activity levels within this working class population. The differences divide out by sex, and age. This study is small in scale and the results are not meant to be conclusive. Rather it is an initial attempt to incorporate different types of osteological analysis and hypothesis testing in the reconstruction of ancient behavior, in Predynastic Upper Egypt.

Anterior dental dimensions and the evolution of human facial form in the Middle and Late Pleistocene.

R. DeRobertis. Dept. of Anthropology, Northern Illinois University, Dekalb, Il, 60115, USA.

A variety of explanations and interpretations of the evolution of human facial form in the middle and late Pleistocene have been proposed in the paleoanthropological literature. Recognizing that the different morphological complexes of the face, (i.e. the dentition, nasal apparatus, and masticatory apparatus) are not discrete units but interact with one another, a study was undertaken to determine the effect one complex of the face, the anterior dentition, has on midfacial prognathism. Due to the lack of pertinent fossil specimens in which both the anterior dentition and the midfacial regions are preserved, analysis was undertaken using a comparative modern human sample. Dental and facial dimension data were scored for 150 modern human crania from four geographical populations. The data were scaled for size then subjected to several methods of statistical analysis. Results indicate that a positive correlation exists between anterior dental dimensions and facial prognathism in modern humans. Given that midfacial prognathism and dental dimensions are often used as defining characteristics of species in the later human fossil record, it is important that any relationship that exists between these two aspects of facial morphology are fully explored and understood. In particular, the maintenance of large anterior dentition for paramasticatory activities in certain groups of late Pleistocene hominids may explain the differences in the evolution of facial form from late Pleistocene to modern human groups.

Experimental test of the effects of masticatory forces on facial growth.

M. Devlin[1], D. Lieberman[2], G. Krovitz[1]. [1]Dept. of Anthropology, Harvard University, Cambridge, MA, 02138, USA, [2]George Washington University.

It is well established that there has been a decrease in humans in lower facial length, with a concomitant increase in dental crowding (especially M3 impactions), over the last few thousand years as diets have become softer and more processed. The likely explanation is that, in contrast to the mandibular and maxillary arches, tooth size is quite heritable and not phenotypically plastic in response to mechanical loading. However, it is not known how much and in what ways masticatory forces influence mandibular and maxillary arch growth, particularly in animals such as humans with retracted faces in which the postcanine teeth do not lie below a rostrum.

To test the effects of masticatory loads at primary sites of growth in the lower face, we present experimental results from a sample of juvenile rock hyraxes (*Procavia capensis*), which, like humans, have a retrognathic face in which the postcanine dentition lies beneath the orbits and neurocranium. Subjects were divided into two groups, whose nutritionally identical diets differed solely in food hardness and toughness. Each animal was CT scanned at the beginning and the end of the experiment, enabling analysis of three-dimensional landmarks from the CT scans, and compared using geometric morphometrics.

The results of growth comparisons between treatment groups indicate few significant differences in overall facial shape between hard-diet and soft-diet individuals, but significant differences in lower facial dimensions. Hyraxes raised on the hard diet have a significantly taller premaxilla; a longer and wider posterior palate; and a longer, taller, wider maxilla near the maxillo-jugal suture. Hyraxes on the soft diet have longer nasals and jugals, and a longer maxillo-jugal suture. These results indicate that masticatory strains do have significant impact on facial bone growth, and that technological changes in food processing may account for the decreases in facial size and increased rates of molar impactions and malocclusions.

How specialized are ripe-fruit specialists?: dietary selection in the face of sympatric competitors and shifting fruit abundance.

J.L. Dew. Dept of Anthropology, UC Davis, CA, 94705, USA.

I conducted an 18-month field study comparing the feeding ecologies of two closely-related, sympatric ripe-fruit specialists, Humboldt's woolly monkey (*Lagothrix lagotricha)*, and the white-bellied spider monkey (*Ateles belzebuth),* in Yasuní National Park, Ecuador. At this everwet *terra firme* Amazonian site I found that both species fed on ripe fruits in very high proportions throughout the year despite seasonal variation in habitat-wide fruit availability. Unlike previous studies of frugivore communities, my observations did not reveal a clear decline in dietary overlap in relation to declining resource availability. Instead, dietary overlap appeared to show two distinct low points: first, when fruit abundance was extremely low, and second, when it was at or near its peak. There was a similarly counterintuitive and complex relationship between dietary breadth and dietary overlap. The two taxa may exemplify Robinson and Wilson's (1998) "specialist as generalist" community. Each specializes on a different set of preferred food resources, but these sets periodically shift and overlap to different degrees in response to fluctuations in resource availability. I propose that dietary specialization by spider monkeys on fatty fruits demonstrates narrowed realized niche width due to character displacement from sympatric woolly monkeys. Evidence for woolly monkey impacts on spider monkey carrying capacity include displacements of spider monkeys at feeding trees, low spider monkey densities compared to other sites, and unusually high sex ratios among spider monkeys biased towards females. This competitive interaction may have played a key role in the evolutionary divergence of these two taxa.

Molecular perspectives on dispersal in lowland woolly monkeys (*Lagothrix lagotricha poeppigii*).

A. Di Fiore. Dept. of Anthropology, New York University and the New York Consortium in Evolutionary Primatology, New York, NY, 10003, USA.

Male philopatry and female transfer are thought to characterize the social systems of atelin primates. Studies of spider monkeys and muriquis clearly document this pattern, and the high relatedness among male group members that results presumably underlies cooperative male bonds seen in those taxa. Female transfer is also seen in woolly monkeys; nonetheless, some data suggest that the dispersal pattern of woolly monkeys may not be equivalent to that of other atelins. During research on woolly monkeys in eastern Ecuador, I encountered solitary males (and even a small bachelor group), but never solitary females. Additionally, I found that the male bonds characteristic of spider monkeys and muriquis are largely absent in woolly monkeys, perhaps implying lower levels of male within-group relatedness. Determining the dispersal pattern of woolly monkeys and examining how that affects within-group relatedness are important for understanding the comparative sociobiology of atelins.

I conducted a genetic study of woolly monkeys using both mtDNA sequencing and microsatellite marker analysis. Preliminary results indicate that the population is diverse genetically and that female dispersal is common: 22 haplotypes were identified for the mtDNA control region in 39 animals from multiple social groups, and all of these groups supported multiple haplotypes as many as 10. This pattern of high mtDNA variability within a small, local population is similar to that seen in female-dispersal primates, such as chimpanzees, and markedly different from that found in taxa where dispersal is almost exclusively by males. The extent to which male woolly monkeys also transfer between groups, and the degree of male-male and female-female relatedness within groups, are currently under investigation.

Dental development in hylobatids, or how to get to the same place in the same time on a different road.

W. Dirks. Dept. of Anthropology, University of Wisconsin - Madison, Madison, WI, 53706, USA.

The chronology of dental development is increasingly used as an indirect measure of interspecific differences in life history. Morphological studies often divide ontogenetic categories using molar emergence stages. Although different species clearly reach these stages at different ages, uncovering other specific differences in relative development of the teeth requires radiographic or histological methods. In this study, I compare dental development in two species of hylobatid, *Hylobates lar* and *H. syndactylus*, using both.

Standard histological thin sections of teeth from three siamangs and three lar gibbons were prepared and analyzed using polarized light microscopy and image analysis software. Radiographs of 15 additional specimens of *H. lar* and 7 *H. syndactylus* were examined for qualitative differences in spatial relationships between teeth.

Although siamangs are twice the body mass of lar gibbons, these two hylobatids develop their dentition within approximately the same time span. Age at death in one siamang was 1,183 days and 1,187 days in one gibbon. In both specimens, the same permanent teeth had emerged and radiographs showed similar stages of development. However, each differed in the chronology of dental development to that age. Possible proximate mechanisms underlying these differences include gibbons' slower daily enamel secretion rate and constraints on the spatial relationships of the developing canine, premolars, and incisors in their shorter faces. Combining histological and radiographic methods was critical for this interpretation.

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Old World monkey mitochondrial DNA evolution.

T. Disotell[1], R. Raaum[1], K. Sterner[1], C. Noviello[1], C. Stewart[2]. [1]Dept. of Anthropology, New York University, New York, NY, 10003, USA, [2]Dept. of Biological Sciences, University at Albany, SUNY.

Resolving the phylogenetic relationships between the living species of Old World monkeys (OWMs) is necessary for understanding the origin, evolution, and transmission of certain zoonotic diseases, most notably SIV/HIV. Sequencing and analysis of mitochondrial DNA (mtDNA) is now widespread in the study of primate phylogeny and population genetics. To date, however, different mitochondrial loci often have been used by different research groups in studies of OWMs. While such single locus studies have helped to illuminate relationships within major clades, they have not provided resolution of the mtDNA phylogeny of the major lineages of OWMs, nor have they given an overall picture of OWM mitochondrial evolution. To allow for integrated studies of primate phylogeny and mitochondrial evolution, we are sequencing the entire mtDNA genomes of representatives from all genera of OWMs using laboratory and analytical techniques that avoid mtDNA pseudogenes found in the nuclear genomes of primates. To date, we have sequenced the entire mtDNA genomes from species representing all of the major groups of OWMs — African colobines, Asian colobines, papionins, and cercopithecins. Our results and analyses provide important new information on the tempo and mode of mtDNA evolution between primate groups, the structure of the control

region in the various genomes, and variation in the patterns and rates of molecular evolution among the various mtDNA-encoded proteins. These new genomic sequences help provide a strong foundation for future studies of OWM phylogeny and population genetics using mtDNA.

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Human cognition and tool use: inspiration for primate studies.

J. Dixon Keller. University of Illinois, Anthropology, Urbana, Illinois, 61801, USA.

Literature on human cognition and tool use during the performance of everyday tasks is reviewed with an eye to articulating the frameworks applied and abstracting generalizations that may raise questions for comparative studies of non-human primate cognition and object manipulation.

Observations common to studies of human cognitive ecology include the following. 1) Humans arrange their environments to facilitate accomplishment. 2) Knowledge is organized for use as general principles and vignettes or schemata representing specific applications. 3) These differentially incorporate visual, verbal, kinesthetic, aural, taste, smell and even emotional information. 4) Humans develop skills in social contexts in which identity as well as expertise is acquired. 5) Rehearsal is critical to tool use. 6) Planning and emergence are in productive tension requiring an ability to envision, assess and revise goals.

Such generalizations and their governing theory generate questions for comparative non-human primate study. 1) How is information in the environment selectively utilized in diverse activities? 2) How might conceptual frames be distinguished from S-R associations? 3) Can cognitive models be proposed by asking what does an animal have to "know" in order to accomplish a task? 4) What are the social contexts for learning skills? 5) Do non-human primates rehearse activities? 6) How can planning and emergence be assessed for non-human primates?

Insights derived from these questions and additional relationships between learning, cognition, and the social environment are discussed. Research funded by the University of Illinois Research Board and Early American Industries Association contributed to the generalizations developed here.

The iodine imperative.

J.E. Dobson. Research Professor, University of Kansas, Lawrence, KS, 66047, USA.

Iodine is absolutely essential for human health, and supplemental iodine is required in most world regions. The physiologic roots of such extreme dependency surely must reach to the foundations of human evolution, yet they have been neglected in evolutionary theory. A major evolutionary theme during the latest human advancement must have been the assimilation of iodine into human tissues through a complex set of adaptations–altering the biochemistry of thyroid and pituitary glands, stimulating thyroid and somatotrophic hormones, impacting muscles and bones, and ultimately producing a more gracile morphology. This adaptation must have taken place in an iodine-rich environment, most likely coastal. Natural sources of dietary iodine are heavily coastal in origin, deriving mostly from saltwater fish, shellfish, and seaweed. Geographic and morphologic evidence published earlier by the author suggest that modern humans may have benefited from this "thyroid boost" while Neandertals did not. Recent findings by others regarding the role of DHA in human brain development are consistent with coastal origins as well.

The influence of maternal diet on prenatally-forming enamel zinc concentrations of children from the Solis Valley, Mexico.

A.E. Dolphin[1], A.H. Goodman[2], D. Amarasiriwardena[2], J. Backstrand[3]. [1]University of Massachusetts, Amherst, Amherst, MA, 01002, USA, [2]Hampshire College, [3]New York University.

This research investigates the relationship between maternal dietary intake, Zn absorption by prenatally -forming dental enamel, and early childhood growth and development. In the mid-1980's, a Mexican/US research consortium conducted an intensive, longitudinal study of the functional consequences of mild-to-moderate malnutrition in six villages in the Solis Valley, Mexico. Dyads of pregnant women and their newborns were studied from ~ 3 months in utero to 6 years of age. The modal diet was found to be low in diversity, with 50-70% of dietary energy being obtained from maize tortillas. Maize contains phytate and calcium, both responsible for inhibiting Zn absorption. Zinc deficiency is endemic in the Solis Valley, resulting in inhibited infant growth and development.

We hypothesized that the large proportion of maize eaten by Solis mothers, and any resultant Zn deficiency, might be documented in the prenatally-developed dental enamel of their children, despite maternal buffering. The zinc content of 62 anterior deciduous teeth from 45 individuals participating in the study was measured using laser ablation-inductively coupled plasma-mass spectroscopy (LA-ICP-MS). We found that tooth Zn concentrations are negatively correlated with total dietary phytate (r = -.404) and Ca (r = -.476). The relationship between the Zn content of enamel and physical growth was found to be complicated by the source of calcium: either in the form of energy dense maize or micronutrient dense dairy products. For Zn, we suggest that you are not what you eat, but what you absorb.

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The sensual side of primate food choice.

N. Dominy[1], P. Lucas[2]. [1]University of Chicago, Chicago, Illinois, 60637, USA, [2]University of Hong Kong.

Scientists frequently study the nutritional properties of foods to understand primate foraging. While this approach may explain why some foods are consumed, it often overlooks how food is found or deemed edible. Understanding how the primate sensory system perceives food quality may yield insight into the origins of several unique aspects of primate anatomy. Here I present data from fieldwork in Kibale, Uganda, where I studied the sensory properties of primate foods. The principal goal was to test between two competing hypotheses advanced for the evolution of routine trichromatic color vision in primates. Both are related to detecting food against a background of mature foliage: the first advocates advantages of detecting ripe fruits while the second advocates advantages of detecting young leaves. Results showed that trichromacy was essential to detecting edible leaves. For consumed fruits, however, there was no similar need: discrimination occurred on both the red-green channel unique to trichromats and the yellow-blue channel common among mammals. Leaf color, moreover, was significantly correlated to the protein:toughness ratio whereas fruit colors were unrelated to sugars, protein, or free amino acids. Results further show that folivory occurs most frequently at dusk, when lower light levels require better color discrimination. It is concluded that routine trichromacy is an adaptation to feeding on young leaves which 'delay greening.' Whether a staple or fallback resource, detecting such leaves characterized by high protein and low toughness offers a clear selective advantage. Supported by the Research Grants Council of Hong Kong, National Geographic Society, Explorer's Club, and Sigma Xi.

The influence of swamp use and fruit consumption on western gorilla (*Gorilla gorilla gorilla*) ranging behavior at Mondika Research Center.

D. Doran, D. Greer. Dept. of Anthropology, SUNY at Stony Brook, Stony Brook, NY, 11794, USA.

Western gorilla habitats are characterized by reduced terrestrial herb density, increased fruit abundance and the presence of aquatic herbs in large swamps, relative to those of mountain gorillas (*G. g. beringei*). Habitat differences are reflected in diet; western gorillas eat more fruit, and, at least at some sites, aquatic herbs than do mountain gorillas. We document ranging behavior for one group of western gorillas (n = 86 nest to nest day ranges from 5/8/01 – 7/31/01) to consider the influence of food distribution and preference on ranging. Mean day range was 2406 m (range = 640 – 4780), significantly greater than the 500 m average of Karisoke mountain gorillas. Gorillas traveled longer distances on the 17% of days they trekked to the swamp (3590, n = 15, 2470 – 4780) versus non-swamp days (2156, n = 71, range = 640 – 4550). On swamp days there was a significant correlation between day range and the number of herb species consumed (r = .6191, n = 15), but no significant relationship between day range and fruit consumption. On non-swamp days, there was a significant correlation between day range and the number of fruit trees visited (r = .6058, n = 71), but no significant relationship between day range and either the amount or diversity of terrestrial herb in the diet. We conclude that fruit consumption has an important effect on western gorilla day range, unlike mountain gorillas. Swamp herbs, although continuously available, are important only occasionally, perhaps in response to decreased availability of fruit in *terre firma* forest.

Functional morphology of the *Australopithecus afarensis* partial upper limb skeleton A.L. 438-1.

M.S. Drapeau. Dept. of Anatomy, New York College of Osteopathic Medicine, Old Westbury, NY, 11568, USA.

In 1992, associated remains of a single individual, A.L. 438-1, attributed to *Australopithecus afarensis* were discovered in Hadar, Ethiopia (Kimbel et al. 1994). The discovery includes complete left ulna, right and left second metacarpals, and a right third metacarpal, and provides the first opportunity to examine these bones in association in *A. afarensis*. In addition, the large size of A.L. 438-1 allows comparison of large and small ulnae within *A. afarensis*, and comparison of *A. afarensis* with other early hominin ulnae without confounding allometric effects.

Most hominoids have equivalent relationships between their metacarpal and ulnar lengths, and A.L. 438-1 fits this pattern. Only *Pan* has relatively longer metacarpals. Olecranon morphology, assessed using length and orientation of the triceps brachii lever arm (TBLA), suggests that A.L. 438-1 and other Plio-Pleistocene hominins (A.L. 288-1, OH 36 and L40-19) used their forearms in a posture more like that of modern humans than apes. The trochleas of A.L. 438-1 and other early hominins are oriented more anteriorly than those of great apes, partially reflecting the proximal orientation of the TBLA. Ulnar diaphyseal curvature in A.L. 438-1 is greater than in *H. sapiens* but less than in great apes. OH 36 and L40-19 are most similar to great apes.

This study suggests that *A. afarensis* did not use its upper limbs as apes or humans do, but had diverged from an ape-like morphology toward a human-like one, suggesting shifts in upper limb use toward a pattern more similar to that of *H. sapiens*.

Physical activity of poor urban women: a comparison of women working and women at home in Cali, Colombia.

D. Dufour. Dept. of Anthropology, University of Colorado at Boulder, Boulder, Colorado, 80309, USA.

We have previously presented evidence that the physical activity level (PAL) and total energy expenditure (per kg body weight) of poor urban women who "work" (engage in income earning activities) is similar to those "at home" (tend to household and childcare responsibilities) (Spurr et al. 1996; Spurr et al. 1997). These findings were unexpected and raised questions regarding the actual types of activities engaged in by the two groups. In this paper we address those questions by comparing the time allocation of the two groups. Time allocation during waking hours (14.2 ± 1.1 hrs/d) was recorded in minute-by-minute diaries by trained observers for two consecutive days for 76 working women and 96 women at home The working women were engaged in informal sector economic activities, such as street vending, childcare and domestic service, in addition to their household and childcare responsibilities. The activities of the women at home were largely restricted to household and childcare responsibilities. Preliminary analysis indicates that the working women tended to spend less time in resting activities (lying and sitting) and less time on some household chores, but between group differences were not significant. We conclude that the time allocation of working women is similar to that of women at home because (1) many of the activities engaged in are the same or similar, and (2) some working women are only engaged in income earning activities for limited time periods.

The identity of the Chemeron temporal.

H. Dunsworth. The Pennsylvania State University, University Park, PA, 16802, USA.

The Chemeron temporal (KNM-BC 1) from the Baringo Basin, Kenya, has been attributed to *Australopithecus cf. boisei* and to early *Homo* because of its unusual combination of features. The type specimen of *A. garhi*, a partial cranium with teeth but without temporals (BOU-VP-12/130), is the same age as the Chemeron temporal (~2.5 Ma). Both have been called candidate ancestors for *Homo*. This paper tests the hypothesis that the Chemeron temporal belongs in *A. garhi* by investigating the relationship between the size of the temporomandibular fossa and the size of the maxillary cheek teeth.

The temporomandibular fossa breadth (tip of the entoglenoid to the lateral margin of the articular surface) and the maxillary cheek tooth length (P3-M3) were measured on a total of 48 individuals of the following: *Gorilla gorilla* (9), *Pan troglodytes* (8), *Pongo pygmaeus* (8), *Hylobates agilis* (9), *Homo sapiens* (10), and the casts of fossil hominids KNM-ER 1813, OH 5, Broken Hill, and Skhul 5.

Linear regression analysis shows a highly significant positive allometric relationship between fossa breadth and maxillary P3-M3 length. This relationship holds for the fossil hominids measured in this study. When KNM-BC 1 and BOU-VP-12/130 are plotted as belonging to one species, the point falls within the 95% confidence interval of the regression. Therefore, we cannot reject the hypothesis that the Chemeron temporal belongs in *A. garhi*.

The fetal skeletons of Kellis: the isotopic, fluorescent microscopic, and osteometric evidence.

T. Dupras[1], M. Tocheri[2], C. Maggiano[1], E. Molto[3]. [1]University of Central Florida, Orlando, Florida, 32816, *USA*, [2]Arizona State University, [3]Lakehead University.

Excavations in the Dakhleh Oasis, Egypt have uncovered over 35 fetal skeletons ranging between 22 – 40 weeks gestation from the Kellis 2 cemetery. The manner in which the remains were interred, the arid climate, and high alkalinity of the soil have created an optimal environment for fetal skeletal preservation.

The developmental age of each fetus was calculated from a suite of skeletal measurements, with femoral diaphysis length given priority when quantifiable. For example, individuals were considered to represent a fetus if their mean femoral diaphysis length was less than 73mm.

Carbon and nitrogen stable isotope analyses of nine fetal skeletons have revealed significant differences between infant, juvenile and adult isotopic values. While the mean for adult carbon isotope values is –19‰, the fe-

tal remains show seven individuals who have a mean of –21 ‰, and two others that are significantly enriched (mean of –13 ‰). Fetal nitrogen values reveal that seven of the individuals have significantly lower nitrogen isotope values (mean = 13‰) compared to the adult female mean of 18‰.

Preliminary fluorescent microscopy analysis of fetal long bone thin sections has revealed the physiological inclusion of tetracycline. This naturally occurring antibiotic (perhaps present in stored grain) passes through the placental barrier and is incorporated into the growing fetal skeleton. In therapeutic doses tetracycline is known to impede skeletal development. The presence of tetracycline in the fetal environment, in combination with maternal nutrition may have contributed to a high prevalence of fetal deaths.

A multivariate examination of the Hexian *Homo erectus* calvarium.

A. Durband, J. Kidder, R.L. Jantz. University of Tennessee, USA.

The *Homo erectus* calvarium from Hexian, Anhui Province, China is an important component of the fossil sample from East Asia. This specimen, PA 830, is one of the more complete Chinese *H. erectus* crania found outside Zhoukoudian. Little work has been done on this important fossil, which is surprising considering its potential contribution to the debate on modern human origins in China. Earlier work by Kidder and Durband (2000) has shown that the large sample of fossil crania from Zhoukoudian exhibits a unique metric pattern not exhibited in specimens from Africa or Indonesia. Multivariate statistics have not been used to compare the Hexian cranium to other relevant fossils and this has hampered our appreciation of the pattern and magnitude of variation in the Chinese fossil record.

This project involves the use of Mahalanobis distances to examine the variation present in a large sample of *Homo erectus* crania. Two separate examinations utilizing up to 7 measurements on 15 crania were performed to maximize the number of available specimens. Random expectation statistics were then used to test for significance between these fossils after Jantz and Owsley (2001).

Our results highlight clear metric dissimilarities between the Hexian calvarium and the fossils from Zhoukoudian. These metric patterns also separate Hexian from Zhoukoudian V, a skull with which it shares some more modern non-metric features. Our results indicate a greater degree of variation in the human fossil sample from China than has previously been recognized.

Polymorphisms past and present.

R.B. Eckhardt. Dept. of Kinesiology and Intercollege Graduate Program in Genetics, The Pennsylvania State University, University Park, PA, 16802, USA.

Frank B. Livingstone is known internationally for over four decades of empirically grounded, conceptually imaginative research on worldwide patterns of genetic variation in human hemoglobin molecules, work justifiably regaining attention through recent studies of alleles conferring malarial resistance (Tishkoff et al., 2001).

For Livingstone, the hemoglobin variants represent not just an isolated gene system of great interest, but also a powerful model for understanding the ubiquity of genetic variation in human populations past and present, and for assessing the power of evolutionary forces, particularly natural selection, to preserve this stock of genetic variation. He developed and maintained these positions for decades before the powerful tools of molecular genetics came into existence. Research using these tools now documents one detectable difference every 185 bases, a frequency over 0.1% (Chakravarti, 1998; Stephens et al., 2001).

Past human populations, continuous with those of the present, were subject to the same forces that shape current patterns of evolution. My own research, guided by Livingstonian principles, has documented numerous instances in which structural features of the hominid skeleton and dentition purportedly diagnostic of taxa at the species level or above, instead occur as common variants within extant species or even local populations of hominoid primates (three decades of examples are summarized in Eckhardt, 2000). Juxtaposing findings on polymorphisms past and present exposes the striking anomaly that the fifteen or more hypothetical hominid taxa proposed by some paleoanthropologists must differ from each other on the average by amounts less than those that differentiate individual humans at present.

A cluster of *Alu* repeats within the gene encoding the L1 cell adhesion molecule may have acquired a regulatory role in the course of hominoid evolution.

D. Edelman[1], F. Jones[2]. [1]The Neurosciences Institute, San Diego, California, 92121, USA, [2]The Neurosciences Institute;, The Scripps Research Institute.

In a previous study, we demonstrated that a cluster of *Alu* repeats found within the human gene encoding the L1 cell adhesion molecule (L1-CAM) is conserved among apes and Old World monkeys. These *Alu* elements are more similar to one another than they are to the consensus Sq and Sx classes to which they belong. This suggests that, while these *Alu* repeats diverged from their consensus sequences, they also evolved in concert with the nearby regulatory region of the L1-CAM gene. Since this cluster is near an important regulatory region and *Alu* repeats can act as *cis* regulatory elements, we hypothesize that this cluster assumed a regulatory function during primate evolution. To test this hypothesis, we examined the *Alu* cluster for regulatory functions using cellular transfection and DNA binding assays. In human MCF7 cells and ape fibroblasts, constructs containing human and ape variants of the *Alu* cluster activated a minimal promoter. This activation was strongest when the gorilla *Alu* cluster was tested. Previously, we found that Otx2, a homeodomain transcription factor, bound to the L1 *Alu* cluster. Recently, we demonstrated that a related protein, *goosecoid*, diminishes activation by all variants of the L1 *Alu* cluster. These data indicate that human and ape L1 *Alu* clusters function as regulatory elements. Currently, we are determining whether sequence differences in the gorilla L1 *Alu* cluster distinguish it functionally from the other ape and human variants. Chromation immunoprecipitation (ChIP) is also being used to identify other proteins that interact with the L1 *Alu* cluster.

Problems in body mass estimation for primitive anthropoids.

N. Egi, M. Takai, N. Shigehara, T. Tsubamoto. Primate Research Institute, Kyoto University, Inuyama, Aichi, 484-8506, Japan.

Body masses in some primitive anthropoids were here estimated from crown area of cheek teeth, and the reliability of estimated body mass values were discussed. Estimation equations were calculated using samples of 11 living prosimian species and of 30 anthropoid species. Among the lower dentition, $M_{1\text{-}2}$ were better body mass estimators because of their lower intraspecific variations in dimensions and relatively lower errors (%SEE) for body mass estimates. Intraspecific variations of sizes were lower in $M^{1\text{-}2}$ than in $P^{3\text{-}4}$ and M^3, but %SEE's of the equations derived from these teeth did not showed differences. The relationships between crown area and body mass were dependent on taxonomy, such that the body masses estimated from crown area of P^4 and molars based on living anthropoids became larger than those based on living prosimians.

The estimation equations were applied to the primitive anthropoids from latest middle Eocene Myanmar (Pondaung Formation). The body masses and ranges estimated in kilograms based on $M^{1\text{-}2}$ and $M_{1\text{-}2}$ crown ar-

eas are as follows: *Bahinia*, 0.77 (0.5 - 1.1); *Myanmarpithecus*, 1.83 (1.5 – 2.2); *Amphipithecus*, 6.04 (4.3 – 7.5); small *Pondaungia*, 5.34 (4.0 – 6.7); and large *Pondaungia*, 8.54 (7.2 – 10.1). *Pondaungia* was separable into two groups, presumably representing two species of different body size. *Bahinia* seemed to fit to the prosimian model better, while the anthropoid model reduced the differences among estimated body masses based on $M^{1\text{-}2}$ and $M_{1\text{-}2}$ for the other three genera.

Populations and languages in the expansion of the Afroasiatic language family.

C. Ehret. University of California at Los Angeles, Los Angeles, California, 90095, USA.

The Afrasan (Afroasiatic) languages originated in Africa, most probably— according to recent linguistic arguments and correlative archaeological findings—in the regions extending from the northern Horn of Africa to the Nubian Nile. Beginning before the emergence of agriculture and overlapping into the early agricultural/food production eras, the Afrasan languages dispersed successively more widely out of this region over a period of several thousand years. They spread throughout the Horn, south into East Africa, westward across the Sahara and North Africa, and north into the far southwest corner of Asia. These developments were surely an extended process involving not only encounters with non-Afrasans, but re-encounters among Afrasan populations and the spread of later Afrasan groups at the expense of earlier ones. The linguistic evidence of inter-language contacts at each stage of expansion indicates that differing forms and extents of encounter of Afrasan-speaking populations with preexisting groups of differing speech communities took place in each affected region. These linguistic patterns of population encounter in different regions and eras open the way toward a renewed and more soundly based exploration of just what the differing genetic markers and skeletal variation (if any) of each of the subpopulations associated with the expansions of the Afrasan languages might have been.

Resolving cultural affiliation through multiple methods: a case study.

J.T. Eng, P.L. Walker. University of California, Santa Barbara, Santa Barbara, CA, 93106, USA.

Determining cultural affiliation is a crucial dilemma faced with respect to the disposition of Native American human remains. NAGPRA states, "Cultural affiliation is established when the preponderance of the evidence — based on geographical, kinship, biological, archeological, linguistic, folklore, oral tradition, historical evidence, or other information or expert opinion — reasonably leads to such a conclusion" (10.2(e)). This analysis of a burial from Temescal Canyon, near the historic border between the Chumash and Gabrielino of California, uses a multiple methods approach to resolve the issue of cultural affiliation.

The cultural boundary between the Chumash and Gabrielino likely varied through time. Linguistic differences suggest that the two groups have origins in different waves of migration into southern California; the Chumash from a southward migration of Hokan-speakers, and the Gabrielino from a later migration of Uto-Aztecan speakers westward into the islands and mainland south of the Chumash (Moratto and Fredrickson, 1984). Thus the Chumash and Gabrielino have different cultural, as well as biological, heritages.

Cultural indicators of affiliation are suggested by the method of treatment of the Temescal Canyon remains (inhumation versus cremation), as well as the orientation and body position. To explore the biological affinities, a discriminant analysis was performed to determine which southern California Indian populations the cranial morphology of the burial most closely resembles. Finally, biomolecular analysis was attempted to clarify the issue of biological relationship through DNA comparisons of a sample from the burial to modern groups, but no ancient DNA was recovered. However, this multimethods approach offered several lines of support for Chumash affiliation for the burial.

Changes in visibility affect ranging behavior and vigilance in vervet monkeys (*Cercopithecus aethiops*).

K. Enstam, L. Isbell. Dept. of Anthropology, University of California, Davis, CA, 95616, USA.

Several known and potential predators of vervet monkeys (*Cercopithecus aethiops*) are terrestrial felids that rely extensively on cover to conceal themselves from their prey during the final stages of an attack. Dense, obstructive ground cover, therefore, may increase the perceived risk of predation for vervet monkeys. Here we describe ranging behavior and other behavioral changes after a brush fire eliminated grass cover in a large area near the study group's home range. The reduction in grass height significantly increased the vervets' ability to see. After the fire, the vervets' ranged significantly farther from the core of their home range along the river and moved into an area that they had not been observed in before the fire occurred. The vervets spent less time on the ground and scanned less often in the burned area compared with their rates of substrate use and scanning behavior in the unburned area. The brush fire also resulted in the growth of a preferred food source of vervet monkeys (young swollen thorns), and we discuss the likelihood that the reduction in perceived risk of predation in the burned area, resulting from better visibility, allowed the vervets to exploit this food source.

Rates of agonism by lemurid primates: implications for establishing female dominance.

E. Erhart[1], D. Overdorff[2], T. Mutschler[3]. [1]Dept. of Anthropology, Southwest Texas State University, San Marcos, TX, 78666, USA, [2]Dept. of Anthropology, University of Texas, Austin, Austin, TX, 78712, USA, [3]Anthropological Institute and Museum, University of Zürich.

Female dominance over males has been considered to be a universal characteristic of the Malagasy prosimians although the wide-spread distribution for female dominance has been questioned and there are equivocal reports for female dominance between studies on the same species. We propose that one of the problems faced in identifying whether a species is female dominant (FD) or not (NFD) is the fact that agonistic rates and encounters are low and rare in wild populations. We reviewed the literature to compare agonistic rates between FD and NFD species and compared these rates to anthropoids. Although FD species have higher rates (0.44/hr) than NFD species (0.29/hr), the difference is not significant. In some species (*E. coronatus* and *E. macaco*) captive populations are more strongly female dominant than wild populations. Captive populations also have significantly higher rates of agonism than wild populations of the same species (p = .02). Finally, agonistic rates for prosimians are significantly lower (mean = 0.38/hr, p = .0002) than anthropoid populations (mean = 3.00/hr). One explanation for the variation among lemurids in the expression of dominance and agonism is that females may have alternative ways to increase their foraging efficiency, particularly when reproductive. These behaviors could be expressed in conjunction with, or in the absence of, dominance. Sex differences in feeding, coordination of group movements between resources, and leadership are ways that individuals may improve foraging effort. As a result, agonistic encounters may not be the best indicator for female dominance and more detailed study is needed.

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Phylogeography and genetic diversity of wild bonobos (*Pan paniscus*).

J. Eriksson, G. Hohmann, C. Boesch, L. Vigilant. Max Planck Institute for Evolutionary Anthropology, Leipzig 4103, Germany.

The need for better assessment of the phylogeographic pattern of genetic variation of the two *Pan* species has recently become increasingly clear due to its relevance for understanding the origin and spread of zoonotic diseases such as SIVcpz-HIV-1 complex of viruses. Furthermore, knowledge of gene flow among different populations of a species can provide information for consideration in the design of conservation plans by influencing the size, shape and number of protected areas. Compared to the common chimpanzee (*P. troglodytes*), found across the equatorial zone of the African continent, the bonobo (*P. paniscus*) has a much more restricted range and is currently only found in the central Congo Basin, between the Congo-Lualaba and Kasai-Sankuru River system. Genetically, the bonobo is by far the less studied of the two *Pan* species and previous research has been limited to individuals from two closely-situated field sites and captive individuals of unknown origin. In this study we investigate the genetic diversity and population structure of *P. paniscus* across their geographical range by sequencing 500 base pairs of the mitochondrial DNA control region using DNA extracted from non-invasively collected fecal samples of approximately 140 individuals belonging to 8 different localities within 3 major forest blocks each separated by large rivers. These results will be compared to similar data from *Pan troglodytes*, including 3 newly sampled localities from regions north of the Congo River, a zone of possible gene flow between the eastern (*P. t. troglodytes.*) and central (*P. t. schweinfurthii*) chimpanzee subspecies.

MtDNA and population movements in prehistoric western North America.

J. Eshleman. University of California-Davis, Davis, CA, 95616, USA.

Studies of mtDNA in Native Americans have demonstrated that the majority of mtDNA types belong to one of five maternal lineages or haplogroups. The distribution of these lineages in the Americas is decidedly nonrandom. Studies of ancient and modern Native American mtDNA have also revealed a general pattern of temporal continuity in haplogroup frequencies in particular regions indicating that drift has not significantly disrupted them. Thus, the distribution of lineages can be used to infer relationships between populations.

Prior to European contact, the west coast of North America contained a virtually unparalleled degree of linguistic diversity and exceptionally high population densities for hunter-gatherer peoples. Some comparative linguists have suggested that many of the languages can be grouped into a few linguistic stocks of related languages. The distribution of two particular linguistics stocks—Hokan, made up of a number of languages in California and the Southwestern U.S. and Northern Mexico, and Penutian, consisting of several languages in California, Oregon and Washington—has long suggested a particular model of migration that has produced the observed distribution of speakers of various languages. This model has also greatly influenced the interpretation of the archaeological record of California. However, the linguistic validity of both stocks is still a point of considerable debate. Through the examination of mtDNA haplogroup frequencies and discrete mtDNA control region sequences from both modern Native Americans and prehistoric human burials, this study tests migration hypotheses based upon these linguistic and archaeological models. Additionally, a comparison between coastal and inland populations along the west coast of North America may suggest an ancient coastal migration to the New World.

More on the three-dimensional trabecular architecture of anthropoid primates: *Macaca fascicularis* and *Symphalangus syndactylus* .

R. Fajardo[1], R. Müller[2]. [1]Interdepartamental Program in Anthropological Sciences, Stony Brook, New York, 11794, USA, [2]Institute for Biomedical Engineering ETH and University Zürich.

High-resolution imaging methods have begun to reveal the intricate nature of non-human primate cancellous bone. Fajardo and Müller (2001) presented preliminary data on the proximal femur of four anthropoid primates, including a macaque and gibbon. Here we present more data expanding our knowledge of the trabecular architecture of the anthropoid femoral neck.

The proximal femora of *Macaca fascicularis* and *Symphalangus syndactylus* specimens were scanned using a High-Resolution X-ray Computed Tomography scanner. Volumes of interest were defined within the neck, proceeding distally from the head-neck transition. The volumes of interest defined within the neck were adjusted in length for size relative to the largest specimen within the overall sample and contoured to the endosteal border. The structural variables calculated within each specimen's volumes of interest included the bone volume fraction, trabecular number, trabecular thickness, structural model index (measure of plate-like to rod-like structure of trabeculae), connectivity density, and the degree of anisotropy.

The data paint an interesting picture of the trabecular bone of these two taxa that does not altogether correspond to expectations based on the locomotor behavior of these two primates. *S. syndactylus* has a slightly higher bone volume fraction of cancellous bone than *M. fascicularis* (7% higher). Consistent with our earlier findings, the cercopithecine has a higher trabecular number (>36% higher) and thinner trabeculae (>24% thinner) than the lesser ape. The negative structural model index values for both taxa indicate that their trabeculae take on the shape of spherical voids (*Syndactylus* -2.128, *M. fascicularis* -0.871). Furthermore, these two taxa exhibit strong differences in the connectivity density (*Syndactylus* 3.515, *M. fascicularis* 8.944). Unexpectedly, both taxa have a relatively high degree of structural anisotropy and the suspensory siamang (1.73) has a higher average anisotropy value than the macaque (1.51).

The evolution of brain shape in hominids.

D. Falk[1], C. MacLeod[2], H. Mohlberg[3], K. Zilles[4]. [1]Florida State University, Tallahassee, Florida, 32303, US, [2]Langara College, Vancouver, B.C., [3]Institute of Medicine, Research Center Julich, [4]Institute of Medicine, Research Center Julich, and Brain Research Institute, University of Dusseldorf.

Results are provided for an investigation of hemispheric shape on a series of endocasts from *Australopithecus, Paranthropus, Homo erectus,* Neandertal, and extant *Homo sapiens*. Endocasts from the fossils were registered by magnetic resonance imaging (MRI) and three-dimensionally reconstructed. The endocasts for extant humans were obtained virtually from MRI of ten skulls and used to generate a mean endocast. Of 32 actual human brains, the one that was determined to be the most 'average' was used as the reference brain for projecting major anatomical and functional brain regions onto the mean human endocast. Endocasts from fossil hominids were then warped using an elastic transformation to the mean endocast from *Homo sapiens*, and the 3-D deformation fields that describe quantitatively the regional distribution of forces effecting the warping were visualized. These procedures permit identification of specific regions of hominid endocasts that change most when transformed into endocasts of modern humans. Considerable hemispheric shape change occurs between endocasts of early hominids and those of modern humans, with the largest overall deformation occurring between australopithecines and *Homo sapiens*. Much smaller differences are found for the *Homo erectus* to *Homo sapiens* transformation, and minimal differences oc-

cur between Neandertals and modern humans. These changes are not randomly distributed over the hemispheric surface, but show local maxima indicating hot spots of hemispheric development during hominid evolution.

Food selection by black and white colobus monkeys (*Colobus guereza*) in relation to plant chemistry in the Kakamega Forest, Kenya.

P.J. Fashing[1], C.B. Mowry[2], E.S. Dierenfeld[3]. [1]Center for Environmental Research and Conservation, Columbia University, New York, NY, 10027, USA, [2]Dept. of Biology, Berry College, [3]Dept. of Nutrition, Wildlife Conservation Society.

Eastern black and white colobus monkeys, or guerezas, are generally regarded as being among the most folivorous of the primates. Recent research has demonstrated, however, that the extent to which guerezas subsist upon leaves varies considerably among sites. We analyzed the nutritional chemistry of leaves from 20 species available to guerezas at the site where they are least folivorous (53% of diet), the Kakamega Forest, Kenya. Chemical constituents that were assessed include crude protein (CP), neutral detergent fiber (NDF), acid detergent fiber (ADF), lignin, dry matter, ash, alkaloids, and condensed tannins (CT). CP levels were significantly higher in the mature leaves of species from which guerezas consumed leaves (mean = 17.4$\pm$ 0.9) than in species from which they did not consume leaves (mean = 13.3$\pm$1.7; Wilcoxon two-sample test; U_s = 70, n_1 = 14, n_2 = 6; P<.05). However, neither NDF nor ADF levels differed significantly between the mature leaves of species from which guerezas consumed leaves (NDF mean = 49.0$\pm$2.6; ADF mean = 35.1$\pm$2.5) and species from which guerezas did not consume leaves (NDF mean = 48.8$\pm$3.3; ADF mean = 36.9$\pm$3.0; Wilcoxon two-sample test; NDF: U_s = 44, n_1 = 14, n_2 = 6; P>.10; ADF: U_s = 51, n_1 = 14, n_2 = 6; P>.10). These results suggest that protein content may have a greater influence than fiber content on guereza leaf choices at Kakamega. CT levels did not differ significantly between the mature leaves of species from which guerezas consumed leaves (mean = .24$\pm$ .12) and those from which guerezas did not consume leaves (mean = .67$\pm$ .31; Wilcoxon two-sample test; U_s = 58, n_1 = 14, n_2 = 6; P>.10). Condensed tannins therefore may not play much of a role as feeding deterrents for guerezas at Kakamega. Overall, the lower level of folivory among guerezas at Kakamega relative to other sites is probably related more to the relative abundance of fruiting trees in the Moraceae family at Kakamega than to leaf chemistry at this site.

Three-dimensional anthropometry: reliability and error.

D. Feathers. Dept. of Industrial Engineering, SUNY at Buffalo, Buffalo, New York, 14261, USA.

New technology has allowed human body measurement to be taken faster and perhaps more accurately. This study investigated three separate anthropometric studies that utilized both three-dimensional electromechanical measurement methods and traditional measurement methods. METHODS: A task analysis of anthropometry outlined potential error sources for three anthropometric studies performed at SUNY Buffalo. Measurement errors were hypothesized to be from physical, experimental and programming errors. A total of 12,226 anthropometric measurements were analyzed. These measurements were treated as both raw and standard deviation data sets. Measurement reliabilities from these data sets were assessed in terms of method, measurer, respective measurements and measurement trials. Errors contributing to these reliabilities were characterized as random or non-random. RESULTS: Data from one SUNY Buffalo study yielded the following significant results: ANOVA for raw data (Participant: F (1,143) = 35.28, p < .001; Method: F (2,143) = 11.54, p < .001; Participant and Method: F (2,143) = 4.57, p = .012), and for standard deviation data (Method: F (2,35) = 5.55; p = .014; and Condition (Clothed/Unclothed): F (1,35) = 10.37; p = .005). DISCUSSION: The electromechanical approach is considered a 'landmark-centric approach,' in contrast to the traditional 'measurement-centered approach.' Measurement differences yielded by both of these approaches, both within and between methods, trials, and measurers, speak of the difficulty in tracking errors that impact measurement reliability. This study was an initial attempt to investigate and categorize the potential sources of error of anthropometric measurements using a novel electromechanical technology.

Enamel defects, well-being and mortality in a medieval Danish village.

R. Ferrell. Dept. of Anthropology, Pennsylvania State University, University Park, PA, 16802-3404, U.S.A.

Accentuated lines in tooth enamel are indicators of physiological events occurring during dental development. Such lines are generally interpreted as indicators of "stress" events that would increase the risk of death of the individual; however, the evidence for a relationship between a younger age at death (indicating a higher risk of death) and a higher incidence of accentuated lines has not been fully investigated. This study tests for a relationship between age at death and number/pattern of accentuated lines in enamel, and addresses some of the implications of such a relationship.

100 micron-thick ground sections of 326 teeth from 108 medieval Danish skeletons (age range 0–30) are analyzed using polarized and non-polarized light microscopy and the Syncroscopy digital imaging system. Using incremental structures in enamel and dentine (e.g. daily cross-striations, striae of Retzius), individual chronologies of accentuated lines are constructed for as much of the period of dental development as possible. Variables are constructed to reflect the patterns of accentuated lines that have been identified, and using survival analysis methods, those variables are tested for a relationship to age at death.

Differential diagnosis of sirenomelia: a case study.

J. Fildes. Dept. of Anthropology, University of New Mexico, Albuquerque, NM, 87106, USA.

Sirenomelia is a very rare congenital abnormality phenotypically similar to the legendary mermaid and is incompatible with life. It is characterized by the fusion of the lower limbs along the postaxial border following a wedge defect in the caudal eminence occurring at the 26th day of gestation. Sirenomelia produces a spectrum of possible skeletal malformations depending on the severity of the initial wedge shaped defect. This deformity is potentially visible skeletally, yet has never been described in the paleopathological literature.

A single documented case of sirenomelia is presented here from the Maxwell Museum Documented Collection. Several skeletal anomalies are found including fusion of the right and left ilia, right and left ischia, and right and left femora, as well as absent fibulae, right radius and right first metacarpal. A differential diagnosis is performed based on the presence of three malformations common to sirenomelia but which do not occur or co-occur in other dysplasias. These are agenesis of the radius, agenesis of the fibula and fusion of the lower limb bones. It is found that this malformation can be differentiated from the majority of other congenital skeletal dysplasias. The only similar condition is caudal regression syndrome, which rarely results in fusion of the lower limbs, but often exhibits similar skeletal defects in the most severe occurrences. If anatomical position is recorded at the time of recovery of a suspected case, sirenomelia should be distinguishable with 100% accuracy. This study provides a basis for recognizing this malformation in undocumented individuals.

The sea hunters of Lamalera, Indonesia: do marriage alliances explain crew formation?

E. Fink[1], M. Alvard[2]. [1]University of New Mexico, Albuquerque, NM, 87106, U.S.A., [2]Texas A&M University.

This paper examines how hunting crews are formed among the Lamaleran whalers. Lamalerans practice a form of asymmetric marriage alliance where clans are grouped into three types and have a relationship as either wife-givers or wife-receivers or 'brothers' to each other's clan. Men hunt in 11-meter traditionally hand-crafted vessels, called *tena*. Each vessel is manned by members from the clan who own it, as well as other clans' members. Optimal crew size based on calculating per capita return rates is 8, but mean crew size is 10.82 and modal crew size is 11. Since crews tend to be larger than what would be predicted solely by return rates, ranging from 8 to 17 men (N = 863), other factors might play a role in crew formation. It is hypothesized that admittance of wife-giving crew members on board may yield benefits associated with preferential mating access to their sisters and daughters. According to this hypothesis, crews are predicted to have a higher proportion of men from wife-giving clans than would be expected by chance. In addition, it is predicted that men hunt in their wives' clans' *tena*. Results do not support the prediction that crews should have a higher proportion of men from wife-giving clans. In fact, results indicate that *tena* tend to admit men from wife-receiving clans (χ^2 = 118.437, p<.001, df = 2). Results do indicate that crews give preference to those men whose wives are of the same clan-type as the vessel on which they hunt (χ^2 = 16.643, p<.005, df = 2).

The comparative morphology of hominin postcranial remains from the Kapthurin Formation, Baringo District, Kenya.

R. Fisher[1], S. McBrearty[2]. [1]Dept. of Anthropology, Yale University, New Haven, CT, 06520-3792, U.S.A., [2]Dept. of Anthropology, University of Connecticut.

Hominin remains from the Kapthurin Formation include two mandibles (KNM-BK 67 and KNM-BK 8518), a right ulna (KNM-BK 66), a right first metatarsal (KNM-BK 63), and two proximal manual phalanges (KNM-BK 64-65). The fossils date to circa 500 ka. While the mandibles and ulna have been studied extensively, the remaining postcranial elements have not been formally described. The goal of this study is to analyze the morphology of the first metatarsal (KNM-BK 63) and one of the manual phalanges, a complete proximal phalanx from the fifth digit (KNM-BK 65).

Eighteen measurements were taken on the first metatarsal. The comparative sample included SKX 5017, OH 8, Omo 1, nine Neandertals, and 93 modern humans (African American, Native American, and Khoisan remains). Nineteen measurements were taken on the phalanx, with a comparative sample composed of Shanidar 4 and 5, and 37 modern humans, including African Americans and Caucasians. Univariate, bivariate, and principal components analyses were conducted.

For most metatarsal measurements, there is considerable overlap between Neandertals and modern humans, and KNM-BK 63 falls within this range. However, principal components analysis reveals that the Baringo metatarsal can be distinguished from modern humans and Neandertals in having more gracile shaft dimensions. Similarly, for most measurements, KNM-BK 65 lies within the largely overlapping ranges of Neandertal and modern human phalanges. The Baringo phalanx is, however, characterized by a more gracile base and corresponding facet. The functional implications of these results are discussed with reference to the other Plio-Pleistocene fossils included in this study.

Dental reduction in Late Pleistocene and Early Holocene hominids.

C. Fitzgerald, S. Hillson. Institute of Archaeology, University College London, London, London, N6 5DR, United Kingdom.

Within the genus *Homo*, the trend over the past 2 million years has been one of dental reduction, but many believe that this has been especially marked over the last 100,000 years, both in Neandertals and so-called anatomically modern *Homo sapiens*. The way in which this reduction came about is a key issue in the evolution of modern humans. This study, the initial results of which are reported in this paper, seeks to clarify the nature of this dental reduction in Late Pleistocene and Early Holocene hominids from Europe, the Middle East and North Africa, and to test the hypotheses that have been offered to explain it. The major collections of relevant hominid remains in the US, Europe and Israel are being studied, which will permit comparisons between regions, periods and taxa.

The study uses cervical measures, taken at the base of the crown, so that worn dentitions can be measured. This makes it possible to include a larger number of specimens and thus consider the question of variability in crown size. In addition, each of the major explanatory hypotheses is being tested by recording observations and measurements designed to examine dentition and jaw function, dental pathology, craniofacial development, general body size, and robustness.

The analysis of results from institutions visited so far in Portugal, France, Israel and the UK suggest that Late Pleistocene/Early Holocene dental reduction is not just a simple universal downward trend in crown size, but that it is a more complex mosaic, with variation between different geographic areas and different date ranges.

Simulating hemoglobin history.

A. Fix. Dept. of Anthropology, University of California, Riverside, CA, 92521, USA.

In one of the truly classic works in anthropological genetics, Frank Livingstone established the interrelationships between agriculture, mosquito ecology, malaria, and consequently, the frequencies of sickle-cell hemoglobin in West Africa. A major inference from Frank's study was the *recency* of malaria as a selective agent in human populations, only becoming significant after the adoption of agriculture in the last few thousand years. Clines of the abnormal hemoglobin alleles might therefore represent continuing waves of advance of adaptive alleles.

In order to model the complex interaction of several hemoglobin alleles, selection, and gene flow spreading adaptive mutants, Frank turned to computer simulation. Numerous insights concerning the competitive increase of different alleles (hemoglobins S, C, and E and thalassemia), the rate of spread of alleles under different migration scenarios, including the potential importance of long range migration, came out of these studies. These experiments also stimulated others to search for mechanisms that might increase the rate of diffusion of hemoglobin variants, including kin-structured migration and epidemic disease selection.

Recent molecular studies have substantiated major aspects of Livingstone's work (including the recent origin of falciparum malaria) and posed challenges to some of his assumptions (such as the number of mutations to hemoglobins S and E). But whatever the fate of his specific hypotheses, his emphasis on the interaction of genetics, ecology, and culture stands as a model for the anthropological approach to the understanding of human variation and evolution.

Paleoanthropology of the Kibish Formation, Ethiopia.

J. Fleagle[1], Z. Assefa[1], F. Brown[2], I. McDougall[3], S. Yirga[4]. [1]Stony Brook University, Stony Brook, New York, 11794-8081, USA, [2]University of Utah, [3]Australian National University, [4]Addis Ababa University.

For over three decades the fossil hominids collected in 1967 from the Kibish For-

mation of southwestern Ethiopia have played a major role in our understanding of modern human origins in Africa. However, interpretations of these fossils have been hindered by ongoing debate over the stratigraphic origin and absolute ages of the remains. In 1999 and 2001 we have conducted paleontological and geological studies in the Kibish Formation in an effort to 1) resolve some of these issues regarding the relative and absolute ages of the fossil hominids; 2) document the archeological and faunal remains from the area; and 3) search for additional hominid remains.

Thus far we have established a tephrostratigraphic framework for calibration of the chronometry of the Kibish Formation and have obtained radiometric dates for parts of Member I, Member II, and Member IV. We have expanded the mammalian fauna from the region to over two dozen taxa of large and small mammals. We have documented a diversity of artifacts from several levels of the Kibish Formation , including abundant Levallois flakes, as well as chopping tools, thinned bifaces and barbed bone points. Finally, we have positively relocated the sites that yielded fossil hominids in 1967 on the basis of original maps, photographic archives and recovery of additional hominid remains that can be fitted to material collected during the 1967 expedition.

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Locating a phylum in time and space.

H. Fleming. African Studies Center, Boston University, Gloucester, MA, 01930, USA.

More accurately locating in time and space the hypothetical homeland of the Afrasian (Afroasiatic) linguistic phylum and subsequent movements of its major daughters (e.g., Semitic, Chadic, Omotic). Afrasian is the predominant linguistic phylum in northern Africa, the Nile Valley down to Khartoum, the Red Sea hills, Ethiopian highlands, lowland Horn and much of Kenya and Tanzania. It appears to have been so for the past twenty or thirty millennia. It probably correlates with numerous archeological and fossil human sites of deeper prehistory.

Two modern revisions of older and disputed dating systems and locational analyses are undertaken. A new dating system suited for phyla with numerous branches is created and applied; called ELD (Essential Linguistic Dating), it escapes most problems of traditional glottochronology, including binaristic insufficiency. For locations of homelands, a modified version of Dyen's Dispersal Theory is used. While not necessarily more accurate than traditional intuitive approaches, its assumptions and derivations are clearer and subject to falsification.

While new data may modify the resulting Afrasian homeland hypothesis, it appears proto-Afrasian was spoken around 25 kya in the area between Meroe and Aksum. Afrasian was probably part of a larger entity, moving from the Nile Valley into western Eurasia for many millennia.

ELD and Dispersal Theory as part of testable hypotheses about linguistic homelands promise to reunite the disparate subfields of 'four-field' anthropology in the pursuit of deeper human prehistory.

Human population size as a predictor of threatened species.

C.D. Fooce, J.K. McKee. Dept. of Anthropology, The Ohio State University, Columbus, Ohio, 43210, USA.

The growth and expansion of pre-human and human populations has long displaced other species and led to their extinction, particularly in the Holocene. Currently one of the greatest threats to species biodiversity and the ecosystems they support may be the profound growth of the human population.

Our hypothesis is that human population size is a predictor of the relative frequency of threatened species in the world. We tested this hypothesis with IUCN data on threatened (extinct, critical, endangered, and vulnerable) mammal and bird species as a proportion of total known mammal and bird species per country. These data were compared to human census data from the world database of the US Census Bureau. Ultimately, we used 114 of the 230 possible countries for this study. Island countries were excluded due to exceptionally high population densities and high numbers of threatened species. Other countries were excluded due to missing data. Using the total percentage of threatened mammals, birds, and a combination of the two, we ran partial correlations of the animal variables with census data from each decade 1950-2000, controlling for the geographic area of each country.

All of the correlations were statistically significant in a two-tailed test at $p < 0.01$. The r-squared values ranged from 0.04 - 0.11, with the current census figures having the greatest explanatory power. We conclude that human population growth has been a significant factor in the long-term and ongoing loss of biodiversity.

Biogeography of platyrrhine communities across the northern tier of South America.

S.M. Ford. Dept. of Anthropology, Southern Illinois University, Carbondale, IL, 62901-4502, USA.

The highest biodiversity in the world is found in Colombia, including the densest primate diversity, up to sixteen species in the inland primary tropical forests. This diversity drops rapidly as one moves along the coast in any direction (west, east, or north), and the nature of these primate communities alters. Obvious major barriers to dispersion include the Andes Mountains, the llanos region of Colombia and Venezuela, the *gran sabana* of the Guianas, and several major rivers, especially the Rio Orinoco. However, the specific effects of these barriers or others is not certain, and collecting in many of these areas is now restricted or impossible.

Data on species and locality were compiled from the largest existing collections of platyrrhines. Latitude and longitude were determined using a variety of gazeteers and maps. Using GIS, distributions of New World monkeys from Ecuador east to the Guianas along the northern tier of the continent and north to Nicaragua were mapped.

This large database of individual localities demonstrates dramatically the regions in which primate community structure and diversity shifts. The loss of small-bodied taxa as one moves north up the Panamanian isthmus is clearly delineated. The role of specific physiographic features in reducing diversity and altering community structure is apparent, along with their differing degrees of effects. Intriguing biogeographic questions for future research are indicated, such as the manifest contrast between the inland radiation of pitheciines vs. the isthmus-oriented radiation of *Alouatta*, which monotypic inland.

The double child burial from Sunghir (Russia): pathology and inferences for Upper Palaeolithic funerary practices.

V. Formicola[1], A. Buzhilova[2]. [1]Dept of Ethology, Ecology and Evolution, University of Pisa, Pisa, Italy, 56126, Italy, [2]Institute of Archaeology, Russian Academy of Sciences, Moscow.

The double burial from Sunghir is a spectacular Upper Palaeolithic funerary example dated to about 24.000 BP. A boy (S2) and a girl (S3), respectively about 13 and 10 years old, were buried at the same time, head to head, covered by red ocher and ornamented with extraordinarily rich grave goods. Examination of the two skeletons revealed that the S3 femora are short and exhibit marked antero-posterior bowing. Pathology is confined to the femora. No other part of this well-preserved specimen shows any abnormality. Previous analyses have attributed these deformities to a congenital condition of uncertain origin, although congenital diseases generally result in diffuse bowing deformities and other skeletal anomalies not shown by S3. However, occasional reports of rare,

unclassifiable congenital conditions presenting localised, and sometimes bilateral, bowing and shortening of long bones suggest that this possibility cannot be ruled out. Faulty foetal posture is an additional factor invoked in explaining neonatal localized bowing of long bones. Absence of shortening of affected bones and the very favourable prognosis of those changes, which resolve during growth, speak against such attribution. A further, and more likely possibility, is an early bilateral fracture of femoral shafts, healed with permanent shortening and bowing. Lack of modern treatment could explain the greater severity exhibited in comparison to today's clinical cases.

Relationships between physical abnormalities and extraordinary Upper Palaeolithic funerary patterns have been suggested elsewhere. The double burial from Sunghir provides additional support for this point of view.

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To what extent are male-male relationships dependent on mother-son relationships in bonobos (*Pan paniscus*)?: a case study on a captive alpha male bonobo.

M. Fortunato, C. Berman. SUNY at Buffalo, Buffalo, NY, 14201, USA.

In spite of male philopatry, bonobo groups are structured around supportive relationships between adult females and between mothers and sons. Relationships between males appear to be weaker, and may be highly dependent on the influence of females, but they have been studied relatively little. We investigated the relationships between the alpha male and other males in a group of 11 bonobos housed at the Columbus Zoo, comparing rates of affiliative and agonistic interaction between the males both when the alpha male's mother was present and absent from the group. Preliminary results suggest that the alpha male's interactions with another, motherless male are dependent on his mother's presence or absence. When his mother (the alpha female) is present, the alpha male engages in lower rates of affiliative interaction and higher rates of agonistic interaction with the motherless male than when his mother was absent. However, when the alpha male interacts with another male whose mother is a member of the group, there is no apparent effect of the presence of either mother on their interaction. These results suggest that the nature and stability of relationships of bonobo males may depend critically on the membership of mothers in the group and in some cases on the their immediate presence.

Revisiting human cold adaptation: craniofacial shape assessed by 3D laser scanning.

M. Friess. American Museum of Natural History, Division of Paleontology, New York City, New York, 10024, USA.

The morphology of the face in modern as well as fossil human populations has been the focus of debates about cold adaptation and/or masticatory stress. Published theoretical models are not conclusive as to exactly how the underlying mechanisms of cold adaptation might affect the face. In this study, a generalized cold adaptation model following Bergmann's and Allen's rules is proposed, and its applicability to present and past populations is tested. For this purpose, relative surface areas as well as volumes were measured using a 3D laser surface scanner. The modern human samples comprise supposedly cold adapted populations such as Inuits and Fuegians, as well as several populations from intermediate and warm climates (Mongolia, Tanzania, Egypt, South Africa). Data were also collected from casts of fossils hominids representing Neanderthals, *H. heidelbergensis* and *H. erectus*.

Results to date indicate that cold response in the human cranium tends to follow Bergmann's and Allen's rules at a global scale of comparison and that Neanderthals fit this general model. However, when populations are compared at a more localized level, the findings are not consistent with theoretical predictions. It is concluded that cold adaptation does play a certain role in craniofacial variation, but further investigation is required in order to differentiate its effects from those of other influential factors, such as masticatory stress.

Obesity an upcoming problem in the developing nations: links to physical activity and birth weight.

A.R. Frisancho. University of Michigan, Ann Arbor, MI, 48109, USA.

It has always been assumed that obesity is a major health problem that affects industrialized nations. However, recent evidence indicates that obesity is also becoming a major health concern of developing nations. Obesity, like other phenotypic traits is the result of genetic and environmental interaction. In industrialized countries obesity it is usually associated with food abundance and low physical activity. On the other hand, in developing countries obesity co-exists with under-nutrition and poverty. It is postulated that the co-existence of obesity and poverty is the result of compensatory response to a negative nutritional experience during growth and development. The objective of this presentation is to review the epidemiological and experimental evidence of the relationship of undernutrition to obesity relevant to developing nations.

Morphological micro-evolution of Nubian Populations from, A-Group to Christian Epochs: gene flow, not local adaptation.

A. Froment. I.R.D. (Institut de Recherche pour le Developement), Orleans Cedex 2, Loiret, 45072, France.

Prior to the Neolithic, populations of the Nile Valley in Nubia are very robust, and, because of a gap in the fossil record, it is difficult to connect them to later populations. Some have postulated a local evolution, due to diet change, while others postulated migrations, especially from the Sahara area. But between 5000 and 1000 BP, many cemeteries have supplied a large amount of skeletons, and the anatomical characters of Nubian populations are easier to follow-up. Twenty-seven archaeological samples (4 at 5000 BP, 5 at 4000 BP, 10 at 3000 BP, 3 at 2000 BP, 5 at 1000 BP), and 10 craniofacial measurements, have been considered. While cerebral skull is fairly stable, facial skull displays several regular modifications, and specially a reduction of facial and nasal heights, a broadening of the nose, and an increase of prognathism, while bizygomatic breadth is unchanged. These features illustrate a trend towards a growing resemblance with populations of Sub-Saharan Africa living in wet environments. However, paleoclimatological studies show that Nubia experienced an increasing aridification during that period. It is then unlikely that such a morphological change could be related to any local adaptive evolution to environment. Random drift is also unlikely, because the anatomical trend is relatively uniform during these millennia. It then seems more plausible that these changes correspond to the increasing presence of Southern populations migrating northward.

East African cercopithecid fossil record and its relationship to global climatic change.

S. Frost. American Museum of Natural History, Division of Paleontology, New York, NY, 10024, USA.

Vrba (e.g. 1992; 1995) has put forth a series of hypotheses about the evolution of African mammals, which she has termed "habitat theory." Habitat theory posits that changes in global climate cause "turnover pulses", relatively short periods of time during which occur large numbers of first and last appearances of species. Based on evidence from African bovids a turnover pulse has been described at 2.5 Ma that coincides with a major global cooling event. Analyses of the African suid fossil record have not found evidence of a turnover pulse at 2.5 Ma

(White, 1995; Bishop, 1999). This study examines whether a turnover pulse occurred in another major African taxon, the Cercopithecidae, at 2.5 Ma.

The East African cercopithecid fossil record is well suited to this analysis because cercopithecids occur at most East African Pliocene and Pleistocene sites, and are relatively speciose (Delson et al., 2000; Frost, 2001). To mitigate some of the biases inherent in any analysis involving paleontological data (White, 1995), this analysis is based on primary observation of original material, or casts, and all of the alpha taxonomy has been determined by the author.

The results of this analysis provide no support for a turnover pulse at approximately 2.5 Ma. In fact, the largest number of first and last appearances are clustered around 3.4 and 2.0 Ma, not coincident with known global climatic changes. I thank the Wenner-Gren (Grant 6436) and L.S.B. Leakey Foundations, NSF (NYCEP RTG award) for support of this research.

Effects of experimental intrauterine stress on postnatal growth of the skeleton.

M.C. Fucini[1], A.B. Orden[2], L.M. Guimarey[3], F.A. Quintero[4], E.E. Oyhenart[5]. [1]Centro de Invest. en Genética Básica y Aplicada (CIGEBA). Universidad Nacional de La Plata., La Plata, Buenos Aires, B1900AVW, Argentina, [2]Centro de Invest. en Genética Básica y Aplicada (UNLP) & Consejo Nacional de Invest. Científicas y Técnicas (CONICET)., [3]H.I.E.P. SSM Ludovica & Comisión de Invest. Científicas de la Pcia. de Buenos Aires., [4]Centro de Invest. en Genética Básica y Aplicada & Comisión de Invest. Científicas de la Pcia. de Buenos Aires., [5]Centro de Invest. en Genética Básica y Aplicada & Consejo Nacional de Invest. Científicas y Técnicas (CONICET).

The aim of the present study was to asses the catch up in skeletal growth of intrauterine growth retarded (IUGR) rats. Wistar rats constituted the following groups: (a) control, (b) sham-operated, and (c) IUGR. The IUGR was produced by uterine vessels bending (day 14th of pregnancy). Vertebral column, femur, humerus, and pelvis were measured on Rx of each animal, from 1 to 84 days old. Data were processed by repeated analysis of variance and LSD post hoc test. The reduced placental blood flow affected the intrauterine growth. The skeletal growth retardation was evaluated according to three criteria: bone lengths versus bone widths; stage (birth, weaning, adulthood) in which the bones were affected; and sex. The results showed a greater effect of IUGR on bone lengths compared to bone widths. The axial segments (vertebral column and pelvis) were retarded more than the bones of the extremities. Males showed a greater susceptibility than females. Both sexes showed catch-up growth in femur and humerus lengths. The other variables did not recover the arrest of growth, remaining significantly lower than control. It can be concluded that IUGR produces allometric changes in the postnatal growth.

Behavior and demography of a semi-free ranging population of long-tailed macaques (*Macaca fascicularis*) at Padangtegal, Bali, Indonesia.

A. Fuentes[1], K. Suaryana[2], A. Rompis[2], I. Arta Putra[2], I. Wandia[2], I. Soma[2], N. Watiniasi[2], N. Suartha[2], I. Harya Putra[2], G. Emel[3]. [1]Dept. of Anthropology, and, Primate Behavior and Ecology Program, Central Washington University, Ellensburg, WA, 98926-7544, USA, [2]Universitas Udayana Primate Research Center, [3]Primate Behavior and Ecology Program, Central Washington University.

The study of semi-free ranging, food enhanced, populations can contribute to our understanding of primate ecology and evolution, especially in the light of widespread sympatry between human and non-human populations (Fa and Southwick 1988). Here we report of the first four years of an ongoing study on the population of long-tailed macaques (*Macaca fascicularis*) at Padangtegal, Ubud, Bali, Indonesia. The behavioral patterns observed in this population may provide insight into aspects of ecological constraints on this species, and possibly contribute conceptually to the investigation into the evolution of modern human behavior.

At the Padangtegal site there are three groups totaling approximately 151 individuals, of which all males over five years of age and 44 of 60 adult females are known individually. From 1998 to 2001 we compiled 1516 hours of focal follows to document general activity rates and conducted population assessments for 38 months of demographic data. Since 1998 we have also conducted research projects to document specific aspects of behavior and ecology.

Overall behavior patterns of this population are similar to those reported for free ranging *Macaca fascicularis* across Southeast Asia with differences in foraging patterns and human interaction levels. Alpha male tenure ranges from 8 months to over four years and male migration has been observed. There appear to be multiple mating strategies practiced by adult males in this population. No infanticide by males has been observed or inferred, however, infant deaths have resulted from female infant taking. Object manipulation is extremely common in this population.

The evolution of human phenotypic plasticity: age and size at maturity.

T. Gage. University at Albany, Albany, NY, 12222, USA.

One of the primary difficulties for proponents of the adaptationist paradigm is garnering evidence of Darwinian selection. Measuring a change in the frequency of an allele over several generations is not an option, particularly in long lived species such as humans. Consequently, it is not surprising that the best example of selection in the human species involves a balanced polymorphism, that is, of course, sickle cell anemia. Here the evidence for selection is obtained by comparing the frequency of the sickle cell allele across an environmental gradient over which selection models predict that the optimum allele frequency should change. Balanced polymorphisms are not the only evolutionary scenarios that might produce variable and hence theoretically testable optimum. This paper describes a model taken from the evolution of life-history literature that predicts phenotypic plasticity in age and size at maturity, and attempts to operationalize it using human demographic and growth data. The model is based on the tradeoffs between growth, fertility, and prereproductive mortality.

Univariate and Multivariate scaling of epiphyseal and diaphyseal dimensions in extant and extinct hominids.

A. Gallagher. Dept. of Human Anatomy & Cell Biology, University of Liverpool, Liverpool, Lancs, L69 3GE, United Kingdom.

In a series of papers in the late 1980's and early 1990's, W. L. Jungers presented a convincing case that AL 288-1 ("Lucy") lacks the relatively large femoral head characteristic of extant *Homo sapiens*. This analysis utilised linear dimensions and circumferences of the epiphyses and diaphyses of the upper and lower limbs in a large sample of living humans and extant African apes. Geometric Means (*GM*), were calculated for the matrix. African apes contrast with living humans in their uniformly smaller lower limb dimensions, but not necessarily uniformly larger upper limb dimensions. Scaling to their respective 'functional' *GM*'s, yields a contrasting picture. African apes have neither uniformly larger upper nor uniformly smaller lower limb dimensions than recent humans. African apes do possess relatively larger proximal ulnae and distal radii, and relatively smaller femoral head dimensions relative to extant humans. This finding unequivocally supports Jungers' thesis.

Multivariate extension of the analysis (PCA) supports the previous results. The extant apes differ from living humans on the

1st Component Axis by virtue of their smaller lower limb epiphyses, and on the second axis by their larger humeral and radial epiphyses. AL 288-1 is isolated on these axes. When her 'total morphological pattern' is considered, AL 288-1 is morphologically 'closer' to extant and extinct *Homo* than she is to *Pan* or *Gorilla*. The large femoral head diameter of *Homo* is primarily a response to mechanical pressures mediated by the increased body mass, rather than enhanced locomotor efficiency of Pleistocene hominin species relative to *Australopithecus*.

Growth of Akwesasne Mohawk adolescents and environmental contaminants.

M. Gallo[1], J. Ravenscroft[1], L. Schell[1], A. DeCaprio[2], M. Denham[1], Akwesasne Task Force On The Environment[3]. [1]University at Albany - SUNY, Delmar, NY, 12054, USA, [2]School of Public Health, University at Albany - SUNY, [3]Akwesasne Mohawk Nation.

Most humans have detectable body burdens of polychlorinated biphenyls (PCBs), hexachlorobenzene (HCB) and dichlorophenyldichloroethylene (DDE) a metabolite of DDT. Evidence suggests that neonates are at greater risk due to relatively high-exposure to lipophilic compounds during breast-feeding. Children born to women who are heavy fish consumers may be especially at risk for toxicant exposure from maternal accumulation during development in utero or from lactation. This study investigates the relationship between PCB levels and growth among adolescents (n = 271) of the Akwesasne Mohawk Nation. The nation is located on the St. Lawrence River between the US and Canada. Traditionally fish has been an important component of the diet there. However, since the 1950s industries contaminated the river with PCBs. In 1985 local health authorities advised people not to consume local fish due to toxicant contamination. Height, weight, body mass index, three breadths, five circumferences, and seven skinfolds were measured. Height-for-age and weight-for-age percentiles and z-scores were calculated using the CDC program EPI6. Serum PCBs are assessed by congener specific analysis; mean concentrations = 1.72 ppb. Among all adolescents, significant inverse relationships exist between BMI and concentrations of seven persistent PCBs. Further work will examine the import of dietary influences on these relationships to determine the causal mechanisms responsible.

Everyday US sign language: A new look at Hewes' hypothesis for a gestural origin of spoken language.

P. Gannon[1], N. Kheck[1], S. Goldin-Meadow[2], A. Valachovic[3], A. Braun[4]. [1]Dept. of Otolaryngology - 1189, Mount Sinai School of Medicine, New York, New York, 10029-6574, USA, [2]Dept. of Psychology, University of Chicago, [3]Dept. of Rehabilitation Medicine, Mount Sinai School of Medicine, New York, [4]National Institutes of Health, Institute on Deafness and Other Communication Disorders.

Gordon Hewes proposed a purely gestural evolutionary origin of spoken language (73). Recently, Corballis commented: "Human language may have evolved from manual gestures, which survive today as a *behavioral fossil* coupled to speech" (99). Goldin-Meadow demonstrated that "for both speakers and listeners, gesture and speech are two aspects of a single process with each contributing its own unique level of representation" (98). To explore this concept we determined comprehension of "Emblem" gestures that are culturally specific and meaningful with or without speech (Ekman & Friesen, 69).

Multiform gestures (n = 31) were presented in silence to 6 adults and 9 teenagers who provided a written characterization and a "power rating" on a scale of 1-10. Gestures commonly used for "check please" (e.g., to a waiter across a crowded restaurant), "time out"; "can't hear you"; "go away" (thanks Panbanisha) and "it tastes gross" were rated as 10. Overall, 80% of gestures were rated as being within the 7-10 range. Not surprisingly, most teenagers did not understand the "check please" gesture. Gestures poorly understood and rated were 5 controls not commonly used in the US. Although gestures used and reported here are *mono-gestures;* that is, single-item gestures, preliminary data suggests that *poly-gestures,* that involve a linked series (e.g., "Looks great, so hurry up and go do it"), are as readily understood.

Everyday US gestures presented here were perceived visually as effortlessly and meaningfully as their spoken/heard equivalents. Our observations support Hewes' pervasive concept of an evolutionary depth of spoken language origins without modality discrimination.

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3d reconstruction of enamel volume in human and gorilla molars.

D. Gantt[1], J. Kappelman[2], R. Ketcham[3], M. Colbert[3]. [1]U.S. Army Medical Dept. Center & School, Academy of Health Sciences, Dept. of Medical Sciences Interservice Physician Assistant Program, Fort Sam Houston, TX, 78234-6134, USA, [2]Dept. of Anthropology, University of Texas, Austin, TX 78712-1086, [3]High-Resolution X-Ray Computed Tomography Facility, Dept. of Geological and Earth Sciences, University of Texas, Austin, TX 78712-1101.

The purpose of this investigation is to use high-resolution x-ray computed micro-tomography (HRCT) as a nondestructive method to accurately and reliably measuring enamel thickness and volume in human and gorilla lower molars. Previous investigations have documented that humans have thick enamel while gorillas have thin, however there has been controversy concerning the destructive techniques used as well as methods of interpretation.

The goals of this investigation were to: 1) accurately measure enamel thickness in a repeatable manner using HRCT; 2) determine the volume of enamel; and 3) describe the pattern of enamel distribution.

The scan thickness of human lower molars was 0.051 mm; with 246 sections and a field of reconstruction of 14.7 mm. Gorilla lower molars the scan thickness was 0.073 mm, with 231 sections and a field of reconstruction of 18.6 mm. Buccal-lingual thickness measurements of the mesial aspect of the crowns are comparable to published sectioned data for both species.

3D reconstruction of the crowns using VoxBlast[tm] allowed for volumetric data to be obtained as well as thickness data in all planes. The volume of enamel in the human molar is 730.24 cubic mm, while in the gorilla it is only 523.15 cubic mm. While the human molar is approximately 25% smaller than that of the gorilla it has approximately 30% more enamel. The significance of this study is that is provides for the first time volumetric data as well as an accurate and repeatable nondestructive method of measuring enamel thickness and its distribution.

The opinions or assertions contained herein are the private views of the authors and are not to be construed as official or as reflecting the views of the Department of the Army or the Department of the Defense.

Experimental field study of tool use in wild capuchins (*Cebus capucinus*): learning by association or insight?

P.A. Garber[1], E. Brown[2]. [1]Dept. of Anthropology, University of Illinois, Urbana, Urbana, Illinois, 61801, USA, [2]Conservation and Science Dept., Lincoln Park Zoo, Chicago.

Several species of capuchins have been observed to use tools occasionally in the wild. This includes the use of sticks as probes and stones as hammers to break open hard-shelled fruits. Under experimental conditions in captivity, capuchins are reported to use tools in a wide range of problem-solving conditions. However, it remains unclear whether capuchins have insight into how a tool functions, or whether capuchin tool use is better understood as a form of associative learning.

From September through November

2000 we conducted an experimental field study of tool use in a group of 15 wild white-faced capuchins (*Cebus capucinus*) inhabiting La Suerte Biological Research Station, Costa Rica. The problem presented to the capuchins involved the use of wooden dowels as probes to obtain a food reward (banana) located inside a clear plexiglas box. The task required the capuchins to manually insert a dowel into any of 7 holes in order to push a banana off a shelf. The banana could then be retrieved through an opening at the bottom of the box.

The capuchins visited the tool use platform 702 times over the course of 55 consecutive days. During the first 21 days of the study, the capuchins explored the box, but made no attempt to manipulate the dowels. On days 22-39, the dowels were inserted through the holes and under the bananas so that touching the dowels would cause the bananas to fall. The capuchins took advantage of this situation and manipulated the dowels to obtain the food reward. When the dowels were placed back on the platform (days 40-55), however, the capuchins made no attempt to use them as tools. These data support the hypothesis that tool use by white-faced capuchins represents learning by associative rather than learning by insight. Additional relationships between dominance, access to resources, and observational learning are discussed.

Evidence for clubfoot (talipes equinovarus) from a Laurel Period site (ca. 2000 BP) in southern Manitoba.

T. Garlie[1], D.C. Merrett[1], C. Meiklejohn[1], D. Finch[2], B. Waddell[1]. [1]Dept. of Anthropology, University of Winnipeg, Winnipeg, Manitoba, R3B 2E9, Canada, [2]Dept. of Anthropology, University of Alberta, Edmonton, Alberta, Canada.

During the last twenty years fluctuating water levels along the Winnipeg River system in southwestern Manitoba have revealed several archaeological sites of significance. In an effort to safeguard this information, a collective effort among the Historic Resources Branch of the Province of Manitoba, the University of Winnipeg and the First Nations groups of Manitoba has been developed. The skeletal remains of three individuals were recovered from the Rivermouth site, an adult in 1987 in presumptive association with Laurel pottery, providing an estimated age of 2000 BP, and an adult and adolescent in 1996 in a late precontact context, ca AD 1600/1700.

This poster examines morphological anomalies in the lower limbs of the adult recovered in 1987. The remains show bi-lateral flattening of the proximal femoral shaft and medio-anterior rotation of the lateral surface of the medial malleolus, shortening of the right femoral neck and antero-posterior shortening and superior flattening of the right calcaneus.

Preliminary analysis indicates that this individual may exhibit congenital clubfoot (talipes equinovarus), possibly representing the first example of this condition from a boreal forest environment. This investigation highlights evidence consistent with the clinical literature, that despite aesthetics, individuals with clubfoot can serve in a functional capacity within a hunter/gatherer society.

The impact of acetic acid pretreatment on apatite carbonate.

S. Garvie-Lok, T. Varney. Dept. of Archaeology, University of Calgary, Calgary, Alberta, T3A 2H4, Canada.

The use of apatite carbonate $\partial^{13}C$ analysis in palaeodietary reconstruction is becoming increasingly common. As well as adding an extra dimension to research based on collagen $\partial^{13}C$ and $\partial^{15}N$ analysis, apatite carbonate offers the potential to extend stable isotope dietary reconstruction into the deep past. The vulnerability of carbonates to diagenesis necessitates careful preparation and evaluation of samples. Current pretreatment methods include dilute acetic acid soaks to remove calcite and other highly soluble mineral contaminants. However, there is variation in both treatment time and acid concentration. This study addresses the impact of such variation on carbonate stable isotope values, sample loss in solution, and sample FTIR characteristics. Samples of fresh and archaeological bone were subjected to 1.0 M and 0.1 M acetic acid soaks. Carbonate $\partial^{13}C$ and $\partial^{18}O$, sample loss and FTIR characteristics were measured at treatment times of 4 to 24 hours. The results suggest that 4 hours suffice to remove highly soluble contaminants; longer treatments may lead to recrystallization. Some samples treated with 1.0 M acid showed unacceptable loss or possible recrystallization, suggesting that 0.1 M acid pretreatment is preferable. However, 0.1 M acid caused smaller shifts in $\partial^{13}C$ and $\partial^{18}O$ for all samples and treatment times. While 0.1 M acid appears to produce superior sample quality, it may not produce results directly comparable to those of 1.0 M acid treatments. This has important implications for the comparison of apatite carbonate stable isotope values in the literature.

Maintenance of spatial proximity in red-fronted brown lemurs (*Eulemur fulvus rufus*) .

J. Gerson. Duke University Primate Center, Durham, North Carolina 27705 USA.

Patterns of spatial proximity reflect affiliative relationships. Maintenance of spatial proximity is another important component of relationships - animals put effort into maintaining relationships beneficial to them but do not invest in non-beneficial relationships. Within a pair, the individual that gains more from the relationship will be more responsible for maintaining proximity than the individual that benefits less from their association. Responsibility for proximity maintenance is therefore important when evaluating hypotheses to explain the patterns of relationships seen. Here, responsibility for proximity maintenance is described for red-fronted brown lemurs *Eulemur fulvus rufus.*

Two groups of free-ranging *E. f. rufus* were studied in northwestern Madagascar. During focal animal observations, all occurrences of approaches and leaves involving the focal animal were recorded and used to calculate Hinde's index for responsibility of proximity maintenance for each pair of individuals. Of 27 possible male-female dyads, Hinde's index was positive for 24 pairs. These results are highly significant (binomial test, $p << .001$). Males were responsible for maintaining spatial proximity to females. This suggests that spatial proximity between males and females is maintained for benefits gained by males. This does not support hypotheses for male-female associations based primarily on benefits to females, such as infanticide protection, male agonistic aid, or male-infant relationships. Male responsibility for proximity maintenance to females is consistent with hypotheses that suggest male benefits to male-female relationships, including increased male mating opportunities. Responsibility for proximity maintenance is an important piece of information to consider when evaluating hypotheses for male-female relationships.

Craniofaciometric diversity in Iraqi males.

W. Gharaibeh. Dept. of Ecology and Evolution, SUNY at Stony Brook, Stony Brook, NY, 11794-5245, U.S.A.

Geometric morphometric methods were employed to investigate the Craniofaciometric relationships among six Iraqi ethno-religious groups. Nine 2-dimensional co-ordinates were digitized on published side view photographs of adult males of the following groups: Assyrians (Nestorian Christians, Neo-Aramaic speakers, n = 86), Kurdistan (mostly Sunni Muslim and Kurdish speakers, n = 9), Upper Iraq (mostly Sunni and qeltu-Arabic, n = 10), South Euphrates (Shi'i Muslim, gelet-Arabic speakers, n = 109), Ahwar (Shi'i, gelet, n = 63) and Middle Iraq (mostly Baghdad, tran-

sition zone between the Sunni qeltu and Shi'i gelet, n = 28).

Generalized procrustes and thin-plate spline analyses were used to acquire the shape variables. The first principal component (49.9%) of the shape variation was found to correspond largely to the angle between the plane of the face and the camera and was regressed from subsequent analyses.

Even though most of the variability was within group, permuted MANOVA tests showed a significant difference between the Assyrians and all other groups ($p<0.001$). Thin-plate spline deformation grids suggested that the Assyrians differed mainly in the position of the opisthocranion, probably a result of occiput flattening by board-cradling. After omitting the opisthocranion from the analysis, the difference between the Assyrians and other groups remained highly significant ($p<0.001$), seemingly reflecting a relative elongation of the facial region in Assyrians on average. Average unwarped images showed other group differences not captured by the landmarks: the Assyrians have relatively heavier jaws and less prominent zygomas on average. The craniofaciometric interrelationships among the groups are discussed within an environmental and historical context.

Application of the poisson model to the analysis of fracture data.

B. Glencross[1], L. Sawchuk[2]. [1]Dept. of Anthropology, University of Toronto, Etobicoke, Ontario, M8Z 4X1, Canada, [2]Dept. of Anthropology, Scarborough Campus, University of Toronto.

The methodological approach taken in analyses of bone fracture data is often "epidemiological", where detailed frequencies are presented and compared to those for other prehistoric and historic populations. However, seldom acknowledged are three issues relevant to analysis and interpretation of such data: the nature and distribution of count data, the individual's susceptibility to fracture, and the effect of age-structure when comparing data from different populations. This presentation explores each issue through the application of the Poisson model and the use of "person-years" as an alternate measure of observation. The methodology is illustrated with examples using long bone fracture data from Indian Knoll, Kentucky.

Results indicate that the Indian Knoll long bone fracture data show marked positive skewness with a mean of 0.4 fractures per individual (SD = 0.73). The probability of a person showing no long bone fractures is 67-74%, while at the other extreme the probability of a person showing four long bone fractures is 0.1-0.4%. Fracture events appear to be random and unrelated amongst individuals with no one showing an extraordinary propensity for injury. Calculated long bone fracture rates equal 3.8 per 1000 female person-years, and 3.9 per 1000 male person-years. Difference in the proportion of female and male individuals showing fracture is not statistically significant ($Z = 0.56$, $p = 0.2877$).

It is concluded that the use of the Poisson model and person-years as an alternate measure of observation will strengthen the basis for interpretation and contribute to a better understanding of bone fractures in the past.

Loud calls in adult male mona monkeys on the island of Grenada, West Indies.

M. Glenn. Dept. of Anthropology, Humboldt State University, Arcata, CA, 95521, USA.

It has been suggested that loud calls of adult male forest-dwelling guenons function to maintain intragroup cohesion, regulate intergroup spacing, and alert other group members of a potential danger by displaying threat behavior toward a disturbance or predator. Previous to my study, the vocal repertoire of the introduced mona monkey population on the island of Grenada had not been studied, and little was known about vocalizations in the ancestral populations of mainland African *C. mona*.

Data on the structure and function of adult male loud calls were collected over 28 months between September 1992 and April 1995. Vocalizations were recorded and their behavioral context noted during 1,472 encounters with wild monkeys.

Adult male loud calls in *C. mona* are made up of two call types: "booms," which are low-frequency (100 to 200 Hz) resonant calls and "low hacks," or low-pitched calls with a frequency range between 0 and 2.5 KHz.

Adult males on Grenada emit loud calls to both maintain intragroup cohesion and regulate intergroup spacing; however, loud calls from adult males in mixed-sex groups on Grenada do not appear to function as alarm calls. Adult males rarely display threat behaviors toward a disturbance while giving booms and low hacks, nor are they commonly located on the periphery of mixed-sex groups. Adult males are rarely the first to see and notify others of a potential threat, and therefore do not appear to act as a "lookout" for their group.

Dental monomorphism in a wild population of *Propithecus verreauxi* from Beza Mahafaly, Southwestern Madagascar.

L. Godfrey[1], J.C. Razafimahazo[2], M. Schwartz[3]. [1]Dept. of Anthropology, University of Massachusetts, Amherst, Amherst, Massachusetts, 1003, USA, [2]Département de la Paléontologie et Anthropologie Biologique, Université d'Antananarivo, Antananarivo 101, Madagascar, [3]Dept. of Anthropology, Yale University, New Haven, Connecticut 06520.

We analyzed metric variation of the teeth of wild Verreaux's sifakas (*Propithecus verreauxi verreauxi*) from Beza Mahafaly in Southwestern Madagascar. This analysis was based on casts made of the maxillary dentitions of captured and released individuals aged 1 year and older. More than 400 casts were made of individuals captured between 1984 and 2001. There were roughly equal numbers of males and females in the database. Measurements included crown heights as well as mesiodistal and buccolingual dimensions of the teeth, along with various breadth dimensions of the muzzle and palate. Second and third molars were not measured as these could not be reliably molded in these short-muzzled, live lemurs. Ages for all individuals were known from field observations or inferred from comparisons of dental wear with that of known-aged individuals. The hypothesis of sexual dimorphism was tested for all traits, and a principal component analysis was conducted to quantify patterns of age, sex, and spatial variation.

This analysis confirms rapid dental eruption in sifakas: at age 1 year, all analyzed teeth were fully erupted with the exception of the upper canine, which was universally erupting. There are dramatic wear-induced changes in the "dimensions" of teeth that correlate with age. Dental monomorphism does indeed characterize this population; minor exceptions to this pattern (e.g., in premolar height) can be understood in terms of minor age differences between the sampled males and females. We now know at which ages sifakas are in their "dental prime" (with fully erupted and relatively unworn teeth) and can explore how this relates to other aspects of their developmental and life history profiles.

***COX8H* is expressed in strepsirrhine and platyrrhine primates, but not in humans.**

A. Goldberg[1], D. Wildman[2], T. Schmidt[2], M. Huttemann[2], M. Goodman[3], M. Weiss[4], L. Grossman[2]. [1]Dept. of Anthropology, Wayne State University, AND, Center for Molecular Medicine and Genetics, Wayne State University, Detroit, Michigan, 48202, USA, [2]Center for Molecular Medicine and Genetics, Wayne State University, [3]Center for Molecular Medicine and Genetics, Wayne State University AND, Dept. of Anatomy and Cell Biology, Wayne State University, [4]National Science Foundation.

Cytochrome *c* Oxidase (COX), an enzyme important in energy metabolism, is composed of thirteen subunits. Three of the subunits are encoded by the mitochondrial genome, whereas the remaining subunits are

nuclear encoded. Of the nuclear encoded subunits, four are typically found as protein isoforms which show tissue-specific and developmental patterns of expression in mammals. COX subunit VIII consists of a ubiquitously expressed isoform, encoded by *COX8L*, and an isoform that is expressed in heart and skeletal muscle, encoded by *COX8H*. Previous research suggests that the gene duplication leading to the COX8 isoforms, preceded the origin of mammals, but that *COX8H* is not expressed in humans and macaques. By obtaining the full-length cDNA of a functional *COX8H* gene from *Eulemur fulvus* and *Ateles belzebuth*, we show expression of the gene does occur in primates. Therefore, loss of *COX8H* expression occurred during primate evolution, in the catarrhine primates. Furthermore, we show that *COX8H* is an unprocessed pseudogene in humans, located on chromosome 11 adjacent to the 26S proteasome p40.5 gene, in the same relative position as in species with a functional *COX8H* gene. Significantly, loss of expression of *COX8H* is not an isolated event, but appears related temporally to previously documented increased rates of evolutionary change for other genes of the electron transport chain in anthropoid primates. Selected adaptive changes in brain oxidative metabolism may have facilitated the evolution of the large energy-dependent primate neocortex. Whether changes in *COX8* gene expression patterns are related to this neocortical expansion remains to be determined.

Relationship between collagen fiber orientation, age and mechanical adaptation of the human mid-shaft femur.

H.M. Goldman[1], T.G. Bromage[2], J.G. Clement[3], C. Thomas[3]. [1]City University of New York, New York, NY, 10021, USA, [2]Hunter College, CUNY, New York, NY, [3]School of Dental Science, University of Melbourne, Australia.

Collagen fiber orientation is an aspect of a bone's microstructure that influences its mechanical properties. Although its spatial distribution is hypothesized to reflect loading during life, its variability in a modern human sample is essentially unknown. Using a large (n = 70) adult autopsy sample, variability in collagen fiber orientation within the mid-shaft femur was examined in relation to age and sex.

Montaged images of entire 100-micron thick cross-sections were obtained using circularly polarized light microscopy (CPLM) under standardized lighting conditions. An automated routine divided images into 48 segments according to anatomical position. Average grey values (reflective of orientation) were quantified for each segment, and one-way ANOVA with Tukey HSD post-hoc tests were applied to assess differences between segments.

Collagen fiber orientation appears non-randomly distributed across the mid-shaft femur, though no single 'human' pattern was identified. Individual variation, unexplainable by age, sex or body size, overwhelms most population level trends. Differences between age and sex groups suggest a strong correspondence between collagen fiber orientation and tissue type distributions. Minimal consistencies demonstrated here may reflect mechanical forces induced at the femoral mid-shaft. However, the myriad of other factors influencing collagen fiber orientation patterning, including disease states, growth trajectories, and metabolic and nutritional status need to be explored further. Only then, in conjunction with studies of other structural and material properties of bone, will we elucidate the linkages between microstructure and functional adaptation.

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Kennewick man revisited: group affiliation and Native American Origins.

R.A. Gonzalez. Dept. of Social Sciences, Division of Anthropology, Niagara County Community College, Sanborn, New York, 14132, USA.

Since the discovery in 1996 at Kennewick Washington, "Kennewick Man" has been a target for fierce political and scientific debated. The question of whether or not his remains are those of a Native American, who lived in the Columbia Plateau some 9,500 B.P., has attracted not only the attention of the anthropological community, but also the attention of the world at large. The present study seeks to test the conclusions reached by J.C. Chatters (1999, 2000, 2001) and J.F. Powell and J.C. Rose (1999), in which it is argued that "Kennewick Man" is more closely affiliated with Polynesians, Ainu, and Jomon rather than modern Native Americans. To test such conclusions, a multivariate statistical analysis by way of principal components was performed on 11 common measurements of the human cranium utilizing data taken from the T. Hanihara and W.W. Howells world craniometric databases. Prehistoric data were also taken from the literature. In total, the study used 38 sample population groups representing modern and some prehistoric people from North America, South America, Northeast Asia, East Asia, and Polynesia. The results obtained from the statistical analysis parallel those of previous studies. "Kennewick Man" shares some morphological similarities with Polynesians. However, there is strong evidence indicating that despite having a strong relationship with Polynesians, "Kennewick Man" also has a strong historical-biological connection with people associated with Tierra del Fuego and Patagonia and even some prehistoric Chinese. There is no evidence suggesting a biological affiliation between "Kennewick Man" and modern Native Americans from North America.

Increasing population sample sizes using global skeletal size variables.

A.D. Gordon. Dept. of Anthropology, University of Texas at Austin, Austin, TX, 78712-1086, USA.

Due to the scarcity of postcranial skeletons with recorded body mass in museum collections, morphological studies that incorporate body size must often draw from multiple populations within a species (demes) to generate samples large enough to yield statistically significant conclusions. Alternatively, studies may include specimens with estimated body mass, but must then incorporate confidence intervals of those predictions in their analyses. This limitation effectively prohibits evolutionary studies that analyze individual demes. This paper presents a technique for developing global skeletal size variables (GSVs), which allows researchers to increase sample sizes.

Using body mass data and multiple postcranial measurements from several primate species, it is shown that researchers can generate GSVs that scale isometrically with mass and are directly proportional to mass – both within single populations and across multiple species. Examples are presented using data from *Papio cynocephalus*, *Pan troglodytes*, *Gorilla gorilla*, *Cebus apella*, *C. albifrons*, *Saimiri boliviensis*, *Alouatta caraya*, and *Aotus azarae*. Each sample has been limited to individuals collected over small ranges of space and time to maximize the likelihood of belonging to the same deme.

Because of the nature of the relationship between these GSVs and body mass, GSVs may be used as measures of overall size in comparative studies rather than body mass. Using a GSV permits researchers to include any reasonably complete postcranial specimen in their studies rather than being limited to only those specimens that have associated mass measurements. Examples of applications of this technique to studies of primate sexual size dimorphism are provided.

Spatial and genetic differentiation in an isolated tropical tree population: reconstructing primate seed dispersal.

B. Grafton, M. Norconk. Biological Anthropology Program, School of Biomedical Sciences, Kent State University, Kent, OH, Kent, OH, 44240, USA.

Primates are important seed dispersers for many tropical plants, but their effect on the spatial distribution of dispersed species

is largely unknown. In this study, we examine a population of *Talisia retusa* (Sapindaceae) trees putatively dispersed by a group of red howler monkeys (Alouatta seniculus) on a land-bridge island in Lago Guri, Venezuela. In order to analyze this population in terms of both spatial and genetic relationships among individuals, coordinates and leaf tissue for DNA extraction were collected from 170 Talisia individuals. Three questions were asked: 1) Are 'small' individuals (<10 cm DBH) spatially independent of 'large' individuals (> 10 cm DBH)?; 2) Are 'small' individuals most closely related to the nearest 'large' neighbor?; and 3) Are all individuals spatially independent of Talisia dispersal sites? Spatial independence was tested using Ripley's K(d) analysis for two populations, and relatedness was estimated using the Random Amplified Polymorphic DNA (RAPD) technique. History of dispersal events was reconstructed based on genetic markers. Due to the lack of other long-distance dispersers at the site, any deviation from non-random distributions of RAPD patterns would suggest dispersal by Alouatta. Results indicate that Talisia populations of different size classes are not spatially independent, and that extant trees of all sizes are distributed independently of the locations to which Alouatta has been known to disperse this species. Preliminary results of the genetic relationships reveal at least some random distributions of RAPD patterns, indicating the effect of Alouatta on the distribution of Talisia at this site. Supported by NSF-SBR 9807516.

Going beyond non-human primates to answer questions of human parturition.

A. Gray. University of California, Riverside, Riverside, CA, 92507, USA.

When direct human observation is not feasible, anthropologists often turn to non-human primates for answers. There is often a reluctance to look at other phylogenetically more distant mammals. However, in some cases, non-human primates cannot offer an appropriate model and by turning to studies of other animals and from other disciplines, we may discover the answer to our questions. This paper discusses such an example, dorsal pitting of the human pelvis.

Dorsal pitting as an artifact of human pregnancy has been noted in the literature. While pitting seems related to pregnancy, it cannot be correlated to specific events such as the number of births or conceptions. Even so, it has been erroneously used as an indicator of the number of pregnancies with each pit representing a pregnancy. In fact, the pitting event is not understood. Little research has been done to document stages of human pregnancy as it relates to pitting to detail the timing and circumstances of the pitting event, as this work could not previously be done without harming the mother.

Recent work in endocrinology, using non-primate mammals, offers insights into the mechanism of dorsal pitting in pregnant human females. In these mammals, pitting is a result of an imbalance between the hormones relaxin and estrogen. This paper will relate these findings to humans and suggest further extensions of this work.

Dental paleopathology of a late prehistoric mortuary from Indiana.

T. Greene. University of Alaska, Fairbanks, Fairbanks, Alaska, 99775-1006, USA.

The Ray site (12W6), located in southern Indiana, contains several secondary burials, two of which have been dated to the Mississippian period (A.D. 1050-A.D. 1450). Three burial styles were noted: (1) burials lined with stone slabs and containing Mississippian pottery, (2) burials lined with stone slabs and but with no Mississippian pottery, and (3) burials not lined with stone slabs and without Mississippian pottery. The purpose of this study is to determine the biological homogeneity of this poorly preserved skeletal assemblage via an analysis of dental pathological conditions, the frequency and expression of which are known to associate with distinct dietary and/or settlement patterns. Conditions studied include the frequency of hypoplastic defects and carious lesions, the type of hypoplastic defects, the earliest age of onset of hypoplastic defects, and the location of carious lesions. A total of 437 teeth were scored for hypoplastic defects and 433 were scored for carious lesions.

No significant differences in dental pathologies were found between burial styles. Therefore, despite considerable burial heterogeneity, dental pathological conditions suggest that individuals from all burials consumed an equally cariogenic diet and underwent similar childhood stresses. It is most likely that all burials are from the same temporal and/or social group, and that the different burial styles represent different stages in the processing of the remains of individuals from a high social status Mississippian mortuary.

The comparative morphology of the hominoid fibula.

T.M. Greiner. New York Chiropractic College, Seneca Falls, New York, 13148-0800, USA.

The origin of habitual terrestrial bipedalism was a key event that separated humans from the ancestral primate stock. Appreciating this event requires an understanding of how bipedal adaptations are reflected in all parts of the anatomy. The fibula represents a frequently overlooked part of the anatomy that is clearly different in humans, apes, and monkeys. Most discussions of fibular morphology are associated with the talocrural joint. While this articulation is undeniably important, the typical hominoid fibular morphology is more complicated. In all hominoids, the distal tibiofibular joint is a syndesmosis, which implies a restricted range of motion. Yet, the proximal joint is synovial, which implies greater ranges of motion. These two joint morphologies seem contradictory, for the fibula cannot move at the proximal joint without also moving the distal joint. A survey of the comparative morphology of these joint surfaces only serves to deepen this conundrum and shows that the functional morphology of the fibula has heretofore not been well described or understood.

This presentation will address this oversight by exploring the morphological and functional specializations of the fibula among the hominoids. Data will be reported that describes the morphological differences of the fibula in association with related bony structures in the tibia and the talus. Attempts are made to determine a functional and evolutionary basis for the differences that are identified. Statistical and mechanical analyses are then used to form a basis for describing fibular variation and for developing a framework to assess functional similarity among primate groups.

Comparison of impression materials used on fossil teeth.

D. Guatelli-Steinberg[1], J. Mitchell[2]. [1]Dept. Anthropology, The Ohio State University, Newark, Newark, OH, 43055, USA, [2]Oregon Health & Science University.

Studies of hominid fossil teeth often employ impression material for the microscopic study of perikymata packing patterns, microwear, and enamel hypoplasias. The purpose of this investigation is to compare different impression materials and techniques to determine which preserves the most enamel surface detail. Maximizing information preserved in tooth impressions is important, not only for precision in such studies, but also because repeated application of impression material may erode enamel surface features on fossils.

Comparisons of surface detail preserved on scanning electron micrographs are made among different materials: Coltene's President's Jet Light Body (the current standard), Struer's RepliSet Fluid (a low-viscosity silicon-rubber compound) and Repliset Thixotropic (a more viscous compound). Self-reported resolutions are 0.2 microns for Coltene's President's Jet Light Body and 0.1 microns for Struer's Repliset. Comparisons are also made between different techniques: a single-stage procedure in which the impression material is directly applied to the tooth surface, and a two-stage process in which an entire tooth crown is inserted into a mould that forces impression material to flow around it. Finally, comparisons are made between scanning electron microscope (SEM) images of the impressions themselves and epoxy replicas made from these impressions.

As expected, at lower magnifications

there are small differences among these different materials and methods which become more pronounced at higher magnifications The advantage of the RepliSet material is that it is SEM-stable, thereby making it possible to save time and increase accuracy by imaging the impression itself rather than an epoxy replica made from that impression.

Human remains from the initial Upper Paleolithic of Üçagizli Cave, South Central Anatolia, and implications for the evolution of the genus Homo in Turkey.

E. Güleç. Dept. of Physical Anthropology, University of Ankara, Ankara, 6100, Turkey.

Rich initial Upper Paleolithic (IUP) localities in the Eastern Mediterranean are rare and few are associated with human remains and reliable absolute dates. Here we report preliminary results of field work and analysis of cultural and human remains from Üçagizli cave in the Antakya region of Turkey. Üçagizli cave Loci 1-3 include two cultural levels, a younger assemblage most closely resembling the 'Ahmarian' from all three loci and an earlier IUP assemblage from Loci 2 and 3 (Kuhn, et al., 1999). Two Anatomically Modern human teeth (LP_3 & ldm[1]) were also recovered from 2 loci in the lower 'Ahmarian' levels. Several AMS radiocarbon dates from layers above and below the human specimens indicate an age range of 35-40,000 BP (Güleç, et al., 2000). These specimens complement the surprisingly small collection of Paleolithic human remains in Anatolia, despite an archeological record that goes back to 900 Ka (Güleç, et al., 1999). Within the Paleolithic of Turkey a few Upper Paleolithic localities have associated human remains, all Anatomically Modern. These include additional isolated teeth from other localities in Antakya, the region of Turkey closest to the Levant, in the northern extension of the East African Rift Valley system. The combined evidence of the archeological and human fossil record nevertheless indicates that Anatolia has been occupied by humans at least since the early Pleistocene, and served as a corridor for migrations of people and cultures between Africa, Europe and Asia.

Stand and be counted: a history of bipedalism as a marker of the human lineage.

T. Gundling. Dept. of Anthropology, William Paterson University, Wayne, NJ 07470, Wayne, NJ, 7470, USA.

Since the 1950's, even quite fragmentary fossils have been attributed to the Hominidae based on the presence of osteological concomitants of bipedal locomotion. Using published and unpublished primary sources this study examines the historical development of bipedalism as the "ultimate hominid synapomorphy."

Nineteenth century scenarios transforming ape into human commonly suggested that bipedalism preceded other human adaptations, despite the absence of a significant fossil record with which to test such hypotheses. Yet by the early 20th century most scholars stated that encephalization occurred first. The reasons for this shift are complex, and here I propose a novel explanation. The accumulation of fossil hominoids resulted in a shift in focus from the process of evolution to the resultant pattern, and taxonomic classification using the pre-evolutionary Linnaean system drove phylogenetic placement. Since human and hominid were erroneously considered equivalent, a fossil had to be demonstrably "human" in order to be included among the Hominidae.

With the emergence of the "biological synthesis" process again superceded pattern. In this new theoretical context, the more complete australopithecine remains coincidentally discovered in South Africa were re-interpreted and bipedalism again attained paramount importance in defining the human clade.

The high taxonomic diversity apparent in the burgeoning early hominid fossil record makes it increasingly difficult to provide an inclusive definition for the human family. The present task for paleoanthropologists is to continue searching for hominid synapomorphies that may have preceded a shift to bipedalism, but postdated the cladogenic event separating the human and African ape lineages.

Using semilandmarks on surfaces to analyze a Neolithic hydrocephalus.

P. Gunz[1], P. Mitteroecker[1], M. Teschler-Nikola[2], H. Seidler[1]. [1]Vienna Institute for Anthropology, Vienna, Vienna, A-1091, Austria, [2]Museum of Natural History Vienna.

We first investigate shape differences between two recent, yet untreated hydrocephalic crania and several normal human crania using geometric morphometrics, modeling the neurocranium with surface-semilandmarks. A Neolithic cranium is compared against the rest of the sample: 42 anatomical landmarks and around 2000 points on the neurocranium were digitized using a Polhemus device. Then our algorithm automatically places 336 semilandmarks on the neurocranium and relaxes them against the Procrustes average, so as to decrease the variance along the curvature (ascribable to measurement error) while preserving the variance that is a result of shape difference. The resulting landmark positions are analyzed using Relative Warps Analysis. Shape variation among the pathologic group of hydrocephalics is much higher than in the normal sample, but a clear shape pattern emerges.

While all hydrocephalics possess very prominent parietal bosses, the Neolithic hydrocephalus is different in the frontal bone, lying within the variability of the normals. This suggests that the Neolithic specimen could represent a rare case of acquired hydrocephalus where the sutures at the back of the skull still had enough degrees of freedom to compensate for the intracranial pressure, while the frontal suture had already fused.

We also test whether parts of the cranium analyzed separately exhibit different diagnostic potential in terms of recognition of hydrocephaly. Only the parietal bone is unequivocally diagnostic, for the frontal and occipital bones not their shape, but only their spatial relationship to other parts of the skull is diagnostic.

Height and SES in the 19th Century.

G. Guthrie, S. Jenkins. Dept. of Anthropology, Buffalo State College, 1300 Elmwood Ave, Buffalo, N.Y. 14222, Buffalo, N.Y., 14216, USA.

The 19th century was a period of social and economic change in Europe and the United States. A small sample (N = 971) of males convicted of crimes in Erie County, New York between 1885 and 1905 was examined for the impact of changing economic conditions.

Data on height and occupation were obtained from prison records. Occupations were divided into three broad categories based on the amount of education and skills required and in conjunction with census records. The analysis is limited to middle and lower incomes. The data was divided into native-born and foreign-born samples. Average height pre- and post - 1860 were calculated.

All groups showed a slight increase in height in the second half of the 19th century with the greatest increase seen in foreign-born group. The increase is not statistically significant. The increase may indicate that legal reform measures of the factory system were beginning to have an impact in Europe

Pattern of morphologic variation among living hominoids.

F. Guy. Harvard University, Cambridge, MA, USA.

The taxonomic study of living hominoids relies on anatomical, molecular, morphological and ethological data. In paleoanthropology, however, only morphological criteria can be used. Among extinct hominoids, a major question is what level of morphologic difference defines two palaeospecies? Does the observed morphologic variation between two specimens reflect intraspecific variability or express systematic differences? Identifying and understanding the different types of variation within a species (intrinsic, sexual

or geographic) is fundamental.

Intra- and interspecific morphological variation was studied in four living hominoid genera on the basis of forty-five quantitative parameters describing the maxilla and the mandible. The sample was made up of 506 crania belonging to thirteen living great ape and lesser ape subspecies. Intrinsic, sexual, microgeographic and geographic variation were studied for each taxa. The degree and the pattern of differences occurring among subspecies and species were determined.

This analysis contributes to a better understanding of the significance of morphologic variation and its taxonomic significance, and provides a set of objective standards for assessing the meaning of differences among the fossil taxa. Subspecific or specific assignments for East - West gorillas and Bornean - Sumatran orangutans were not solved here. Nevertheless, a specific distinction between *P. troglodytes* and *P. paniscus* was confirmed. Results confirmed the subspecific designation for the three common chimpanzee groups, but underlined the singularity of *P. t. verus*. Among Gibbons, results confirmed a subspecific distinction between *H. l. carpenteri* and *H. l. entelloides*, and at least a subgeneric distinction between gibbons and siamangs.

Iron depletion increases the energy cost of work in non-anemic Mexican women.

J. Haas[1], J. Seymour[1], S. Hernandez[1], J. Dehaene[2], S. Villalpando[2], J. Rivera[2]. [1]Division of Nutritional Sciences, Cornell University, Ithaca, NY, 14853, USA, [2]National Institute of Public Health, Cuernavaca, Mexico.

In studies of anemic women, iron deficiency has been shown to result in reduced physical performance as measured by VO_2max (oxygen consumption at maximum physical exertion), presumably due to impaired oxygen transport related to reduced hemoglobin (Hb) concentration. Less severe forms of iron deficiency may also affect physical performance through reduced cellular oxidative capacity. The important role of iron in the synthesis of many of the enzymes involved in oxidative metabolism suggests that moderate levels of iron deficiency may impair muscular energy transformation at levels that are not as severe as those reflected in VO_2max. In this study we tested the effects of iron deficiency on energetic efficiency using a randomized double-blind design that assigned 41 marginally iron depleted women (18 to 45 years of age) to receive either a daily oral iron supplement (20mg elemental iron as ferrous sulfate) or a placebo capsule. After 6 weeks of iron supplementation body iron stores and transport improved with no effect on Hb concentration. While energy costs to perform moderate work (60 watts on cycle ergometer) significantly declined with iron supplementation, this effect was reduced after controlling for group differences in fat free mass. Improvements in tissue iron status, measured by transferrin receptors, that accompanied repletion by supplementation was associated with reduced energetic cost of work and appears to mediate the supplementation effect. These results support the hypothesis that tissue iron depletion reduces energetic efficiency at moderate levels of physical exertion.

The ancient Neolithic people of Ukraine: osteological and dental considerations.

A.M. Haeussler[1], I. Potekhina[2]. [1]Arizona State University, Phoenix, AZ, 85016, U.S.A., [2]Institute of Archaeology, National Academy of Sciences of Ukraine, Phoenix, AZ, 85016, U.S.A.

Following a practice that goes back to at least Mesolithic times, members of Neolithic tribes of Ukraine buried their dead in collective cemeteries. Comparative skeletal analysis has shown that the Dnieper-Donets Culture population as a whole, although not homogeneous, was tall with massive hypermorphic skeletons, and very wide faces, whose bizygomatic breadth often exceeded the world maximum. Dolicho-mesocrany, a low face, and very low orbits enhanced the specific appearance of this population, which is classified as Proto-European.

Dental morphological trait analysis further indicates that the Neolithic tribes lack homogeneity through time. Frequencies fall into expected patterns of relative decrease in cusp size and number in some traits (double shoveling, tuberculum dentale, cusp 5, second molar hypocone), but increase in others (shoveling, Carabelli's trait, and enamel extensions). Jacobs (1994) showed an increase in the dental dimensions of four of the samples.

As was the case in the Mesolithic Ukraine samples, variations in the frequency of hypoplasia vary (0.0% to 53.8%) indicating differential pathology producing stress. Archaeological and biochemical reports indicate the beginning of the transition from foraging to farming at the later stage of the Dnieper Donets Culture. In general, such key health indicators as adult height, robusticity, and dental pathology show the rather high health status of the Neolithic people of Ukraine.

The negative impact of family size on nutrition and development in a Shuar village: evidence of a quantity-quality tradeoff.

E.H. Hagen[1], H.C. Barrett[2], M.E. Price[3]. [1]Innovationskolleg Theoretische Biologie, Humboldt-Universität zu Berlin, Berlin, 10115, Germany, [2]Dept. of Anthropology, University of California, Los Angeles, [3]Dept. of Anthropology, University of California, Santa Barbara.

The Shuar are Native South American horticulturists. Anthropometric and other health data were collected from approximately 150 members of a Shuar village in Ecuador. Indices of recent access to food included body mass index (BMI), and an index of body fat computed from triceps and abdominal skinfold thicknesses. Indices of long term access to food and other nutrients were height-for-age, arm muscle area, and a 'development' index computed from mid-upper-arm circumference and calf circumference. Family variables that were predicted to correlate with these indices included the number of consumers, the number of producers, reproductive value, and father status. After controlling for age and sex, each of these variables was significantly correlated with the indices of recent access to food among dependents aged 3-20, and a multivariate regression model incorporating all four accounted for 36% of the variance in the body fat index, and 29% of the variance in BMI. The indices of longer-term access to food and nutrients correlated with number of consumers and producers, and father status for this same group of dependents. A multivariate regression model incorporating these three variables accounted for 23% of the variance in the development index. The consumer/producer ratio and father status were correlated with arm muscle area, and accounted for 8% of the variance. These results accord well with parental investment theory, as well as with the work of Chayanov. They also replicate, in part, earlier results reported for a Yanomamö village by Hagen et al. (in press).

Relationship of nasal morphology to metabolic performance during nose-breathing and mouth-breathing.

R. Hall. Oregon State University, Corvallis, Oregon, 97331, USA.

Studies of nasal variation in modern humans have shown that nasal shape, size, and projection vary climatically, with longer, narrower and more projecting noses associated with dry, cold climates, and wider, shorter noses associated with humid, hot climates. There is a need for research that tests the physiological basis for these correlational data — the goal of research begun in this pilot study, which is focused on morphology and energetics.

Fifty healthy young adults are subjects of this research, which related five nasal variables to metabolic measures during four

separate trials: at rest and exercise under conditions of nose-breathing and mouth-breathing. It examined possible confounding measures: weight, height, sitting-height, bi-acromial and bi-iliac width, body composition (estimated with the BODPOD, a device for air displacement plethysmography), exercise habits, personal history, and ethnicity. Inter-relationships among the diverse variables, and initial analyses, are discussed, as are implications for human variation and evolution of nasal shape. Results show that nasal projection (the distance between subnasale and the tip of the nose) has a significant relationship with VO2 during exercise in nose-breathing; but, surprisingly, nasal height, breadth and length do not. Nasal projection does not have a relationship with VO2 during mouth-breathing.

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Modularity within and among limbs: Implications for evolutionary divergence in fore- and hind limb morphology in primates.

B. Hallgrimsson[1], B.K. Hall[2]. [1]Dept. of Cell Biology & Anatomy, Faculty of Medicine, University of Calgary, Calgary, Alberta, T2N 4N1, Canada, [2]Dept. of Biology, Dalhousie University.

Divergence in fore- and hind limb morphology characterizes several vertebrate lineages and is a prominent feature of hominoid, including human evolution. Recent progress in developmental biology has lead to increasing understanding of the developmental-genetic mechanisms that are shared among the limbs and as well as those responsible for the differences between them. However, the degree to which evolutionary divergence in fore- and hind limb morphology is constrained by shared developmental mechanisms is not understood. Using a sample of cleared and stained CD1 mouse limbs obtained from fetuses ranging in age from gestational days 16-20, we analyzed morphological integration and fluctuating asymmetry (FA) of 2D landmarks in fore- and hind limb structures. FA has recently been suggested as a powerful tool for the analysis of modularity in development. Our results show that integration was strongest within individual limb elements. Landmark positions were also significantly integrated among limb elements within each limb while serially homologous landmarks between the limbs did not show significant covariation. FA was significantly integrated within individual limb elements but not among elements or among limbs. Fetal age was not significantly related to morphological integration patterns. We conclude that there is little evidence for the existence of across-limb developmental modules affecting limb skeletal development. These results are consistent with the view that developmentally determined patterns of covariation between the fore- and hind limb do not have significant constraining effects on evolutionary divergence between the limbs. We discuss the implications of these results for limb diversity in primate evolution.

Evidence for summer rains during Neandertal occupation at Amud Cave, Israel: the stable isotope data.

K. Hallin[1], M. Schoeninger[2], H. Schwarcz[3]. [1]Dept. of Anthropology, University of Wisconsin, Madison, Madison, Wisconsin, 53706, USA, [2]Dept. of Anthropology, University of California at San Diego, La Jolla, CA, 92093, [3]School of Geography and Geology, McMaster University, Hamilton, ON, CA, L8S 4M1.

Most recent models of the occupation of Neandertals and early modern humans in Israel have posited that Neandertals entered the region approximately 70-40 ka as a result of European climate degeneration at the onset of the Wurm glaciation (Oxygen Isotope Stage 4). European Neandertals possess several morphological features that have been interpreted as adaptations (or exaptations) to cold temperatures and low moisture in contrast with early modern humans who display more tropical or subtropical adapted features. Bar-Yosef proposes that early modern human and Neandertal occupations alternated as climatic conditions in Israel fluctuated from warm and dry to cool and dry.

We tested Bar-Yosef's hypothesis through stable oxygen and carbon isotope analyses of fossil herbivore enamel carbonate from the Neandertal site, Amud (~55 Ky.), located in the Upper Galilee to reconstruct paleoclimatic conditions during the late Pleistocene. A baseline comparative sample was established from the teeth of modern analogues across Israel representing present climatic conditions. Today, Israel is characterized by a long, dry summer and a rainy winter.

Through zoning profiles and information on eruption and mineralization patterns for modern analogues, seasonal patterns in the d18O of rainfall was determined. Our data indicate systematic intra- and inter-tooth changes in oxygen composition (as much as 5 permil) consistent with seasonal changes in body water composition. These compositional differences reflect a bimodal pattern in rainfall and correspond to pollen data derived from the Hula Basin for this time period (Gat, 1981; Horowitz and Gat, 1984). It appears that 55 Kya. Israel enjoyed some amounts of summer rains and the Neandertals inhabiting Amud lived under wetter conditions than populations in Europe. Supported by Sigma Xi and the Wenner-Gren Foundation (to K.A.H.).

Phalanges of *Omomys carteri* from the Eocene of North America and the morphology of early primate grasping digits.

M. Hamrick[1], H. Covert[2]. [1]Dept. of Anthropology &, School of Biomedical Sciences, Kent, OH, 44242, USA, [2]Dept. of Anthropology, University of Colorado-Boulder.

The tarsiiform primate family Omomyidae is represented by an increasing sample of dental and skeletal remains from the Eocene of North America and Europe. We describe here proximal and intermediate phalanges from the middle Eocene Bridger Basin of North America attributed to *Omomys carteri* that provide new insights into the substrate preferences of omomyids. Phalanges were first identified in a sample of approximately 132 postcranial specimens of *O. carteri* from the "*Omomys* quarry" (UCM Loc. 93026) in Bridger C beds. Additional specimens from Bridger B beds, in which *O. carteri* is also common, were recognized based upon their similarity with fossils from the "*Omomys* quarry."

Proximal phalanges of *Omomys* resemble those of *Microcebus murinus* and *Galago senegalensis* in having a ventrally directed proximal articular surface related to frequent flexion at the metacarpo- and metarsophalangeal joints. The shafts of *Omomys* proximal phalanges are long and slender, and robusticity indices (midshaft diameter/length) for these specimens are similar to those of *Tarsius* pedal phalanges and manual phalanges of *M. murinus* and *G. senegalensis*. Intermediate phalanges of *Omomys* have a broad distal articular surface that is compressed dorsoventrally and articulates with a broad, flat terminal (ungual) phalanx.

Similarities in phalanx shape between *O. carteri* and *Microcebus* indicate that *Omomys* likely preferred positional behaviors on small, fine branches. Furthermore, *Omomys*, *Notharctus* and the Messel adapiforms share with extant tarsiers and strepsirhines proximal phalanges that are more slender and elongate than those of anthropoids, suggesting that the condition observed in *Omomys* is primitive for euprimates.

Galloping kinetics of primates vs. non-primates: implications for understanding primate locomotor evolution.

J. Hanna, D. Schmitt. Duke University, Hillsborough, NC, 27278, USA.

During walking, primates experience higher peak vertical forces (PVF) on their

hindlimbs relative to their forelimbs; non-primate mammals show the opposite pattern. This difference is integral to many hypotheses about the evolution of primate locomotion in which the role of the forelimb changes from a supportive strut, to a more mobile, grasping organ, and finally to use in tension. However, primates also gallop, which is important to consider because it may engender high forces or different loading ratios. Because data on galloping are limited and contradictory (Kimura, 1992; Demes et al., 1994), we quantified absolute and relative PVF during galloping on the ground in *Cercopithecus, Macaca, Papio*, and *Saguinu*s (steps = 107), and compared our data with published data on other primates and non-primates.

Non-primates, and almost all primates, maintained similar forelimb to hindlimb PVF ratios during galloping and walking (<10% difference). This result suggests that weight-shifting mechanisms used during walking are conserved during galloping. *Saguinus,* which has claw-like nails, has PVF ratios like non-primates. Forelimbs and hindlimbs in primates and non-primate mammals experienced higher absolute PVF during galloping compared to walking. This suggests that all limbs may be operating closer to their safety factors during galloping. Finally, as suggested by higher forces on the forelimbs during galloping, the transition in the role of the forelimb from compression to tension, during primate locomotor evolution, is likely to have taken place in animals in which galloping was not a significant portion of their locomotor repertoire.

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From Lucy to Littlefoot: a three dimensional analysis of Plio-Pleistocene hominin tarsal remains.

W. Harcourt-Smith, P. O'Higgins, L. Aiello. University College London, London, WC1E 6JJ, UK.

The locomotor affinities of Plio-Pleistocene hominins are still under much debate. Some suggest that *Australopithecus afarensis* was fully bipedal, whilst others postulate that the geologically more recent *Homo habilis* retained certain arboreal adaptations. The issue is further complicated by the suggestion that the tarsals of Stw573 (Littlefoot), presently attributed to *A.africanus*, retained a mosaic of locomotor adaptations, with a human-like ankle joint but an ape-like opposable hallux capable of grasping. This study analyses the 3D shape differences between these Plio-Pleistocene hominin pedal remains. 3D landmark co-ordinates were collected for three tarsals from the medial column of the foot: the talus, navicular and medial cuneiform. The comparative adult sample consisted of 80 modern humans, 40 gorillas, 40 chimpanzees, 16 bonobos and 43 orangutans. Data were registered by generalised Procrustes analysis and then statistically compared using PCA. Results suggest that the original functional interpretation of the Stw573 pedal assemblage needs to be reassessed. For PC1 the medial cuneiform falls well outside the ape range of variation, just within the human range of variation and is similar in shape to OH8. This implies that Stw573 was not capable of opposing its hallux. However, the navicular falls at the limit of the ape range of variation, and outside the human range, and the talus falls in between the human and ape ranges. This suggests that Stw573 has a more ape-like ankle complex but is more human-like distally. This finding is discussed in the context of Plio-Pleistocene hominin locomotor behaviour. Supported by the Wellcome Trust.

A worldwide survey of deciduous tooth size distributions in recent humans.

E. Harris[1], L. Lease[2]. [1]University of Tennessee, Memphis, Tennessee, 38163, USA, [2]Ohio State University.

This analysis reports on a spatial-temporal survey of published studies of primary tooth crown dimensions in humans (75 samples). Mesiodistal data are analyzed (10 dimensions). Sexual dimorphism is minor, averaging 2% across all 10 tooth types. All size distributions of the samples are positively skewed because of megadont native Australians. Europeans, which are best represented in the literature, have the smallest tooth crowns of any continental grouping assessed. The Darroch-Mosimann (1985) method of reducing size effects was used; basically standardizing the data variable-wise, then ordinating groups on their factor scores. Principal components analysis produced just two canonical axes: overall size (71%) and a front-back (i1-i2-c *vs.* m1-m2) polarity (12%) based on the intergroup (not ontogenetic) covariance matrix. This latter component discriminates between groups with relatively large anterior teeth (Europeans) from those where relatively more tooth substance in apportioned to the molars (Africa and Asia). Size differences predominate over shape between sexes from the same groups (M > F). Europeans have small teeth with comparatively large anterior dimensions. Asian and Sub-Saharan African samples share features of average crown size but large cheek teeth. Indian and European samples show considerable overlap on both axes, with average size overall but comparatively large posterior teeth. The few Amerindian samples are too variable to characterize. Based on comparisons of archeological and living samples, tooth size reductions are documented here for Europe, India, and the Near East compared to Neolithic and Mesolithic samples. The biological and anthropological relevance of these distributions is discussed.

Infanticide and subsequent mating behavior in a black and white colobus monkey group.

T. Harris. Yale University, New Haven, CT, USA.

Like predation, infanticide is widely considered to be an important force in primate social evolution, but is rarely observed. Infanticide is relatively common in some colobines, but only a few cases are known for black and white colobus monkeys (*Colobus guereza*). I describe a recent case in the Kibale National Park, Uganda, that adds to our knowledge of infanticide in this species and that does not clearly support the sexual selection hypothesis for the evolution if infanticide. In this case, an adult male from a neighboring group attacked and killed a young infant whose mother remained in her own group and began mating with males there only ten days later. She engaged in two mating periods of several days each, separated by approximately one month, during which she copulated frequently. The group contained several adult and subadult males, but the female mated almost exclusively with the dominant adult male and initiated a majority of the copulations. Subadult males tried to interrupt some of the copulations, but subordinate adult males did not. The infanticidal male made no observed attempts to mate with the victim's mother. I will use the results of progesterone, and possibly other hormone assays from urine samples collected in the field to determine whether the female was potentially fertile at the time of these matings.

Limb preference in the lowland gorilla (*Gorilla gorilla gorilla*).

R. Harrison, P. Nystrom. Dept. of Archaeology and Prehistory, University of Sheffield, U.K., Sheffield, S. Yorkshire, S1 4DT, U.K.

To gain a better understanding of when the species-level right limb preference seen in modern humans evolved, limb preferences in our closest living relatives have been investigated. Most research has focused on the chimpanzee (*Pan troglodytes*), a species that shows individual preferences especially during tool use (McGrew and Marchant 1997). A study conducted by the authors on bonobos (*P. paniscus*) found a similar pattern, i.e. individual preferences especially during tool use but no evidence of a species-level limb bias.

In the present study limb preference in lowland gorillas is examined to ascertain whether a similar pattern is displayed by all African ape species. Twenty-two individuals from 5 captive groups were observed for a total of 328 hours. Behaviour was recorded by focal animal sampling and each individual was observed throughout the daily routine.

Results from this study suggest that no species-level preference is present in gorillas. Furthermore, individual preferences are sporadic. This level of preference (lower than that found in bonobos) may be expected since gorillas diverged from the hominid lineage at an earlier stage than did the common ancestor of chimpanzees and bonobos. The results from the present study support the suggestion that right limb preference evolved after the divergence of the *Pan* and hominid lineages.

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The first record of fossil hominins from the Ndolanya Beds, Laetoli, Tanzania.

T. Harrison. Dept. of Anthropology, New York University, New York, NY, 10003, USA.

Renewed investigations at Laetoli have succeeded in recovering additional finds of *Australopithecus afarensis* from the upper Laetolil Beds (~3.4-3.8 Ma), as well as the first recorded hominins from the upper Ndolanya Beds (~2.5-2.7 Ma). The latter specimens consist of an edentulous maxilla (EP 1500/01) and a proximal tibia (EP 1000/98). The size of the roots of the cheek teeth and the specializations of the lower face confirm that 1500/01 can be assigned to *Paranthropus*. Further comparisons indicate a close similarity to KNM-WT 17000, especially in having strong alveolar prognathism, a shallow palate, and a relatively large canine root. Accordingly, the specimen is attributed to *P. aethiopicus*. To date, this taxon has only been recorded from the Turkana Basin from horizons dated to 2.3-2.8 Ma. The age of the newly discovered maxilla, therefore, fits well with the temporal span of *P. aethiopicus*, although it does extend the geographical range of the species more than 700 km to the south. The proximal tibia is comparable in size to those of smaller, presumably female, individuals of *A. afarensis* from Hadar (e.g., A.L. 288-1aq, A.L. 129-1b), and it appears to be morphologically quite similar. Given that no postcranials are definitively associated with *P. aethiopicus* from the Turkana Basin, and that several other species of early hominins, probably with generally similar postcranial morphologies, may have been contemporaries in East Africa at this time (i.e., *A. garhi* and *Homo* sp.), it is difficult to establish whether the proximal tibia belongs to the same species as the maxilla.

An investigation of habitual activity patterns at the historic period Maya site of Tipu, Belize, using musculoskeletal stress markers (MSM).

K. Hartnett. Arizona State University, Tempe, AZ, 85281, USA.

Habitual activities among prehistoric and historic populations have been a major interest among anthropologists since the birth of archaeology. This study utilizes musculoskeletal stress markers, or MSM, to determine the habitual activity patterns of a historic period Maya population from Tipu, Belize. MSM are distinct skeletal marks manifested on the area of a bone where a muscle, tendon or ligament inserts onto the periosteum and into the underlying bony cortex (Hawkey and Merbs, 1995). The markers can be quantified using a visual scoring method (Hawkey, 1988).

The human remains buried in the cemetery at Tipu are bounded by the dates 1544 and 1707, which mark the founding and abandonment of the colonial town. The site of Tipu has a very unique history stemming in part from the fact that it was located in one of the few areas of the lowland Maya civilization where an intensely Maya way of life was carried on long after the Spanish conquest of the Yucatán peninsula. The skeletal remains consist of a total of 631 individuals, 198 of which were used in this study. Statistical analyses of the MSM patterns indicate that there was a sexual division of labor between males and females at the site. Furthermore, analysis of the MSM of individuals buried in different locations, such as in the front or back of the church as opposed to outside the church walls, suggests that burial location corresponds to differences in social statuses or occupations.

Analysis of the posterior cranial profile morphology in Neanderthals and modern humans using geometric morphometrics.

K. Harvati[1], D. Reddy[2], L. Marcus[3]. [1]Dept. of Anthropology, New York University, New York, NY, 10003, USA, [2]American Museum of Natural History, [3]Queens College, American Museum of Natural History.

The occipital bun is one of the most frequently discussed Neanderthal traits. It encompasses the posterior projection an d convexity of the occipital squama and is associated lambdoid flattening. The presence of a 'hemibun' in Late Paleolithic European specimens has been seen as evidence for interbreeding or continuity between Neanderthals and early modern Europeans. However, his feature is difficult to measure, and the term 'occipital bun' is applied to a range of morphological patterns. Furthermore, its validity as a Neanderthal autapomorphy has been disputed.

We used geometric morphometrics to quantitatively evaluate the shape variation of the posterior cranial profile in Neanderthals, modern humans and early European specimens, with the purpose of assessing the presence and degree of expression of this trait, and the degree of similarity of this feature between modern humans and Neanderthals. 251 modern humans, 10 Neanderthals, 7 Late Paleolithic Europeans, and 2 early anatomically modern humans were measured. A ridge curve was collected along the midline (bregma - opisthion) using a Microscribe 3-D digitizer. This was resampled to produce an equal number of semilandmarks for each segment and specimen. The coordinates were fitted using Generalized Procrustes Analysis with "sliding" of semilandmarks, and were analyzed using multivariate statistical techniques (PCA, CVA, Mahalanobis D^2).

Preliminary results show that Neanderthals are mostly, although not completely, separated from modern humans in both the PCA and CVA. They are separated by a large morphological distance from the Late Paleolithic sample.

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The pelvis of Stw 431 (*Australopithecus africanus*): new indications for differences in locomotion to *A. afarensis*.

M. Haüsler. Anthropologisches Institut und Museum, Universitaet Zürich, Zürich 8057, Switzerland.

The partial skeleton Stw 431 from Sterkfontein, South Africa, consisting of several fragments of the pelvis, sacrum, vertebral column and upper limb, is the best preserved skeleton of *Australopithecus africanus* ever recovered from Member 4. In contrast to the Sts 14 partial skeleton from the same locality and Member, it belongs to an adult individual, is undistorted, and the surface bone is in an excellent condition. This allows a reconstruction of the pelvis and a detailed analysis of muscle and ligament attachments.

Despite its much larger body size, the overall configuration of the Stw 431 pelvic girdle closely resembles that of Sts 14. Compared to AL 288-1 *A. afarensis*) from Hadar, Ethiopia, in both South African specimens the pelvic canal is rather sagittally than transversely oval. The more sagittally oriented iliac blades, the strong markings of the *ligamentum iliofemorale* on the pelvis, the prominent *eminentia iliopectinea* and the large an-

terior horn of the acetabulum may suggest a bipedalism with more extended legs in *A. africanus* than in *A. afarensis*, and the *processus transversi sacrales* imply a better system of sacral stabilisation in erect posture. The pattern of the gluteal muscles, however, is quite human-like in both species, save for a larger anterior portion. In contrast, the abdominal muscles have a shorter attachment area in AL 288-1, and *m. latissimus dorsi* extends farther laterally, indicating more powerful arms than in the South African species. Thus, major differences in their locomotor behaviour may have existed between *A. africanus* and *A. afarensis*.

The Nile Valley route Out-of-Africa further considered: an examination of the Late Pleistocene archaeology of northeast Africa and the Levant.

A. Hawkins. Dept. of Anthropology, University of Toronto, Toronto, ON, M6R 2N1, Canada.

Genetic evidence points to an African origin for modern humans, but the migration routes that people may have followed remain a matter of debate. Three possible routes have been considered: the Nile Valley, the Horn of Africa to the Arabian Peninsula, and Morocco to Gibraltar. The Nile Valley corridor has received significant attention recently.

Evidence from archaeology bears on the question of the nature and timing of migrations out of Africa. Late Middle Stone Age (MSA) archaeological material from northeast Africa shows common elements across environmental and possibly cultural areas in the Late Pleistocene. Specifically, similarities in lithic reduction technology and in the use of space suggests that Nile Valley and Western Desert populations had connections that can be detected archaeologically. By contrast, the Levantine Mousterian archaeological record shows considerable diversity and only general similarity to the material from northeastern Africa. This is interpreted as evidence that populations migrated out earlier than the late MSA, that they used a different route, or that migratory populations originated south of Egypt and had only an ephemeral, archaeologically invisible presence in Egypt. Terminal Pleistocene material also lacks clear indications of connections between northeast Africa and the Levant.

Further research on the question of migrations out of Africa could be framed in terms of why stable populations might have moved from one region to another. Desiccation in the Late Pleistocene may have played an important role, but current research on the Late Pleistocene climate of the Western Desert is still in preliminary stages.

Primate origins: disruption of eye position and oculomotor coordination by the masticatory muscles in *Otolemur* and *Felis*.

C. Heesy[1], C. Ross[2], B. Demes[2]. [1]Interdepartmental Doctoral Program in Anthropological Sciences, Stony Brook, NY, 11794-8081, USA, [2]Dept. of Anatomical Sciences, SUNY Stony Brook.

The oculomotor system is responsible for precise, calibrated, coordinated movements of the eyes to acquire images on the retinae and maintain them in these positions during movement of either the object or the observer. In many mammals the anterior temporalis, and in some the medial pterygoid, lie adjacent to the eye, extraocular muscles, and remaining orbital contents. Cartmill (1970, 1972, 1980) hypothesized that the anterior temporalis muscle and fascia would become tensed and dragged medially into the orbital contents during mastication, thereby potentially disrupting normal eye position and extraocular muscle coordination. The unpredictable misalignment of the visual axes would result in *oscillopsia* (the apparent movement of objects and the environment) and *diplopia* (the sensation of seeing an object at two different locations in space). Cartmill additionally hypothesized that the primate postorbital bar evolved to insulate the eye and orbital contents from these types of disruption by preventing the anterior temporalis from being dragged medially.

Both hypotheses were evaluated in a primate, *Otolemur garnettii*, and a carnivoran, *Felis catus*, using a two-camera kinematic method. EMG electrodes were implanted in the anterior temporalis and medial pterygoid of anesthetized individuals, and both muscles were stimulated individually while eye movements were videotaped. Two-dimensional kinematic analysis indicated that both muscles displaced normal eye position sufficiently to cause diplopia, based on comparisons of eye displacements with physiologically derived data on binocular disparity. These results suggest that the masticatory musculature can disrupt eye position, and therefore oculomotor coordination and the postorbital bar does not prevent this disruption.

Craniofacial form comparison between Bornean and Sumatran orang-utans.

S. Hens. Dept. of Anthropology, California State University, Sacramento, Sacramento, CA, 95819-6106, USA.

The current range of extant orang-utans (*Pongo pygmaeus*) includes the two southeast Asian islands of Borneo and Sumatra. These populations are geographically and reproductively isolated resulting in two recognized subspecies. Numerous inquiries surrounding the geographic and subspecific skeletal variation in orang-utans has led to inconclusive results.

The current study uses 3-D coordinate data from 25 landmarks representing the face, palate and neurocranium of 72 adult wild-shot orang-utans from both Borneo and Sumatra. Data were analyzed using Euclidean Distance Matrix Analysis (EDMA), a registration free method for quantitative comparison of forms in 3-D space that analyzes all possible linear distances between biological landmarks.

Results indicate that significant differences exist between the two subspecies for both males and females in all three anatomical regions. Sumatran males are significantly larger than Bornean males in multiple dimensions. Sumatran males exhibit a longer face, with more facial projection in the nasal and alveolar regions and the zygomatics. Sumatran males also show a longer palate and higher cranial vault. Bornean males exceed Sumatran males only in three dimensions, all related to the width of the skull over the ears. Sumatran females exceed Bornean females in the snout, palatal length, posterior neurocranium and cranial height. Bornean females show significant dimensions related to the forward rotation of the eyes, facial hafting onto the skull, naso/oropharynx and the height of the anterior neurocranium. Differentiation of the two island groups into two subspecies is supported by this analysis. Further examination of localities within Borneo may potentially illuminate populational geographic differences.

Dating the depositional sequence and Australopithecine 'Grey Breccia' of Makapansgat Limeworks using magnetostratigraphy.

A. Herries, A. Latham. Dept. Archaeological Sciences, University of Liverpool, Liverpool, Merseyside, L69 3BX, U.K.

After detailed stratigraphic mapping and re-sampling at the Makapansgat Limeworks, the original dating of the site by magnetostratigraphy is reassessed. A re-evaluation of the geology has enabled us to reconstruct the phases of infill of most of the site with confidence. Tracing of the lateral continuation of speleothem and clastic units has enabled us to reconstruct a complete sequence from the basal units to the surface outcropping breccias. Eight reversals in magnetic polarity have been identified within the whole sequence. In four cases the reversals occur with a change in depositional regime, eg from speleothem to clastic deposition. In the remaining cases reversals occur within single phases of clastic deposition. One reversal occurs at the base of the main red mud sequence where clastic deposition

begins to dominate over speleothem precipitation. A further series of reversals occurs at the very top of the breccia sequence where the sediments outcrop at the surface. Clastic deposition outpaced the depositional rate of speleothem and so the relative thicknesses covered by changeover has suggested to us relative time periods covered by the different types of sub-unit. A comparison of the section with the Global Polarity Timescale has enabled us to ascribe most probable time periods for the sequence and thus aid in the dating of the Australopithecine Grey Breccia. From this comparison the sequence as a whole is estimated to run from approximately 2.0 to 4.0 million years ago.

Dental macrowear analysis of the late prehistoric Ray Site, Warrick County, Indiana.

M. Hill, C. Schmidt. University of Indianapolis, Indianapolis, IN, 46227, USA.

The skeletal material from the late prehistoric Ray Site (12W6) in southern Indiana consists of several mass graves of commingled and fragmented remains. This late prehistoric mortuary contains artifacts from roughly synchronic terminal Late Woodland and Mississippian cultures, confounding a cultural association for the skeletons. Moreover, the site has at least three distinct types of burial.

The current study of the comparatively well-preserved dental material seeks to determine if molar macrowear differs among individuals from each burial type. It also compares the Ray Site macrowear to that from two nearby Middle Mississippian sites and from six Indiana Late Woodland populations.

A total of 1,095 teeth were studied (Ray Site n = 292, Late Woodland n = 454, Mississippian n = 349). Macrowear was scored on all molars via the Scott (1979) system. For statistical analysis, the scores were rank-transformed. Intrasite and intersite comparisons were made using ANOVA, controlling for age and tooth type. No difference exists among individuals from each of the three burial types within the site. Intersite comparisons find that the Ray Site macrowear scores are quite low for all molars and are more similar to those found among the Mississippian individuals.

These results are consistent with the findings of a recent report of Ray Site dental pathology (Greene, 2000). The macrowear suggests a relatively non-abrasive diet for those interred at the Ray Site.

Food insecurity and nutritional status among low-income Hispanic children.

D. Himmelgreen[1], R. Pérez-Escamilla[2], Y. Peng[3], A. Bretnall[1]. [1]University of South Florida, Dept. of Anthropology, Tampa, Florida, 33620, USA, [2]University of Connecticut, [3]Hispanic Health Council.

Food insecurity occurs when the availability of nutritionally adequate and safe foods or the ability to acquire acceptable foods in socially acceptable ways is limited or uncertain (Anderson 1990). Over time, food insecurity can cause malnutrition (under- and over-nutrition), impaired physical and mental development, and disease and death. An exploratory study was conducted on 190 low-income Latino households with children (1-6 yrs) to examine the relationship between food insecurity and nutritional status. Using the Radimer/Cornell Scale (a questionnaire-based measure of food insecurity) it was determined that 23.7% of households were food secure, 40.5% were food insecure, 22.1% of adults skipped or cut back on meals, and 13.7% of children experienced periodic hunger. According to Body Mass Index (BMI) percentiles, 15.4% of children were classified as underweight while 32.4% were obese. Over 21% of children showed growth stunting and 14.4% were both obese and stunted. On the one hand, underweight was more likely to be found in children from food insecure households (78.5%) than in children in food secure households (21.5%). The same pattern was found when examining growth stunting. On the other hand, growth stunting and obesity were more likely to be found among children from food secure households (21.7%) than among children from food insecure households (13.3%). This paper will examine the associations between food security/insecurity and child nutritional status.

Kinematics of bipedal locomotion in bipedally-trained Japanese macaques (monkey performance monkeys).

E. Hirasaki[1], N. Ogihara[2], Y. Hamada[3], M. Nakatsukasa[2]. [1]Osaka University, Dept. of Human Scineces, Laboratory of Biological Anthropology, Suita, Osaka, 565-0871, Japan, [2]Kyoto University, Laboratory of Physical Anthropology, [3]Kyoto University, Primate Research Institute.

Recent studies have revealed that the Japanese macaques (*Macaca fuscata*) that are highly trained to stand and walk bipedally (Monkey Performance monkeys) show morphological changes in the musculoskeletal system (e.g. more robust limb bones, existence of the lordosis etc). These reports suggest that they could walk bipedally more efficiently than the non-trained monkeys, but little is known about their kinematics. The aims of this study were to examine the kinematics of bipedal walking of the trained monkeys, and to compare the results with those of non-trained monkeys. The subjects (4 males) used in this study have been trained for at least two years to stand and walk bipedally. Two non-trained monkeys (ordinary macaques cared for common locomotor experiments) were also tested. Limb, trunk and head movements during locomotion on a treadmill at velocities of 1.5 to 5.0 km/h were measured using a video-based motion analyzer (Frame-Dias, DKH). The results revealed that the trained monkeys walked with longer stride and lower step frequency than did the non-trained subjects. This is achieved by more extended hindlimb joints. The knee joint often showed the human like "double knee action." As a result of this hindlimb kinematics, the body translated up during the single-limb support phase, unlike the case of the non-trained monkey in which the body translated up during double-limb phase. These differences between the two groups were kept over the range of walking velocities tested. Collaborated with Suo-Sarumawashi (Japanese monkey performance association). Supported by Japan Society for the Promotion of Science (#12440245).

Measuring enamel thickness in papionins.

L. Hlusko[1], G. Suwa[2]. [1]University of Illinois, Urbana-Champaign, Urbana, IL, 61801, USA, [2]University Museum, University of Tokyo.

Enamel thickness is a critical trait in the study of mammalian, particularly hominoid evolution, but has played a minor role in studies of cercopithecoids. The few studies available demonstrate that enamel thickness varies in cercopithecoids and correlates with dietary adaptations and phylogenetic relationships. A new protocol for accurately measuring enamel thickness in papionin mandibular molars was developed and is presented here. Unworn or slightly worn M1, M2, and M3s of 36 papionins (*Papio* n = 28, *Mandrillus* n = 2, and *Theropithecus* n = 6) were CT scanned through a section at the protoconid tip, "bisecting" the buccal protoconid face. A Microfocal x-ray source (spot size <10 microns) was used at 130kvp and 0.08mA. Each CT slice was based on 900 views taken in 2 minutes, and was reconstructed in a matrix size of 512x512, resulting in pixel sizes of 50 microns. These CT scans showed that the most buccal aspect of the protoconid in these taxa has uniform enamel thickness for ~3mm in height. These CT data demonstrate that, unlike in hominoids, cercopithecine teeth whose enamel is worn within this range can be measured directly using calipers. Application of this protocol to baboon molars from the Southwest Foundation for Biomedical Research demonstrates the method to be replicable. Therefore, we can study inheritance and the developmental mechanisms responsible for variation in enamel thickness. Because radial enamel thickness is mea-

sured from the worn occlusal surface, this non-destructive protocol can be widely applied to fossil, modern skeletonized, and cast material of cercopithecines.

Dental microwear of canines and M1s of late stone age compared with those of the modern age of Western Japan.

T. Hojo. Emerit. Prof. Univ. OEH, Japan, Kitakyushu city 807-0805, Japan.

Scanning electron microscopic (SEM) analyses of dental microwear have revealed features on the occlusal surfaces of teeth (Hojo, 1989; 2000). In this study high-resolution impressions were made from the occlusal surfaces of canines and molars of the late stone age, and those of the modern age in Western Japan using "President Light Body" polyvinylsiloxane (Coltene/Whaledent). The sputter-coated epoxy resin casts made from the impressions were analyzed at the magnification ranging from 7X to 500X. Micropits of a M_1 of late stone age were six in number, 29.4 mm in the mean length (SD = 30.76), and 19.24 mm in the mean width (SD = 29.63), but microstriations were 20, 62.0 mm long (SD = 36.00), and 6.1 mm wide (SD = 1.78). A canine of late stone age showed that micropits were fewer than microstriations: seven micropits (Mean diameter = 24.6 mm, SD = 17.00), 18 microstriations (Mean length = 49.4 mm, SD = 43.70; Mean width = 4.6 mm). A canine of the modern age had 11 micropits (Mean diameter = 34.9 mm, SD = 19.06), and two striations, below 3 mm wide and below 10 mm long. Many striations of late stone age teeth might be related with eating shellfish with much sand.

Brain endocast reconstructions of *A. boisei* (Konso) and *A. garhi* (BOU-VP-12/130): some contrasts.

R.L. Holloway. Dept. of Anthropology, Columbia University, New York, New York, 10027, USA.

While the cranial remains that have yielded these two brain endocasts are incomplete, both are undistorted, and preserve the dorsal portion almost completely in the case of the Konso specimen; less so for *A. garhi*. Volumetric estimates were done for fully reconstructed brain endocasts. The Konso specimen averaging about 545-550 cc's (based on two reconstructions) and the *A. garhi* specimen roughly 450 cc's. The Konso volume is more reliable. The Konso specimen is almost identical to known *A. boisei* specimens, particularly OH 5, except that it is the largest found so far. The dorsal surface is quite smooth, there being no reliable cerebral convolutional detail, a situation similar for the *A. garhi* specimen. Meningeal vessels are beautifully preserved on Konso, but not *A. garhi.* There is no indication of an enlarged marginal/occipital sinus (M/O) on the Konso specimen, however small the transverse and sigmoid sinuses. The Konso specimen shows only very mild petalial asymmetry; the *A. garhi* specimen is too incomplete to provide such information. In addition to the large difference in brain endocast volumes, the shapes of the two endocasts are very different, and the suggestion that *A. garhi* could be representative of a line leading to early *Homo* is reflected in this difference.

A reanalysis of the Tabun C2 mandible.

N.E. Holton. Northern Illinois University, DeKalb, IL, 60115, USA.

The Tabun C2 mandible has played an important role in understanding the relationship between Neandertals and modern humans in Western Asia. The mosaic morphology of this specimen has been emphasized by researchers, while a recent analysis has questioned the presence of a true retromolar space. Furthermore, the morphology of the coronoid process and the mandibular notch have been cited as evidence of this specimen's modernity.

Features of the mandibular ramus are examined to investigate the nature of the retromolar space and the size and morphology of the coronoid process and mandibular notch. A sample of Natufian mandibles, exhibiting a relatively high frequency of retromolar spaces, was examined to determine the cause of this feature in modern humans. The morphology of this feature in the Tabun C2 specimen is compared with both a Neandertal and the Natufian sample. The coronoid process and morphology of mandibular notch have been examined in the context of mandibular robusticity to determine the contribution of the pre-angular notch to the retromolar space of Tabun C2 as well as the their use as phylogenetic characters. Results of this analysis show that this specimen does possess a true retromolar space. The contribution of the pre-angular notch is shown to be the result of an enlargement of the coronoid process, resulting in the appearance of an enlarged notch. The mosaic nature of this specimen is reinforced, emphasizing the complex nature of the relationship between modern humans and Neandertals in Western Asia.

Mutation accumulation and reduced mortality in human populations.

R.D. Hoppa[1], S. Pletcher[2], K. Bos[1]. [1]Dept. of Anthropology, University of Manitoba, Winnipeg, Manitoba, R3T 5V5, Canada, [2]Galton Laboratory, University College, London, United Kingdom NW1 2HE.

The long-term demographic evolution of humans has resulted in a number of changes in the force of mortality at different ages. Our focus is the potential impact of the accumulation of slightly deleterious mutations on current and future age-specific demographic and health patterns in humans. The health implications of the accumulation of deleterious mutations have been addressed by a number of biologists and population geneticists.

It has been noted that natural selection in contemporary, wealthy nations is considerably reduced compared to even the past 200 years. A variety of cultural adaptations including most recently, substantial advances in medical intervention has reduced mortality for all age groups.

Experimental evidence has shown that many mutations are age-specific and ages experiencing strong selection are most effected by these age-specific mutations. Those ages that have not experienced selection for a long period show lesser effects of mutation. This suggests that the ages most susceptible to mutational degradation are those that were until very recently under strong selection. This lead us to hypothesize that genetically based ailments whose effects are experienced at those ages for which selection has been recently reduced might be expected to show the first signs of mutational accumulation (Pletcher and Hoppa 2000). However, assessing the impact of mutation accumulation on humans is difficult. This paper explores what we know about the link between mutation accumulation and certain health conditions, and the evidence for secular patterns in the age-specificity of such conditions.

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A histological study of comparative mammalian cortical bone.

H. Horni, R.R. Paine. Texas Tech. University, Lubbock, Texas, 79414, USA.

The objective of this research is to present statistical differences in the histological features of mammalian cortical bone, including Haversian systems, Haversian canals, and osteocyte densities. Histological differences can be helpful in the identification process of human bone in medico-legal investigations where only few and fragmentary bones are available. Mammals found in west Texas were used, including armadillos, cats, deer, goats, and pigs, Cross-sectional

samples were taken from the humerus, the ulna, the radius, the femur, and the tibia at three different levels, proximal, mid-shaft, and distal. As both human and non-human fragmentary bone appear similar at the gross morphological level, cortical bone was utilized as research material.

Specimens were prepared using standard histological equipment, producing thin sections approximately 75 microns thick. Randomly selected areas were used in the data collection. When plexiform bone was encountered, a new location was randomly selected after noting where and in which species the plexiform bone appeared. Species specific data was collected and averaged. Non-human species averages were compared to the human bone averaged data, in the attempt to distinguish statistically significant differences among them. As a result, a descriptive statistical model is provided for the purpose of identifying human bone fragments from non-human remains.

The role of phospholipid metabolism and mental illness in the late stages of human evolution.

D. Horrobin, Laxdale Research, Stirling, Scotland

The emergence of modern humans involved a major change in human culture with the appearance of great diversity, new technologies, art and religion. This emergence was probably associated with a genetic change in brain biochemistry. This likely involved synaptic connections that are made up primarily of phospholipids rich in arachidonic acid (AA). AA is involved in signal transduction processes and two strains of transgenic mice with altered AA-related functions have shown improved cognitive performance. Several lines of evidence now suggest that schizophrenia is related to abnormal AA metabolism. Schizophrenia is of great interest in the context of late stage evolution: 1. It exhibits abnormalities in AA metabolism related to synaptic function. 2. All human populations show about the same genetic risk of schizophrenia indicating that the genes were introduced prior to any racial separation. 3. Families of schizophrenic patients display high creative, scientific, artistic and religious skills (as examples both Einstein and Joyce had schizophrenic children). AA-related genetic abnormalities, when expressed in a milder form in patient relatives, might explain changes in synaptic connectivity and hence brain function responsible for late stages in human evolution. The introduction of schizophrenia to humanity may also have been responsible for the emergence of technical, artistic and religious skills.

A method for understanding the causes of patterns of genetic diversity in human populations.

K. Hunley, D. A. Merriwether. University of Michigan, Ann Arbor, MI, 48109, USA.

Genetic data may be used to try to understand human behavior at various levels of organizational hierarchy, e.g., is language a barrier to movement, how do people move between subpopulations within a language group, how do changes in population size affect overall group structure, who is prohibited as a mate, who is not, etc.? Unfortunately in the absence of independent ethnographic information about these demographic and cultural processes, our ability to extract behavioral information from genetic data is constrained.

Here we explain why this is so using migration rates estimated from F statistics for a native South American population. We explain why M, the number of migrants ever shared between subpopulations in these native South American's, which is really an estimate of the total genetic divergence between subpopulations, underestimates the actual number of migrants shared. We then combine ethnographic information on migration patterns, mating systems, and subpopulation demographic history with the Bayesian approach of Rannala and Mountain (1997) to more accurately estimate M and its confidence intervals. Finally we illustrate how this approach of combining ethnographic and genetic data can be used to make sense of the overall patterns of genetic diversity that characterize human populations.

Asymmetrical angular rotation of the femur; divergence between prehistoric and modern American populations.

D. Hunt[1], H. Williams[2]. [1]Dept. of Anthropology/MRC112, National Museum of Natural History, Smithsonian Institution, Washington, D.C., 20560, U.S.A., [2]Dept. of Anthropology, George Washington University.

Asymmetrical angular torsion has been observed in the femoral head of Native American populations and has been speculatively attributed to habitual sitting posture among Native American females. To assess the frequency of this angular torsion, both the left and right femora from four Native American populations, Hawikkuh (n = 81), Puye (n = 64), Illinois (n = 98), and Arikara (n = 90), were measured. A comparative sample of Terry Collection Whites (n = 102) and Blacks (n = 99) was also measured.

Analysis of the absolute difference of femoral torsion indicates there are significant differences between the males and females in the Native American populations; these differences were not found between the sexes in the Terry sample. No significant differences were found between any of the male groups. In the female groups there are no significant differences between the Terry Blacks, Terry Whites, and the Puye. But significant differences are present between these populations and the other Native American groups. There were no significant differences between the remaining Native American groups. It is intuitive that increased frequency of asymmetry in femoral torsion is the result of environmentally or culturally influenced biomechanical stressors. These could include the manner of sitting or repetitive stressors related to work or subsistence routines; varied stressors may be responsible for similar results in femoral morphology. Additionally, compensating tibial rotation was observed, suggesting that it appears the entire lower limb should be evaluated as an interrelated system. Computer modeling of muscular lever arm torque on femoral morphology is planned.

The single species hypothesis: truly dead and pushing up bushes, or still twitching and ripe for resuscitation?

K. Hunt. Indiana University, Bloomington, IN, 47405-7100, USA.

Frank Livingstone proclaims himself to be the last living proponent of the single species hypothesis. Is this merely a contrarian posture, or does biological evidence warrant reconsideration of just how speciose the hominin lineage is? A species-rich, bushy phylogeny finds support in punctuated equilibria theory and in the cercopithecoid speciosity. If blue-monkeys and redtails are skeletally indistinguishable, such reasoning goes, should we not expect more species of hominin than are apparent from skeletal evidence alone? A contrarian perspective notes that not all monkey taxa are speciose. Importantly, two broadly distributed, semi-terrestrial monkeys, vervets and baboons have not speciated at all. A single-species perspective sees a different superfamily as a model for hominins, closer in phylogeny, body size, and diet: the Hominoidea. *Pan* in particular is genetically diverse and widely distributed, yet has speciated only allopatrically. Furthermore, despite genetic separation for 1.6 Ma, West African chimpanzees readily interbreed with other subspecies. Arguably, no two contemporaneous species of hominin were separated by more than 1.6 Ma. E.g., *A. boisei* persists until ~900ka, while its lineage presumably arose with *A. aethiopicus* at 2.5 Ma, meaning A. boisei was reproductively isolated from *Homo* little more than are subspecies of chimpanzee. Hominin "species" distinctness might have been maintained more by allopatry or centripetal niche separation than reproductive isolation. The single-spe-

cies proponent might argue that for 6 Ma the hominin lineage has been a single, phenotypically diverse amalgam of sequentially diverging and converging populations, never constituting more than a single biological species at any one time.

Recruitment and firing patterns of jaw muscles during mastication in ring-tailed lemurs.

W. Hylander, C. Vinyard, C. Wall, S. Williams, K. Johnson. Duke University Primate Center, Durham, NC, 27710, USA.

There is a growing consensus that symphyseal fusion in primates is an adaptation to strengthen or stiffen the connection between the left and right sides of the mandible. Support for this comes from EMG and bone strain analyses on anthropoids and thick-tailed galagos which demonstrate that anthropoids (1) recruit relatively much more muscle force from the BS deep masseter, and (2) peak activity of this muscle occurs very late in the power stroke (Hylander et al., 2000). As we only considered one strepsirrhine, thick-tailed galagos, the purpose of this study is to expand our sample by analyzing EMG activity in the jaw muscles of ring-tailed lemurs.

We recorded and analyzed EMG activity of the deep and superficial masseter muscles in 2 adult male and 2 adult female ring-tailed lemurs (*Lemur catta*). Our data indicate that both the recruitment and firing patterns of the masseter are much more similar to galagos than they are to anthropoids. Compared to anthropoids, ring-tailed lemurs recruit relatively little force from their BS deep masseter and they do not exhibit the late peak activity of this muscle.

Although the recruitment and firing patterns of the masseter in thick-tailed galagos and ring-tailed lemurs are very similar, we believe that it is premature to assume that all living strepsirrhines are characterized by these same patterns. In fact, we suspect that those living strepsirrhines with stiffer and stronger symphyses, e.g., sifakas, will have recruitment and firing patterns more like anthropoids. We are currently testing this hypothesis.

Cultural transmission of a communicative gesture in a captive group of bonobos (*Pan paniscus*).

E. Ingmanson. Language Research Center, Georgia State University, Decatur, GA, 30034, USA.

Evidence that great apes possess linguistic abilities allowing them to learn language has focused attention on their natural communication systems: to what extent do apes utilize these skills without human intervention? Because of the long generational intervals of apes and difficult observational conditions, field studies have not provided some of the information on continuity, learning and transmission needed to address these questions. Observations of captive groups may clarify the mechanisms and variables involved. During 1986-88, I observed the use of a discreet gesture, clapping, as a form of communication during grooming by a captive group of *Pan paniscus* at the Zoological Society of San Diego. This gesture served as a signal to indicate the nature of the behavior, functioned to initiate and intensify the activity, and was similar to a rocking gesture observed among wild bonobos at Wamba. During this period, I documented the context and extent of the gesture among adolescent and adult individuals, as well as the emergence of its use in a young juvenile female. In 1994, I again observed this group in order to determine whether the use of the gesture had been maintained within their behavioral repertoire. In spite of many social and environmental changes during the intervening years, the gesture continued to be used in the same manner as previously observed, and had continued to be transferred to individuals of the next generation. The socially intense nature of grooming appears to provide a natural context for the emergence of complex communication in these apes.

Ontogenetic variation in forelimb postcranial morphology of Gorilla.

S. Inouye. Midwestern University, Chicago College of Osteopathic Medicine, Downers Grove, IL, 60515, USA.

Much of the variation in the crania and postcrania between *Pan* and *Gorilla* is well documented, and these differences between the genera have been linked to functional variation. However, there have been many fewer studies on postcranial variation within *Gorilla,* compared to those on *Pan.* These studies on postcranial and cranial variation within *Gorilla* suggest that there are three distinct species— *Gorilla gorilla gorilla* (western lowland gorilla), *Gorilla gorilla graueri* (eastern lowland gorilla), and *Gorilla gorilla beringei* (mountain gorilla). However, there is some debate about the extent and significance of this morphological variation. Therefore, I investigate the postcranial variation in the forelimb between *G. g. gorilla* and *G. g. beringei* from an ontogenetic and allometric perspective.

Using multivariate and bivariate analyses of 39 variables that describe mainly articular dimensions of the forelimb, I found that there is considerable allometry in the shoulder, elbow, and wrist regions of *Gorilla* during ontogeny. Furthermore, ontogenetic scaling accounts for the differences between mountain and lowland gorillas in many characters. I also found non-allometric differences between *G. g. gorilla* and *G. g. beringei* , some of which may relate to the purportedly greater terrestriality in the latter (and conversely, the greater arboreality in the lowland gorilla). However, some of the non-allometric features seem to run counter to this functional interpretation. The implications of the results from this study for understanding the relationship between postcranial morphology and function, the taxonomic status of *Gorilla*, and the evolution of knuckle-walking in African apes will be discussed.

The role of Neolithic peoples in Northeast African prehistory: a biocultural perspective from Nabta Playa, Egypt.

J. Irish[1], R. Schild[2], A. Froment[3], F. Wendorf[4]. [1]University of Alaska Fairbanks, Fairbanks, Alaska, 99775-7720, US, [2]Institute of Archaeology & Ethnology, Polish Academy of Sciences, Warsaw, Poland, [3]Laboratoire IRD-ERMES, Technoparc, Orleans, France, [4]Dept. of Anthropology, Southern Methodist University, Dallas, TX.

The Combined Prehistoric Expedition's excavations at Nabta Playa, in Egypt's Western Desert, revealed much information about the obscure pastoralists who inhabited the region from 9800-4500 B.P. Among the more remarkable finds are complex Late and Final Neolithic stone structures and alignments that probably had religious/ceremonial functions.

The features suggest Nabta may have been a regional ceremonial center between 6500-4500 B.P. If so, these people can no longer be viewed as simple bands. There must have been a strong central authority controlling the populace to yield such elaborate architecture. It is unlikely these developments occurred in a cultural vacuum. Thus, they may have influenced contemporary and, potentially, later groups (e.g., Predynastic) in the nearby Nile Valley.

Until recently, the degree and type of this influence could only be estimated by cultural comparisons. However, analysis of 30 skeletons recovered from a Late Neolithic cemetery at Gebel Ramlah now provides a second line of evidence. Dental and craniometric data were compared to those in several Nile Valley groups. To understand the remains from a broader perspective, they were also compared to samples from greater North Africa, sub-Saharan Africa, and the Mediterranean-area.

Although the Nabta folk share several features with the Nile samples, which implies some degree of relatedness, they are somewhat distinct. Extra-regional comparisons

support this disparity and identify them as biologically heterogeneous, with features reminiscent of both North and sub-Saharan Africans. Implications of these phenetic-based affinities, and their correlations with archaeological findings, are presented in detail.

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A new skeleton of *Theropithecus brumpti* (Primates: Cercopithecidae) from Lomekwi, West Turkana, Kenya.

N. Jablonski[1], M. Leakey[2], C. Kiarie[2], M. Anton[3]. [1]Dept. of Anthropology, California Academy of Sciences, San Francisco, CA, 94118-4599, USA, [2]Dept. of Palaeontology, National Museums of Kenya, [3]Departamento de Paleobiologia, Museo Nacional de Ciencias Naturales, Madrid, Spain.

We report here on a new and relatively complete skeleton of the fossil papionin *Theropithecus brumpti* from the site of Lomekwi, west of Lake Turkana, Kenya. The specimen, KNM-WT 39368, was recovered from the site of LO 5 (3º 51'N and 35º 45'E), from sediments dated to approximately 3.3 myr. The skeleton is that of an old adult male and preserves a number of articulated elements, including most of the forelimbs and tail. The forelimb exhibits characteristics generally associated with a terrestrial locomotor habitus, such as a narrow scapula and a highly stable elbow joint, with those of habitual arborealists, such as muscle attachments reflecting a large rotator cuff musculature and a flexible shoulder joint. The distal humerus and digits also exhibit features, unique to *Theropithecus*, which represent adaptations for manual grasping and fine manipulation. Thus, KNM-WT 39368, one of the earliest known theropiths, exhibited the food-harvesting anatomy that distinguished *Theropithecus* through time. Based on the anatomy of KNM-WT 39368 and the habitat preference of *T. brumpti*, the species is reconstructed as being a generally terrestrial, highly dexterous, very large-bodied, sexually dimorphic, facially adorned and possibly folivorous papionin that was restricted to riverine forest habitats in the Lake Turkana Basin from the middle to latest Pliocene. It was adapted for propulsive quadrupedal locomotion over generally even ground, and yet was highly adept at manual foraging. The estimates for very large body mass, especially in males, render unlikely the possibility that the species was highly arboreal.

Life history of male white-faced capuchins (*Cebus capucinus*), Santa Rosa National Park, Costa Rica.

K. Jack[1], L. Fedigan[2]. [1]Appalachian State University, Boone, North Carolina, 28608, USA, [2]University Of Alberta.

Life history data on the dispersing sex are difficult to obtain and often absent from studies of free ranging primates. Such data, however, are essential to comparative primate socioecology. We detail the life history of males residing in three groups of *Cebus capucinus* in Santa Rosa National Park between 1984 and 2000. Thirty-eight males were born in three groups: 14 died, 21 emigrated, and 3 had not yet dispersed. Natal emigration occurred at a median age of 54.6 months and median tenure of immigrant males within groups was 42.7 months for immatures (N = 19), 27.7 months for subadults (N = 10), and 48.9 months for adults (N = 32) (SURVIVAL analysis). All immature males (N = 29), subadult males (N = 10), and 82% of adult males (N = 27) dispersed voluntarily, while six adult males were evicted by new immigrants. Natal emigration appeared to be in response to an attraction to extragroup males or dispersing coresident males, while secondary emigration appeared to be the result of an attraction to extragroup mates. Parallel dispersal (dispersal with coresident males or into groups containing familiar males) was common and did not decrease significantly with age: natal 71%, immature secondary emigrants 75%, subadult 80%, and adult males 67%. Male *Cebus capucinus* change groups continually throughout their lives and the high rates of parallel dispersal may function to maintain male relatedness in groups and reduce the costs of frequent dispersal.

A paleopathological assessment of early medieval subadults from English and German skeletal populations.

T. Jakob. Dept. of Archaeology, University of Durham, Durham, Co. Durham, DH1 3LE, United Kingdom.

This study investigates and compares dental and skeletal disease patterns from 204 subadult individuals. Data was collected for 118 children from three English cemetery sites and 86 children coming from three cemeteries in southwestern Germany. All sites date to the Early medieval period (5^{th}-7^{th} century AD).

Only individuals younger than 18 years were classified as subadults. Dental eruption patterns, epiphyseal fusion and long bone length were used to establish age estimates. The English sample contains a higher proportion of children ranging from 7 to 12 years of age, while more German children died at a younger age (1-6 years). The percentage of very young children (fetuses to 1 year) is comparatively higher in England, but older subadults (13-18 years) from both countries showed approximately the same mortality rates.

The analysis of skeletal disease indicators such as cribra orbitalia, periostitis, and maxillary sinusitis revealed that subadult individuals from Germany showed significantly higher frequencies of iron-deficiency anemia as well as non-specific infection. Trauma-induced osteochondritis dissecans occurred more often in the English sample. Dental pathologies include enamel hypoplasia, dental caries, and calculus formation on deciduous and permanent teeth with higher caries rates for the German children.

This paleopathological research is aimed to contribute to the understanding of dietary and environmental factors as well as health and disease patterns in Early medieval subadult populations from two countries.

The consistency of ethnic differences in diurnal blood pressure variation in employed women.

G.D. James[1], J.M. Gaines[1], H.B. Valdimarsdottir[2], G.H. Montgomery[2], D.H. Bovbjerg[2]. [1]Binghamton University, Binghamton, New York, 13902, USA, [2]Mount Sinai School of Medicine.

Several studies show that the proportional change in blood pressure (BP) from waking environments to sleep among African-Americans is relatively blunted compared with Caucasians, but few have evaluated the reproducibility of this phenomenon. This study compares the consistency of the proportional change in BP from work (approx. 11AM-3PM) or home (approx. 6PM-10PM) to sleep (10PM-6AM) between African-American (N = 36, age = 40.4$\pm$ 8.4) and Caucasian (N = 52, age = 38.2$\pm$ 8.4) women over 3 monthly assessments. Subjects were employed at either of two medical centers in NYC. BP over the day was measured using an ambulatory monitor. Ethnic differences were assessed using a MANCOVA-repeated measures analysis with ethnicity as a fixed factor and age as a covariate. The results show that BP changes from work to sleep were consistent over time within each ethnic group; however, the home-sleep systolic BP difference tended to increase with time ($p<.05$). The BP changes of the Caucasian women from work to sleep (systolic, $p<.016$; diastolic, $p<.001$) and home to sleep (systolic, $p<.018$; diastolic, $p<.053$) were significantly higher than those of the African-American women. These results suggest that the ethnic difference in daily BP variation persists over time and provides additional evidence that the difference in

diurnal BP variation may contribute to the ethnic differences in cardiovascular morbidity.

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Less is more: why simple rules are adaptive solutions to complex foraging problems.

C. Janson. Dept. of Ecology and Evolution, State Univ. of New York at Stony Brook, Stony Brook, NY, 11794-5245, USA.

For over 30 years, primatologists have assumed that the optimal solution for choosing an efficient spatial route through a set of known locations (such as fruit trees) is analogous to that for the Traveling Salesman Problem (TSP). The TSP, common in human geography and business applications, involves finding the shortest route among N points, and is very difficult to solve for large N. However, virtually all algorithms for solving the TSP assume precise knowledge of the location of the goals to be visited. For wild animals, such precision in spatial knowledge is unlikely. When spatial location is known only vaguely, simple and robust rules may actually perform better, or not notably worse, than complex algorithms that assume perfect knowledge. In this talk I present a set of results on travel route choice and efficiency based on simulations of simple "rules of thumb" versus conventional computer algorithms to "solve" the TSP. As the degree of spatial vagueness and the number of goals increase, the performance of the TSP algorithm declines relative to the "rule of thumb" algorithm. Thus, the use simple rules for spatial movements by primates may not reflect cognitive constraints, but in fact might be an adaptive trait.

Assessing craniofacial secular change in American whites and blacks using geometric morphometry.

R.L. Jantz, D. Wescott. University of Tennessee, Knoxville, TN, 37919, USA.

Striking changes in craniofacial size and, especially, shape have been documented for American Whites and Blacks of both sexes over the last 125 years using traditional craniometrics. The skull has become narrower and the vault has increased in height and length. The use of three-dimensional data in the form of Cartesian coordinates allows complex anatomical variation to be more readily depicted. It therefore provides a more precise understanding of the anatomical modifications responsible for secular change.

In this paper, we examine secular change in the face and vault shape of American Whites and Blacks from the mid-19th to the mid-20th century using three-dimensional landmark data. Cartesian coordinates of 18 anatomical landmarks were obtained for 316 American White and Black crania. Additionally, coordinates for 7 landmarks were reconstructed from traditional cranial measurements on approximately 700 crania. Procrustes analysis and principal component analysis were carried out on residuals. The principal components were then regressed on year of birth, and an analysis of variance was conducted on the main effect of ancestry and the interaction of ancestry and year of birth.

Results suggest that most of the secular trend in American crania is associated with changes in the posterior vault. Secular changes in the craniofacial skeleton, especially in vault height, parallel those observed in stature. This suggests that the alterations in crania of American Blacks and Whites may be driven by improvements in nutrition and health during infancy and childhood. However, genetic changes over the last 125 years cannot be ruled out.

Morphometric shape variations associated with retroflexion of the human fetal midline cranial base.

N. Jeffery[1], F. Spoor[2]. [1]Evolutionary Anatomy Unit, University College London, London, London, WC1E 6JJ, UK, [2]Evolutionary Anatomy Unit, University College London.

Developmental variations of the ventral angle between the primate anterior and posterior cranial base are said to underlie changes to the spatial relationships between the face, the endocranium, the oropharynx and the cervical spine. While numerous past studies have documented basicranial angulation and changes to its associated anatomy over ontogenetic time, the alterations of basicranial shape (i.e. form minus size) remain to be fully investigated. This study explores midline shape changes of the basicranium, including the median aspect of the midface, during human prenatal development with the null-hypothesis that the nature of the shape variation accompanying angulation depends on the progress of endochondral ossification in creating gradients of differential growth between cartilage and bone.

Fifty-four formalin preserved human fetuses, ranging from 10 to 29 weeks gestation, were imaged using high-resolution MRI. Coordinates for ten landmarks defining the midline basicranium and midface were acquired and degrees of ossification were scored. Shape variations of this landmark configuration were explored with geometric morphometric techniques. Results showed relevant shape variations along PC1 (34% of total variance) with increasing fetal centroid size (PC1 scores vs. centroid size: $r = 0.86$, $P<0.001$) that are contemporaneous with the degree of ossification. The shape changes observed are centered over the sphenoid body and midface and are consistent with basicranial retroflexion and facial projection and anterosuperior rotation. No direct link was established between ossification and the nature of the shape variation. However, the findings suggest that ossification may play a role in modulating the magnitude and location of the major shape variations that accompany angulation of the human fetal basicranium.

Within-individual variation in heart rate and energy expenditure at rest.

M. Jenike. Pomona College, Claremont, CA, 91711-6397, USA.

Estimation of the rate of energy expenditure at rest (REE) is integral to field studies of human energetics. Estimated REE is commonly used in combination with measures of time allocation and measures of energy expenditure during activity to derive estimates of total daily energy expenditure (TDEE). Estimates are often derived from published equations or from field measurements with portable metabolic analyzers.

Twenty-four undergraduates participated in a repeated measures study of the flex-HR method of estimating TDEE. A TEEM 100 (Medical Graphics) portable metabolic analyzer was used to measure O2 consumption, CO2 production, and heart rate for each participant while standing, sitting and lying down during each of five laboratory sessions spread over 13 weeks. From these measures, an average REE and an average resting heart rate were calculated as the mean of the rates during sitting, standing, and lying down. Preliminary analysis of these results shows substantial variation within participants across the five measurements. The coefficient of variation for each participant for REE ranges from 2% to 14% (median 8.3%), while the coefficient of variation for each participant for heart rate ranges from 3% to 14% (median 8.2%).

The significance of these results is evaluated with respect to the estimation of TDEE of free-living individuals in longitudinal studies that employ single measures of REE in combination with repeated applications of heart-rate-, observation- or recall-based methods of estimating time spent at rest.

Sexual dimorphism and testicle size in white-collared lemurs (*E. albocollaris*).

S. Johnson[1], A. Gordon[1], R. Stumpf[2]. [1]Dept. of Anthropology, University of Texas at Austin, Austin, TX, 78722, USA, [2]Dept. of Anthropology, SUNY - Stony Brook.

Previous studies of strepsirhine primates have revealed little sexual body size dimorphism, particularly in Lemuriformes. Re-

searchers have suggested that other forms of dimorphism – including canine dimorphism – may be more prevalent among smaller primates. Initial observations of white-collared lemurs (*Eulemur albocollaris*) indicated the possibility of sex differences in canine length. Accordingly, we investigate body size and canine dimorphism in this species, with comparisons to closely related red-fronted lemurs (*Eulemur fulvus rufus)* and a hybrid population. We also present data on variation in testicle size in these populations.

We analyze dimorphism using non-parametric bootstrap with replacement to generate 95% confidence limits for ratios of mean male and mean female values. Our results indicate sex differences in canine length in *E. albocollaris* (significant at $\alpha = 0.05$), as well as limited evidence for slight size dimorphism in this species (both favoring males). In addition, we find limited evidence for slight size dimorphism in this species (both favoring males). We also find some indication of canine dimorphism in the hybrid population, but none in *E. f. rufus*. Neither of these latter taxa show size dimorphism. *E. f. rufus* males have larger testicles on average, as well as greater variation in size. *E. albocollaris* males have intermediate testicle size and hybrid males the smallest. This variation among populations may be related to differences in social structure, including group size and cohesion. In addition, variation in aggressive encounters between social groups may relate to morphological characters linked to mating systems.

Subadult sex determination from the skeleton.

S. Johnson. Graduate from East Carolina University, Charleston, SC, 29407-3506, USA.

The purpose of this study is to test previously established sex determination methods using the ilium and the mandible as well as the predictive value of the first cervical vertebra on a sample of subadults of known age and sex. Long bone measurements and visual observations were recorded for 240 skeletons from the Hrdlicka Collection housed at the Smithsonian Institution in Washington, DC. Crosstabulation and logistic regression analysis revealed results that were not as accurate as those found previously, but all were above 50%. It was also found that the first cervical vertebra is not a good sex predictor in the subadult. Using all the methods proposed, the sex of subadult skeletons can be estimated with an accuracy of about 73%. This percentage is well above chance (50%) and shows that these methods would be very useful in paleodemography and forensic cases.

The paleoepidemiology of celiac disease: osteological evidence from prehistoric Europe.

L. Johnson-Kelly. Cornell University, Dept. of Anthropology, Ithaca, New York, 14853, USA.

Though celiac disease (gluten intolerance, non-tropical sprue) affects 1% of modern people of European descent, and up to 5% of some modern North African populations, it has received little consideration as a cause of disease in past societies. Celiac disease is a malabsorption syndrome resulting from the consumption of gluten-containing grains (wheat, rye, barley, spelt, triticale, kamut, etc) in genetically susceptible individuals, and is associated with skeletal and dental pathologies, including cribra orbitalia, porotic hyperostosis, spina bifida, rickets, and hypoplastic dental enamel defects. Untreated celiac disease can be lethal, and so was undoubtedly subject to strong negative selective pressure in farming societies that relied on gluten-containing grains such as wheat. However, a study of pathological indicators in European skeletal material indicates that the skeletal pathologies associated with celiac disease achieve peak frequency not in the Neolithic, when grain-based agriculture was first introduced, but much later, during the Middle Ages, when access to non-grain foodstuffs was severely reduced. It is important to understand the past distribution of celiac disease in order to understand why this genetically-based disorder is still so prevalent in wheat-eating cultures. Such a study is also critical to answering the question of why Europeans would have adopted a subsistence system based on foodstuffs whose consumption led to disability and death in a certain percentage of the population.

Associations with blood pressure in Blackfeet women.

S.L. Johnston. West Chester University, West Chester, PA 19383, Downingtown, PA, 19335-3903, USA.

Although blood pressure and its determinants have been studied in a number of populations that have undergone recent modernization, factors associated with blood pressure in Native American populations are not widely reported. The present study examines blood pressure and its association with nutritional status and socioeconomic factors in Blackfeet women in Montana.

As part of a larger study, 141 women, ages 18-93 years, had their blood pressure (two readings, averaged for analyses) and pulse measured in a seated position using a protocol. Height, weight, five circumferences, and four skinfolds were measured using standard anthropometric techniques. Participants also were interviewed concerning socioeconomic characteristics, reproductive histories, and other domains.

Mean systolic blood pressure (SBP) was 122.3±17.9 mm Hg (median 120). Mean diastolic blood pressure (DBP) was 74±11 mm (median 72). SBP was associated, in bivariate analyses, with age ($p<.001$), BMI ($p<.001$), weight ($p<.002$), and waist-hip ratio (WHR) ($p<.005$), but not with any socioeconomic variables. However, in stepwise regression, education consistently entered with BMI and age to explain 26%-28% of the variance. DBP was associated with BMI ($p<.02$), weight ($p<.01$), education ($p<.004$), household income ($p<.02$), and current employment ($p<.001$). In stepwise models, BMI, employment, and education explained 9%-10% of the variance.

In Blackfeet women, SBP and DBP are positively associated with body mass; SBP tends to increase with age, as is typical of modernized populations; and education has a positive effect on both SBP and DBP. These and other findings are discussed further and interpreted.

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The reproductive ecology of high pastoralist fertility.

S. Joseph. Dept. of Ecological Anthropology, University of Georgia, Commerce, GA, 30529, USA.

Research on the relationship between mode of subsistence and fertility is crucial to developing a theoretically informed reproductive ecology of human subsistence/productive systems and to understanding the evolutionary origins of agriculture and population growth. While human population ecology of hunter-gatherers (e.g., Howell 1979; Hill and Hurtado 1996), horticulturalists (e.g., Wood et al. 1985; Wood 1992; Nell and Weiss 1975) and agriculturalists (Knodel 1988; Wrigley and Schofield 1981) have been well studied, comparatively less is known of pastoralists. Several studies pose that pastoralists exhibit low to moderate levels of natural fertility and with few exceptions (e.g., Leslie 1988; Brainard 1986) low levels relative to neighboring agriculturalists (Muhsam 1951; Henin 1968, 1969; Ganon 1975; Hill 1985; Duncan and Randall 1988; Marriott 1994; see also Sellon and Mace 1997). However, in a detailed comparison of pastoralist and agriculturalist demography, Randall (1994) concludes that fertility differences, if they are real and not due to poor data quality, are insignificant. New demographic findings from Levantine Beduin pastoralists reveal relatively high natural fertility (TFR = 8.805). These findings will be presented in conjunction with recent demo-

graphic studies of pastoralists elsewhere to discuss some of the. mechanisms (specifically, the early introduction of weaning foods) to help explain the high fertility of pastoralists in this region and address more fundamental questions about the origins of high fertility in early agricultural societies.

Did the autralopithecines speak? Hypotheses and hypoglossals.

W. Jungers, A. Pokempner. Dept. of Anatomical Sciences, School of Medicine, Stony Brook University, Stony Brook, New York, 11794-8081, USA.

The search for human-like speech capabilities in the hominid fossil record necessarily focuses on indirect evidence. One of the most original hypotheses to emerge comes from Kay et al.'s (1998) study of hypoglossal canal size in relation to (skeletal) oral size. They concluded that the human pattern of tongue motor innervation and speech potential is very different from that of African apes and australopithecines, and that the modern condition probably evolved in middle Pleistocene *Homo*. DeGusta et al. (1999) conducted a broader interspecific analysis and rejected these conclusions. We believe that both studies make inappropriate size-adjustments and/or unwarranted assumptions, and we have conducted our own analysis.

We collected, sectioned, and measured 255 molds of hypoglossal canals from gibbons, siamang, orangutans, gorillas, chimpanzees, bonobos, and a diverse human sample. A scale-free index of "relative size of the hypoglossal canal" was computed as the ratio of the square root of canal area to the cube root of oral size. Sexual dimorphism was not significant, and species-specific data were analyzed using analysis-of-variance and post-hoc comparisons.

In absolute terms, humans have significantly larger canals than any other species except gorillas, but there is extensive overlap with chimpanzees. Humans also possess significantly larger hypoglossal indices except in comparison to *lar* gibbons, but overlap with siamang and African apes is considerable. Values for *A. afarensis* are well within the recent human range. We concur with DeGusta et al. that relative size of the hypoglossal canal is not a reliable predictor of human-like speech capabilities.

Sex determination from the adult clavicle in a south Asian sample.

C. Katzmarzyk. University of Toronto, Toronto, Ontario, M5S 3G3, Canada.

Osteometric analysis of the clavicle to determine sex of an individual has met with varying success. It is known that the degree of sexual dimorphism varies between populations, thus standards derived from one population may not be accurate for another population. As a result, clavicles from 151 adult male (n = 124) and female (n = 27) cadavers of Sri Lankan origin are analyzed to examine the efficacy of clavicular measurements to determine sex. It was found that in 67% of paired male clavicles, the left bone is longer by 0.5 to 12 mm, whereas in the paired female sample, the left bone is longer in half the specimens by 1 to 9.5 mm. Overall, the length of the male clavicle varies from 116 to 168 mm, with an average of 144.21 ± 8.70, whereas the female left clavicle extends from 115 to 151 mm with a mean length of 129.38 mm ± 9.43. No female bone in this series has been found to have a length more than 151 mm, and therefore, a clavicle having a length more than this should be considered as male. On the basis of this criterion, only 45 out of 232 male bones (19%) can be assigned as male. Conversely, the shortest lengths of the male and female clavicle reported are 116 mm and 115 mm respectively. Therefore, if the length of the bone is less than 151 mm, sex determination on clavicular length is not accurate.

Secular changes in physical activity levels in Canada: Implications for the obesity epidemic.

P. Katzmarzyk, M. Bruce. School of Kinesiology and Health Science, York University, Toronto, ON, M3J 1P3, CANADA.

There is currently a debate as to whether the increases in the prevalence of obesity that have occurred over recent decades are the result of decreases in physical activity or increases in dietary intake. Data from five Canadian population surveys were compiled to examine temporal trends in physical activity. The sample included 89,882 adults (20-64 y) from the 1981 Canada Fitness Survey, 1988 Campbell's Survey, and the 1994, 1996, and 1998 National Population Health Surveys. Physical activity levels were determined in the same manner in each survey, which allowed for comparisons across surveys. A list of physical activities was provided, and participants indicated the number of occasions and average amount of time spent on each activity. Yearly physical activity energy expenditures (AEE) were calculated using the frequency, duration, and the metabolic costs of the activities. Temporal trends were examined using general linear models, including the year of the survey as an independent predictor, along with sex, age and geographic region. Briefly, there were significant temporal, sex, age and geographic effects in physical activity (all $p<0.0001$). Men had higher AEE than women, and there were gradients of decreasing AEE with increasing age and from Western to Eastern Canada. There was also a significant trend for decreasing levels of physical activity over time. Mean AEE fell from 2.32 kcal/kg/day in 1981 to 1.99 kcal/kg/day in 1998. The temporal changes in AEE are in a direction that supports the hypothesis that physical inactivity may be partly responsible for the increasing prevalence of obesity.

***Pondaungia cotteri* , a slow-moving primate seed predator from the Eocene of South Asia.**

R. Kay, D. Schmitt, C. Vinyard. Dept. of Biological Anthropology and Anatomy, Duke University, Durham, NC, 27710, USA.

Our analysis of recently reported finds of upper and lower teeth and mandibular, humeral, and calcaneal fragments indicate that *Pondaungia cotteri* (late middle Eocene, Myanmar) was a slow moving quadrupedal seed predator.

At 5-6 kg, *Pondaungia* is as large as any known Eocene primate, and comparable in size to the largest extant platyrrhines and strepsirrhines. The mandibular corpus is robust and the symphysis is rugose with strong transverse tori, both suggesting an ability to resist large chewing loads. The robust spatulate upper central incisor and projecting robust upper canine indicate powerful biting as occurs in husking. The molars have weak shearing crests and narrow occlusal surfaces. These features and thick enamel with a preponderance of microwear pits, suggest a hard-object, low-fiber diet. Collectively, the dental and mandibular anatomy suggests *Pondaungia* was a seed predator.

The humeral head is rounded and proximally oriented with low tuberosities indicting an extremely mobile shoulder like that of lorids and atelids. The elbow joint exhibits articular features for enhanced stability in habitually flexed positions: a screw-type trochlea, an anteriorly expanded capitulum, and an expanded grooved capitular tail. These distal humeral features, along with a large medial epicondyle, are shared with *Alouatta,* a slow moving quadruped. The distal humerus of deliberate arboreal quadrupedal lorids is less similar— the enlarged capitulum and capitular tail are the only features in the above list common to both. The short distal load arm of the calcaneus also is consistent with, but not exclusive to slow arboreal quadrupedalism.

Mapping diversity: craniofacial affinities in the mid-Holocene Nile Valley considered with archaeological and linguistic data.

S.O.Y. Keita[1], A.J. Boyce[2]. [1]Field Museum of Chicago, Roosevelt and Lakeshore Drive,

Chicago, Illinois, [2]Institute of Biological Anthropology, Oxford University.

The appearance of agriculture in the Nile Valley occurs some 2000 years after its development in Europe and the Near East. The major cultigens are the same in these areas. It has been hypothesized by some researchers that agriculture emerges in the NileValley concomitant with the arrival of speakers of the Afro-Asiatic language family, both being brought after the differentiation of the Nostratic macofamily speech community. In this view agriculture (and Afro-Asiatic) come from Europe, the locale of the Nostratic cradle in this model. A phenetic craniometric analysis of early farmers from the Nile Valley of Upper Egypt was undertaken in order to explore this hypothesis. Badarian crania were studied with European and African series from the Howells' database, using generalized distances and cluster analyses (neighbour joining and UPGMA algorithms). Greater affinity is found with the African series. The results are considered with a variety of linguistic and archaeological evidence, as well as the findings of simulation studies relevant to this study. It is concluded that the earliest Nile Valley farmers in Upper Egypt for which there is record were locals, not European immigrants, and therefore that the development of agriculture in this region was not due to demic diffusion ultimately from Europe. The problems with phenetic affinity studies considered in isolation from other evidence will be discussed, as well as the flaws of thinking in terms of absolute identity, and not relative similarity.

Molar growth in the late Miocene hominoid *Dryopithecus laietanus* .

J. Kelley[1], C. Dean[2], D. Reid[3]. [1]University of Illinois at Chicago, Chicago, IL, 60612, USA, [2]University College London, [3]University of Newcastle.

The developmental milestones that describe the pace of life are collectively known as life history. Since dental development is highly correlated with ontogeny as a whole, the evolution of ape life history can be traced through the fossil record of dental development. We examined molar crown and root formation in *Dryopithecus laietanus*, a fossil ape from the 10 million-year-old site of Can Llobateres in Spain, and considered by some to be within the living great ape and human clade.

Three molars of *D. laietanus* were sectioned to expose the incremental growth lines preserved in the enamel and dentine. Long-period striae (Retzius lines) and short-period cross-striations in enamel, and von Ebner's lines in dentine, were used to calculate crown formation times, enamel secretion rates and root extension rates. Crown formation times were relatively short, about 2.0 years for the first molar and 2.25 years for the second molars. These values are comparable to those of the early Miocene stem hominoid *Proconsul nyanzae*, but shorter than those of extant chimpanzees. Enamel secretion rates consistently increased from inner to outer enamel over all parts of the crown, with the fastest rates, nearly 6 μm/day, found in the outer cuspal enamel. While the pattern of enamel secretion is very similar to that of the chimpanzee, average secretion rates were uniformly higher in *Dryopithecus.* Despite similar crown formation times, the pattern of enamel secretion differs from that of *P. nyanzae* in several respects. Initial root extension rates were relatively slow, approximately 8-9 μm/day. A calculated minimum age at first molar emergence, a reliable proxy for overall life history, at 31.5 months is well within the chimpanzee range.

How did they fight over scarce resources? the frequency of fractures in the Julio C. Tello skeletal collection from Nasca, Peru.

C.M. Kellner. University of California, Santa Barbara, Santa Barbara, California, 93106, USA.

Archaeological survey and excavation as well as iconographic analyses of the Nasca culture (A.D. 1-700) of arid southern Peru have revealed an ancient society controlled by infrequent rainfall and little arable land. During times of resource scarcity or social stress, interpersonal competition may have been an important aspect of life in this region. This competition may manifest itself bioarchaeologically in a high frequency of fractures suffered in "hostilities", especially cranial fractures.

The Julio C. Tello skeletal collection from Nasca was analyzed for evidence of fractures. Approximately 11% of the 283 individuals from three cemeteries in the Las Trancas valley reveal skeletal fractures. Over 60% of the total fractures are cranial, located mostly on the parietal and the frontal bones. These are mainly depressed healed fractures clearly visible near the face or temple region.

The placement of these cranial fractures, their high frequency, and their non-lethal nature may suggest that the Nasca were competing over scarce resources, but probably in a ritual manner with people who were in their own social group. These competitions may not have been necessarily to the death. For instance, evidence of such non-lethal cranial injury is common among the Chumash hunter-gatherers of southern California, who competed over marine resources and vital trading routes.

The evidence of cranial fractures in the Tello collection may help shed light on the nature of interpersonal competition in Nasca prehistory.

Age-based anthropometric standards for protective respiratory equipment: a community-based study of at-risk children.

K.M. Kelly, S.R. Reynolds, G. Moore, A.M. Stromquist, J.A. Merchant. Institute for Rural and Environmental Health, College of Public Health, University of Iowa, Iowa City, IA, 52242, USA.

Concerns about agricultural-related injuries to children have lead to recent adoption of "North American Guidelines for Children's Agricultural Tasks." The guidelines address the age-appropriateness of the agricultural tasks and recommend the use of protective equipment including respirators. However, the appropriateness of commercially available respirators for children was not addressed. Morphologic data gathered from at-risk populations are essential to engineering appropriate protective equipment and for deriving standards to assist parents with selecting respiratory protection for children.

We report on our efforts to assess the appropriateness of respirators for children and to develop age-based anthropometric standards for respirators. The sample consisted of facial measurements on 185 children (101 males, 84 females). The children were between 8 and 16 years of age at the time of measurement (mean = 11.8 ± 2.6 years). Measurements were collected as a nested study within a longitudinal rural health cohort. Measures were selected to evaluate variability in the length and width of the face, lips, nose and head.

Statistical comparison of the children's measurements with comparably collected, published adult data demonstrated that the children were significantly smaller than the adults (t-test, $p<0.05$) in several critical engineering dimensions. However, we caution against simply seeing a child as a small adult. Growth and development produce changes in proportion as well as size. Standards must consider morphology. This study explores these age-related changes in facial morphology and their critical effects on respirator fit as well as the some of the ethical issues raised by this research.

Quantification of anisotropy in trabecular bone fabrics.

R. Ketcham[1], T. Ryan[2], M. Maga[2], A. Gordon[2]. [1]Dept. of Geological Sciences, University of Texas at Austin, Ausin, TX, 78712-1101, USA, [2]Dept. of Anthropology, University of Texas at Austin.

Studies of trabecular bone fabrics using high-resolution X-ray CT (HRXCT) offer unique opportunities for anthropological research. Microtrabecular structure of extant primates can be linked to locomotor behaviors, in turn providing a tool for interpretation of fossil material in which trabeculae are preserved. The degree of anisotropy (DA) is one of the most commonly used descriptors for trabecular structure, with low values indicating relatively isotropic bone reflecting a diverse loading regime, while high values denote anisotropic bone as would be expected with unidirectional or stereotypical loading.

Because DA has been calculated in a number of ways, comparison of DA values across different studies utilizing different data and methodologies is problematic. In this study we examine the variation of DA values generated by the built-in randomness of DA algorithms, the choice of thresholding method, and intra-specific variation using trabecular data from the femoral head of several specimens of *P. potto*. We find that all of these factors can significantly alter DA results, though intra-specific variation is the largest factor. We therefore suggest that unless methods are precisely replicated, comparisons of DA values among studies should only be done via relative relationships rather than absolute values. It is also highly advantageous to analyze species using multiple rather than single individuals.

Furthermore, because DA is only a single scalar value, it can lead to unwanted convergence: different trabecular fabrics can yield indistinguishable results. We thus explore graphical and mathematical means to utilize additional data, particularly orientation, to help meaningfully differentiate among trabecular fabrics.

Expansion of ALFRED, the ALlele FREquency Database.

K. Kidd[1], M.V. Osier[1], H. Rajeevan[2], L. Druskin[3], N.P. Tosches[3], A.J. Pakstis[1], J.R. Kidd[1], K. Cheung[3], P.L. Miller[3]. [1]Dept. of Genetics, Yale University, New Haven, CT, 06520-8005, USA, [2]Dept. of Genetics & Center for Medical Informatics, Yale University School of Medicine, [3]Center for Medical Informatics, Yale University School of Medicine.

We are converting ALFRED (http://alfred.med.yale.edu/alfred/) into a curated publicly accessible database expanding the contents to include published allele frequency data on defined population samples and unpublished data from other researchers who are willing to submit them. To encourage user input to the design and enhanced functionality of the database we have placed links on each page of the Web interface to the administrator's email address. This email address also serves to accumulate suggestions from the community about what criteria should be used to evaluate data for entry into the database since allele frequency data based on very small or ill-defined samples have limited anthropologic utility. Data that do not meet the quality standards agreed to by the community should not be entered into the database or should have a clear "warning" associated with the entry. As of September, 2001, ALFRED contains over 3500 allele frequency tables (one polymorphism in one population); this number should increase rapidly in the next few months. Currently ALFRED has tools for accessing the raw allele frequency data and the data can be displayed graphically either as frequencies or as heterozygosities and numerically in different tabular representations. To the degree possible ALFRED will either contain or have links to specific protocols used to type the polymorphisms as well as links to other relevant databases. (Ongoing support of ALFRED is provided by NSF grant BCS-0096588.).

Defining relationships between Native American Groups: a biodistance study of the North Carolina coastal plain.

K. Killgrove. East Carolina University, Durham, NC, 27705, USA.

Population relationships on the North Carolina coastal plain have previously been reconstructed based on language, material culture, typology of ossuary sites, and robusticity of human skeletal remains, creating a tripartite division of Native Americans into Algonkian, Iroquoian, and Siouan linguistic/cultural groups. However, many prehistoric populations in North Carolina exhibit conflicting or ambiguous material culture and ossuary evidence, preventing classification and regional grouping. In this study, biodistance measures are used to clarify Late Woodland population relationships.

Biological distance of skeletal remains is examined by way of nonmetric cranial traits, as suboptimal preservation of ossuary material made metric assessments impractical. Eleven ossuaries, totaling over 200 individuals, are examined from three different regions of the coastal plain for the presence or absence of 25 nonmetric variants. These data answer the questions of whether prior cultural classifications hold true, whether residence and marriage patterns can be determined based on biodistance and sex data, and whether populations with mixed or ambiguous characteristics can be classified based on biological distance data.

Because investigation of most ossuary sites in North Carolina has been limited to robusticity of skeletal elements and non-contemporaneous ethnohistoric accounts of language variation, further research into the biological variation of these Native Americans is a necessary correlate to previous culture studies.

Climate, body size allometry and the effect on craniofacial measurements.

P. Killoran. Binghamton University, Binghamton, NY, USA.

There has been considerable interest in the role of climate on body size in the recent literature and the implications for understanding our fossil ancestors. This research seeks to extend this climatic research and examine the degree to which measures of the face and head are integrated with those of the body. The degree of allometry using linear regression was determined for a series of cranial and facial widths and pelvic breadth. A similar analysis was conducted for cranial and facial lengths and femoral length.

Three hundred skeletons were measured from arctic to subarctic, cold temperate, tropical and subtropical climates. The author collected the database over the past six years at The Cleveland Museum of Natural History, The National Museum of Natural History, The Musée de l'Homme, Paris, The Institute of Human Biology, Vienna and the Canadian Museum of Civilization, Hull.

Bi-iliac breadth was not as large as anticipated for the arctic and subarctic peoples examined and some of the tropical people had larger pelvic breadths than anticipated. Stature plays a significant role in the available surface area and the best climatic patterns were observed between ratios of stature to pelvic width. Males exhibited femoral and pelvic patterning in accordance to the rules of Bergmann and Allen to a greater degree than their female counterparts. Lastly, both cranial breadths and cranial lengths did have negative allometric relations with both measures of body width and body length as anticipated. The implications of these finds will be discussed.

Parameterized reference models for morphological comparison of fossil and modern skulls.

J. Kim[1], G. Weber[1], A. Neumaier[2]. [1]Institute for Anthropology, University of Vienna, Vienna, Vienna, A-1090, Austria, [2]Dept. of Mathematics, University of Vienna.

In the field of anthropology, the discrimination of taxa and the quantitative description of ontogenetic or evolutionary change requires the analysis of morphological patterns. Geometric Morphometrics uses landmarks and furthermore semi-landmarks to extract information from unsampled regions

between landmarks. In 3D, the semi-landmarks are points that are allowed to slide along the surface of a skull. Thus, a surface approximation is needed for their computation.

Therefore nine surface approximation methods are investigated: 1) Conic Triangles, 2) Kriging, 3) piecewise linear, 4) piecewise quadratic, 5) translation- and rotation invariant polynomials, 6) implicit radial basis functions, 7) spherical polynomials, 8) radial basis functions, and 9) spherical finite elements. Following criteria are evaluated: approximation quality, parameter sensitivity, visual quality, computation cost, memory usage and implementation effort.

Methods 1 and 2 are nonlinear methods in that they involve nonlinear optimization techniques, whereas methods 3-9 are linear and thus simplify computational aspects (less computation time, less memory usage, simpler algorithms). However, the approximation and visual quality of the nonlinear methods (Conic Triangles and Kriging) is far better. Therefore, these nonlinear methods will be subject to further investigation and starting point for the computation of parameterized reference models which consist of a quasi mean skull and a set of parameters that describe the variation. Subsequently, the reference model will be the basis for the statistical analysis of morphological patterns.

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Secular change in craniofacial asymmetry studied by geometric morphometry and procrustes methods.

E. Kimmerle, R.L. Jantz. University of Tennessee, Knoxville, TN, 37902, USA.

Periods of rapid morphological change are normally accompanied by high variability and high asymmetry. Marked change in American craniofacial form over the past 150 years has been documented and this change has been accompanied by increased variability. We might therefore expect to see increased fluctuating asymmetry in cranial-facial morphology. This hypothesis was tested using craniofacial landmark data obtained from the Terry anatomical collection, the W.M. Bass donated collection and recent forensic cases. Terry collection crania have mainly 19th century birth dates, while the Bass donated collection and recent forensic cases have 20th century birth dates. Asymmetry was assessed using procrustes rotation of paired craniofacial landmarks in the manner described by Klingenberg and McIntyre (*Evol.* 52:1363-1375, 1998). Crania of the 20th century exhibit more fluctuating asymmetry than 19th century crania. Crania from both centuries exhibit directional asymmetry favoring the left side in centroid size. Twentieth century crania also exhibit increased fluctuating asymmetry in centroid size. We demonstrate how geometric morphometry provides insights into cranial asymmetry unobtainable from conventional point-to-point data.

Timing differences in male versus female ontogenies.

S. King. Dept. of Anthropology, University of Massachusetts, Amherst, MA 01003-9278, Amherst, MA, 1002, USA.

Whereas sex differences in the *absolute* timing of ontogenetic events in dimorphic species are well appreciated, differences in the *relative* timing of ontogenetic events are generally assumed to be trivial, such that data from both sexes are often pooled in analyses of developmental sequences. A notable exception to sequence similarity is in the relative timing of eruption of the canine complex: the canine tends to be the last-erupting tooth in males while the third molar is often the last-erupting tooth in females. This suggests that ontogenetic sequence data may be useful in discriminating males from females in dimorphic, but not in monomorphic, groups.

Discriminant function analysis of skeletal and dental developmental data (for *Gorilla gorilla*, *Pan troglodytes*, *Hylobates lar*, *Trachypithecus cristatus*, *Cercopithecus ascanius*, *Macaca fascicularis*, *Lophocebus albigena*) contradicts much of these earlier findings. First, the relative timing of developmental events is significantly different in males and females. Relative timing data alone can easily discriminate male from female anthropoids. Second, it is not only the canine complex that accounts for ontogenetic sex differences. When canine-complex data are removed from the analysis, other dental, as well as postcranial and craniofacial developmental traits, can reliably discriminate males from females. Third, even in sexually monomorphic species, the relative timing of events places males and females on different ontogenetic trajectories. For example, male and female *Hylobates lar* of all ages can be discriminated with 86.7% accuracy based on developmental timing data alone.

Developmental stress in a post-medieval population of Londoners.

T. King[1], L. Humphrey[1], S. Hillson[2]. [1]The Natural History Museum, London, N/A, London SW7 5BD, United Kingdom, [2]Institute of Archaeology.

This study evaluates childhood stress in a sample of known age-at death and sex individuals from the 18th and 19th century crypt of Christ Church, Spitalfields. Linear enamel hypoplasia (LEH) is used as an indicator of developmental stress. The non-destructive method used here relates LEH to the incremental growth structures at the crown surface. This allows a chronology for the age at occurrence and duration of each growth disturbance to be established. Recently published histological data on the timing of crown formation for the anterior teeth are also used in the determination of these chronologies.

All individuals exhibit enamel growth disturbances, with each individual exhibiting between 2 and 14 defects. Age at first defect ranges from 1.2 to 2.8 years, and age at last disturbance varied from 2.9 to 5.6 years. The mean interval between LEHs ranges from 63 to 117 days, and each growth disruption lasts between 23 and 51 days. The amount of growth disruption seen at the crown surface represents between 8% and 31% of visible enamel formation time. These parameters are calculated using a nine-day average perikymata periodicity.

Evidence from both living and past populations suggests that early environment has long-term consequences for an individual's health and longevity. The data generated from this study are used to examine the relationship between childhood growth disruption and subsequent morbidity and mortality. Differences in the incidence, timing and duration of growth disturbance between males and females are also investigated. Supported by The Wellcome Trust.

Isotopically based reconstructions of early to middle Pliocene paleohabitats at Laetoli, Tanzania.

J. Kingston[1], T. Harrison[2]. [1]Dept. Anthropology, Emory University, Atlanta, GA, 30322, USA, [2]Dept. Anthropology, New York University.

Although early hominid habitats at Laetoli have traditionally been interpreted as upland grassland and open woodland biomes, recent analyses of fossil faunal assemblages suggest that these ecosystems may have been more heavily wooded. In light of emerging evidence indicating that penecontemporaneous and older hominid sites in Africa are wooded or forested, it is important to establish whether Laetoli is anomalous in representing an open grassland habitat as it potentially extends the range of ecological contexts in which we should interpret early human evolution. Stable carbon isotopic analyses of herbivore enamel provides key data, especially when interpreted in conjunction with analyses of taxonomic and morphological aspects of vertebrate assemblages, invertebrates, paleobotany, and lithofacies. By early Pliocene, C_4 grasses were well established in East African paleoecosystems and semi-quantitative

assessments of relative proportions of C_3 and C_4 plant biomass in the past are indicative of the extent of canopy cover. Stable carbon and oxygen isotopic analyses focused on fossil enamel fragments of multiple individuals from over 22 fossil vertebrate taxa, fossil ostrich eggshell, and paleosol components recovered from the lower Laetolil Beds (>4.3-3.8 Ma), the upper Laetolil Beds (~3.8-3.4 Ma), and the upper Ndolanya Beds (~2.5-2.6 Ma). Samples were collected from a number of localities at different stratigraphic levels in order to develop a high resolution spatiotemporal ecological reconstruction of the Laetoli region. The data indicate that although the local ecosystem was heterogeneous with both C_3 and C_4 dietary plants available, the relative proportions of obligate browsers, mixed feeders, and grazers are inconsistent with open grasslands and reflect more wooded conditions.

Activity patterns of subfossil lemurs: evidence based on the relative size of the optic canal.

E.C. Kirk[1], R.F. Kay[1], W.L. Jungers[2]. [1]Duke University, Durham, NC, 27710, USA, [2]SUNY Stony Brook.

It is currently not known whether subfossil lemurs were diurnal like large extant anthropoids, or whether subfossil lemurs resembled most other large mammals in having cathemeral or nocturnal activity patterns. Definitive resolution of this question is complicated by the fact that orbit diameter is a relatively poor indicator of activity pattern at large body size. We circumvent this problem by studying the size-adjusted ratio of optic foramen area and orbit diameter as an osteological estimate of the relative degree of retinal summation (the OFQ; Kay and Kirk 2000, AJPA 113:235-262). Most of the subfossil taxa considered in this analysis (including *Babakotia*, *Megaladapis*, *Mesopropithecus*, *Pachylemur*, and *Palaeopropithecus*) have relatively high OFQs that are outside the range of extant nocturnal and cathemeral primates, but within or above the range of extant diurnal strepsirrhines. This analysis thus presents the first direct evidence that most large-bodied Malagasy strepsirrhines were diurnal, and largely corroborates current conventional wisdom in this respect. These findings further support the hypothesis that the last common ancestors of both the lemurid and indrid clades were diurnal, suggesting that *Eulemur* and *Avahi* are secondarily derived in exhibiting cathemeral and nocturnal activity patterns (respectively). The only likely exception to this finding of widespread diurnality among large subfossil lemurs is *Archaeoindris*, which in some cases demonstrates OFQs most comparable to extant nocturnal primates.

Evaluation of the genetics of the Nile corridor in the context of African diversity, geographic distances, and language families.

R. Kittles[1], S.O.Y. Keita[2]. [1]Howard University, Washington, DC, 20060, USA, [2]Chicago Field Museum.

Explanations of human biological variation in extant African populations have historically been shaped by a racial paradigm, especially as it relates to northern and eastern Africa. Research on different genetic systems has consistently revealed high levels of genetic diversity in African populations and a subset of that diversity in non-African populations. In addition, the pattern of linkage disequilibrium appears to increase in non-African populations in relation to geographic distance from East Africa. Thus the Nile Valley may have been an important corridor for human migrations out of Africa.

Here we present an analysis of a large mtDNA dataset consisting of speakers from the Afro-Asiatic, Nilo-Saharan, and Niger-Congo language groups from eastern and western Africa. Genetic distances between populations were calculated from the data and compared with each other and to geographic and linguistic distances using the Mantel matrix correlation analysis. Comparisons of distance matrices revealed significant correlations between mtDNA diversity and geographic distances but not among the language groups ($p = 0.234$). Distinct patterns of mtDNA haplotypic variation were observed between eastern and western African populations suggesting historical migrations and movements of women between diverse populations.

Mixture analysis as an alternative to 'determination of ancestry'.

L. Konigsberg, R.L. Jantz. Dept. of Anthropology, University of Tennessee, Knoxville, TN, 37996-0720, USA.

Forensic anthropology remains as one of the last "bastions" of 'racial' classification, leading MacEachern (*Curr. Anthropol.* 2000, 41:359) to write: "a significant goal … appears to be the substantiation of law-enforcement folk taxonomies." Traditionally, such classificatory attempts have been criticized in biological anthropology because they make a number of untenable a priori assumptions. Pritchard, Stephens, and Donnelly (2000 Genetics 155:952) have recently shown that "model-based clustering" of RFLP data produces "two very distinct clusters, corresponding to the Africans and Europeans in the sample." In this paper we examine model-based clustering (also known as 'mixture analysis') as a tool to discern group structure in craniometric data from the Forensic Databank.

We used missing-data finite mixture analysis to analyze seven craniometric variables from 502 male crania in the Forensic Databank that had positive identifications, and information on 'ancestry.' The analysis allows for incomplete craniometric data and group classifications that are completely missing. We fit a two-group model using W.W. Howells' male European and male Sub-Saharan African data for starting values, but then allowed the analysis to find a maximum likelihood two-group solution. Of the 171 males in the database who were listed as "black," 136 classified into one group, while of the remaining 331 individuals (248 listed as "white," 29 as "Hispanic," 11 as "Native American," and 5 as "European" or admixed), 293 classified into a second group. Taking the two groups as representing those with ancestry from Africa versus those without African ancestry, the mixture classification was 85.4%.

The paranasal sinuses: an active residual system.

R. Koritzer, G. Hack. University of Maryland dental School, Glen Burnie, Maryland, 21060, USA.

Cadaveric dissections (N = 20) revealed the posterior wall of the maxillary sinus to serve as an origin for both medial and lateral pterygoid muscle segments. This anatomic finding has previously been unnoted in the literature. As a result of this observation, the present authors postulate that the thin sinus walls may flex when the pterygoid musculature contracts during jaw activity. This alternating flexion/relaxation cycling may act to ventilate the human sinus system, thus facilitating sinus drainage. This ventilation system is analogous to that observed in certain archosaurs, where jaw musculature fuses with the lateral sinus wall, providing a mechanism for active ventilation. Recognition of this system in humans allows the potential to efficaciously manipulate the system in pathologic sinus conditions. Cool venous blood from the highly vascularized paranasal mucous membranes has been described as aiding in brain cooling in humans. The proposed ventilation system, may assist in controlling brain temperature and insure the integrated functions of the brain, as the brain is extremely sensitive to heat stress. It has been suggested that the brain size of man's ancestors began to increase dramatically once hominids developed mechanisms capable of cooling the brain. Moreover, this

pumping system may also function to oxygenate the dural venous sinuses, thus creating an intracranial reserve of oxygen for the brain. This system offers fertile ground for speculation about the co-evolution of human sinuses and brain size.

Inter-group variation in ranging patterns in golden-mantled tamarins, *Saguinus tripartitus* .

C. Kostrub. University of California, Davis, Davis, CA, 95616, USA.

I present data on seasonal variation in ranging and diet from a 24-month study of golden-mantled tamarins (*Saguinus tripartitus*) at the Tiputini Biodiversity Station in eastern Ecuador. Data on diet were collected via scan sampling during 262 partial and full day follows of three habituated groups. The proportion of feeding time devoted to fruit was higher in the rainy season months of April through July than in the dry season months of August through October. Data on the number and types of fruit sources used by golden-mantled tamarins were collected via "all occurrences" recording of fruit feeding bouts. These data reveal that the number of different fruit sources used per day also varies seasonally, with the lowest diversity of fruit sources being used in the dry season. Corresponding with this seasonal variation in diet is seasonal variation in ranging behavior. Ranging data from sixty full day follows of two study groups reveal an average day path length of 1481 m (range: 466 – 2308 m). Mean day path length for the rainy season months was 43% longer than mean day path length for the dry season months. The fact that groups traveled further when they were eating more fruit suggests that the use of widely dispersed fruit sources may be an important determinant of ranging behavior in this species.

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A Preliminary study of positional behavior in *Alouatta caraya* in northern Argentina.

M. Kowalewski[1], C. Alvarez[2], D. Pereyra[3], E. Violi[3], G. Zunino[2]. [1]Dept. of Anthropology, University of Illinois at Urbana-Champaign, Urbana, Illinois, 61801, USA, [2]Museo Argentino de Cs. Naturales, Div. Mastozoologia, Argentina, [3]Universidad Nacional de la Patagonia San Juan Bosco, Argentina.

The study of positional behavior provides insights into the ways in which primates acquire resources and solve problems of weight-bearing when exploiting an arboreal environment. A group of *Alouatta caraya* was studied during July 2000 in a flooded forest on Isla Brasilera (27° 20' S and 58° 40' W) located near the confluence of the Rio Paraná and Rio Paraguay in northern Argentina. Nine of the 12 individuals of the group were darted, marked with color-coded anklets, and limbs, tail and body weight measurements were recorded. Quantitative data on positional behavior and support use were collected at two minutes intervals using an instantaneous focal animal sampling technique. A total of 130 hours and 2868 activity records were scored. We found that sitting was the most common positional behavior (63%) engaged in by black howlers. Quadrupedal walking accounted for 14% and lay accounted for 12% of the samples. The prehensile tail provided support during 50 % of all positional behaviors. During feeding, sitting (75%), suspending (18%) and quadrupedal standing (6%)accounted for 98% of the positional repertoire. During travel *A. caraya* walked quadrupedally 81% of the time and crossed gaps by bridging (14%). The positional behavior of *A. caraya* in this flooded forest was consistent with data in a dryer forest. Additional relationships between howler feeding ecology, body mass, patterns of positional behavior, and body and limb proportions are discussed. This research was funded by the Dept. of Anthropology, UIUC, USA and ANPCYT-PICT#6171-National Agency of Scientific and Technological Promotion, Argentina.

Brain growth in rabbits with delayed onset craniosynostosis.

A.M. Kreithen[1], S. Weinberg[1], G. Cooper[2], A. Burrows[3], T. Smith[1], H. Losken[4], M. Mooney[1], M. Siegel[1]. [1]University of Pittsburgh, Pittsburgh, PA, 15260, USA, [2]Baylor College of Dentistry, Texas A & M University Health Sciences Center, [3]Slippery Rock University and University of Pittsburgh, [4]University of North Carolina.

It has been suggested that premature craniosynostosis may be the result of abnormal brain development. The present study tested this hypothesis in a rabbit model with delayed onset coronal suture synostosis. Brains were harvested from New Zealand White rabbits ranging in age from 25 to 233 days postconception. Forty-one hemispheres from wild-type controls and 59 hemispheres from rabbits with delayed onset synostosis were considered. The craniosynostotic morphology first becomes evident in this model at approximately 21 days postconception. Brains were fixed in 10% paraformaldehyde. The calvariae were removed to allow brain measurement with digital calipers. Neurocortex length, width, and a width-to-length index were compared between groups. High r^2 values were found for both length and width. For both length and width, slopes were similar at the younger ages, but diverged between 80 and 100 days postconception. In addition, analysis showed that length increased more rapidly in controls than in affected animals, while width increased more rapidly in affected animals than in controls. A test of homogeneity of regression line slopes showed significant ($p<0.05$) differences between groups for neurocortex length, neurocortex width, and the width-to-length index. These findings suggest that altered brain growth is a postsynostotic event in this animal model, rather than itself being the cause of this type of premature craniosynostosis.

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Morphometric variation in proximal femoral development in primates and mammals.

M.A. Kriz[1], P.L. Reno[2], C.O. Lovejoy[3]. [1]Dept. of Anthropology, Kent State University, Kent, OH, 44242-0001, USA, [2]Biological Anthropology Program, Division of Biomedical Sciences, Kent State University, [3]Dept. of Anthropology and Biological Anthropology Program, Division of Biomedical Sciences, Kent State University.

The proximal femur has garnered significant anthropological interest because of its importance for the interpretation of early hominid locomotion. Although the hip has been the subject of numerous biomechanical analyses, the developmental mechanisms responsible for its architecture and morphology are still poorly understood. The proximal femur originates as a common chondroepiphysis in which secondary ossification centers for the femoral head and greater trochanter emerge separately and remain so throughout growth. However, in humans, a thin bridge of cartilage (of complex composition) connecting these two structures persists along the posterosuperior surface of the femoral neck (Ogden, *JA*, 1981, *Hip*, 139-87). This intraepiphyseal region remains distinct throughout most of ontogeny and is never replaced by osseous tissue. On the other hand, the capital and trochanteric ossification centers of many mammals (including numerous primates) coalesce such that a single bony epiphysis covers the entire proximal end. These fundamental developmental differences have not been addressed in previous analyses of the primate femoral neck.

We present a comparative analysis of these two distinct ossification patterns. Us-

ing a principal components analysis of traditional and uniquely defined osteometrics from a large sample of mammals, we document that clear (but complex) differences in proximal femoral morphology are associated with developmental mode. In addition, because even simple inspection shows that superficially similar regions of the proximal femur have different developmental origins (i.e., epiphyseal or subchondral), neither cortical nor trabecular architecture of the femoral neck can be assessed across diverse primate species without careful consideration of these fundamental developmental differences.

Differences in DNA preservation in skeletal remains.

C. Kuba. Deptment of Anthropology, Arizona State University, Tempe, AZ, USA.

While it is known that adult skeletal remains tend to preserve better than subadult remains in the archaeological record, it is unclear if this relationship would extend to include the preservation of DNA in skeletal tissues. To explore differences in DNA preservation between adult and subadult remains and to determine if enough DNA was present to permit determination of familial relatedness, eleven 1 g bone samples and six 0.4 g samples were taken from adult long bones, and seven 0.4 g subadult bone samples were used from two historic cemetery collections from Indianapolis, Indiana. Samples were processed to obtain DNA via decalcification, solubilization, organic extraction, and concentration. The processed samples were tested via yield gel analysis and slot blot hybridization. The DNA samples were subjected to PCR using primers for amelogenin and for two Short Tandem Repeats (STR), TPOX and FES/FPS. Results indicate that biological age does not strongly influence the quantity of human DNA obtained or the quality of lower molecular weight DNA sequences, represented by amelogenin and TPOX. However, biological age did have an influence on the ability to amplify high molecular weight sequences, tested with the FES/FPS primers. The amount of bone sampled appears to influence the success rate for the amplification of DNA products. Greater success was obtained using 1 g samples than the 0.4 g samples in some tests, whereas the 0.4 g samples performed better in others. The DNA present in these samples was not preserved well enough to permit familial testing.

Handedness and directional dermatoglyphic asymmetry in individuals exposed to alcohol prenatally.

C. Kuehn[1], L. Newell-Morris[2], D. Holman[3], A. Streissguth[4]. [1]University of Washington, Depts. of Anthropology & Epidemiology, Maternal and Child Health Program, Seattle, WA, 98195, USA, [2]University of Washington, Dept. of Anthropology, [3]University of Washington, Dept. of Anthropology, Center for Studies in Demography and Ecology, [4]Dept. of Psychiatry and Behavioral Science, Fetal Alcohol and Drug Unit.

Both fluctuating asymmetry (FA, random deviation from bilateral symmetry) and left-handedness have been suggested as indicators of disturbance of prenatal development. We showed previously that FA of the a-b ridge count was increased in patients diagnosed with Fetal Alcohol Syndrome and Fetal Alcohol Effects. Here we test the hypotheses 1) prenatal exposure to alcohol is associated with increased non-right-handedness (NRH), and 2) NRH is associated with increased dermal FA. Palmar a-b ridge counts were obtained from 152 (62F, 90M) affected individuals and 76 (41F, 35M) controls. Affected individuals were interviewed and classified as right-handed (RH) or NRH (left-handed and ambidextrous). Asymmetry was calculated using the formula [100*(R-L)/[(R+L)*0.5)], which controls for size. NRH was increased in the affected group (15% F, 23% M). Sex and handedness were significantly associated with asymmetry (two-way ANOVA, sex: p = 0.041; handedness: p = 0.014). Mean ridge-count asymmetry values by handedness revealed directional asymmetry (DA, non-random deviation from bilateral symmetry) toward the left side in both sexes (NRH: -9.48F, -6.85M; RH: -5.34F, -2.37M). Comparison of the variance in asymmetry by sex showed that FA of NRH was not significantly increased compared to that of RH. In summary, hypothesis 1 is supported, but hypothesis 2 is not, as asymmetry was of the directional type. NRH and increased left DA may be markers of prenatal neurodevelopmental perturbation occasioned by maternal alcohol consumption; their association with later symptomology warrants further investigation. Support: IHS 282-91-0013, Seattle Foundation.

Site formation in the early hominid sites of Gauteng (SA) and its influence on the archaeological record

K. Kuman, Archaeology Department, University of the Witwatersrand, PB 3, Wits 2050, Johannesburg, South Africa

The earliest archaeology of Southern Africa is preserved in four Plio-Pleistocene hominid sites that range from 2 to 1 m.y. in age – Sterkfontein, Swartkrans, Kromdraai and Drimolen. Three of these sites are best known for their Oldowan and/ Early Acheulean stone tools, while Swartkrans and Drimolen have bone tool industries. A few inhabited cave sites improve the archaeological record in the later Acheulean. This paper will consider the rarity of the earliest cultural material in the Plio-Pleistocene of Southern African and discuss the nature of the more abundant but open-air Acheulean sites in the middle Pleistocene of South Africa. Newly excavated Acheulean sites along the Limpopo River in the North will be discussed.

A comparative analysis of tooth mineralisation and paranasal sinus development in the Taung child

K.L. Kuykendall[1], J Bozic[1], G.C. Conroy[2]. [1]School of Anatomical Sciences, University of the Witwatersrand, 7 York Rd, Parktown 2193, Johannesburg, South Africa, [2]Department of Anatomy and Neurobiology, Washington University School of Medicine, St. Louis, MO, USA.

Computed tomography has become a valuable tool for non-invasive analysis of fossil hominid anatomy. The Taung skull was first examined using CT by Conroy and Vannier, who documented details of the developing dentition and paranasal sinuses, including: 1) the presence of a small sphenoid sinus; 2) an estimated maxillary sinus volume of 3.5 cm^3; and 3) extensions of the maxillary sinus into the zygoma and hard palate.

In this study, a more detailed CT comparison of the paranasal sinuses in Taung and 3 chimpanzee and 3 human juveniles of similar dental development status was conducted. Specimens were examined using 1 mm serial scans in sagittal, coronal and axial orientations. The right maxillary sinus volume in Taung is estimated at 3.0 cm^3, but may be affected by calcite deposition within the sinus. Estimates of maxillary sinus volume are between 4 – 6 cm^3 in the chimpanzees, and 5 – 6 cm^3 in the humans.

As in previous studies, Taung and chimpanzees at this dental developmental status demonstrate both intrapalatal and zygomatic extensions of the maxillary sinus; human juveniles do not. However, intrapalatal extensions of the maxillary sinus are not observed in available fragmentary adult 'gracile' australopithecine maxillary specimens (from Sterkfontein, Makapansgat and Hadar), or in adult 'robust' specimens from Swartkrans.

As with developmental patterns already documented for the dentition, these observations suggest that the developmental pat-

tern of the maxillary sinuses in australopithecines differed from both modern chimpanzees and humans. These patterns remain to be further clarified by subsequent CT analysis.

Maternal nutritional status and diet during pregnancy and offspring lipid metabolism in Filipino adolescents.

C. Kuzawa[1], L. Adair[2]. [1]Dept. of Anthropology, Emory University, Atlanta, GA, 30322, USA, [2]University of North Carolina, Chapel Hill.

Despite evidence that lower birth weight is associated with a more atherogenic lipid profile and cardiovascular mortality later in life, the contribution of maternal nutritional status and diet during pregnancy to these associations remains a matter of speculation. This paper investigates this problem in a sample of 600+ Filipino adolescents enrolled in the Cebu Longitudinal Health and Nutrition Survey, a one-year birth cohort study begun in 1982-1983 (Cebu City, the Philippines). Maternal third trimester nutritional status (arm fat) and dietary composition (Kcal and % fat, protein, and carbohydrates) are related to lipids in offspring measured 15-16 years after birth. Multivariate models controlled for factors at birth and at the time of cholesterol measurement, and considered effects with and without controlling for birth weight.

Among male offspring, lower maternal adiposity during pregnancy was associated with elevated total cholesterol, LDLc, TC/HDLc and LDLc/HDLc ratios, and positively related to HDLc. The percentage of maternal calories from protein during pregnancy was positively related to atherogenic lipid levels in males, suggesting a role for maternal dietary composition in lipid programming. All relationships were independent of birth weight, raising questions about the utility of birth weight as a proxy for nutrition and its impact on the fetus. Relationships were absent in females, highlighting a possible contribution of sex steroids. Collectively, these findings provide some of the first evidence that maternal nutritional status and diet during pregnancy may have lasting effects on lipid metabolism in offspring, and raise broader questions about the adaptive significance of such effects.

Interpretations of biostratigraphy, dating and faunal changes in the Pleistocene-aged hominin bearing deposits of Gladysvale Cave, South Africa.

R. LaCruz, L. Berger. University of the Witwatersrand, Johannesburg, Gauteng, 2050, South Africa.

The Gladysvale cave system on the Witwatersrand of South Africa is known for producing an abundant and diverse fauna as well as hominin fossils from Pliocene and Pleistocene deposits. The site is now recognized as having one of the most complete stratigraphies of any of the southern African fossil bearing cave systems. Recent excavations have concentrated on external calcified and decalcified deposits dated provisionally to between c1.3 mya to c240 kybp. Geological, geochronological and taphonomic analyses of the excavated unit and fossils, suggest that over 10 major and more than 20 minor horizontally bedded strata occur in approximately 6 meters of vertical deposit. These represent a nearly continuous record of sedimentation throughout the whole of the early and middle Pleistocene. Within this sequence are abundant fossil faunas, including a hominin, that can be directly related to specific geological strata. This has presented, for the first time in a South African context, the possibility to create a South African Pleistocene biostratigraphy. It also allows for the examination of faunal changes through time against predictions of the effects of climatic changes on mammalian communities. Additionally, morphological changes in certain genera and species may be documented. GIS analyses suggest that more detailed associations of fauna with strata exist, and a more accurate record of faunal community changes at this locality may be established allowing for comparisons with other sites within this temporal range.

Darwin meets DHA: Natural selection, diet, and brain evolution.

J. Langdon. Dept. of Biology, University of Indianapolis, Indianapolis, IN, 46227, USA.

We can now identify a number of dietary nutrients that are essential to normal brain growth, development, and function; and it is probable that more will be discovered as our understanding of nutrition increases. How can this knowledge be related to evolutionary models? To what extent have dietary changes in our prehistory limited, permitted, or stimulated the expansion of the brain?

Evolutionary scenarios are easily constructed that suggest substantive increases in the intake of calories, protein, lipids or other nutrients corresponding to significant changes in dietary niche were necessary to support the hominid brain. Such arguments make a number of implicit assumptions: 1. The nutrient supply to the brain is sensitive to variations in dietary intake. 2. Brain function is sensitive to variations in nutrient supply. 3. Fitness is sensitive to this variation in brain function. 4. Dietary shifts in hominid evolution have increased fitness by enhancing dietary intake of limiting nutrients.

These assumptions are potentially testable. I have examined the clinical literature relating to dietary linolenic acid and docosahexaenoic acid (DHA) to evaluate the proposed relationship of aquatic resources in the diet to hominid evolution. While there is supporting evidence certainly for the first three assumptions, only the most extreme interpretations of published data support the argument that DHA has been a limiting nutrient in hominid brain evolution.

Morphological correlates of forelimb protraction in primates.

S. Larson. Dept. of Anatomical Sciences, Stony Brook University, Stony Brook, New York, 11794-8081, USA.

Primates are distinguished from most other mammals in displaying a more protracted forelimb posture and greater forelimb angular excursion during quadrupedal walking. It has been suggested that these unique characteristics can be related to several interconnected selective factors that were involved in the successful occupation and radiation of primates into the arboreal small-branch niche. To test this hypothesis, it is necessary to determine when these unique postural characters first appeared in the evolution of primates. However, tracking changes in kinematic characteristics is only possible if there are morphological correlates of those characteristics. The goal of this study was to investigate several morphological features of the scapula and proximal humerus in a variety of mammals to identify any that distinguish primates from nonprimates and could be related to use of a more protracted shoulder joint.

Features that were examined included the overall shape of the proximal humerus, the shape and orientation of the muscle insertion facets on the tubercles, the width and orientation of the intertubercular groove, and the orientation of the glenoid cavity. Among the traits that distinguished primates from nonprimates were the degree of anterior projection of the greater tubercle, orientation of the supraspinatus facet and the intertubercular groove relative to the axis of the humeral head, and the angle of the glenoid cavity relative to the scapular spine. Documentation of the appearance and distribution of such features in euprimate fossils will hopefully help us to better understand the early evolution and radiation of primates.

Assessment of classification of crania using Fordisc 2.0: Nubian X-Group Test.

A. Leathers, J. Edwards, G.J. Armelagos. Emory University, Atlanta, GA, 30322, USA.

Fordisc 2.0, a popular forensic anthropology program, claims to classify “an unknown

adult crania" based on "known samples" using twenty-one cranial measurements. The known populations are based on WW Howell's sample that reflects the most common continental racial classification. While the Fordisc 2.0 authors state that "there are no races, only populations," it is clear that Howell was intent on providing known groups that would be distributed among the continental "racial" groups. We tested the accuracy and effectiveness of Fordisc 2.0 using twelve cranial measurements from a homogeneous population from the X-Group period of Sudanese Nubia (350CE-550CE). When the Fordisc program classified the adult X-Group crania, only 51 (57.3%) of 89 individuals were classified within groups from Africa. Others were placed in such diverse groups as Polynesian (11.24%), European (7.86%), Japanese (4.49%), Native American (3.37%), Peruvian (3.36%), Australian (1.12), Tasmanian (1.12%), and Melanesian (1.12%). The implications of these findings suggest that classifying populations, whether by geography or by "race", is not morphologically or biologically accurate because of the wide variation even in homogeneous populations. Howell's samples lack the distinct morphology necessary to make Fordisc 2.0 a useful tool for classifying unknown crania.

Evolutionary patterns in Pleistocene human brain size.

S. Lee[1], M. Wolpoff[2]. [1]University of California at Riverside, Riverside, CA, 92521-0418, USA, [2]University of Michigan.

The increase of cranial capacity in hominid evolution is unarguably significant over the tenure of the genus *Homo*. However, consensus is yet to be reached regarding the pattern of increase: some have used brain size evolution as a reflection of gradualism, some have claimed that certain portions of the human lineage were characterized by stasis, and still others have contended that brain size evolution in some geographical regions has proceeded at different rates than in others. In this paper, we address the problem of how human brain size has changed in the Pleistocene using a new approach.

We collected from literature 92 hominid cranial capacities dated to between 50 Ka and 1800 Ka. To reduce error introduced by dates, we rounded the date estimates to the nearest 100 Ka for specimens dated between 1800 Ka and 300 Ka, and to the nearest 50 Ka for specimens between 300 Ka and 50 Ka. The final data set used in the analysis consists of 17 time samples. We developed a resampling algorithm using a distribution of increments to test the null hypothesis that a single process generated the observed increase pattern.

The results of our analyses do not reject the hypothesis of a single cause of brain size change, but refute an interpretation of punctuated equilibrium during this period. The implications of this study regarding the hypothesis of Pleistocene human cladogenesis are discussed.

Reassessing evolution of open environments associated with the early South African hominids, using a ^{13}C-based index.

J. Luyt[1], J. Lee-Thorp[1], M. Sponheimer[2]. [1]University of Cape Town, Cape Town, Western Cape, 7701, South Africa, [2]University of Utah.

Environmental information provides a key contextual framework for understanding evolution of hominids and indeed all extinct fauna. Establishing a sequence of environmental changes for the South African hominid sites is plagued by the difficulties associated with their stratigraphic complexity, uncertainties about biases due to collecting agents and preservation, and imprecise chronologies. The well-known alcelaphine and antelopine bovid index based on the proportions of fossil bovid taxa and habitat preferences of their modern relatives provided strong evidence for long-term shifts from closed, earlier habitats to later, more open and arid environments between 3 and 1 Myrs. Habitat preferences of fossil bovids, however, may in certain cases have differed from those of the modern taxa, possibly introducing errors in this scenario. Here we provide a revised index of 'open' faunal indicators based on the relative proportions of C_4 (grazers) and C_3 herbivores in a number of the SA sites, which have been established from carbon isotopic data. The revised indices, when placed in chronological sequence, suggest that woody elements of the vegetation may have been underestimated earlier. More importantly, the most significant environmental change occurred shortly after 1.7 Myr, and not at 2.5 Myr. In spite of the changes in environment, however, hominid diets show similar contributions of C_4 foods to a mostly C_3-dominated diet for millions of years.

Cranial trauma as evidence of violence in a native Alaskan skeletal sample from Nunivak Island, Alaska.

S. Legge. University of Alaska Fairbanks, Fairbanks, AK, 99708, USA.

Cranial trauma is investigated in a skeletal collection from Nunivak Island, Alaska. Eleven cases of cranial trauma were observed. These included 6 adult males and 5 adult females, representing a frequency of 11.5% among the males and 6.9% for females in the sample. Statistical analysis indicates no significant difference in the occurrence of trauma in this sample between males and females. The wound types include both blunt force trauma and blade weapon inflicted. Seven of the wounds show signs of healing or have healed completely, whereas the other 4 show no indication of healing and were most likely directly related to the cause of death. Finally, a skull of a middle adult (35-49 years) male exhibits a bony "bar" within the right eye orbit extending from the superior margin of the orbit to the lacrimal bone. This is possibly the result of a healed trauma and may be an ossification of the *orbicularis oculi*.

This research was funded in part by the Smithsonian Institution Office of Repatriation. A special thanks must also be made to the people of Nunivak Island for allowing this research to be conducted at the University of Alaska.

Conservation of lemurs in the Onive-Vohidahy region of eastern Madagascar.

S. Lehman. University of Toronto, Toronto, Ontario, M5S 3G3, Canada.

The Onive-Vohidahy region contains some of the last tracts of unexplored and unprotected rain forest in eastern Madagascar. I conducted a total of 135 km of surveys from October 19 to November 3, 1999 and from February 15 to April 4, 2000 at seven sites in the region. A total of 97 primate groups representing nine species were censused. Overall density estimates for nocturnal lemurs (1.01 individuals/ha) and diurnal lemurs (0.29 individuals/ha) were significantly lower than those found in protected areas. *Avahi laniger* (0.08 individuals/ha), *Microcebus rufus* (0.75 individuals/ha), and *Cheirogaleus major* (0.17 individuals/ha) had density estimates much lower than those reported for conspecifics at nearby national parks. There was evidence of recent feeding activities by *Daubentonia madagascariensis* at four of the sites. *Eulemur rubriventer* exist at densities comparable to those found in protected areas (0.18 individuals/ha). Few *Varecia variegata variegata* (0.006 individuals/ha), *Eulemur fulvus fulvus* (0.05 individuals/ha), or *Hapalemur griseus griseus* (0.12 individuals/ha) were censused. I observed two groups of what may be a hybrid form of *E. f. fulvus* and *E. f. rufus*. Neither *E. f. rufus* nor *Propithecus diadema edwardsi* were censused, indicating that both species may be in danger of localized extinction. Lemurs are hunted using blowguns and snare traps. Forest destruction is caused by slash and burn agriculture and logging. The conservation status of primates in the Onive-Vohidahy region should be viewed as extremely precarious. Supported by O.N.E.,

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Brain growth, life histories, and cognition in primate and human evolution.

S. Leigh. Dept. of Anthropology, University of Illinois, Urbana, Il, 61801, USA.

Developmental studies have substantially increased our understanding of primate cognitive evolution. However, relatively little is known about how brain morphological development covaries with life histories and cognition. Consequently, this study examines brain size growth variation in primates with the goal of refining our view of the relations between brains, life histories, and cognition.

This analysis analyzes anthropoid primates, including hominins, with data obtained from literature sources, museum specimens, and captive samples. When possible, size variables are analyzed. Regression analyses describe age-related changes in brain size.

Primates show great diversity in patterns of brain growth. Differences in brain growth rates are clear in comparisons within anthropoid clades, and the time course of brain growth differs within these groups. Brain and body growth patterns appear to be independent in many cases. Modern human brain growth rates are substantially higher than those of *Homo erectus*, but changes in hominin brain growth duration are more difficult to assess.

Brain growth patterns are subject to substantial evolutionary changes. Correlations between the costs of brain growth and life histories may be evident. The increase in brain growth rates over the course of human evolution is consistent with patterns found in other primates. This probably reflects considerable increases in the metabolic demands of human infancy, and may point to major evolutionary changes in the development of cognitive abilities. Diversity in primate brain growth patterns may parallel salient interspecific differences in the ontogeny of cognition.

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The origins of diagonal-sequence walking gaits in primates: an experimental test involving two didelphid marsupials.

P. Lemelin, D. Schmitt, M. Cartmill. Duke University Medical Center, Durham, NC, 27710, USA.

Diagonal-sequence (DS) walking gaits (i.e., hindlimb footfall precedes that of the contralateral forelimb) distinguish primates from other mammals, which rely on lateral-sequence (LS) walking gaits (i.e., hindlimb footfall precedes that of the ipsilateral forelimb). It has been suggested that the DS pattern originated in ancestral primates in association with the use of grasping extremities for movement among thin, flexible branches (Rollinson and Martin, 1981; Larson, 1998). We tested this contention by comparing footfall patterns and interlimb coordination in two didelphid marsupials of varying ecologies: *Caluromys philander*, a fine-branch arborealist, vs. *Monodelphis domestica*, a more terrestrial relative.

Over 100 gait cycles on runway and instrumented poles of different diameters were analyzed from normal and high-speed videotapes of both marsupial taxa. Duty factor (i.e., duration of the stance phase as a percentage of the stride period) and diagonality (i.e., phase relationship between the forelimb and hindlimb cycles) were calculated for each gait cycle. We found that *Caluromys* uses both LS and DS walking gaits on the runway. When on the smallest pole, *Caluromys* displays gaits with higher diagonalities (50 or above), which translate into DS gaits only. In sharp contrast, *Monodelphis* relies primarily on LS walking gaits on both runway and pole. Like many primates, *Caluromys* is capable of using both DS and LS walking gaits. The fact that this marsupial uses DS gaits exclusively when walking on small poles strongly suggests that primate gaits evolved to meet the demands of locomotion on thin branches.

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Measuring human energy expenditure: what have we learned from the flex-HR method?

W. Leonard. Dept. of Anthropology, Northwestern University, Evanston, IL, 60208, USA.

The measurement of daily energy expenditure is an important aspect of research on human health and nutrition. Over the last 30 years, GB Spurr has been a leader in developing and implementing methods for more effectively assessing energy expenditure and physical activity in traditional and modernizing populations. One of his most notable contributions has been the development of the "Flex Heart Rate" (flex-HR) method. Since its inception in the late 1980s, the flex-HR method has become a standard tool for measuring daily energy expenditure in free-living human populations.

This paper will review the initial development and validation of the flex-HR technique, and examine recent refinements and applications of the method. Additionally, I will evaluate variation in levels and patterns of energy expenditure among both subsistence-level and Western populations that have been studied with the flex-HR method. These analyses highlight how the flex-HR technique has improved on earlier methods of assessing energy expenditure (e.g., time allocation/"factorial" methods), and greatly advanced our understanding of human energy requirements.

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MtDNA HV1 relationships of the Ancash: an ordination and phylogenetic investigation.

C. Lewis[1], B. Lizárraga[2], R. Tito[2], A. Stone[1]. [1]University of New Mexico, Albuquerque, NM, 87107, USA, [2]Universidad Nacional Mayor de San Marcos.

This research examined the mitochondrial DNA (mtDNA) in 36 Quechua speakers from the state of Ancash, Perú. The 9-bp deletion and the three restriction sites characteristic of the four major American Indian mtDNA haplotypes were examined. The frequencies of these haplogroups were compared with those in other South American populations. In addition, the hypervariable region I (HVI) was sequenced. The HVI sequences were compared to 18 other American Indian populations using both an ordination and phyletic procedure. The results were used to infer the degree of congruence between genetics, geography, and language. Preliminary results suggest that geographic distributions are more congruent with mtDNA data than language. Additionally, the results illuminate the benefits of examining genetic sequences using both 3D scatter plot and tree building methodologies.

Artificial cranial modification as a social marker in the Jequetepeque Valley, Peru.

M. Lichtenfeld. SUNY Binghamton, Binghamton, New York, 13905, USA.

The aims of this study are to understand the cultural practice of ACM and the expression of the modifications as a social marker, in the Jequetepeque Valley, Peru. Artificial Cranial Modification (ACM) is part of a suite of body modification traits and is quite variable among different social groups (Antón, 1989). The Jequetepeque Valley underwent many cultural changes over the 1500-year time span (AD 1- AD 1500) that I have examined for this work. Over the past decade excavation campaigns in this valley have added a lot of material from all four cultures considered here (Moche, Transitional, Lambayeque, and Chimu/Inka).

Overall, the sample of individuals with ACM showed a lot of variation in the ways

that people of the Jequetepeque Valley chose to modify their children's heads. ACM within the valley was differentiated by culture and social group. The Moche and Lambayeque were the two cultures that displayed the most obvious differences, with the Moche being the least modified, while the Lambayeque individuals showed the most heavily modified crania. Individuals from the Transitional period were marked by elements of ACM from both the Moche and Lambayeque styles, while the Chimu changed the ACM in the valley from more extreme back to less extreme form.

The major analytical tool used in this study to examine ACM was thin-plate spline (TPS), which is capable showing geometric differences between two forms both graphically and statistically. The application of TPS has shed new light on variability of ACM and the expression of ethnicity on the North Coast of pre-Columbian Peru.

Growth versus repair responses to loading in the limb.

D. Lieberman[1], O. Pearson[2], J. Polk[1]. [1]Harvard University, Cambridge, MA, 02138, USA, [2]University of New Mexico.

Humans, like most mammals, have tapered hindlimbs, with thinner distal than proximal elements. Distal tapering has been shown to save humans substantial kinetic energy costs during the swing phase, but data on limb fracture rates suggest that such energetic savings come at the cost of lower safety factors. Currently, we do not know how or if humans and other mammals modulate growth (modeling) versus repair (remodeling) responses to mechanical loading to compensate for the presumed structural disadvantages of limb tapering. Most models propose that modeling and remodeling are coordinated to maintain mechanical equilibrium, adapting functionally comparable regions to similar peak strains. We test here the alternative hypothesis that different limb bones are not adapted to similar mechanical strengths. Instead, we propose that limb bones initially trade-off growth versus repair responses to loading at different locations in proportion to variations in the energetic costs of adding mass at those locations. Our model is tested through comparisons of exercised versus sedentary sheep from three age categories: juvenile, subadult, and adult. Histological analyses of midshaft growth and repair rates show that similar loads induce higher rates of growth in proximal midshafts and higher rates of repair in distal midshafts. Studies of cross-sectional, midshaft strains normal to the bone's long axis indicate that distal elements are adapted to higher strains and maintain lower safety factors than more proximal elements. However, growth rates decline and repair rates increase as animals age, and moderate levels of loading stimulate both processes significantly less in subadults and adults.

The 1999 status of the race concept in physical anthropology: two studies converge.

L. Lieberman, R.C. Kirk. Central Michigan University, Mt Pleasant, MI, 48859, USA.

Race, once a core concept, has increasingly been rejected by physical anthropologists. One of the two studies reported here is a content analysis of textbooks of introductory physical anthropology. The number of textbooks rejecting/accepting race was as follows: 1932-69: 1 rejects, 13 accept; 1970-79: 14 reject, 12 accept; 1980-89: 9 reject, 4 accept; 1990-99: 17 reject, 1 accepts. In a second series of studies, questionnaires were mailed in 1984 and 1999 to all persons listing physical anthropology as a specialty in the *Guide to Departments* of the American Anthropological Association. The proportion of respondents disagreeing with the statement that "There are biological races in the species *Homo sapiens*" was 41 percent (148 of 364) in 1984, and 69 percent (131 of 190) in 1999. Our two series of studies indicate a significant degree of change in the status of the race concept. A third study, authored by Matt Cartmill, is cited here for comparison. Cartmill (*American Anthropologist* 1998) reported on a content analysis of articles published in alternate years of the American Journal of Physical Anthropology from 1964 to 1996. He found that the proportion of studies of race had remained relatively constant. We discuss the similarities and differences between Cartmill's study and our own.

Yuendumu childhoods: political economy and enamel hypoplasia.

J. Littleton. Dept. of Anthropology, University of Auckland, Auckland, New Zealand.

Human biological studies of contact between European and Indigenous populations have focused upon a basic contrast between pre- and post-contact health. This study examines how health transitions are reflected in the pattern of linear enamel hypoplasia (LEH) incidence. These defects of the enamel are commonly used as non-specific indicators of stress in skeletal populations but there have been few well-documented historic sequences. The series of dental casts of Aboriginal people resident at Yuendumu (n = 377), a Government Settlement in Central Australia, were studied in order to see whether changes in LEH incidence are consistent with historical changes in the developmental environments experienced by these people.

Members of the University of Adelaide Dental School made the Yuendumu dental casts between 1950 and 1970. The casts are of people born between the 1890s and 1959, and therefore cover the period of establishment of the settlement in 1946.

The prevalence of LEH increases markedly through this time from 37.5% of the oldest cohort (growth completed before mission establishment) to more than 89.6% of the cohort born between 1955-1960. The age pattern of defects also changes, with an earlier mode of onset in later cohorts.

Possible intervening factors such as severe attrition are taken into account. Nevertheless, the overall pattern demonstrates clearly the increasing impact of morbidity among the Yuendumu population despite increasing government attempts to improve the health of Indigenous inhabitants within the "total institution" and highlights the value of LEH as a marker of morbidity .

Temporal bone morphology and earliest *Homo*.

C. Lockwood, W. Kimbel, J. Lynch. Arizona State University, Tempe, AZ, 85287-4101, USA.

Two temporal bone specimens figure prominently in discussions of the earliest record of the genus *Homo*. The Chemeron temporal (KNM-BC1) is dated to 2.4 Myr, and Sts 19 is considered to be from Sterkfontein Member 4, but its provenience is uncertain. Arguments that these specimens may represent *Homo* have been based on very different morphological grounds. Here, we use geometric morphometrics and morphological observations to re-evaluate their affinities.

Three-dimensional landmarks were recorded for all available hominin specimens from the African fossil record, as well as large samples of extant hominoid species. Relative warp analysis was used to assess shape differences and patterns of variation, and thin-plate spline analysis was used to determine how morphological characters impact the relative warps. All analyses were conducted using the program *Morphologika* (O'Higgins and Jones, UCL, 1999).

The most informative analysis is based on 14 landmarks from the glenoid region and the tympanic part of the temporal bone. On the first three relative warps (61.8% of the total variance), KNM-BC1 is clearly distinct from a phenetic cluster that includes specimens of *Homo*, *Australopithecus africanus*, and Sts 19. For example, the mandibular fossa is more laterally positioned in KNM-BC1 than it is in *Homo*, contrary to published reports. KNM-BC1 is slightly more similar to *A. boisei* and may represent an

Australopithecus population of unresolved affinities. On the other hand, Sts 19 is intermediate between *A. africanus* and *H. habilis* and, in some analyses, more similar to *H. habilis*.

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The wild chimpanzee's working day: activity budget at Gombe National Park, Tanzania.

J. Lodwick, W. McGrew. Zoology Dept, Miami University, Oxford, OH 45056, Oxford, Ohio, 45056, USA.

All organisms divide the day into periods of activity ("working day") and inactivity (rest), in order to make a living. The proportion of time allocated to each depends on the social, biotic, and abiotic factors in the environment to which the species is adapted. Primates probably budget their activity according to an evolutionary stable strategy that maximizes foraging and sociability while minimizing competition and predation. We ask if activity is truncated or extended within the circadian day, and how the independent variables can explain variation in length of working day.

We extracted long-term data from chimpanzees' (*Pan troglodytes schweinfurthii*) Travel-and-Group-Charts from 1974-1992, archived at the Jane Goodall Institute, University of Minnesota. From rising and retiring times, we calculated the average working day-lengths of Kasakela community chimpanzees for 2203 all-day follows. Activity duration was correlated with seasonal circadian cycles of dawn to dusk.

Wild chimpanzees at Gombe National Park, Tanzania, averaged 49-50% of a 24-hour period to be spent in foraging, locomotion, social activity, and daytime rest. Average working day duration (mean = 701 min.) in our study resembled Wrangham (1992), with diurnal activity starting (06:55 hr.) shortly before dawn and ending (18:36 hr.) shortly before dusk. Males and females beyond the age of weaning showed no significant differences in day-length. Other variables tested include female reproductive status (gestation, lactation, estrus), dominance (high, medium, low rank), seasonality (wet, dry), and party size and composition (solitary, social, etc.).

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Genetic diversity and the non-existence of human races.

J. Long[1], R. Kittles[2]. [1]Dept. of Human Genetics, University of Michigan Medical School, Ann Arbor, MI, 48109-0618, USA, [2]Howard University.

Many physical anthropologists and human biologists abandoned the concept of human races as Platonic types more than half a century ago. The static nature of the concept of human races is inconsistent with the Darwinian theory of evolution. Our understanding of human biological diversity is now presented broadly using population concepts. However, a consensus on specific models and alternative concepts to explain this diversity has been slow to emerge. Research over the last thirty years has consistently demonstrated that when heterozygosity at marker loci is partitioned, the within population component greatly exceeds the between population component. Unfortunately, many studies repeated this result without effort to extend it or critically examine the statistical methods or sampling designs for fundamental limitations or biases. The analyses reported in this paper review some of the pitfalls of partitioning heterozygosity from the perspective of the underlying population and sampling assumptions. Using several large data sets consisting of highly polymorphic loci, these analyses demonstrate the robustness of one principal finding: substantial heterozygosity within human groups. The results also demonstrate that the pattern of variation between groups is complex and that there may be hidden assumptions related to statistical methods and population sampling practices that could greatly bias results and interpretations. These results do not resurrect racial or typological thinking. However, they point to more productive lines of inquiry based on evolutionary process and to the genomic and population sampling designs that will be necessary to implement these.

Serotonin transporter promoter length variants among the Cercopithecinae.

J. Lorenz[1], K. Smith[1], J. Viray[2], P. Bender[1], J. Beck[1], D. Smith[2]. [1]Coriell Institute for Medical Research, Camden, NJ, 08103, USA, [2]Dept. of Anthropology, University of California, Davis, USA.

Studies of both human and non-human primates have linked CNS levels of the neurotransmitter serotonin (5-HT) to a suite of behavioral and psychiatric traits involving, among other things, fear, aggression, and anxiety. A 44 bp insertion/deletion in the human serotonin transporter gene (5-HTT) promoter region has been identified that affects 5-HTT transcriptional activity (Lesch et al. 1996). Thus the 5-HTT promoter length polymorphism has been targeted in association and linkage studies of neuropsychiatric disease. A 21 bp insertion/deletion with transcriptional effects has also been identified in the 5-HTT promoter region of rhesus macaques (*Macaca mulatta*) (Lesch et a. 1997). Rhesus macaques serve as a model for many human diseases, differences in aggression, anxiety measures and other behaviors might be due in part to length variation at the 5-HTT promoter. Researchers have also noted intraspecific differences in aggression among various populations of rhesus macaques as well as interspecific differences in levels of aggression among various macaque and other related species and hypothesized that the differences may be in part genetic. Little is known about the distribution of variation among rhesus populations for the 5-HTT length polymorphisms, nor for that matter, the degree of variability found at this locus in related species.

In this study we used PCR amplification of the variable region of the 5-HTT promoter to genotype individuals from several species: rhesus macaques (Indian, n = 144; Chinese, n = 48; Vietnamese, n = 14; Burmese, n = 10); Barbary macaques (*M. sylvanus*, n = 48); stump-tailed macaques (*M. arctoides*, n = 48); pigtailed macaques (*M. nemestrina*, n = 52); long-tailed macaques (*M. fasicularis*, n = 20); Vervets (*Cercopithecus aethiops*, n = 10) and mangabeys (*Cercocebus sp*., n = 5). Rhesus was the only species in which there was a short form of the 5-HTT promoter. The frequency of the short allele varies from 0.26 in the Indian rhesus to 0.40 in the Burmese rhesus. Barbary macaques are all homozygous for an allele that is 20 bp longer than the rhesus long allele. This study provides information about genetic variation within and among species at a locus that may have significant functional consequences.

Shifting status: four years of adult male hierarchy in *Macaca fascicularis* at Padangtegal, Ubud, Bali, Indonesia.

J. Loudon[1], A. Fuentes[2], A. Welch[3]. [1]UNUD-CWU Balinese Macaque Project, Central Washington University, Ellensburg WA 98926, Lake Grove, NY, 11755, U.S.A, [2]Dept. of Anthropology, Central Washington University, Ellensburg, WA 98926, [3]InterDept.al Doctoral Program in Anthropological Sciences, SUNY-Stony Brook, Stony Brook, NY 11794-4364.

This study presents data collected on three groups of semi-free ranging long-tailed macaques (*Macaca fascicularis*) at Padangtegal, Ubud, Bali, Indonesia. Data were collected 3-4 months per year from 1998-2001. The purpose of the study is to examine the aspects of adult male rank in these three macaque groups. Within the four years each group's alpha male has either emigrated outside the study population without aggression or has been "forced out" into another group within the study population by an immigrant male, who attained the alpha position.

15 adult male macaques were included in the study. Male interaction data were collected via all occurrence observations and focal animal follows. Rank was determined by access to contested resources, approach-retreat interactions, direction of displacements, directionality of submission, and winners and losers of aggressive interactions.

Our data suggest that alpha male status was maintained by strong relationships with high-ranking females and/or with coalitions with other high-ranking males. Alpha males without strong social networks (with matrilines or other adult males) were forced to leave their group by immigrant males. Low-ranking adult males generally stayed spatially peripheral to the core of the group. Some males remained low ranking for the 4-year span of the study. This suggests that for some males, the benefits of a low rank might outweigh the costs of emigrating.

Although alpha males had access to contested resources (food) and were frequently observed in close proximity to the high-ranking females, it is unclear whether or not high rank is associated with increased mating success.

Developmental field fluctuation: a potential basis for skeletal morphological variation.

C.O. Lovejoy, P.L. Reno, M.A. Kriz, B.A. Rosenman. Dept. of Anthropology and Division of Biomedical Sciences, Kent State University, Kent, OH, 44242-0001, USA.

Our understanding of limb development has recently burgeoned. Of particular importance are revelations that 1) bony morphology is largely determined by pattern formation, 2) growth foci such as physes and synovial joints are established as sequentially delimited cellular communication fields, and 3) variation in these fields is most likely determined by cis-regulatory elements acting on restricted numbers of downstream anabolic genes demarcated by selectors such as Hox and Pax. An obvious implication is that shaft morphology is not determined primarily by loading history, but rather by slight variances in the structure and position of enhancers and silencers. If true, then population differences in metric and non-metric features may reflect fixation of slight differences in field composition and/or cis-regulatory elements. We tested this "fluctuating field basis" of osteological variation by examining the ontogeny of platymeria and rugosity of the third trochanter in two skeletal groups: Libben and Hamann-Todd. Using simple metrics and seriation of the third trochanter in femora ranging from 50 mm to 360 mm, we found that the Libben (in which adults are both markedly platymeric and also often exhibit pronounced third trochanters) subadult femora manifest platymeria and greater third trochanter rugosity at birth; further, they show no correlation of rugosity with age. Age-matched femora from the Hamann-Todd Collection are both less rugose and less platymeric throughout ontogeny. Much of both metric and "non-metric" variation may therefore reflect slight differences in pattern formation and not differences in external loading regimens.

Reconstructing the Grauballe Man: a Danish bog body, CAT-scan and 3-D visualisation.

N. Lynnerup[1], M. Dalstra[2], A. Jurik[3], P. Asingh[4]. [1]Laboratory of Biological Anthropology, University of Copenhagen, Copenhagen, 2200 N, Denmark, [2]University of Aarhus, Denmark, [3]Aarhus University Hospital, Denmark, [4]Moesgaard Museum, Denmark.

The Grauballe man is one of Denmark's most well-preserved bog bodies, dating back 2000 years. He was found in 1952 and it was determined he had had his throat cut and probably suffered fractures of the skull and leg. The body was subsequently subjected to extensive conservational and reconstructive procedures.

Presently, the body has been subjected to new analyses, especially exhaustive CAT-scanning. The results of the CAT-scanning have enabled us to make a detailed documentation of the state of preservation and the earlier conservational procedures. Also, these results have given us new information on the bone fractures, soft-tissue wounds, age-determination, and ultimately the creation a stereolithographic model of the skull.

The presentation will focus on the software and procedures used to make the 3-D visualisations, and will discuss the general theme of segmenting, i.e. separating, various anatomical, especially skeletal, features by CAT-scan imaging. CAT-scanning is becoming a widely used method to analyse human remains, and as such it is important to focus proactively on both possibilities as well as pitfalls of the methodology.

The one-million-year-old human remains from the Danakil (Afar) Depression of Eritrea.

R. Macchiarelli[1], L. Bondioli[2], A. Coppa[3], Y. Libsekal[4], L. Rook[5], E. Abbate[5]. [1]Laboratoire de Géobiologie, Biochronologie et Paléontologie Humaine, Univ. de Poitiers, Poitiers, Poitou, 86000, France, [2]Sect. Anthrop., Natl. Prehistoric Ethnographic, [3]Dept. Animal & Hum. Biol., Univ. of Rome, [4]National Museum of Eritrea, Asmara, [5]Dept. Earth Sciences, Univ. of Florence, Italy.

Geopaleontological research carried out in the northern Danakil (Afar) Depression of Eritrea by an Italo-Eritrean team resulted in the discovery of several late Early Pleistocene fossiliferous sites in the area of Buia (Abbate et al., 1998). Paleoanthropological findings consist of one-million-year-old cranial (UA 31), postcranial (UA 173), and dental (UA 222 and 369) remains from a single outcrop in Uadi Aalad.

The UA 31 cranium expresses a remarkable blend of morphological features in the neurocranium and face. The braincase is long and exceptionally narrow which, combined with its relatively great height, results in an estimated endocranial volume of 900 cc.

Based on two associated pelvic fragments (UA 173), we consider UA 31 a probable female, although it has prominent, thick supraorbital tori. There is an especially large zygomatic process filled by a voluminous maxillary sinus. The height of the maxilla probably is the largest found in any known hominid from Pleistocene Africa. We also note the low position of the zygomatic root.

There are few comparable specimens from this time period in Africa, but considering earlier ER 3733 and 3883, OH 9) or later (OH 12, Bodo) specimens, UA 31 differs markedly, illustrating the great variability of Early-Middle Pleistocene *Homo*.

The "Buia Research Project", initiated by the Univ. of Florence and developed in collaboration with the National Museum of Eritrea and the Eritrea Dept. of Mines, is supported by the Italian CNR, the Univ. of Florence, the Italian Ministry for Foreign Affairs, the MURST COFIN99, and the L.S.B. Leakey Foundation.

A Lower Miocene Lorid femur from Napak, Uganda.

L. MacLatchy[1], R. Kityo[2]. [1]Boston University, Boston, MA, 2215, USA, [2]Makerere University.

The timing and nature of the divergence of the lorisoid clade into bushbabies and slow lorises is poorly documented by the fossil record. For the Miocene, dental remains have been assigned to lorids and galagos, but postcranial elements are rare and suggestive of galago affinities or general quadrupedalism and lack clear cut lorid adaptations indicative of slow climbing. For instance, known Miocene lorisoid femora have cylindrical femoral heads like those of modern leaping galagos. In contrast, a proximal femur recovered in 2001 from the 19 Ma Uganda site Napak IV (BUMP (Boston Uganda Makerere Paleontology) 20) has the large, globular, mediolaterally compressed and anteriorly offset femoral head found in extant lorids. Also as in modern pottos, the

femoral head is elevated above the greater trochanter, the neck is short and the *fovea capitis* is positioned posteroinferiorly on the medial aspect of the head. Differences between the new femur and modern lorid femora include a femoral head articular surface lacking a posterior facet and a less medially placed lesser trochanter. The overall morphology is lorid-like, however, and indicates a wide range of hip movement.

Femoral head diameter of BUMP 20 is approximately one-third greater than that of a potto, making *Mioeuoticus* and *Progalago,* both potto-sized possible lorids from Napak, problematic candidates for attribution. BUMP 20 thus not only suggests that the adaptive divergence of the two lorisoid lineages was well under way by the early Miocene, it may represent a taxon significantly larger than known Miocene and extant lorisoids.

Computerized shape analysis of hominid endocasts.

C. MacLeod[1], D. Falk[2], H. Mohlberg[3], J. Shah[3], K. Zilles[3]. [1]Dept. of Anthropology, Langara College, Vancouver, BC, Canada V5Y 2Z6, Burnaby, BC, V5A 4B3, Canada, [2]Florida State University, [3]Forschungszentrum, Juelich, Germany.

A novel computerized, voxel-based deformation procedure was applied which allows an algorithmically driven 3-D analysis of shape differences between virtual fossil and modern human and ape endocasts. The procedure warps fossil hominid endocasts to a human reference endocast to reveal neocortical and cerebellar regions that changed most during hominid brain evolution.

Endocasts of *Australopithecus africanus*, *Paranthropus boisei*, *Homo erectus*, and *Homo sapiens neanderthalensis*, 8 human skulls, and 7 bonobo latex endocasts were submerged in water and scanned using magnetic resonance imaging and a 3-D scanning sequence. The resulting grey-value images were transformed into binary masks, then reconstructed into virtual endocasts. Human and bonobo reference endocasts were formed by averaging 8 and 7 endocasts, respectively. Each fossil endocast was warped into the modern human endocast by means of a multigrid elastic deformation algorithm which deformed all voxels of the virtual fossil endocast into those of the reference endocast, thus transforming the shape of the fossil endocast into that of the modern human endocast. The local degree of deformation of each voxel was visualized and colour-coded (deformation field).

This procedure quantifies and illustrates major evolutionary changes in endocast shape and, by comparison with human brain maps, the relative development of functionally identified brain regions.

Cyclical and non-cyclical mortality in two Hungarian villages.

L. Madrigal[1], T. Koertvelyessy[2], B. Ware[1], T. Cuevas[3]. [1]Dept. of Anthropology, University of South Florida, Tampa, FL, 33620, USA, [2]Dept. of Anthropology, Ohio University, [3]Dept. of Anthropology, University of Costa Rica.

Agricultural populations, characterized by sedentism and proximity among potential hosts, are commonly thought to experience epidemics in a cyclical pattern. Recently, Madrigal et al. (2001) demonstrated that an agricultural community in Costa Rica did not suffer from such cycles. Here we performed periodogram analysis of the mortality of two peasant communities in Southwestern Hungary (Acsa and Miklósi), with the purpose of determining if they experienced population epidemic cycles. The data consist of neonatal mortality rates and of counts of adult mortality by year from 1800 through 1895. Significance was established using Fisher's g statistic (Warner, 1998).

The infant and adult series from Acsa did not show any significant periodicities (g = .10 and g = .09 respectively). In Miklósi, whereas the adult mortality was not cyclical (g = .08), the infant mortality was at the .01 level (g = .18), and indicated a 2-year cycle.

This project supports the value of examining mortality time series of adults and subadults separately. It also indicates that cycles of mortality might be found in some subgroups, but not in others within the same settlement. Finally, the fact that 3 out of 4 series did not show any cycles points out that cycles of mortality might not be as ubiquitous in agricultural populations as is generally thought.

Direct three dimensional morphometric analysis of calcanei of some catarrhines.

M. Maga. University of Texas at Austin, Dept. of Anthropology, Austin, TX, 78703, USA.

The goal of this study is to examine the external morphology of the calcaneus in humans, chimpanzees, gorillas and baboons using 3D data acquisition tools such as laser and photographic scanning. The scaling of the calcaneal tuber volume, which is defined to be the volume of bone between the most posterior point on the medial talar articular surface and the very posterior point on calcaneal tuberosity itself, is discussed.

When the raw volume data is regressed against the geomean of linear variables taken from calcaneus, the initial results suggest slightly positively allometric scaling among humans (n = 15, mean = 47.18cm^3), chimpanzees (n = 9, mean = 13.91cm^3), gorillas (n = 11, mean = 32.41cm^3), and baboons (n = 21, mean = 4.11cm^3). However, if humans are left out, the scaling relationship among non-human primates includes isometry in its 95% confidence interval. These results are slightly higher for non-human primates than previously published in literature.

Using 3D modeling software, stacks of coronal slices are extracted from each specimen and their cross sectional areas are calculated. To be able to make interspecific comparisons, areas are converted into an index by dividing the cross sectional area of each slice from one individual by the maximum cross sectional area observed in that specimen. The change of this index is plotted against the length of calcaneus. According to the initial results, there may be different pattern in these plots for humans, chimpanzees, and gorillas. If a consistent difference can be obtained from higher number of samples, this index can also be used for distinguishing locomotor behavior in fossil taxa.

Intertooth and intrafacet dental microwear variation in archaeological humans: implications for dietary research.

P. Mahoney. University of Sheffield, Sheffield, England, S1 4DT, UK.

Dental microwear research is increasingly used to investigate the diet of archaeological humans. Yet the effect of some non-dietary variables on human microwear patterns is still poorly understood and this could undermine dietary inference. The present study investigated two of these variables in archaeological humans: microwear patterns were compared between molar types (intertooth) and between the top and bottom of facet 9 (intrafacet).

Dental casts of the 1st, 2nd and 3rd mandibular molars were taken from 8 age-matched (18-28 yrs) individuals from the Late Bronze-Early Iron Age archaeological site of Tell es-Sa'idiyeh, Jordan. The impressions were examined with a scanning electron microscope at 500x.

Three microwear features were significantly influenced by either molar type or location on the facet: 1) Scratch length decreased from the 1st to the 3rd molar; 2) The percentage of pits increased; 3) The number of pits increased at the bottom of the facet on the 1st molar.

These results indicate that two non-dietary variables affect microwear patterns in archaeological humans. Jaw movement and bite force during mastication, together with variations in enamel thickness and microstructure may contribute to these patterns. The results also show that there is a need for standardisation when selecting a molar

and a location upon facet 9 for investigation into the diet of past human populations.

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Investigating the spread of the Uto-Aztecan language family and maize cultivation in North America using mtDNA.

R. Malhi, D. Smith. Dept. of Anthropology, University of California, Davis, Davis, CA, 95616, USA.

Recent linguistic and archaeological studies suggest that the spread of the Uto-Aztecan language family was the result of a population expansion associated with the innovation of maize cultivation in Central Mexico. In order to investigate the existence and nature of this population expansion, this study analyzed the distribution of mtDNA haplogroups and variation in Control Region sequences among Native American populations in the Great Basin, U.S. Southwest, and Central Mexico. The results of this study suggest that the spread of the Uto-Aztecan language family and maize cultivation in North America were not caused by a demic diffusion like process. Additional analysis of nuclear DNA polymorphisms, however, suggests that this cultural spread was facilitated by a predominantly male migration.

Play behavior in infant western lowland gorillas at the Lincoln Park Zoo.

S. Mallavarapu. Dept. of Zoology, Southern Illinois University, Carbondale, IL, 62901-4502, USA.

To successfully maintain captive populations of lowland gorillas, zoological parks must ensure that the animals are exhibiting normal behavioral patterns. These patterns can be monitored by studying play behavior in infants. Play has been considered as a strong indicator of normal development. An ethological investigation was made on a group of western lowland gorillas (*Gorilla gorilla gorilla*) at the Lincoln Park Zoo, Chicago. Focal animal sampling and all-occurrences sampling were used to collect data during June and July 2000.

The primary focus of this study was on play behavior in five infant western lowland gorillas. Play was categorized into three types: solitary play, social play, and mother-infant play. In my study group, age and gender had no influence on the percentage of time spent by each individual in these three play categories. All of the infants spent most of their time engaged in solitary play and social play. Mother-infant play was found to be almost non-existent by the time an infant reached two years of age. Social play peaked during the early afternoon and consisted mainly of contact play. Infants spent a greater amount of time engaged in object play, as compared to locomotor and self-directed play. No significant differences were evident in the play behavior of infants raised by a surrogate as compared to that of infants reared by a natural mother.

The results support past research and indicate that infant gorillas thrive in appropriate captive conditions. Using experienced surrogate mothers is effective in integrating infants into pre-established groups.

The Samnites of Alfedena Iron age burials: an assessment of inter-personal cranial trauma.

D. Mancinelli[1], R.R. Paine[2], M. Ruggieri[3], A. Coppa[4]. [1]Dipartimento di Scienze Ambientali, University of L'Aquila, L'Aquila, Abruzzo, 67100, Italy, [2]Dept of Sociology, Anthropology & SW, Texas Tech University, Lubbock, TX, 74910, USA, [3]Soprintendenza Archeologica dell'Abruzzo, Chieti, Italy, [4]University of Rome, Rome, 185, Italy.

The Samnites of Alfedena Iron Age skeletal population (6th & 5th centuries B.C.) excavated during the 1973-74 field seasons from the Abruzzi region of Italy was first examined for cranial trauma in 1981 by Macchiarelli et al. They found four cases with cranial trauma specific to inter-personal conflict. This well documented Italian population was recently reexamined for cranial & post-cranial trauma. Of the 95 individuals examined (87 skulls), 18 adult individuals (18.9%) exhibited intentional trauma, 12 (13.8%) of them have cranial injuries. Our findings suggest that inter-personal conflict had been grossly under-estimated for Alfedena (1981). A break down of cranial trauma by sex shows 18% of the males and 4% of the females suffered intentional trauma, resulting in ante-mortem healing, or perimortem injury and death. Our findings under-score the violent circumstances experienced during the Iron Age protohistory of Italy, a period of time characterized by considerable population growth related to improved agricultural practices. Males were more likely to exhibit cranial trauma than females, suggesting that external social pressure for resources was considerable.

We compared this material to a second population consisting of 108 individuals also from the Alfedena necropolis. This material had been excavated during the late 19th and early 20th centuries and had not been examined for trauma prior to our research. In this second collection we found an additional 14 intentional, interpersonal injuries, 12 of them to the cranium, representing 12.9 % of this segment of the population. In summary, of the 195 skulls examined, 26 individuals (13.3 % of them) exhibit cranial trauma.

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Mode and tempo of the hominid pelvis evolution.

F. Marchal. Laboratoire d'Anthropologie des Populations du Passé, UMR 5809 CNRS Université Bordeaux 1, Avenue des Facultés, 33405 TALENCE CEDEX FRANCE.

A synthesis of a large study about the hominid pelvis is presented here. In this study, a morphological approach was combined with a new morphometrical analysis. Almost 450 pelvic bones from extant humans and African apes, both immature and adult, have been studied to set the comparative framework of this analysis.

It seems that we can distinguish two main architectural pelvic patterns: the ape one and the hominid one. The last common ancestor of these two lineages probably exhibited the ape pattern. The split between these two patterns is very likely to correspond to something different from heterochronies. Within the hominid pattern, we can delineate quite important differences between two sub-patterns: the australopithecine on one hand, and the Homo on the other hand. The latter emerged at least two million years ago and remained fundamentally unchanged for two million years. The emergence of modern human showed a new variant of this sub-pattern. The dichotomic and hierarchic story of this major component of the locomotor skeleton does not fit the current taxonomic attributions of known hominids, which raises several fundamental questions deserving further studies.

Percussive technology: wild chimpanzees pound open baobab fruits.

L. Marchant, W. McGrew. Dept. of Anthropology, Miami University, Oxford, OH, 45056, USA.

Wild chimpanzees (*Pan troglodytes*) from Senegal to Tanzania use anvils of stone or wood to smash open hard-shelled fruits, e.g. *Strychnos* spp. Wild chimpanzees from Ivory Coast westwards use hammers and anvils of stone or wood to crack open nuts, e.g. *Elaeis guineensis*. Chimpanzees elsewhere in Africa do not crack nuts, even when these species and the appropriate raw materials are available. This behavioral variation suggests cultural diversity in percussive food processing.

We report new data from Mt. Assirik, Senegal, on the use of elementary technology to process the fruit of the baobab tree (*Adansonia digitata*). The methods were archaeological, as the field season in the spring of 2000 followed the season of consumption, so that only food remnants and stones were available. We "excavated" four baobab tree

processing sites, where we counted, weighed and measured hundreds of stones and fruits, and noted their spatial relations. Using these indirect measures, we compared two hypotheses: Both hammers and anvils were used, versus, only anvils were used.

Data were analyzed in terms of the relative location of smashed-open fruits to stones of various sizes and conditions (e.g. portable vs. embedded). For example, within a 10 m. radius of the tree's trunk, stones are randomly distributed, but smashed fruits are non-randomly distributed relative to stones. Fruits processed without percussive technology, by Guinea baboons (*Papio papio*), served as controls. Results indicate that processing was by anvil alone, rather than by hammer-and-anvil.

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Were Neanderthals full of of "NO" gas? The relationship between paranasal sinus morphology and nitric oxide production.

S. Marquez[1], P.J. Gannon[2], W. Lawson[2], J.S. Reidenberg[1], J.T. Laitman[1]. [1]Center of Anatomy and Functional Morphology, Mount Sinai School of Medicine, New York, NY, 10029, USA, [2]Dept. of Otolaryngology, Mount Sinai School of Medicine.

The anatomy and function of the Neanderthal upper respiratory tract (URT) has been a topic of great interest, particularly as a possible window on their lifestyles. Neanderthal paranasal sinuses (pns) have been described as expansive although the precise reasons for this are not well understood. However, the pns are the prime site for production of nitric oxide (NO), a gas with neurotransmitter-like functions. In the URT, NO exerts functions on ciliary activity, gland stimulation, and acts as an aerocrine messenger between the upper and lower airways that selectively reverses hypoxic pulmonary vasoconstriction without causing systemic vasodilation. NO also functions in host defense (Fliegelman, Gannon, and Lawson, 1998) insuring sterility of the pns permitting mucus drainage through their ostia into the airflow pathway thus serving as a valuable adjunct in the air-conditioning process of humidification (Gannon et al., 1997).

This qualitative and quantitative study examined pns morphology via CT imaging in a multiregional sample of 125 human skulls and compared them to assessments of the nasal complex in archaic *Homo sapiens*. Modern groups exhibited population specific pns morphology with respect to ecogeographic localities. Notably, Neanderthal pns dimensions differed from European modern populations. This suggests that Neanderthal pns volumes may reflect a different clade trajectory, perhaps due to differing NO production rate and utilization.

We hypothesize that the idiosyncratically large size of Neanderthal pns is related to greater production of NO. This sinonasal / aerocrine adaptation was selected to meet the critical cardiopulmonary system demands imposed by the vigorous lifestyle of Neanderthals.

Vertebrae numbers of the early hominid lumbar spine.

S. Martelli[1], M. Haüsler[2]. [1]Dept. of Anatomy and Developmental Biology, University College London, London, WCiE 6JJ, ENGLAND, [2]Anthropologisches Institut und Museum, Universitaet Zurich-Irchel.

Early hominids are generally said to have possessed six lumbar vertebrae, a view mainly based on Robinson's (1972) interpretation of the Sts 14 partial *Australopithecus africanus* skeleton from Sterkfontein, South Africa and reinforced by Walker and Leakey's (1993) description of KNM-WT 15000, an almost complete *Homo erectus* skeleton from Nariokotome, Kenya.

An argument against this hypothesis is that a modal number of six lumbar vertebrae in early hominids would require repetitive shortening and lengthening of the entire precaudal spine during evolution. Further, six lumbar vertebrae are claimed to be biomechanically advantageous for early hominid bipedalism, yet there is no explanation for lumbar shortening in later humans.

Our re-examination of these fossils could not confirm the presence of six lumbar vertebrae in any early hominid. Particularly the discovery of a partial rib articulating with the sixth last presacral vertebra of Sts 14 that is clearly unlike a lumbar rib, the morphology of the *processus spinosi* and *facies articulares*, and the discovery of a fragmentary rib facet on the sixth last presacral vertebra of Stw 431, another partial *A. africanus* skeleton from Sterkfontein, all suggest that these vertebrae are the last thoracics.

In KNM-WT 15000, the sequence of the morphologies of the lumbar vertebrae, especially of their *facies articulares* and *processus spinosi,* contradict Walker and Leakey's (1993) assumption that Th12 is missing. The simplest and most parsimonious interpretation is that the sixth last presacral vertebra represents Th12. All this provides strong support for the presence of only 5 lumbars in all hominids.

The old ladies of Black Mesa: a 900-year chronicle of diet and health recorded in bone and teeth.

D. Martin[1], J. Fan[2], M. Sanders[1], R. White[1]. [1]Hampshire College, Amherst, MA, 01002, USA, [2]University of Massachusetts/Amherst.

An impressive wealth of data exists for many aspects of diet and health for Native Americans living on the Hopi Reservation. More importantly, this is one area of the U.S. where indigenous people have continuously inhabited a single region for over a thousand years. For the last 20 years a large archaeological collection of ancestral Hopi skeletons from Black Mesa have been extensively examined. In addition, we have begun working with collaborators from the Hopi Nation to collate current data on diet and health in order to build a 1000-year chronology. This multidisciplinary approach for integrating health from precontact to contemporary times is useful for understanding the impact and human cost of changes in diet, disease, and resources to different segments of the population over time. It also serves to highlight the usefulness of data derived from ancestral remains to communities today. This report focuses on elderly women as a group that is vulnerable. Using skeletal and dental data derived from observation and measurement, radiography, bone densitometry, microscopy and biochemical assay, a profile of health is reconstructed from ancient times to modern. The data reveal that when comparing age-at-death, frequencies of pathology, stature, bone density, occupational stress markers, information on reproduction, diet and disease, there remains a consistent pattern of relatively good health unbroken by massive changes in political-economic and cultural processes. These data suggest that simplistic models correlating dietary and cultural change with declines in health need to be challenged and tested with data sets that can examine health before, during and after these significant changes.

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Bone remodeling in the Atapuerca-SH Mandibles: implications for growth pattern in Middle Pleistocene hominids: a preliminary report.

C. Martínez Maza, A. Rosas. Atapuerca Research Team, Museo Nacional de Ciencias Naturales, Madrid, Spain, Madrid, Madrid, 28006, Spain.

In spite of the growing interest in craniofacial morphogenesis, investigation on patterns and processes of bone remodeling in fossil hominids [Bromage, T. 1987 1: 607-

613] scanning microscopy is still under-developed.

In this study we present preliminary results on the mapping of bone remodeling in the *H. heidelbergensis* Atapuerca-SH mandibles (Middle Pleistocene) using ESM. A comparative sample of modern humans (known sex, Coimbra University) was employed for comparisons. We focus our interest in the study of the anterior aspect of the mandibular symphysis, and explored the microanatomy of this region in order to characterize the histological basis of morphological variability. A precise characterization of remodeling reversals, resting areas, and, when possible, timing of activity, is presented.

This paper addresses the question of whether the appearance of evolutionary novelties at the symphysis (e.g. incurvatio mandibulae and mentum osseum) in different lineages (e.g. *H. sapiens* and *H. heidelbergensis*) is a consequence of homologous morphogenetic processes.

In order to shed light on this problem, a model of field remodeling pattern and growth directions in the Atapuerca-SH mandibles was proposed on the basis of detailed analysis of size and shape. In this model, resorption at the anterior symphysis was related to size in such a way that the larger the mandible, the more developed appear those features generally associated with a chin. Morphology of the anterior symphysis seems to be associated with specific aspects of the direction and duration of the ontogenetic trajectory of the mandible. Both, European Middle Pleistocene hominids and modern humans seem to share some specific growth processes.

Phylogeographic patterns of mtDNA reflect the population history of Puerto Rico.

J. Martínez-Cruzado, G. Toro-Labrador, J. Viera-Vera, M. Rivera-Vega, J. Startek, M. LaTorre-Esteves, A. Román-Colón, R. Rivera-Torres, I.Y. Navarro-Millán, E. Gómez-Sánchez. Dept. of Biology, University of Puerto Rico at Mayagüez, Mayagüez, PR 00680.

We aim to contribute to our knowledge on the population history of Puerto Rico by estimating the maternal genetic contribution of Africans, Caucasians and Amerindians to Puerto Ricans. This is accomplished by means of RFLP-haplogroup identification of mtDNAs obtained from a sample representative of Puerto Rico. Partial results obtained from 787 out of 804 randomly selected individuals show a predominance of Amerindian mtDNAs (61.4%) and substantial amounts of sub-Saharan African (26.8%) and Caucasian (11.8%) mtDNAs. This suggests that the migration of women to Puerto Rico at any time after the Spanish colonization has always been low relative to the amount of local women, and that women arriving from sub-Saharan Africa more than doubled the Caucasians. Geographic distribution analysis shows that sub-Saharan African mtDNAs are concentrated mostly in the eastern half of the island, especially in or close to the metropolitan area of San Juan. Information obtained from interviewing the participants will lead to a similar analysis on the geographic distribution that existed in the first half of the 20th century. Haplogroup distribution analysis shows that West Africa was the main source of Africans. Furthermore, it shows that 88% of the native Taínos belonged to haplogroups A or C. Despite the confirmed presence of haplogroup D in pre-Columbian Taínos of the Hispaniola, this haplogroup was virtually non-existent among Puerto Rican Taínos. MtDNAs belonging to Caucasian superhaplogroups H-V, J-T, and U-K were found in approximately equal amounts. Canarian and North African Berber sequence haplotypes were frequent among Caucasian mtDNAs.

Structure-based prediction of joint motion.

T. Masterson[1], P. Loubert[2], A. Saltarelli[1]. [1]School of Health Sciences, Central Michigan University, Mt. Pleasant, MI, 48859, USA, [2]School of Rehabilitation and Medical Sciences, Central Michigan University.

This study tests the relationship between structure and function as predicted by the theory of arthrokinematics. 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. Range of motion values were measured on 21 joints from three different human cadavers. Specimens are transected with a ban saw 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. An additional correlation is made using published range of motion data for humans. Our results demonstrate a moderate correlation between the observed and structurally predicted range of motion ($r = 0.74$), as well as between published range of motion values and structurally predicted range of motion ($r = 0.76$). Several kinematic relationships were observed between articular surfaces during movement that suggest additional considerations that must be taken into account in order to achieve a higher correlation between joint structure and function. The relationship tested in this study may 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.

Health in predynastic Egypt: using skeletal stress markers to assess the overall health of a working class population in Hierakonpolis.

J. Matovich. University of Alaska Fairbanks, Fairbanks, AK, 99709, USA.

Hierakonpolis is located near the Nile river, 650 kilometers south of Cairo. It is one of the largest Predynastic sites known in Egypt, and is considered to be one of its first capitals. In February 2001, an assessment of health and diet based on skeletal stress markers was undertaken on 52 skeletons representing the working class inhabitants of Hierakonpolis. The following characteristics were examined: linear enamel hypoplasia (LEH), porotic hyperostosis (PH), cribra orbitalia (CO), pathology, trauma, dental caries, degenerative joint disease (DJD), degenerative disc disease (DDD), and other pathologies. This sample showed mild to moderate frequencies of PH, CO, dental caries, and calculus deposits; characteristics that are consistent with a grain-dependent diet. LEH was observed on 12 individuals, including two that also exhibited bowing of the femora, tibiae and fibulae. Most adults showed mild to moderate DJD and DDD, reflecting lifetimes of hard, physical labor. Frequencies of spina bifida occulta, dental abscesses and periodontal disease were also observed. Interestingly, the rest of these people appear to be young adults and in good health. Whatever caused their death is not immediately apparent from their skeletal remains. This important question merits further study.

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Dental morphology and biological affiliation: a population study.

L. Matzke[1], C. Strong[2]. [1]University of British Columbia, North Vancouver, British Columbia, V7M 2E3, Canada, [2]University of Toronto.

The assessment of dental morphological variation is a major aspect of the study of human dentition. Forensic anthropologists often use dental traits as a means of determining the racial affiliations of an individual. This study was conducted on a sub-set population of 78 individuals interred from 1830-1930 in Irish Catholic cemetery on grounds now owned by the Pearson International Airport

in Mississauga, Ontario, Canada. Archaeological Services Inc. from May through August 2001 excavated the skeletons, totaling 629, for relocation. Using the Arizona State University Dental Anthropology System, this study assesses the morphology of 15 dental traits: winging, shoveling, double shoveling, canine distal accessory ridge, metacone, tuberculum dentale, upper molar cusp 5, Carabelli's cusp, parastyle, enamel extension, lower molar cusp number, protostylid, lower molar cusp 5, cusp 6, cusp 7. The frequencies of these traits within this population demonstrate that a presence/absence approach for the purposes of racial determination is of little use in forensic contexts. Using these conventional dental traits, our data suggest that only through a standardized assessment of the degree of expression of multiple dental traits can one make useful assessments of racial affiliations.

Patterns through time: a comparison of dental pathology between the Late Woodland, Illinois Bluff burial mounds to Spiro Mounds, Oklahoma, based on changes in subsistence economy.

A.T. Mayes. University of Colorado, Boulder, Boulder, Colorado, 80301, USA.

The effects on health and nutrition from a change in subsistence economy are explored using dental evidence. What are the biological consequences of dramatic change in subsistence from a reliance on local flora and fauna, to a reliance on maize crop agriculture?

Material culture in the Illinois Valley indicates a transition to the Bluff phase in the late Late Woodland (600 AD). Observations include an increase in habitation sites, a change in land use, and the use of burial mounds. According to the archaeological data, this parallels the introduction/intensification of maize agriculture. (Conner 1984:81) Comparisons will be made with Spiro Mounds, Oklahoma, a population that overlaps and is later than Illinois Bluff temporally, who were living through a transition period, exploiting more local resources than Illinois Bluff.

Dental pathology from Illinois Bluff is severe compared to that of Spiro Mounds with a high incidence of dental pathology such as enamel hypoplasias (81%), compared to Spiro Mounds (45%), as well as Goodman's data on Late Woodland Dickson Mound (45%), and Acculturated Late Woodland Dickson Mound (60%). Interestingly, it parallels that of Middle Mississippian Dickson Mound (80%).

While an increase in dental pathology due to an increase in maize agriculture was expected, the degree to which it exhibited was not. Differences in environment and social structure will be discussed.

Logic processing of expert knowledge: a formal alternative to quantitative approaches to sex and age estimation.

D.G. McBride, R.A. Benfer, Jr., N.L. Furbee. Dept. of Anthropology, University of Missouri, Columbia, MO, 65211, USA.

Estimation of sex and age are important first steps in any forensic case. Although multivariate, quantitative approaches have been available since the 1930s, new methods based on rigorous application of rules are more recent. Among the new approaches are inductive (data mining) development of tree-like classification algorithms and deductive (first order predicate calculus) production-rules. The first method permits probabilistic classifications to be developed from existing cases of known sex and age. The method guarantees that a subset of indicators, often all that is available in a forensic case, will be applied in an optimal order. We present strengths and weaknesses of this method using a sample of ossa coxarum from the Terry Collection.

Deductive methods permit development of rules that mimic an expert's process and performance in classification. Three experts were interviewed in order to learn the features and methods they used to assess sex and age from the os coxae. The Exsys expert system shell uses Bayesian logic to combine information from a number of possibly contradictory anatomical features as accurately and flexibly as a human expert. We present a comparison and discussion of three intelligent systems from experts with extensive experience in forensics and bioarchaeology. We argue that inductive and deductive methods are useful in teaching how experts classify, and in developing systems that hold several advantages over traditional quantitative ones, particularly the ability to combine available indicators from incomplete skeletal material and provide exception handling for incongruous data.

Soft tissue constraints on basicranial flexion and length.

R. McCarthy[1], D. Strait[2], C. Kirk[3]. [1]Doctoral Program in Hominid Paleobiology, The George Washington University, Washington, DC, 20052, USA, [2]Dept. of Anatomy, New York College of Osteopathic Medicine, [3]Dept. of Biological Anthropology and Anatomy, Duke University.

Basicranial flexion in *Homo sapiens* and other primate species is most likely an adaptation to fit the brain into a limited neurocranial space. This "spatial packing" hypothesis interprets basicranial flexion as a response to evolutionary increases in brain size. However, recent studies suggest that reductions in basicranial length are more important for the evolution of basicranial flexion than are increases in brain size. To test this hypothesis, it is necessary to determine if soft tissues adjacent to the midline base constrain its length at larger sizes, irrespective of increases in total brain size.

This study uses regression analysis and phylogenetically independent contrasts to test the influence of soft tissues on basicranial length in haplorhine and strepsirrhine primates. Volumes for the brain, frontal and temporal lobes, non-cortical brain, cerebellum, neocortex, olfactory bulb and eyeballs were collected from the literature, museum specimens and MRI scans. Basicranial flexion and length were measured from radiographs and CT scans.

The brainstem and temporal lobes scale with isometry relative to one or more parts of the midline basicranium, whereas other soft tissues including the eyeballs, olfactory bulb and neocortex do not. In other words, contact between specific areas of the brain and the midline basicranium is more likely a constraint on basicranial length than is contact with other soft tissues, or with the entire brain. Therefore, allometric scaling of *parts* of the brain, but not the entire brain, may promote basicranial flexion by intensifying the spatial packing problem in large-brained primates.

Functional morphology of the metacarpophalangeal joints of *Kenyapithecus* and *Australopithecus* : Implications for the adaptive history of locomotion among African apes and humans.

M. McCrossin. New Mexico State University, Las Cruces, NM, 88003-8001, U.S.A.

Recently, there has been much interest in the question of whether humans passed through a knuckle-walking stage but little fossil evidence to determine if this mode of locomotion was present in human ancestry. Strong dorsal transverse ridges on the distal ends of metacarpals II-V of *Pan* and *Gorilla* (preventing hyperextension at the metacarpophalangeal joint) are unique to knuckle-walkers, and serve therefore as indicators of this locomotor pattern in fossil taxa. However, moderately developed transverse dorsal ridges are sometimes present in terrestrial papionins. Hence, the presence of a dorsal ridge may be indicative of digitigrade hand postures, including both the dorsal digitigrady of knuckle-walking apes and the palmar digitigrady of terrestrially adapted cercopithecoids.

Metacarpals of *Kenyapithecus* and *Australopithecus* afford an opportunity to determine whether the dorsal ridge was present and, if so, whether it was developed

to the degree seen in knuckle-walkers or terrestrial cercopithecoids. A metacarpal of *Kenyapithecus* has a strong transverse dorsal ridge. I assessed metacarpal torus salience by indexing the dorsopalmar diameter of the third metacarpal at the torus versus the dorsopalmar diameter of the articular portion of the metacarpophalangeal joint. Gorillas and chimpanzees have higher values for this index than any other primates. *Kenyapithecus* falls within the range of African apes, indicating that its metacarpal torus helped to resist excessive dorsiflexion at the metacarpophalangeal joint during knuckle-walking. Metacarpals of *Australopithecus*, in contrast, lack dorsal ridges.

This evidence indicates that the last common ancestor of African apes was a knuckle-walker. Knuckle-walking adaptations were not retained, however, by *Australopithecus*.

Anatomical comparison of male orangutans and gorillas.

R. McFarland[1], J. Gurche[2], A. Zihlman[3]. [1]Cabrillo College, Santa Cruz, CA, 95060, USA, [2]Denver Museum of Nature and Science, [3]University of California, Santa Cruz, Santa Cruz, CA, 95060, USA.

Orangutans and gorillas are large-bodied apes that differ in ecology, locomotion, and diet. We completely dissected, measured, and weighed tissue (muscle, bone, skin, fat) of an adult Bornean male orangutan and four adult male lowland gorillas. For each animal we determined the distribution of body mass to body segments (including the head), tissue composition, and skeletal dimensions. Body proportions reflect the locomotor pattern of each species. For example, orangutan forelimbs (19.8% of total body mass) are heavier than hindlimbs (17.7%), emphasizing the power of the forelimbs. In contrast, gorilla hindlimbs (18.1% total body mass) are heavier than forelimbs (15.6%). Analysis of hands and feet further highlights locomotor differences. Orangutan hands and feet are more massive compared to those of gorillas; the orangutan foot is 1/3 the length of the entire hindlimb and comprises 16.4% of hindlimb mass. In gorillas the foot is only 10.5% of hindlimb mass.

Both ape species are significantly sexually dimorphic, particularly in head anatomy. Head tissues of males and females express a different pattern in each species. For example, the mature male orangutan has pronounced cheek pads comprising over 1/3 of head mass and equal in width to biacromial breadth. Platysma fans out into the fat pad, raising the question of pad mobility. Contrasting to the male orangutan, the male gorilla's distinctive dome-shaped head is due to build-up of connective tissue in the sagittal and nuchal regions rather than in the face. These anatomical findings contribute to interpreting the behavioral ecology of male orangutans and gorillas.

Stable isotope composition in *Propithecus diadema edwardsi* from Talatakely and Vatoharanana in Ranomafana National Park, Madagascar.

E. McGee[1], S. Vaughn[1], P. Wright[2]. [1]San Jose State University, San Jose, CA, 95192-0100, USA, [2]State University of New York, Stony Brook.

Although now protected, select areas in Ranomafana National Park (RNP) experienced substantial habitat modification due to logging in 1986 and 1987. The harvesting of old growth trees is presumed to have altered energy/nutrient cycling in local ecosystems, although how and to what extent is not fully understood. It is suggested that changes in energy/nutrient cycling due to habitat modification are reflected in the isotopic composition of primate hair to the extent that these changes impact diet and habitat use.

We compared the carbon stable isotope ($\partial^{13}C$) and nitrogen stable isotope ($\partial^{15}N$) composition of hair obtained in November 2000 from 12 individuals of *Propithecus diadema edwardsi* from Talatakely (secondary forest) with 8 individuals of the same species from Vatoharanana (primary forest) in RNP. Average $\partial^{13}C$ in *P. diadema edwardsi* from Talatakely was –23.4‰ (± 0.2); average $\partial^{15}N$ was 2.1‰ (± 0.2). Average $\partial^{13}C$ in *P. diadema edwardsi* from Vatoharanana was –23‰ (± 0.1); average $\partial^{15}N$ was 3.3‰ (± 0.2). Differences in stable carbon and nitrogen isotope composition of *P. diadema edwardsi* from Talatakely and Vatoharanana may reflect approximately a half step diffference in trophic level. The low variance in stable isotope composition of both groups suggests homogeneity within each group in diet and habitat use.

Experimental evidence for the effects of reduced ground predator pressure on the habitat use of arboreal monkeys in the Tai Forest, Ivory Coast.

W. McGraw, R. Bshary. Dept. of Anthropology, Ohio State University, Mansfield, Ohio, 44906, USA.

It is widely believed that predation is a major selective force in primate evolution. Despite its importance, demonstrating that primates ultimately behave to limit predation risk is difficult and most evidence consists of theoretical models, indirect tests and anecdotes. Assessing the proximate effects of predator pressure is more feasible. Here we examine the influence of predation risk on the habitat use of two arboreal monkeys - *Procolobus badius* and *Cercopithecus diana* - in the presence of a third, terrestrial species - the sooty mangabey (*Cercocebus atys*).

We predict that mangabeys are the best watchmen for ground predators. To evaluate their ability to detect ground predators, an observer disguised as a leopard approached mangabey groups that were intermingled with other cercopithecids. In each experiment we recorded the species present, the species that alarmed first and distance from the observer of the alarming species. We then examined strata use of diana and red colobus in the presence and absence of mangabeys.

Mangabeys alarmed to the approaching predator first more than any other monkey. Mangabeys also alarmed at greater distances from the observer. When co-mingled with mangabeys, red colobus and diana monkeys were observed significantly more at low forest levels and on the ground. We conclude that (1) mangabeys are the best detectors of ground predators, (2) red colobus and diana monkeys significantly alter their habitat use with mangabeys present, (3) the shift in habitat use is related to the presumed reduction in ground predator pressure afforded by the presence of mangabeys.

Ethno-archaeology of unhabituated chimpanzees at Mont Assirik, Senegal, West Africa.

W. McGrew[1], P. Baldwin[2], L. Marchant [3], J. Pruetz[4], S. Scott[5], C. Tutin[6]. [1]Depts. of Anthropology & Zoology, Miami University (Ohio), Oxford, OH, 45056, USA, [2]Dept. of Psychology, University of Stirling, [3]Dept. of Anthropology, Miami University (Ohio), [4]Dept. of Anthropology, Iowa State University, [5]Dept. of Zoology, Miami University (Ohio), [6]Dept. of Biological & Molecular Sciences, University of Stirling, Scotland.

The savanna-dwelling chimpanzees (*Pan troglodytes verus*) of Assirik, Senegal, make and use tools, but they are not (yet) observable at close range. Thus, their elementary technology is amenable only to entho-archaeological study, in which indirect data on artifacts and fecal contents add to sparse behavioral records.

These wide-ranging apes show 15 behavioral patterns that appear to be material culture, in the sense of learned behavioral diversity (Whiten et al., 1999, Nature, 399:682-85). Their technological repertoire can be split into subsistence (N = 7, food pound, termite fish, ant dip, ant peel, ant fish, fluid dip, water dig), social (N = 5, buttress beat, branch clasp, branch shake, object throw, play start), and maintenance (N = 3, nest build, nest line, leap napkin).

These can be classed as customary, habitual or present, in terms of decreasing frequency. Some patterns, e.g. termite fishing

or baobab pounding, leave assemblages of hundreds of artifact in predictable contexts at enduring worksites. Other patterns, e.g. play start, are rare and ephemeral, and are (now) only anecdotal. Nevertheless, the proportions of the three-way functional classification are like those at study-sites with habituated subjects (cf. Whiten et al.'s 1999, overall sample from 6 other populations). Also, Assirk's small repertoire is only incompletely known, not impoverished, as indicated by the proportions of the 15 patterns that reach customary (N = 4), habitual (N = 8), and present (N = 3) status. These results indicate that systematic cross-cultural analyses can be extended to the ethnographic record of our closest relations.

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Comparing traditional craniometric and non-traditional landmark based methods for investigating cranial variation.

A.H. McKeown[1], R.L. Jantz[2]. [1]Jamestown Rediscovery, Jamestown, VA, 23081, USA, [2]University of Tennessee, Knoxville.

Investigations of variation in craniofacial morphology have traditionally employed linear measurements and angles for recording size and shape information. The advent of coordinate based methods for morphometric research has provided researchers with powerful new tools for such endeavors. By collecting landmark locations as Cartesian coordinates, size and shape variation in multiple dimensions can be captured and utilized in analysis, but does the additional information contained in the coordinate data truly enhance our interpretations of variation in craniofacial morphology? This paper compares the various aspects of analyses employing coordinate landmark data and geometric morphometry to their traditional craniometric counterparts.

The distinct differences in data collection protocols and methods for missing data estimation are considered as are issues surrounding the partitioning of the form into its size and shape constituents. Direct comparisons of analytical results and interpretations for the different approaches are addressed employing craniometric and coordinate data sets observed on crania from components of the Extended and Post-contact Variants of the Coalescent Tradition of the Great Plains. Similar statistical methods achieve relatively comparable results; however, the visual presentation of shape differences permitted by coordinated based methods appears to be more informative. Comparison of the craniometric and coordinate based analyses of the same samples allows for an exploration of the benefits and drawbacks of each method.

Forensic Anthropology Symposium: Introduction.

L. Meadows Jantz. Dept. of Anthropology, University of Tennessee, Knoxville, TN, 37996, USA.

The field of forensic anthropology is often considered an applied one. However, due to the very nature of forensic anthropology, that is the personal identification of human remains, ongoing research is critical for success of our endeavors in the medicolegal arena. As early as the end of the 19th century, physical anthropologists were conducting research and applying new methods to personal identification. Dwight was studying stature as well as sexing methods, while Todd continued into the first part of the 20th century with his work on the pubic symphysis age methods. Going into the 21st century, new technology has allowed us to develop methodology that improves our ability to more accurately assess skeletal remains. Our research on secular change in skeletal dimensions indicates how much the population has changed since the early research was conducted. Re-evaluation of existing methods as well as the development of new methods is necessary. Application of broader statistical treatments to current problems is providing forensic anthropologists with more powerful tools. The papers presented here are only a sample of the research that is being done in the field. They illustrate that forensic anthropology has moved beyond case studies to develop its own theoretical and methodological approaches, which contribute, in turn, to skeletal biology and biological anthropology in general.

Overcoming biases in the paleodemographic record: estimating adult skeletal age and population growth, with an example from the Archaic of the eastern woodlands.

R. Meindl[1], R. Mensforth[2], H. York[3]. [1]Dept. of Anthropology, Kent State University, Kent, OH, 44242-0001, USA, [2]Dept. of Anthropology, Cleveland State University, [3]School of Biomedical Sciences, Kent State University.

(1) A problem in paleodemography is that for any given prehistoric cemetery, each of a continuum of stable populations could have filled it with exactly the same age proportions. When the assumption of stationary population size (*i.e.*, r = 0) is imposed on an extinct population which in fact had been growing during the occupation of the site, life expectancy is underestimated, sometimes by a great margin. (2) There is a lesser problem, which is osteological and involves bias in the direct estimation of adult skeletal age. Whenever traditional bony sites play a large role in skeletal aging there is a tendency to under-estimate the age of the cemetery's oldest decedents.

An analysis of the 4500 year-old hunter-gatherer-fisher population of the Ward site of Kentucky (15McL11) is an attempt to address these two biases. Traditional methods of age estimation for children and adolescents produced the base of the cemetery age pyramid. To address the second bias adults were aged using only the auricular surface of the ilium. Ethnographic anthropology has provided surveys of the total fertility of women from hunter-gatherer and horticultural populations of Africa, Australia, and South America. To confront the problem of unknown growth rates, these fertilities have been used to complete the paleodemographic reconstruction (mortality and growth) of the Late Archaic population of this study.

Midtarsal flexibility, footprints, and the evolution of bipedalism.

J. Meldrum. Idaho State University, Pocatello, ID, 83209-8007, USA.

Midtarsal flexibility of the chimpanzee foot contrasts with the comparatively rigid platform of the human foot. The "midtarsal break" permits the independent functions of the grasping forefoot and levering hindfoot during climbing. After the transition to bipedalism, this grasp-climb adaptation was lost, increasing mechanical advantage of ankle plantarflexors and efficiency and economy of distance walk/running.

Ape, human, and Plio-Pleistocene hominid footprints were examined for indications of a midtarsal break. The human footprint reflects its rigid-platform architecture. Pressure releases occur at typical points, especially behind the ball and hallux. Comparisons with chimpanzee footprints are complicated by the abducted position of the hallux and distinctive mode of facultative bipedalism. Reexamination of stereophotos and casts from the 1978 Laetoli footprint excavation confirmed indications of midtarsal flexibility. Few foot skeletons or footprints of Pleistocene hominids are known prior to Neandertals. The Terra Amata footprint (ca. 400 kya) remains to be published, but may exhibit midtarsal flexibility.

Footprints of an alleged North American ape exhibit a midtarsal pressure ridge and other indicators of midfoot flexibility. Examination of high resolution images of the feet of the subject of the disputed Patterson-Gimlin film footage, correlate with the inferred kinematics of the footprints, in that a midtarsal break is evident. Additional examples reiterate the consistent presence of this feature. The evaluation of these data,

controversial though they remain, provides a fresh perspective for the evaluation and discussion of the pattern and timing of the emergence of the distinctive features of modern human bipedalism.

Effect of ecological conditions on the daily activity budget of adult male mantled howler monkeys (*Alouatta palliata*) living in a forest fragment at Bocas del Toro Province, Republic of Panama.

K. Meltz. Dept. of Anthropology, Northwestern University, St. Louis, MO, 63119, *USA*.

As tropical rainforests continue to be destroyed primatologists are focusing a great deal of attention on primate ecology. Although mantled howler monkeys (*Alouatta palliata*) have been extensively studied in undisturbed areas, there is relatively little information on these primates in forest fragment habitats. This study examines the foraging behavior and activity budgets of mantled howler monkeys living in a forest fragment on Isla Colon, Bocas del Toro Province, Panama. Focal animal surveys were used to study the feeding, ranging, and behavioral patterns of four adult male howlers in one of the troops within the forest. These data were compared to K. Milton's (1980) data from Barro Colorado Island, Panama.

Howler monkeys of this study were more active than those of Milton's study, spending more time traveling (16.9% vs. 10.2% of total time) and less time resting (59.2% vs. 65.5%). Howlers in the present study consumed more foliage, with leaves accounting for 66.20% of total feeding time as compared to 53.4% in Milton's study. In addition, the howler monkeys in this study expend more energy per day than Milton et al.'s (1979) subjects (430 kilocalories per day versus 428 kilocalories per day). The results are surprising in that the Bocas del Toro sample has a lower diet quality, and yet has higher activity and energy expenditure levels than the Barro Colorado sample. These differences appear to reflect the ecological effects of forest fragmentation, such as increased biomass per unit area and resource availability.

Age, sex, and race-related patterns of skeletal osteomalacia in the Hamann-Todd Collection.

R. Mensforth. Dept. of Anthropology, Cleveland state University, Cleveland, Ohio 44115, Cleveland, Ohio, 44115, USA.

International health surveys show that skeletal deformities due to vitamin D deficiency are rare in adult humans. Though uncommon, reports from areas where osteomalacia is endemic show that young adult women with repeated pregnancies are at greatest risk of acquiring pelvic deformities which, at parturition, result in high levels of infant/maternal mortality. In contrast, in industrialized societies osteomalacia is generally less common, less severe, and mainly occurs elderly women and men with marked osteopenia, low BMD values, and one or more J-Type osteoporosis fractures.

This study was initiated to explore prevalence and severity of vitamin D deficiency among Hamann-Todd Collection (HTC) adults from the early 20th century. The skeletons of 1,122 Black and White woman and men were examined for the presence/absence and skeletal distribution of osteomalcia-induced pseudofractures (PFS). Results show that PFS primarily affect bones of the axial skeleton where the sternum (89.3%) was the best indicator of osteomalacia, followed by the sacrum (25.4%), ribs (23%), vertebrae (22.1%), and os pubis (14.8%). The ischium (2.5%), coccyx (1.6%) and scapula (1.6) were least often affected. PFS frequencies exhibited statistically significant age/sex/race related associations. Sex/race comparisons show that intrinsic BMD differences determine the extent to which physiological osteomalacia will result in skeletal deformities (i.e., BM 1.7% < BF 6.4% < WM 9.8% < WF 30%). PFS frequencies were markedly age-progressive for all sex/race groups, and common among the elderly (+70 years: WF 61%, WM 31%, BF 35%, BM 5%). L2 QCT trabecular BMD data show that HTC individuals with osteomalacia often exhibited substantial osteopenia or frank osteoporosis at time of death.

New hominid distal humeral material from Sterkfontein, Swartkrans and Drimolen.

C. Menter, L.R. Berger. University of the Witwatersrand, Johannesburg, Gauteng, 2050, South Africa.

There is considerable difference of opinion with regard to the hominid distal humerus. A number of researchers have noted significant differences in the hominid distal humerus, while others have pointed out that the traits certain researchers have used to separate hominid distal humeri into both functional and/or taxonomic groups are widely variable. The traits referred to include the development of the anterior lateral trochlear crest, the shape of the humeral 'pillars', position of the lateral epicondyle in relation to the capitulum and the depth of the *zona conoidea* (capitulo-trochlear sulcus).

Recent finds in South Africa from both Sterkfontein, Swartkrans and Drimolen enlarge the previously known sample of hominid distal humeri. These finds include Stw 431c, Sts 2198a, DNH 32, SK 24600 and SKX 10924. We present here descriptions and the current taxonomic assessment of these specimens. In addition, the comparative hominoid sample studied of the traits listed above demonstrate that there is considerable variation in the hominoid distal humerus. As there are other elements comprising the Stw 431 upper limb some of these are referred to in the present study.

Spatial cognition and memory in a symbol-using chimpanzee.

C. Menzel, J. Kelley. Georgia State University, Decatur, GA, 30034, USA.

The ability to recall environmental features and past events in some detail is important in human thinking, planning and communication. Philosophers since the time of Aristotle have suggested that "memory proper" is a uniquely human trait. In this study, the author used an artificial language as a tool to study memory. A female common chimpanzee that already knew a large number of arbitrarily designated visual forms (lexigrams) watched as an experimenter hid an object in the woods outside her outdoor enclosure. After an imposed delay of up to 16 hours, the chimpanzee had an opportunity to interact indoors with a person who did not know whether a trial was being conducted, much less the type or location of the object. A keyboard in the indoor cage displayed 256 lexigrams. From Trial 1, the chimpanzee attracted the person's attention, touched the lexigram corresponding to the type of object hidden, went outdoors (if followed), and vocalized and pointed until the person found the object. The chimpanzee remembered whether the person who found the object subsequently removed it or replaced it. She retained lexical and spoken English cues of object type for extended delays. She retained televised cues of object location overnight. She could report object locations accurately by touching a 2-dimensional image of the woods. Bronowski's claim that all animals other than humans are imprisoned in the here-and-now is clearly mistaken.

Is Pastoralism a Pain in the . . . . ?: paleopathology in Early Neolithic Iran.

D.C. Merrett. Dept. of Anthropology, University of Manitoba, Winnipeg, Manitoba, R3T 5V5, Canada.

The transition to agricultural subsistence in the Near East is thought to be spatially and temporally variable with respect to the earliest domesticates. Palaeoclimatic amelioration occurred at a much later date in the eastern Fertile Crescent, the Zagros Mountains, than in the more westerly and southerly Levant. The concomitant Neolithic cultural transition also varies among the regions of the Near East. In the Zagros, the earliest

agriculture is characterized primarily by the domestication of goats and the development of transhumant pastoralism (Hole, 1984), while the utilization of domesticated cereals was delayed relative to the Levant.

This paper assesses the skeletal consequences of the adoption of a pastoral subsistence strategy through examination of the axial skeleton of 2 adolescents and 14 adults from the site of Ganj Dareh in western Iran, dated to ca 7000 bc. The skeletal remains were examined with respect to lesion location within the vertebral column and within the individual vertebrae, lesion prevalence in the sample and the balance between bone resorption and deposition.

The bodies of thoracic, lumbar and sacral vertebrae exhibit osteophytic new bone formation and resorptive lesions. Through differential diagnosis the possible pathological and/or activity-related aetiologies, that include tuberculosis, brucellosis, actinomycosis and osteoarthritis, are assessed. The inter-relationships between health status and subsistence strategy are discussed.

New mtDNA haplogroups in Melanesia.

D.A. Merriwether[1], J. Friedlaender[2]. [1]University of Michigan, Ann Arbor, Michigan, 48109-1382, USA, [2]Temple University.

We sequenced over 600 individuals from Papua New Guinea, Irian Jaya, the Bismark Archipelago, Boutgainville, Ontong Java, Santa Cruz, Vanuatu and New Caledonia. We now identify 8-9 major haplogroups present in Near Oceania. Many of these appear to be very old. Several have very restricted distributions. Haplogroup V is only found in the village of Garaina on PNG. Haplogroup VI is in PNG, the Bismarks and Bougainville. Haplogroup VII is only found on Bougainville in non-Austronesian speaking populations. Haplogroup VIII is restricted to New Britain, Haplogroup IX is found only in the Tolai of New Britain. Haplogroup IX shares many mutations with a rare haplogroup in Australian aboriginal peoples, possibly indicating ancient common ancestry for the two populations. We present preliminary data showing the relative ages of the haplogroups in different regions, language groups, and populations and relate this to several models of peopling of the Pacific.

Evaluation of computer enhanced facial reproduction at the National Center for Missing and Exploited Children using Terry Collection death masks and photographs.

G. Miller[1], D. Hunt[2], S. Lofton[1], J. Mullins[1]. [1]National Center for Missing and Exploited Children, Alexandria, Va., USA, [2]Dept. of Anthropology, National Museum of Natural History, Smithsonian Institution, Washington, D.C., 20560, U.S.A.

Advances in computer technology and sophistication in image morphing graphics have allowed enhancement to traditional clay sculpturing and artist drawing methods for facial reproduction in forensic applications. The National Center for Missing and Exploited Children (NCMEC) employ clay tissue reconstruction methods along with the application of Adobe Photoshop software to supplement the clay reproduction with photographic skin overlay, producing a photo-like color image.

To assess the accuracy of the NCMEC computer imaging and clay reproduction, eight skulls from the Terry Anatomical Collection were provided to the NCMEC and facial reproductions were performed by clay tissue reconstruction and computer enhanced skin overlay. Unidentified Terry collection death masks and cadaver photographs (including those belonging to the skulls) were later supplied to the NCMEC. Death mask and cadaver photographs were super-imposed on the clay and computer facial reproductions to test matching abilities and to determine the similarity and disparity between images in facial forms and features. Results from the overlays illustrate regions more directly communicated by cranial features had greater continuity between reproduction methods than areas of cartilaginous structures and regions of thicker musculature.

Staff members of the NCMEC were surveyed to match a series of both the clay and skin enhanced facial reproductions to the death masks. Correct association was greater between the death masks and clay reproductions, most likely due to the similarity of the clay and plaster than the tissue enhanced images. Computer imaging still requires advanced artistic abilities and extensive training to produce reliable images.

Craniofacial variation in *Homo habilis* compared to modern chimpanzees.

J.M. Miller[1], G.H. Albrecht[2], B.R. Gelvin[3]. [1]Dept. of Pathology and Laboratory Medicine, UCLA, Los Angeles, CA, 90095, USA, [2]Dept. of Cell & Neurobiology, USC School of Medicine, Los Angeles, CA, 90049, USA, [3]Dept. of Anthropology, California State University, Northridge, Northridge, CA, 91324, USA.

Species number in the *H. habilis* cranial sample (KNM-ER 1813, OH 24, STw 53, KNM-ER 1470) is controversial. Comparisons to small samples of analog species of modern hominoids lead some researchers to believe there are two or three different species represented. Most commonly, KNM-ER 1470 is referred to "*Homo rudolfensis*" while the others are referred to *H. habilis*. However, using large analog samples, Miller et al. (1997, 1998) showed that the fossils are far less variable than modern gorillas and do not exceed the variation in modern humans.

The present study compares the *H. habilis* specimens to variation in *Pan troglodytes*. The chimpanzee data consist of 12 craniofacial measurements on 389 adults collected and generously made available by Colin Groves. Principal components was used to summarize sexual, subspecific, and species level variation in chimpanzees as a "yardstick" for assessing differences among the fossils. The results indicate that the variation among the fossils is: (1) less than overall species level variation in *P. troglodytes*, (2) less than species level intrasexual variation in *P. troglodytes*, (3) less than subspecies level variation in *P. t. schweinfurthii* and *P. t. troglodytes*, and (4) slightly more variable than subspecies level variation in *P. t. verus*. These findings do not support a rejection of the single species hypothesis.

Taphonomic summary of Middle Pleistocene hominid sites in the Western Cape.

R. Milo. Dept. of Geography, Economics & Anthropology, Chicago State University, Chicago, IL, 60628-1598, USA.

World-wide, Middle Pleistocene sites that preserve a record of hominid presence and activity are uncommon. Sealed sites that preserve faunal remains and artifacts in primary context are rarer still. Two important Middle Pleistocene sites—Elandsfontein Main (EFTM) and Duinefontein 2 (DFT2)—are located in the Western Cape of South Africa. While animal bones and artifacts from both sites are to some extent time-averaged, partly articulated skeletons of large mammals testify to the penecontemporaneous nature of large parts of the assemblages. This is particularly true of Duinefontein 2, where excavation has revealed partial carcasses lying *in situ* on an ancient, undulating land surface.

This paper presents a taphonomic summary of Middle Pleistocene sites in the Western Cape, focusing particularly on EFTM and DFT2. The evidence considered includes the taxonomic composition of the assemblages, bone modification data, and the spatial distributions of bones and artifacts. I argue that both sites represent ancient landscapes (*sensu stricto*) on which nearby bodies of fresh water attracted animals and hominids. Skeletal part distributions, spatial distributions and bone modification suggest natural death assemblages rather than bones accumulated by hyenas, porcupines or hominids. The same evidence suggests that homi-

nids had little impact on large mammal communities and, consequently, that hominids had not yet achieved a significant place within the guild of large carnivores.

Pulsatile hormone secretion, episodic growth patterning, heterochrony, and punctuated equilibria: A unifying model.

N. Minugh-Purvis[1], S. Crockford[2]. [1]Dept. Cell and Developmental Biology, University of Pennsylvania School of Medicine, Philadelphia, PA, 19104, USA, [2]Pacific Identifications, Inc.

In the 1980s, it became apparent that human growth is an episodic rather than linear phenomenon, characterized by spurts of size increase followed by periods of stasis. Lampl's documentation of growth in infants during the first year of life revealed a striking pattern of periodic growth episodes in recumbent body length and head circumference. A similar periodicity is known to characterize enamel secretion by ameloblasts resulting in incremental enamel growth in developing teeth. We propose that the same endocrine regulator is likely responsible for the pulsatile growth seen in these widely diverse systems and that these are but two manifestations of the same underlying phenomenon. If so, the episodic growth signatures preserved in the fossil record should provide significant insight into, and even permit accurate reconstruction of, the growth patterns characterizing a variety of biological complexes in earlier hominids.

Based on a variety of experimental evidence reported in the literature, we suggest that the activity of thyroid hormone and related compounds is key to understanding the timing and duration of normal growth patterning. We present a model which provides a unifying framework explaining growth and morphogenesis by 1) examining the role of thyroid hormone on cell differentiation in a variety of tissues; 2) delineating several known biological pathways along which regular, episodic growth patterning occurs; 3) illustrating how alterations (heterochronies) in thyroid hormone activity are a significant force which not only alter ontogenies, but, ultimately, are capable of producing evolutionary change and altering phylogenies as well.

Demographic and social constraints on male chimpanzee behavior.

J. Mitani[1], D. Watts[2], J. Pepper[3], D.A. Merriwether[1]. [1]Dept. of Anthropology, University of Michigan, Ann Arbor, Michigan, 48109, USA, [2]Dept. of Anthropology, Yale University, [3]Santa Fe Institute.

Wild male chimpanzees, *Pan troglodytes*, are well known for affiliating and cooperating in a variety of behavioral contexts. Prior field research indicates that maternal kinship does not affect patterns of affiliation and cooperation by males in the same social group. Two questions remain unclear from this finding. First, why don't male chimpanzees selectively bias their behavior toward maternal kin? Second, what factors account for who affiliates and cooperates with whom? We conducted behavioral observations of an unusually large community of chimpanzees at Ngogo, Kibale National Park, Uganda, to test the hypothesis that demographic constraints limit the number of maternal kin with whom male chimpanzees can cooperate, and thereby lead them to form selective bonds with non-kin of similar age and status. Results indicated that male age and rank are significantly associated with six measures of social behavior. Members of the same age cohort and individuals close in rank were more likely to affiliate and cooperate than males that belonged to different age and rank classes. Additional analyses replicate earlier findings and show that males who affiliated and cooperated were not closely related through the maternal line, as assayed by mtDNA haplotype sharing. These results add to our growing understanding of the important role demographic and social constraints play in primate behavior.

Adaptive strategies and resource utilization of the mantled howling monkey (*Alouatta palliata*) in a small forest fragment in Nicaragua.

K. Mitchell, J. Floyd, L. Winkler. University of Pittsburgh, Pittsburgh, PA, 15221, USA.

Alouatta palliata is characterized by its diverse habitat utilization, flexible foraging strategies, and variable home range size. The small home range sizes reported for some areas raise intriguing questions about resource utilization. The present study investigates resource utilization in a small forest fragment (<2 hectares) on Ometepe Island, Nicaragua. This fragment has been continuously occupied by a small group of monkeys (N = 6-7) during the last two field seasons (Summer 2000, Spring-Summer 2001).

This study was conducted in July-August 2001 to assess group feeding activity and resource availability. The area was surveyed and trees (over 3 meters high) were mapped. DBH measurements were taken of feeding trees and of 20% of the remaining trees. Feeding activity and type of food ingested were monitored using instantaneous focal and group sampling (53 observation hours). Plant diversity was assessed by transects ($20m^2$) around feeding trees. Identical methodology (with 74 observation hours) was used to study feeding strategies of a comparison group in a larger home range 4 km away in order to assess resource utilization differences.

The study group in the fragment and the comparison group spent nearly the same amounts of time feeding, but there are substantial differences in dietary composition. The study group spent more time eating fruit and ate fewer leaf species. This forest fragment differed substantially from surrounding areas in possessing a large number of *Ficus* (39 trees, 30% of tree population) that appeared to be a keystone resource important to the survival of the group in this small area.

Semilandmarks on curves and surfaces in three dimensions.

P. Mitteroecker, P. Gunz. Institute for Anthropology, University of Vienna, Fischamend, Austria, A-2401, Austria.

Three dimensional semilandmarks offer the opportunity of incorporating information about curved forms that lack traditional landmarks into statistical shape analysis. Semilandmarks cannot be defined on a single specimen; rather, they exist in the context of the group average of the sample. Because their position is relaxed against an average shape, semilandmarks do acquire a geometric homology that allows them to be used in subsequent statistical analyses. The intention is to decrease the variance along tangent directions (ascribable to measurement error) while preserving the variance that is a result of shape difference.

The algorithm presented here places semilandmarks on either ridge curves or surfaces of every specimen in an sample. We can simultaneously analyze semilandmarks on ridge curves or sutures, surface semilandmarks (which are most efficient when the surface is rather smooth) and traditional landmarks.

The semilandmarks are allowed to slide along the curvature until the bending energy of the thin plate spline between each specimen and the mean shape is minimal. Their position along the curve depends on the position of the surrounding traditional landmarks that constrain their shift. Their position in the direction perpendicular to the curve is defined by the properties of the specimen's shape. A prerequisite is a set of anatomical landmarks and several arbitrarily placed points on the geometry between the fixed landmarks. All points can be digitized using various tools, e.g. a Polhemus or a Microscribe digitizer, a laser-surface scanner or a CT-scan.

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The elusive 'second species' at the Sterkfontein fossil site: the dental evidence.

J. Moggi-Cecchi. Laboratori di Antropologia, Dipartimento di Biologia Animale e Genetica, Università di Firenze, Florence, Italy, 50122, Italy.

Hominid specimens recovered from Member 4 of the Sterkfontein site have been assigned to *Australopithecus africanu*s. Several studies suggested that a few specimens may represent another taxon (e.g. Clarke, 1994).

The coefficient of variations (CV) of both MD and BL diameters of the extended dental sample from Sterkfontein have been compared with those of other fossil hominid species. For some teeth and some diameters, the Sterkfontein sample shows higher CV values than the other samples, although no consistent pattern seems to be evident. Overall, the descriptive analysis of the CVs does not provide a strong evidence for the existence of a 'second species' in the Sterkfontein sample.

A metrical analysis comparing the mean values of the MD and BL diameters with those of the combined sample of South African 'robust' Australopithecines has also been carried out. Overall, anterior teeth of 'robust' Australopithecines are significantly smaller than those of *A. africanus*, whereas the opposite is true for the premolars. The mean values of the molar teeth of *A. africanus* do not differ significantly from those of *A. robustus*, with a few exceptions. Some molar teeth of the Sterkfontein sample are comparable in size with those of *A. robustus*. However, it seems difficult at this stage to assign isolated teeth to a species different from *A. africanus* only on the basis of dental dimensions.

The combined information from the CV analysis and the metrical comparisons does not provide a conclusive evidence for the existence of a 'second species' in the Sterkfontein Member 4. At this stage, on the basis of the metrical dental evidence alone, the 'second species' remains elusive.

Orbicularis oris muscle morphology in individuals with cleft lip with or without cleft palate and their relatives.

M. Mooney[1], S. Weinberg[2], K. Neiswanger[3], R. Faix[3], D. Richardson[3], S. Petiprin[3], K. Bardi[3], R. Giles[3], E. Carter[3], A. Bowen[3], M.L. Mazarita[4]. [1]Dept. Oral Medicine & Pathology, Pittsburgh, PA, 15261, USA, [2]Dept. Anthropology, University of Pittsburgh, [3]University of Pittsburgh, [4]Cleft Palate Craniofacial Center, University of Pittsburgh.

While the birth prevalence of orofacial clefting is approximately 500-1,000 per 1,000,000 births, only a few genetically linked phenotypic markers have been identified. Recently, however, a sub-clinical defect of the orbicularis oris muscle (OOM) was detected in the first-degree relatives of individuals with CL/P. These relatives had significantly more OOM defects compared to controls. It was, therefore, hypothesized that these subepithelial defects may represent a useful feature for estimating recurrence risks. Unfortunately, previous analyses of OOM defects have been limited to first-degree relatives in non-multiplex families and failed to characterize the defect. Therefore, as part of a large multiplex family study on the cleft phenotype and genotype, ultrasound images were collected from affected (CL/P) probands and their affected and unaffected extended relatives (n = 66). The goal of this study was to develop a protocol for OOM morphology analysis from ultrasound images and to compare data collected from unaffected relatives (n = 43) to unaffected controls (n = 52). The OOM were rated on a scale from normal to major/multiple defects. The combined proportion of relatives with OOM defects was then calculated. The results of chi-square analysis revealed significant ($x2 = 12.93$; $p<.001$) differences in the proportion of unaffected relatives (44%) with OOM defects compared to controls (11%). These results strongly agree with previous figures from the literature and lend support to the notion that such sub-clinical defects may indicate an increased familial risk to CL/P.

Morphological and molecular variation in ancient and modern Sudan.

L. Moore. Dept. of Anatomy and Developmental Biology, University College London, London,WC1E 6JJ, United Kingdom.

Sudan is the largest country in Africa, with almost unparalleled cultural and linguistic diversity, and has long been the focus of myriad anthropological and archaeological research projects. However, the many and complex human migrations from the Neolithic onwards, and thus the origins of many of the modern human populations in Sudan remain poorly understood.

This study compares the patterns of variation reflected in parallel genetic and craniometric analyses. 319 DNA samples from modern Sudanese populations were typed for 17 Y chromosome polymorphic markers. Results from this analysis show striking differences in the frequency and distribution of haplotypes between northern and southern Sudanese populations (Moore, 2000). In the morphological analysis, 44 craniometric measurements were taken from 354 crania representing populations in Sudan, Ethiopia, Uganda and Kenya. The broad north-south differences seen in the Y chromosome analysis were also evident morphologically. However, the twin analyses also reveal insights into different aspects of population movements throughout that region. While variation between the results of the two studies can be expected, given the lack of exact correspondence between the genetic and morphological samples, as well as the fact that the genetic study utilized Y chromosome markers which reflect male variation only, they also serve to highlight the importance of using both molecular and morphological data to give a more complete picture of ancient population movements.

Moore LJ (2000) Y chromosome diversity in modern Sudan. *American Journal of Physical Anthropology Supplement* 30:231.

Anatomical correlates to nectar feeding among the strepsirhines of Madagascar.

M. Muchlinski. University of Texas, Austin, Austin, Texas, 78712, USA.

The purpose of this study was to test for cranial adaptations to nectar feeding in a large sample of strepsirhine taxa. Nectar feeding represents a small proportion of the yearly diets of the Malagasy lemurs. Monthly nectar consumption, however, can range between 25-75% of the total feeding time. Nectar clearly serves as an important secondary seasonal resource for at least some lemur species, particularly for members of the genera *Eulemur* and *Varecia*. Anatomical correlates to nectar feeding have been established for facultative nectar feeders such as marsupials and bats (Dumont 1997; Howell and Hodgkin 1976), but have not been identified among strepsirhines.

Based on previous studies of the crania of non-primate nectar feeders, thirty cranial measurements were taken on 250 museum specimens of Malagasy lemurs, representing 30 species. Most cranial measurements for these Malagasy prosimians scale with negative allometry, so that as body mass increases, features such as snout length decrease relative to body size. The lemurs with the highest percentage of nectar feeding in their diet, *Eulemur macaco* and *Varecia variegata*, appear to mirror nectar feeding bats and marsupials in their cranial morphology. That is, their snouts are longer than one would expect based on body mass alone. This preliminary study may lend further support to the hypothesis that lemurs play an important role as pollinators in Madagascar's delicate ecosystem.

Leptin and reproductive function in captive male macaques and baboons.

M. Muehlenbein[1], B. Campbell[2], R. Richards[3], F. Svec[3], K. Phillippi[4], M. Murchison[4], L. Myers[5]. [1]Reproductive Ecology Laboratory, Dept. of Anthropology, Yale University, New

Haven, CT, 6520, USA, [2]Dept. of Anthropology, Boston University, [3]Section of Endocrinology, Dept. of Medicine, Louisiana State University Health Sciences Center, [4]Dept. of Veterinary Medicine, Tulane Regional Primate Research Center, [5]Dept. of Biostatistics, Tulane University School of Public Health and Tropical Medicine.

Leptin is considered to act as a signal relating somatic energetic status to the reproductive system. However, given the relatively indirect role of energetics in successful reproduction among males, the role of leptin in modulating male reproductive function is unclear. We chose to investigate this issue by comparing leptin, adrenal and gonadal hormones, as well as various measures of body size and mass among captive male rhesus (N = 69) and pig-tailed (N = 43) macaques and savanna baboons (N = 21). These species were specifically selected to represent different breeding strategies and hence, presumably different levels of importance of body fat stores for breeding.

The results obtained here indicate that, despite substantially different amounts of body fat and mass, rhesus macaques, pig-tailed macaques, and baboons exhibit similar leptin levels (2.21 ± 0.43, 2.12 ± 0.39, and 2.37 ± 0.45 ng/ml, respectively; N.S. by ANOVA). Measures of adiposity were associated with leptin levels within the two macaque species. Leptin was not related to gonadal function in any of the three species, but was related to measures of adrenal function.

Taken as a whole, these findings: 1) suggest species differences in the relationship between adiposity and hypothalamic function as mediated by leptin; 2) confirm the association between individual variation in adiposity and leptin within the macaque species; 3) raise questions about the role of leptin in species differences of adrenal function.

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Causes for primate sociality: inferences from other mammals.

A. Mueller, C. Soligo. Anthropological Institute, University of Zuerich, Zuerich, ZH, 8057, Switzerland.

An important attribute for the entire order Primates is that all species exhibit a social lifestyle. Whereas diurnal and cathemeral species generally forage in cohesive groups, the nocturnal prosimians are mostly seen alone when active but nevertheless exhibit social networks that are distinguished by sleeping groups and regular interactions. There has been discussion of the reasons why some primates forage in groups while others do not, but it has never been investigated why all primates exhibit a social lifestyle. Because it is impossible to examine a non-social primate, we here use rodents as a model to investigate causes of sociality in primates because of their wide variety of ecological adaptations. We found most social rodents among large-bodied arboreal species that include a large portion of fruits in their diet. Fruits and other plant products, such as flowers, seeds and young leaves, are patchily distributed in time and space and therefore difficult to find. These food resources are, however, predictable and dependable when their location is known. Hence, membership in a social unit would intensify food exploitation if information on feeding sites is shared. Because sociality was already present in the common ancestor of primates, we argue that the first primates fed predominantly on plant products such as fruits and flowers, and that as a consequence social networks arose.

Histologic examination of age in chimpanzees.

D. Mulhern, D. Ubelaker. Smithsonian Institution, Washington, DC, 20560, USA.

The purpose of this study is to contribute to the growing body of research documenting quantitative differences in mammalian bone microstructure. Specifically, a comparative study of chimpanzee and human bone histology is conducted by applying Kerley's technique for estimating age at death in humans to chimpanzee femora, tibiae and fibulae. Age estimates for the chimps based on histologic variables are compared to known ages to assess similarities and differences.

The study sample includes thin sections from the leg bone midshafts of 13 chimpanzees originally prepared by Kerley as part of a study on skeletal age changes in the chimpanzee. Twelve juveniles ranging in known age from 2 to 15.3 years and one adult, with a known age of 35 years are represented. Each section was analyzed according to Kerley's 1965 method for determining age in human bone using microscopic bone structures.

Results indicate that chimpanzees exhibit the same age-related changes in histologic variables as humans. Numbers of secondary osteons and osteon fragments are positively correlated with age; the number of non-Haversian canals and the amount of circumferential lamellar bone are negatively correlated with age. Estimated ages for the chimpanzees based histologic variables are generally higher than known ages demonstrating some tendency toward more mature bone in chimpanzees compared to hypothetical age-matched humans. Paired student's t tests revealed significant differences ($p<0.05$) between estimated and known age for six out of twenty individual and combined variables.

The frequency and chronological distribution of linear enamel hypoplasia in a 19th century almshouse population.

J.L. Muller, P.M. Williams, J.E. Sirianni. State University of New York at Buffalo, Buffalo, New York, 14261, USA.

The Highland Park skeletal collection consists of 305 individuals, associated with the Monroe County almshouse cemetery, Rochester, NY. It is estimated that the cemetery interred inmates between 1826 and 1863. Historical documentation for the Rochester area indicates that the nineteenth century was a period of urbanization and immigration. Linear enamel hypoplasia (LEH), the disruption of amelogenesis, is significant in determining the physiological stress a population incurs. In an ongoing effort to evaluate the general health of this almshouse population, the frequency and chronological distribution of LEH is investigated.

A total of 121 adults were assessed. Measurements for each tooth include: the number of hypoplasias, the crown height, the onset of LEH, and the latest development of LEH. Age of onset was determined using the measurement of the most cuspial hypoplastic line. The chronology of enamel development was determined in 0.5 year developmental periods.

Approximately 28% of individuals exhibit hypoplastic defects on at least 1 tooth. The mandibular canines display the highest frequency of LEH (22.9%), followed by the maxillary incisors (18.64%), and the maxillary canines (18.60%). The occurrence of hypoplastic lines is found to be greatest between 2.0 and 3.5 developmental years.

Compared to other historical samples, the frequency of LEH in the Highland Park sample is fairly low. The lower socio-economic status and poor health associated with almshouse inmates does not necessarily reflect their health and status during years of development. Therefore, the results are not unexpected due to the transitory nature of Monroe County almshouse inmates.

Testosterone and reproductive aggression in wild chimpanzees.

M. Muller. Harvard University, Cambridge, MA, USA.

The "Challenge Hypothesis" posits that variation in male testosterone levels is more closely associated with aggression in reproductive contexts than it is with changes in

reproductive physiology. Numerous bird studies support this idea, but few tests have been conducted with primates. This study, which examined the relationship between testosterone levels and reproductive aggression in wild chimpanzees (*Pan troglodytes schweinfurthii*), is the first such test for a great ape.

Data collection was conducted over a 14-month period in Kanyawara, Kibale National Park, Uganda. Urinary testosterone levels were quantified by radioimmunoassay from more than 500 samples collected non-invasively from 11 adult males.

All of the adult males showed testosterone increases during periods when parous females exhibited maximally tumescent sexual swellings. These periods were also marked by increased rates of male aggression (charging displays, chases, and attacks), and increased severity of male aggression.

In order to examine the effects of sexual behavior on male testosterone levels in the absence of reproductive aggression, testosterone levels were quantified during periods when nulliparous females exhibited maximally tumescent sexual swellings. Chimpanzee males copulate with parous and nulliparous females at similar rates. However, nulliparous females are not as attractive to males: they are not mate-guarded, nor do rates of male aggression increase when they exhibit sexual swellings. In this study male testosterone levels did not increase when maximally tumescent nulliparous females were present. Thus, the predictions of the Challenge Hypothesis were generally upheld for chimpanzees. This suggests that the hypothesis may have wider applicability among primates, including humans.

Energetics of bipedal and quadrupedal walking in Japanese macaques.

M. Nakatsukasa[1], E. Hirasaki[2], N. Ogihara[1], Y. Hamada[1]. [1]Laboratory of Physical Anthropology, Kyoto Univesity, Kyoto, Kyoto, 6068502, Japan, [2]Dept. of Biological Anthropology, Osaka University.

There is no living non-human primate in which bipedalism comprises a major positional component. This is an inherent problem to the study of human bipedal adaptations through cross-species comparative methods. However, specialized non-human bipeds can be obtained under experimental conditions. Bipedal monkey attractions have been developed widely in Asian countries. Japanese macaques that engage in traditional performance are trained to stand and walk bipedally daily for about one hour. We preliminarily report on their locomotor energetics. Since Taylor and Rowntree (1973), comparative locomotor energetics in non-human primates has rarely been studied. The experiment was conducted in a special chamber with a gas analyzer. The subjects walked quadrupedally and bipedally with various speeds (1.5-5.0km) on a treadmill. The cost of quadrupedalism was almost equivalent to the published data (Taylor et al., 1982). While walking bipedally, energetic expenditure increased by 20%. Locomotor costs increased linearly with speed and energetic expenditure was always higher in bipedalism by 20%. Our results contradict those of Taylor and Rowntree (1973), who found bipedal and quadrupedal running required a same energetic cost in chimpanzees and capuchins. The reason for the difference is unclear. However, we agree with them that bipedal vs. quadrupedal energetic Rubicon is not large. Indeed, these macaques can walk bipedally over a few km without interruption despite the extra locomotor cost. However, the ecological Rubicon (availability of food resources which can cover the extra cost) also should be considered if we further argue the price of bipedalism in non-human primates.
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More evidence for visual predation in the slender loris (*Loris tardigradus*).

K.A.I. Nekaris. Oxford Brookes University, Oxford, N/A, OX3 OBP, United Kingdom.

The importance of visual predation has been implicated not only in discussions of primate origins, but also has been considered of vital adaptive relevance to the divergence of anthropoids and prosimians. The slender loris, an insectivorous primate with extreme visual convergence, has been a key example in these discussions. In this paper, I present the first data on prey capture techniques of two Sri Lankan subspecies.

Both qualitative and quantitative observations were made from May-August 2001. For *L. t. nordicus*, seventeen days were spent in the North Central Province, totaling over 55 hours of direct observation. One week was spent in the Southern Province observing the more elusive *L. t. tardigradus*, resulting in only four hours of data collection. Four hours of video tape were analyzed allowing for critical examination of 32 prey capture sequences, examples of which will be presented.

Both subspecies clearly focused on insect prey items using vision as they moved, either swiftly or slowly, through the trees and undergrowth, grabbing them from the air or picking them from a branch. In almost all cases, animals continued chewing as they walked, sometimes catching three to four flying insects in sequence. Only very large prey items were associated with a pause in movement. Of 32 capture sequences, lorises obtained prey items by pulling them from a branch (n = 7), or by catching them from the air (n = 25). The results of this study provide support that the slender loris is an adroit visual predator, capable of complex detection and capture, despite its nocturnal habits.

Project funding: Margot Marsh, PCI, Columbus Zoo.

Bioarchaeological investigations of a 2700 BP cemetery, Republic of Palau, Micronesia.

G.C. Nelson, S.M. Fitzpatrick, J.M. McLaughlin. Dept. of Anthropology, University of Oregon, Eugene, Oregon, 97403-1218, USA.

Archaeological excavations of a Yapese stone money quarry on Orrak Island, Republic of Palau conducted during August 2000 unexpectedly encountered human remains at depths greater than 70 cm in all four excavation units. Radiocarbon dating of a parietal fragment returned a date of 2680 " 40 years BP (University of Arizona, AA 40957) making this the earliest directly dated evidence for human occupation of Palau.

The retrieved sample consists of at least eleven individuals, represents both sexes, and includes ages infant through adult. The Chelchol ra-Orrak site is taphonomically complex with much to work out through future excavation. However, it appears that primary and secondary burial contexts exist as both articulated and isolated elements are found, including in the latter a grouping of four crania.

Analysis of twelve craniometric variables for the two measurable crania show that although grouping with other Micronesian samples the Orrak individuals are distinct, particularly in the variables of cranial height and breadth. Skeletal analysis reveals slight degenerative changes in the ankles and knees of one individual and on two lumbar vertebrae from separate individuals. One humerus is quite robust exhibiting extensive deltoid tuberosity development and thickened cortical bone with reduced medullary cavity diameter.

It appears that the Chelchol ra-Orrak site is underlain by a burial ground dating to near the beginnings of human habitation of Palau. Further scheduled excavations will add much to this current glimpse of the early peoples of western Micronesia and possibly offer new insight into questions surrounding the peopling of the Island Pacific region.

Paleoenvironmental reconstructions with respect to the extinction of *Sivapithecus* in Pakistan.

S. Nelson. Dept. of Anthropology, Harvard University, Cambridge, MA, 02138, USA.

Within Pakistan Siwalik sediments, *Sivapithecus*, a hominoid, appears 13 Ma and disappears at 8.4 Ma. Carbon and oxygen isotope analyses were conducted to reconstruct paleodiets and habitats for two time inter-

vals, 9.3-9.2 Ma, or the U-level, and 8.1-8.0 Ma, or the Dhok Pathan level. Environmental inferences can thus be made for *Sivapithecus* habitat and for habitat just after *Sivapithecus* went extinct. A total of 96 teeth from 16 taxa were sampled, including suids, bovids, tragulids, proboscideans, rhinocerotids, giraffids, and equids. $\partial^{13}C$ results for the U-level indicate the presence of closed woodland or forest, though none with completely closed canopy, and some open habitat, with possibly small patches of C_4 grass. Carbon results for the Dhok Pathan are significantly more enriched than U-level values, indicating more open, drier habitats, with some forest still present but diminished. Dhok Pathan equids provide the only clear evidence of C_4 grasses, suggesting C_4 grasses were present but not extensive. Dhok Pathan $\partial^{18}O$ values are significantly more enriched than U-level values, suggesting an increase in seasonality with a decrease in rainfall or change in precipitation source. For several taxa, individuals cluster in their $\partial^{13}C$ and/or $\partial^{18}O$ values, suggesting they fed in particular parts of the habitat, with the most closed/wet habitat taxa going extinct by the Dhok Pathan, and some other taxa shifting to more open, drier habitats. Thus *Sivapithecus* paleoenvironment included closed, wet forest, with this habitat diminished and replaced by more open habitat and a more monsoonal environment around the time *Sivapithecus* went extinct.

A preliminary re-evaluation of the mylohyoid groove of Gran Dolina specimen ATD6-5.

A.J. Nevgloski Jr. SUNY at Binghamton, Binghamton, NY, 13903, USA.

In 1994 a research team excavating at Gran Dolina, Atapuerca, Spain, discovered human remains that would later be given the name, Homo antecessor. Among these remains is a subadult mandibular fragment (ATD6-5) which exhibits morphology generally similar to both African and European Lower and Middle Pleistocene specimens. Rosas and Bermudez de Castro (1999) recognize several characters that distinguish this specimen, notably the position and anterior extension of the mylohyoid groove.

This study is concerned with the analysis of these distinguishing characters. Samples of modern human adults (n = 42) and subadults (n = 57), as well as casts of fossil humans, were studied to determine variation in these features. A six-stage grading system was developed to facilitate evaluation of the anterior extension of the mylohyoid groove. Results show that 36 out of 42 (or 85.71%) modern human adults fall within stages 1 and 2, with a mylohyoid groove being at or posterior to the M3. Thirty-seven of the 57 (or 64.91%) subadult modern humans exhibit stages 3 or 4, which is similar to the morphology shown for the subadult ATD6-5 specimen, as well as that of KNM-WT 15000 from Nariokotome. In addition, the low position of the mylohyoid groove is exhibited by several subadult modern specimens. The results of this study suggest that there may be an ontogenetic component to the low position and extreme anterior placement of the mylohyoid groove.

Distribution of linear enamel hypoplasia in Ceboidea.

E.A. Newell[1], D. Guatelli-Steinberg[2]. [1]Dept. of Sociology and Anthropology, Elizabethtown College, Elizabethtown, PA, 17022, USA, [2]Dept. of Anthropology, The Ohio State University-Newark.

Recent studies of linear enamel hypoplasia (LEH) in non-human primates have focused on describing taxonomic variation in prevalence across the order, providing an important comparative context for evaluating LEH. From these studies, a taxonomic pattern in the distribution of LEH has emerged: frequencies increase from prosimian to monkey to ape grades. Subsequently, most investigations have centered on hypoplasia in apes (Tsukamato, 2001; Guatelli-Steinberg, 2000; Hannibal, 2000; Skinner, 2000 & 1986; Stottlemire, 1998; Eckhardt & Protsch von Zeiten, 1993), while few have focused on other anthropoids. The present research expands the framework for the interpretation of LEH in non-human primates by examining the differences in frequency found among ceboids.

In 14 ceboid genera (N = 1303), Newell found LEH frequencies ranged from 0% in *Callicebus* (N = 79), *Cebuella* (N = 27) and *Callimico* (N = 5), to 25% in *Cebus* (N = 229). Studying different samples, Guatelli-Steinberg found a similar range of frequencies among five genera (N = 107), from 0% in *Saimiri* (N = 16) to 32% in *Cebus* (N = 28). Variation in LEH frequencies is closely related to variation in the duration of maturation across the order (Newell, 2000 & 1998). The results of this study suggest that within the Ceboidea, there is a similar correlation: indirect measures of maturation length explain part of the variation in LEH frequencies across genera and species. Furthermore, large sample sizes from a number of species permit an examination of other factors, both physiological and environmental, that contribute to an explanation of species differences in ceboid LEH.

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A morphometric approach to quantifying between-sample differences in joint shapes.

W. Niewoehner. California State University - San Bernardino, San Bernardino, CA, 92407-2397, USA.

Linear measurements are typically used in multivariate analyses of size and shape. Ultimately, the investigator must divine the relationship of the principal components to the biological shapes being investigated. This process is substantially more difficult when complex shapes such as joint surfaces are considered.

A more satisfactory approach uses 3–D landmark coordinates of the carpometacarpal joint surfaces from samples of Neandertals (N = 13), Early (N = 12) and Late Upper Paleolithic (N = 9) humans, and North American and European Holocene humans (N = 37) in a morphometric analysis (Niewoehner, 2000).

The landmark coordinates (digitized from a grid projected onto each joint surface) are imported into the Morphologika software program (O'Higgins & Jones, 1998). The program performs a Procrustes superposition of the landmarks. Next, shape variation is assessed in the program through a principal components analysis of Kendall's tangent space coordinates (Kendall, 1984).

Principal components scores are analyzed with a canonical discriminant function using the SAS statistical software (SAS, 1989) to test the null hypothesis of between-sample equivalence of joint shapes. Only the principal components that are significantly correlated with their canonical components scores ($p \leq 0.05$) are further considered. The shape changes associated with any particular principal component are visualized directly in the Morphologika software by interactively morphing the 3-D wire frames of the Procrustes mean joint shapes.

3-D visualization of the principal components of joint shape variation is crucial for determining the functional implications of between-sample differences in carpometacarpal joint configurations.

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Populations in Island Melanesia provide evidence for non-selection based variation in skin pigmentation.

H. Norton[1], J. Friedlaender[2], D.A. Merriwether[3], G. Koki[4], C. Mgone[4], M. Shriver[1]. [1]The Pennsylvania State University, University Park, PA, 16802, USA, [2]Temple University, [3]University of Michigan, [4]PNG Institute for Medical Research.

Pigmentation of the skin and hair is one of the most variable phenotypic traits seen

in human populations. Many hypotheses advanced to explain global differences in pigmentation cite natural selection acting on groups at varying latitudes as the driving force behind inter-population pigmentation variation. However, few have studied the variation that can exist over small spans of latitude. Island Melanesia provides an example of a region where there is a minimum change of latitude (~10˚ for the region included in this study), but extensive variation in skin and hair pigmentation. This study combines measurements of skin pigmentation taken in 1966 on the islands of Malaita and Bougainville with those taken in 2000 on the islands of New Ireland and New Britain. The results suggest that in the area studied there is a cline of increasing skin pigmentation as one travels west to east from New Britain to Bougainville, suggesting that there is continuous variation in pigmentation across the region. We have compared levels of skin pigmentation as measured by the M (Melanin) index between males and females, between the islands we studied, the main language groups of the region (Austronesian and Non-Austronesian). The narrow span of latitude covered in this study suggests that natural selection is not a plausible factor explaining the evolution of pigmentation variation in this region. An alternative theory is discussed which suggests that the pigmentation patterns that we observed, particularly in Bougainville, may be due to the unique population histories of these islands.

Ethnicity and the ancestors: a bioarchaeological investigation of ethnic boundaries.

K.C. Nystrom. University of New Mexico, Albuquerque, New Mexico, 87131, USA.

The examination of ethnicity in the archaeological record is a difficult enterprise and should be approached with a multivariate historical perspective. Historically, ethnicity has been considered to correspond to artifact distribution, artificially separating groups into cultural spheres. It is the interaction between groups, however, where the expression and control of an ethnic signal is the strongest. Located in the *ceja de la selva* of northern Perú, the funerary component of the Laguna de los Condores contains evidence for a shift in ethnic identity of the Chachapoyas. A bioarchaeological investigation into ethnic expression combines more traditional archaeological data with physical anthropology methodology in order to more fully address the existence and nuances of archaeological ethnicity. These questions are addressed by characterizing Chachapoyas cranial morphology through the production of principal components utilizing cranial metrics and non-metrics variables. These results are then discussed in conjunction with archaeological evidence concerning the meaning and nature of the shift in mortuary customs and how this relates to the imposition of Inka rule.

Dental microwear pattern in hamadryas and anubis baboons.

P. Nystrom[1], L. Swedell[2], J.E. Phillips-Conroy[3], C.J. Jolly[4]. [1]Dept. of Archaeology and Prehistory, University of Sheffield, Sheffield S1 4ET, Yorkshire, S1 4ET, U.K., [2]Dept. of Anthropology, Queens College - CUNY, Flushing, NY 11367, [3]Dept. of Anatomy and Neurobiology, Washington University Medical School, St. Louis, MO 63110, [4]Dept. of Anthropology, New York University, New York, NY 10003.

The dental microwear pattern of hamadryas baboons (*Papio hamadryas hamadryas*) living in the Awash National Park, Ethiopia, was examined and compared with anubis and anubis-like hybrid baboons from a different region of the Park. Dental impressions were collected from 6 hamadryas and 25 anubis and anubis-like hybrid individuals ranging in age from subadult to young adult. Dental microwear on facet 9 of the second maxillary left molar were examined using SEM. Feature density, type and dimensions were examined.

Several significant differences were detected between hamadryas and anubis baboons: The hamadryas had a higher feature density, a higher proportion of small pits, and striation and pit widths were smaller compared with the anubis.

Even though the two baboon subspecies inhabit different ecological zones in the Park, the plant species eaten do not differ greatly except that the hamadryas frequently included palm nuts (*Hyphaene thebaica*) in their diet. The consumption of this highly abrasive fruit may be the reason for the increased feature density. Furthermore, the soil in the hamadryas' habitat is richer in volcanic glass that may contribute towards the increased feature density and small pit size.

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Geometric morphometric approaches to the study of soft tissue growth and expression in the human face.

P. O'Higgins[1], N. Jones[1], A. Ghattaura[1], P. Hammond[2], T. Hutton[2], M. Carr[1]. [1]Dept. of Anatomy and Developmental Biology, University College London, London, England, WC1E 6JJ, England, [2]Dept. of Biomedical Informatics of the Eastman Dental Institute, University College London.

Geometric morphometric (GM) methods have proven to be of value in the analysis of variations in the form of the skeleton of the face. However, little attention has been paid variations in facial soft tissue morphology during growth and functioning. Here we present analyses of the soft tissues of the living human face utilising 2D photography and VRML meshes captured with a 3D photographic imaging system. These meshes, together with their texture maps provide realistic and accurate 3 dimensional representations of the face. We have developed software that allows us to landmark such images and to apply GM approaches to compare facial morphology between different subjects or the same subject through a range of different facial expressions. These lead to studies of soft tissue growth and motion in the human face. Both are important from the point of view of understanding normal human soft tissue facial variation and function. As such they have potential application in assessing normal and disordered growth and normal and disordered motion of the face. Our results indicate that soft tissue growth of the human face is reliably modelled using these methods, and that the extension to the analysis of motion also yields useful descriptors that have potential for clinical application. Further, variations in facial morphology due to growth or motion can readily be visualised by generating animations through warping of the VRML mesh. Such animations are highly informative and therefore of potential use in anthropological, anatomical and clinical contexts.

Variation in foraging and food processing techniques among white-faced capuchins (*Cebus capucinus*) in Santa Rosa National Park, Costa Rica.

R. O'Malley, L. Fedigan. Dept. of Anthropology, University of Alberta, Edmonton, Alberta, T6G 2H4, Canada.

Members of the genus *Cebus* demonstrate great skill in exploiting embedded foods and bypassing plant and animal defenses. Past studies have shown that *Cebus* diet and foraging behaviour varies significantly between sexes, age classes, groups, and populations. Only recently has greater attention been given to exactly what food processing techniques are employed, and how they vary within and between social groups. These are important questions because such variability might reflect what social learning processes (if any) underlie the acquisition and persistence of such techniques, and aid in determining whether they arise and persist through cultural processes.

A six-month field study was conducted among habituated *Cebus capucinus* in Santa Rosa National Park. 318 hours of focal animal data were collected from two adjacent groups numbering 28 individuals total. Data

were collected on foraging variables (foraging height, substrate use, proximity to others, and foods eaten) in addition to more specific data on food processing (hand and mouth use, hand movements, and techniques used).

Differences found in the foraging behaviour of age/sex classes are largely consistent with previous studies. A number of food processing techniques were documented for specific food items, and most individuals showed a strong preference for only one or two techniques. However, the spread of these preferences does not break down consistently along age/sex classes, groups, affiliates, or matrilines. These findings suggest that individual learning processes, rather than social learning processes, underlie the acquisition of food processing techniques.

Results of a pilot field extraction experiment will also be briefly described.

A comparison of relative enamel thickness of deciduous and permanent teeth in *Pan troglodytes* .

A. Olejniczak, L. Martin. IDPAS, Stony Brook University, Stony Brook, NY, 11794, USA.

Previous studies of enamel thickness in hominoids have concentrated on permanent teeth. Deciduous teeth form more quickly and need to function for a shorter period than permanent teeth so substantial differences in enamel thickness might be expected. This study compares relative enamel thickness (RET) for eight pairs of chimpanzee (*Pan troglodytes*) dp4s and M1s from the same individuals; four left mandibular and four right mandibular pairs were examined. Each tooth was sectioned in a buccal-lingual plane through the mesial cusps, yielding a series of sections ranging from 50 to 100 microns apart. Each section was photographed and measurements were taken following Martin (1983). RET is given by the ratio of the enamel area to the length of the enamel-dentine junction, divided by the square root of the dentine area, expressed as a percentage.

Measurements of multiple sections from each tooth demonstrate that RET decreases as an "ideal plane of section" is approached from either the mesial or distal direction. The ideal plane goes through the tips of both the dentine horns and the enamel cusps, yielding the minimum RET. The minimum RET recorded for each tooth is thus the best approximation of the ideal plane and is used in all calculations.

The mean RET of the deciduous premolars is 8.7 and the mean RET of the molars is 11.8. Among *Pan troglodytes* individuals, deciduous premolar enamel is approximately 74% as thick as permanent molar enamel, although one unusual individual had thicker enamel in the deciduous premolar than the permanent molar.

Down Syndrome: an example of the interaction between culture, demography, and biology in determining the prevalence of a genetic trait.

C. Olsen[1], P. Cross[2], L. Gensburg[2], J. Hughes[2]. [1]University at Albany, State University of New York, Albany, NY, 12222, USA, [2]New York Dept. of Health.

The incidence of Down syndrome (DS) at conception is highly dependent on the maternal age distribution and age-specific pregnancy rates. The live birth prevalence of DS reflects these factors and fetal deaths. Since the introduction of prenatal diagnosis in the early 1970's, the role of fetal deaths in the equation has increased. Between 1920 and the early 1970's, DS live birth prevalence decreased in many populations due to declining fertility rates, particularly among older women. In the late-1970's the trend reversed, as the median age of populations and birth rates among older women steadily increased. This paper illustrates these interactions using data we have analyzed for New York State (NYS) and comparative data obtained from the literature. Between 1983 and 1992, DS live birth prevalence in NYS remained stable at about 10.4 per 10,000 live births. The number of prenatal tests performed increased by 96% and the number of DS fetuses detected prenatally nearly tripled. This was balanced by a steady increase in births to women aged 30 and over and an increase in the number of DS births. We estimated that without prenatal diagnosis, DS live birth prevalence would have reached 15.3 per 10,000 live births. In this paper we also examine more recent data to compare NYS trends in the 1990's with predictions from the literature.

Effect of moderate undernutrition on the functional components of the axial skeleton.

A.B. Orden[1], E.E. Oyhenart[1], M.F. Cesani[1], M. Zucchi[1], M.C. Muñe[1], M.E. Villanueva[2], R.R. Rodriguez[2], E.R. Pons[2], H.M. Pucciarelli[1]. [1]Centro de Invest. en Genetica Basica y Aplicada (UNLP). Consejo Nacional De Invest. Cientificas Y Tecnicas (Conicet), La Plata, Buenos Aires, B1900AVW, Argentina, [2]Servicio De Diagnostico Por Imagenes. Fac. Cs. Veterinarias, UNLP.

The aims of the present study are to asses if moderate undernutrition affects the functional components of the axial skeleton in growing rats, and if so, to evaluate its intensity on each component. Two experimental groups were followed up: (1) Control: rats fed on a stock diet ad libitum, and (2) Undernourished: rats fed on 75% of the daily food eaten by controls of the same age and sex. All the animals were x-rayed every 10 days, from 21 to 100 days old. Cranial, cervical, thoracic, and lumbar-sacral lengths were measured on each radiograph. Data were processed by repeated analysis of variance, and Bonferroni post hoc tests. The quadratic equation ($y = a+bx+cx^2$) explained at least 99% of the age, and age*sex variation in all the segments. Age*treatment and age*treatment*sex interactions were explained by high order equations. The post hoc comparisons showed that controls were greater than the undernourished. These results indicated that moderate undernutrition modified the mostly linear growth patterns of the axial skeleton. There were not sex differences. Undernutrition affected most the lumbar-sacral (18%), followed by the cervical (14%), thoracic (10%), and craniofacial (7%) skeleton. These findings show that growth in different regions of the axial skeleton has a particular susceptibility to nutritional stress.

Estimation of body mass and diet for fossil cercopithecids from the Asbole area of the Afar, Ethiopia.

C. Orr[1], Z. Alemseged[2]. [1]Arizona State University, Tempe, AZ, 85282, USA, [2]IHO/ASU.

Fossil cercopithecids that are considered in the present study come from the Asbole area of the Afar region, Ethiopia, and are collected by the Busidima-Dikika Paleoanthropological Research Project. The area contains sediments that are biostratigraphically dated to Middle Pleistocene. Over thirty mammalian species, including four primates, were encountered. The four primate species are *Theropithecus oswaldi, Cercopithecus sp. , Papio sp.* and *Colobus sp*. Except for *Theropithecus*, regression models based on first and second mandibular molar measurements are used to estimate body mass, and indices of shearing capabilities regressed on field-derived dietary data are used to predict the percentage of fruit and leaves in the diet of these taxa. Taxa represented at Asbole fall within the body mass ranges for their extant analogs (*Cercopithecus* ~ 5 kg, *Papio* ~ 14 kg, and *Colobus* ~ 8 kg). Asbole *Cercopithecus* is reconstructed as being highly frugivorous, and despite a wide range of variation around the dietary estimates, as evidenced by broad 95% confidence intervals, our fossil *Colobus* specimens fall well below both extant *Procolobus badius* and *Colobus guereza* in percent folivory. Low shearing relative to extant colobines seems to be a hallmark of the fossil taxa throughout the evolutionary history of the lineage.

Social races and human populations: why forensic anthropologists are good at identifying races.

S. Ousley[1], R.L. Jantz[2]. [1]Dept. of Anthropology, Smithsonian Institution, Washington, DC, 20560-0138, USA, [2]Dept. of Anthropology, University of Tennessee, Knoxville.

Forensic anthropologists use social race terms in reporting results, and as a result some consider them advocates of the biological race concept. However, no suggestions for practical non-racial terminologies have come forward. Also, the arguments for or against the existence of biological races have rarely centered on a thorough analysis of data. As a result, Norman Sauer's question "If races don't exist, why are Forensic Anthropologists so good at identifying them?" (*Soc. Sci. Med.* 34:107, 1992) has never been adequately answered. Craniometric data from the Forensic Data Bank at UT Knoxville were explored to answer Sauer's trenchant question.

Discriminant function analysis (DFA) maximizes differences among predefined groups and can correctly distinguish between a sample of American Whites and Blacks using cranial or postcranial measurements 85 to 95% correctly. However, Japanese, Chinese, and Vietnamese males can be separated equally well, as can Japanese from Nagasaki and Tohoku prefectures, and American Whites from the 19th and 20th centuries. So separation in DFA does not imply that different populations are different biological races *per se,* unless an almost infinite number of races is allowed.

Depending on the methodology, differences may or may not be found between different populations. Sometimes these populations may correspond to social races, or language, geography, or other subjective criteria. In fact, one would expect to find differences between reproductively and geographically separated populations due to drift and selection. As Howells (1995) said, "There are no races, only populations." "Race" can and should be used in its social context only.

Dental morphology and pathology of prehistoric Canary Island populations: a new perspective.

L. Owens. Institute of Archaeology, University College London, London, London, WC1H 0PY, UK.

Dental morphology and pathology can be used to investigate human population biology, diet and health. This project uses traditional and innovative methods to examine the prehistoric colonisation and exploitation of the Canarian islandscape (Lanzarote; Fuerteventura; Gran Canaria; Tenerife; La Palma; La Gomera; El Hierro). Information on population distribution and migration is sought through deployment of the ASU dental anthropology system. Patterns of dental pathology – valuable in reconstructing palaeoeconomy – are studied using a scoring system devised by Hillson (2000). The unusually variable ecology of the islands provides an opportunity to examine the distribution and development of human groups in terms of economic and ecological adaptation. A radiometric temporal framework is in place, to test for genetic and dietary changes through time.

Preliminary results indicate considerable biological diversity within and between the islands of the Canarian archipelago, and that this is likely to be related to population movements through time. Limited occlusal wear and elevated levels of caries are observed for Gran Canaria and Tenerife, where agriculture is both ecologically viable and historically attested. This contrasts with individuals from the desiccated island of Fuerteventura, which demonstrate pronounced wear and low prevalence of caries. The western islands of La Gomera and El Hierro seem to occupy an intermediate position between these poles. The economic implications of these findings are considered.

Human skeletal indications of the emergence of chronic infectious disease in Northern Viet Nam.

M. Oxenham. Colorado College, Colorado Springs, Colorado, 80903, USA.

This study examines human skeletal evidence for the emergence of chronic infectious disease in northern Viet Nam. The sample includes the remains of 190 individuals representing the Mid-Holocene and Metal period. The aim of this study is to develop insights into both the range of chronic infectious diseases these early Vietnamese populations may have been exposed to and the history and development of disease in the region. Further, this study will contribute to the ongoing development of the epidemiological database of disease in tropical and sub-tropical Southeast Asia specifically, and the world generally.

Results revealed that no individuals in the Mid-Holocene sample displayed skeletal lesions consistent with a diagnosis of chronic infectious disease. However, a number of Metal period individuals had lesions that included an infectious disease in their respective differential diagnoses. Diagnosis in four instances included a fungal condition.

Factors contributing to the apparent first appearance of chronic infectious disease in Metal period Viet Nam include: (1) The evolution of pathogens over time, leading to chronic rather than acute responses; (2) Higher levels of debilitation and/or decreased levels of immunocompetence in the Metal period; (3) Increased contact with bacterial and/or fungal vectors in the Metal period. The last two factors may be related to historically and archaeologically documented major demographic (Han colonizing efforts) and economic (agricultural intensification) changes in the region during the Metal period.

Skeletal pathologies associated with malnutrition mortality: implications for interpreting the paleopathology of nutritional deficiencies.

R.R. Paine[1], B. Brenton[2]. [1]Texas Tech University, Lubbock, Texas, Lubbock, TX, 79410, USA, [2]St. John's University.

In this presentation we offer an analysis of skeletal pathologies from 25 individuals known to have died from malnutrition. These cases are part of the extensive "Raymond Dart" skeletal collection, housed at the University of Witwatersrand Medical School, Johannesburg, South Africa. The collection provides an unique research opportunity, most of the individuals have been autopsied and a biological profile including age, sex, height, weight, ethnicity, and cause of death is available for them.

The sample was drawn from a 20th Century Black South African population. The malnutrition cases include scurvy and beriberi, as well as, general dietary deficiencies. Individuals were found to exhibit alveolar bone loss, dental caries, enamel hypoplasias, periostitic lesions, osteomyelitis, cribra orbitalia, and cranial pitting. A number of trauma-related lesions were also noted. The biocultural dimensions of poverty, violence and these skeletal findings will be discussed.

Improved insights into skeletal-based interpretations of nutrition-related health problems, and for the paleopathology of nutritionally stressed prehistoric and historic populations are provided by this research. Future work will include the histological examination of ribs to determine microstructural bone patterns linked to malnutrition.

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A reference distribution of Fst values for SNPs.

A.J. Pakstis, J.R. Kidd, K.K. Kidd. Dept. of Genetics, Yale University, New Haven, CT, 06520-8005, USA.

A distribution of Fst values for a large number of SNPs based on a sampling of human populations from all major geographic

regions can be helpful in assessing whether or not genetic variation at some new locus has been subject to selection. Extremely large or small Fst values relative to a large reference distribution would certainly support the possibility of some form of selection at work, at least historically. We have accumulated data on 73 autosomal SNPs in 33 population samples (averaging ~53 individuals per population) distributed across all major continental regions. Most of the SNPs are located in intronic regions of some 27 different loci or gene clusters (21 widely separated regions on 14 different chromosomes) and none of the SNPs is known or suspected to have been subject to selection. The mean of the Fst distribution is 0.14 (std.dev = 0.065; range, 0.04 to 0.37). At 20 of the loci (66 SNPs), 2 to 7 SNPs have been studied per locus making it possible to test for any tendency for similarity of Fst values of SNPs at the same locus. The correlation ratio (eta) was 0.64, just significant at the 5% level (F-ratio = 1.64 with 65 and 46 df), indicating some global correlation based on very tight linkage. This work was supported in part by NIH GM57672, MH62495, AA09379, and NSF BCS-9912028.

Sex differences in chimpanzee and orangutan diet and the sexual division of labor in humans.

S. Pandolfi[1], C.P. Van Schaik[2], A.E. Pusey[1]. [1]Biological Anthropology & Anatomy, Duke University, Hillsborough, NC, 27278, USA, [2], [3]University of Minnesota.

It is well documented that many human societies exhibit a sexual division of labor. Traditionally, among modern hunter-gatherers, females are thought of as the "gathering sex" while males are thought of as the "hunting sex." Sex differences in chimpanzee (*Pan troglodytes*) and orangutan (*Pongo pygmaeus*) feeding ecology have also been reported. Specifically, chimpanzee males hunt more and eat more meat, while females participate in more tool-assisted extractive foraging. Orangutan females, on the other hand, eat more meat than males (although the two species vary greatly in their hunting styles), and there are no sex differences in tool use. Four hypotheses have traditionally been proposed to explain dietary sex differences in non-human primates: "Care of Offspring," "Male Dominance," "Nutritional Constraints," and "Social Considerations." Our examination of more than 64,000 feeding bouts of the chimpanzees of Gombe National Park, Tanzania and 17,525 hours of focal sampling on the orangutans of Suaq Balimibing, Sumatra, shows that in addition to differences in faunivory, there are also sex differences in vegetable food diet. The first two hypotheses, while they may help explain the differences in faunivory, are inadequate for explaining the differences in folivory and frugivory. The remaining two hypotheses, however, may be more encompassing. We found that while nutritional constraints placed on females by gestation and lactation likely influence dietary sex differences in great apes, differences in behavioral socioecology are largely responsible for the variation in chimpanzee and orangutan diet. The differences between the two species may also be explained by differences in social strategies, as chimpanzees and orangutans have vastly different social organizations. Dietary sex differences among great apes are noteworthy because they may represent the ancestral condition from which the sexual division of labor in humans developed; they may also show that this division is likely largely due to sex differences in socioecological strategies, and not solely physiological differences. As the dietary sex differences in chimpanzees closely resemble those seen in modern hunter-gatherers, we conclude that these differences may have evolved in the *Pan-Homo* clade.

What does an ability to use tools tell us about 'cognition'.

M. Panger. George Washington University, Washington, DC, 20052, USA.

The ability of an animal to 'solve' a problem with the use of a tool has often been used as a proxy for overall cognitive ability. A survey of the primate literature including 6 families, 43 genera, and over 150 species demonstrates that tool use *per se* can be found in a variety of species, but that habitual tool use is limited to a few genera living under specific conditions: captive *Cebus* spp., *Gorilla gorilla*, and *Pan paniscus* and captive and free-ranging *Pan troglodytes* and *Pongo pygmaeus*. These primates are often considered the most 'intelligent' non-human primates. A perception fueled by their sensorimotor skills and their relatively large brains, and in the case of the great apes, their phylogenetic proximity to humans.

How tool use correlates with overall cognitive abilities, however, remains debatable. There is growing evidence that a species' ability to solve problems using tools does not necessarily correspond with an increase in other problem-solving or decision-making abilities, or with greater complexity in social behavior. For example in species such as *Pan troglodytes* and *Pongo pygmaeus,* tool-use does correlate with success in discrimination learning and mirror self-recognition tests and also with an ability to socially deceive others. In species such as *Cebus* spp. and *Papio* spp., however, this is not the case. Additional relationships among problem-solving skills, decision-making, social 'intelligence', and tool use are discussed and suggest that adaptations associated with complex foraging patterns may not, by themselves, necessarily lead to higher levels of overall cognitive abilities in primates.

Tortoises and hares: management of pace in relation to work intensity and sustainability.

C. Panter-Brick. University of Durham, Durham, DH1 3HN, UK.

This paper focuses on the nature of work in labour-intensive societies, and the management of work pace in habitual tasks. How can heavy workloads be achieved and sustained? Many arduous activities, such as carrying loads, demand endurance over time rather than intensive effort per unit time. Work pace management lies in regulating both the work rate and the rest pauses during physical activity. It is useful to distinguish between strategies that maximise long-term endurance (adopted by 'tortoises') and those that maximise short-term productivity (adopted by 'hares'). They are appropriate to different work contexts, and suit individuals of different health statuses and abilities. Adjustments in work pace are an important aspect of the links between physical activity, health, and productivity. Yet they are underresearched, partly because it remains a challenge to devise good measures of work pace and work intensity.

A study of the human skeletal remains of the Mycenaean tombs from Bronze Age Sykia, Lakonia, Greece.

A. Papathanasiou. Ephory of Paleoanthropology and Speleology, Greek Ministry of Culture, Athens, 11636, Greece.

The Bronze Age site of Sykia, located in southern Greece, close to modern Molaoi, was a peripheral urban center of the Mycenaean world and is dated from the 14th to the 12th centuries BC. Three tombs with multiple burials from the Mycenaean cemetery that were excavated in 1996 have yielded the fairly well preserved but frequently commingled and fragmented skeletal remains of the inhabitants of a town, which has not been identified yet. This study provides insight into the life and health of this population through the analysis of the human osteological remains of the entire population represented by this cemetery. The Sykia population consists of a minimum number of 35 individuals; 27 adults, of which eight have been identified as male and seven as female, eight subadults, and no infants. The mean adult age was 31.3 years. The mean stature for the males was 170.5 cm and for the females 161.3 cm.

The pathological conditions that were observed on dental remains include relatively low incidence of caries 7.2% (15/208 teeth), linear enamel hypoplasias 5.8% (12/208), and maleruption 1.4% (3/208), and moderate incidence of premortem tooth loss 9.1% (19/208). Tooth wear was cupped but not severe. Pathological conditions observed on skeletal remains include relatively high incidence of osteoarthritis (14.3%), musculoskeletal stress markers (20%), and healed fractures (11.4%). Also, two individuals exhibited periosteal reaction, and one exhibited the Klippel-Feil syndrome. Only one instance of porotic hyperostosis was observed in contrast to other Greek populations in which anemic conditions were highly prevalent.

Male dominance rank reversals during the breeding season in ringtailed lemurs (*Lemur catta*): changes resulting from female mate choice.

J. Parga. University of Texas at Austin, Austin, TX, 78712, USA.

Although the breakdown of the male dominance hierarchy during the breeding season is well documented in *L. catta*, mechanisms causing this disruption have not been fully explained. I will present evidence which suggests that male rank reversals are precipitated by female mate choice. Data on rank reversals were collected as part of a study on mate choice in free-ranging ringtailed lemurs on St. Catherine's Island, USA during June – December 2000. Male dominance rankings were determined prior to the start of the breeding season by approach/withdraw interactions and agonistic wins and losses. During the breeding season, I documented rank reversals by collecting all occurrences of agonistic and reproductive behavior. Male rank reversals occurred during the breeding season in three out of eight observed mating bouts. These rank reversals were transitory, typically lasting for a few hours; all were less than a day in duration. Each time a rank reversal occurred, the estrus female expressed mate choice by sexually presenting to a lower-ranking preferred male; in one case, a female also chased away a higher-ranking unpreferred male. Each male who rose in rank mated with an estrus female following the reversal. When a female exhibited sexual preference for only the alpha male of a troop, no rank reversals occurred. Evidence suggests that males assess their potential 'payoff,' in terms of mating success, by observing female mate choice. If females exhibit sexual preference for them, lower-ranking male ringtailed lemurs appear more likely to increase their mating effort, and affect a rank reversal.

Early modern humans and the formation of Middle Stone Age shell middens along the Cape west coast.

J. Parkington. Archaeology Dept., University of Cape Town, Cape Town, Cape, 7701, South Africa.

There are no persuasively modern hominid remains that are demonstrably earlier than the fragments associated with shell middens and Middle Stone Age tools along the shores of the Fynbos biome in southernmost Africa. The best known contemporaries of MSA hominids are the "neandertal" people, who, although recognisably archaic in anatomy and arguably not modern in behavioural terms, were also leaving behind, admittedly modest, shell middens along a coastline associated with a "Mediterranean-type" ecosystem. Elsewhere there are claims for southwestern Asia and the whole of Africa as the cradle(s) of modern people. This presentation tackles the issue of why the combination of rich marine and poor terrestrial ecosystems around the western and southern Cape coasts might have generated the earliest anatomically and behaviourally modern people. Marine foods are arguably essential for building the large brains characteristic of modern people.

An analysis of a quantitative method for rib seriation using the Spitalfields documented skeletal collection.

R. Pastor, S. Owers. University of Bradford, Dept. of Archaeological Sciences, Bradford, West Yorkshire, BD7 1DP, United Kingdom.

The accurate recording of human ribs is essential in forensic anthropology and human osteology. Accurate rib seriation facilitates the correct assessment of minimum number of individuals from commingled remains and the analysis of trauma patterns to the chest cavity, as well as the identification of the fourth rib for age estimation. A dependable and reliable method of rib seriation has advantages for the analysis of the rib cage in degraded remains from forensic cases and fragmentary remains from archaeological contexts.

This research tested a quantitative method of rib seriation based on three metric variables, Superior (anterior) Costo-Transverse Crest Height (SCTCH), Head-to-Articular Facet Length (HAFL) and Articular Facet-to-Angle Length (AFAL). Ribs from a sample of 133 individuals from the documented collection of the Christ Church Spitalfields Crypt burials (NHM, London) were measured for this study. The method was first described by Hoppa and Saunders (1998) using only SCTCH. This study confirms results of the previous study and extends it with the application of two new measurements and further analyses on sex and population bias. All three dimensions have a clear association with rib number. SCTCH proved to be the most useful method for rib seriation, indicating that all ribs can be individually identified from others in the sequence (Spearman's Correlation Coefficient = 0.83, $p < 0.01$). For both SCTCH and AFAL, the central ribs are distinct from each other. SCTCH is not the method of choice for distinguishing between ribs 8 and 9, but HAFL proved useful for this. All three metric variables, used in combination with each other, may be useful for quantitatively seriating human ribs especially with fragmentary skeletal assemblages.

Effects of age and exercise on long bone modeling and remodeling.

O. Pearson[1], D. Lieberman[2]. [1]Dept. of Anthropology, University of New Mexico, Albuquerque, NM, 87131, USA, [2]Dept. of Anthropology, Harvard University.

Bones adapt to mechanical stresses by modeling (growth) and Haversian remodeling (repair). To test the effects of age on the modulation of these responses, we examined 44 male Dorset sheep, divided into three age classes: juveniles, subadults, and young adults; each class was subdivided into exercising and control groups. Exercising animals trotted on treadmills for 60 minutes/day for 90 days, controls did not; bone growth was labeled with fluorescent dyes. After the experiment, each right femur, tibia, and metatarsal was sectioned at midshaft and analyzed using fluorescent microscopy. We measured the mm^2 of subperiosteal bone added (SPA) during the experiment, the number of secondary osteons/mm^2. cortical area (CA), and Imax of each section.

Exercise produced: a rapid decline in SPA with age in the femur and tibia but little difference in the metatarsal; rapidly declining numbers of secondary osteons with age in the metatarsal, a minor decrease in the tibia, and no change in the femur; much less increase in all Imax values with age; and no clear pattern in CA. Thus, exercise induces a trade-off in modeling versus remodeling in juvenile limbs, but age dampens these responses. Juvenile humans have a greater osteogenic response to activity than adults; remodeling changes are less well characterized.

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Giant lemurs were hunted and eaten in Madagascar.

V. Perez[1], L. Godfrey[1], M. Atkinson[2]. [1]Dept. of Anthropology, University of Massachusetts Amherst, MA, 01003, USA, [2]Natural History

Museum, Oxford, UK.

We report here the first definitive evidence of hunting and consumption of giant lemurs in Madagascar. Specimens of *Palaeopropithecus ingens* and *Megaladapis* (subgenus *Megaladapis*) from Taolambiby, a subfossil site in southwestern Madagascar, show classic signs of butchering. The characteristics of the tool-induced bone alterations (sharp cuts near joints, spiral fractures, and percussion striae) suggest dismembering, skinning, and filleting. Until now, conclusive evidence of megafaunal modification by humans in Madagascar was limited to a few hippo and elephant-bird bones and one extinct aye-aye tooth. The "new" modified specimens belong to the Oxford Museum of Natural History. Collected 90 years ago (1911), these specimens were virtually unknown to science until they were effectively rediscovered in the summer of 2000.

Madagascar experienced a dramatic loss of megafauna over the past two millennia. Gone are flightless elephant birds, pygmy hippopotamuses, giant tortoises, and approximately one third of the lemur species (including all species weighing more than 10 kg). The role humans played in the extinction process is still hotly debated. Whereas we know that the great majority (if not all) of the Holocene megafauna were alive when humans first arrived in Madagascar (ca. 2000 b.p.), there is good evidence that at least some (including *Palaeopropithecus* and *Megaladapis*) survived the advent of humans by 1500 years or more. Some researchers dismiss hunting as a major factor contributing to megafaunal extinctions on the grounds that the people who colonized Madagascar were fishermen, herders, and agriculturalists and not big-game hunters. Our data do not speak to the relative cultural importance of hunting, but they do demonstrate that a role for hunting in the extinction process cannot be summarily dismissed. The time frame for the extinctions argues against a Blitzkrieg model of rapid extinction via overkill. Nevertheless, hunting may help to explain the high vulnerability to extinction of large-bodied species.

Health, labor, and political economy in Provincial Arabia.

M. Perry. University of New Mexico, Albuquerque, NM, USA.

In bioanthropological investigations, it is imperative that researchers consider how political-economic processes interrelate with human biology to affect the health of ancient populations. An interesting case model for this approach is provided by examining the political relationships between the diverse indigenous populations of the Near East and the Roman administration along the eastern frontier of the Roman Empire. The skeletal remains from three sites within the region were included in this analysis: the habitation camp of pastoral nomads at Zabayir Zahir ed-Diyab in central Jordan; the ancient port city of Aila at the northern tip of the Gulf of Aqaba; and the agricultural village of Rehovot in the north-central Negev.

At each site, the available skeletal remains were examined for non-specific indicators of stress, osteoarthritis, and trauma to provide a profile of community health and habitual activity. These methods were combined with 87Sr/86Sr isotope analysis to clarify the residential life history of a sample of individuals from each site. By incorporating the available historical and archaeological data with the bioanthropological results, variation in health, activity levels, and population movement can be explained by differences in access to resources and labor control within the communities, as well as macro-micro interactions between the indigenous population and the Imperial administration.

This research was made possible through the support of the American Center of Oriental Research, the Joukowsky Family Foundation, the Smithsonian Institution, CAORC, Geochron Laboratories, and Samuel Bowring of the Department of Earth, Atmospheric, and Planetary Sciences at MIT.

Upper limb morphology and the division of labor among southern African Holocene foragers.

S. Pfeiffer, J. Stock. Dept. of Anthropology, University of Toronto, Toronto, Ontario, M5S 1A1, Canada.

The size and shape of adult humeri can provide information about lifetime behaviors among past human groups. Morphological differences between sexes can indicate gender-based division of labor. Mechanically relevant morphological variables include the relative strength of the diaphysis, asymmetry between antimeres, and the relative contributions of shape and size to that asymmetry. This study compares osteometric measurements and midshaft cross-sectional geometry of paired humeri from Later Stone Age South African foragers (n = 33:15m, 18f), each with a Holocene ^{14}C date. Narrowly defined archaeological contexts, excellent preservation allowing confident attribution of sex, and continuity with ethnographically described Khoisan people heighten the value of information from this sample. When the midshaft strength of the humerus is controlled for body size, both sexes appear to have more gracile upper arms than other groups of foragers. Within the group, the male humeri are significantly stronger than females'. Strength and shape asymmetry are greater among the males, yet the cross-sections tend to be more circular. Female humeri are less bi-laterally asymmetric and the diaphyses tend to be less circular. These results are consistent with more variable patterns of habitual behavior among males, including the regular use of light-draw bows, and more consistent and repetitive habitual activity among females, likely resulting from the use of digging sticks.

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Life and death in Kentucky: a bioarchaeological view from the Revolution Era to the Progressive Era.

S. Phillips. Dept. of Anthropology, Indiana State University, Terre Haute, Indiana, 47809, USA.

This study examines health changes in the skeletal remains from a family cemetery located in rural south central Kentucky. The temporal span of the interments links United States history from its Revolutionary War period up to the mid-twentieth century. This analysis considers how health patterns changed in this family line from the pioneer period, through the Industrial Revolution, and beyond the Progressive Era.

The materials for this study are comprised of skeletal, archaeological, and documentary data. The skeletal population (n = 70) represents original Euro-American pioneers and their subsequent descendents in the region. Archaeological data include the associated grave goods. The documentary materials (headstone epitaphs, census data, family bibles, county records, newspapers, etc.) supplement this analysis with contextual data. Methods for this analysis include differential diagnosis of skeletal and dental lesions, demographic assessments (life tables, mortality rates, morbidity rates, etc.) and stable isotope and trace element assessments of diet.

This analysis demonstrates changes in health and the quality of life that largely transpired during the late nineteenth and early twentieth centuries. Many measures, such as childhood stress markers, frequency of infectious skeletal lesions, quality of diet, maternal mortality, and life expectancy indicate a decline in health during the last quarter of the nineteenth century followed by a rebound during the first decades of the twentieth century.

This project was supported by the living descendents, the Kentucky Transportation Department, the US Army Corps of Engineers, the Kentucky Heritage Council, and Lincoln County, KY.

Taphonomic analysis of butchered chimpanzee skulls from Liberia.

T. Pickering[1], R. J. Clarke[2], R. Protsch Von Zieten[3]. [1]Tulane University, New Orleans, Louisiana, 70118, USA, [2]Sterkfontein Research Unit, [3]Johann Wolfgang Goethe Institut.

Butchery damage has been observed on two non-modern hominid cranial specimens from prehistoric Africa—the Stw 53 hominid skull from Sterkfontein, South Africa (identified as early *Homo* or late *Australopithecus* and dated ca. 2 mya), and the Bodo cranium, from the Middle Awash, Ethiopia (identified as archaic *H. sapiens* or *H. heidelbergensis* and dated ca. 600 kya). It is not yet possible to infer the reason(s) for the butchery of the Sterkfontein and Bodo hominids, but reasonable hypotheses include curation (e.g., trophy collecting), cannibalism, mutilation and/or funerary procedures. Our taphonomic analysis of 278 chimpanzee (*Pan troglodytes verus*) crania, collected in the 1950s by Dan horticulturalists of Liberia, provides data directly relevant to testing these hypotheses. Because the Dan prepared the chimpanzee crania as trophies it is likely that they bear cutmark patterns distinguishable from those inflicted by less purposeful processing of head elements, such as may occur with butchery related solely to subsistence activities or mutilation. In addition, modern chimpanzees are morphologically similar to the hominid species represented by the Sterkfontein and Bodo fossil specimens—with smaller cranial vaults, more receding foreheads and more prognathic faces than are possessed by modern humans. This means that the butchered chimpanzee sample is probably a better model for the Sterkfontein and Bodo early hominids than are trophy skulls of modern humans.

Thermic exposure of the burials from Cuicuilco, Mexico.

C. Pijoan, J. Mansilla, G. Valenzuela. Instituto Nacional de Antropologia e Historia. Mexico, Mexico, D.F., 1090, Mexico.

When studying the burials from the Prehispanic site of Cuicuilco (650-200 B.C.) in Mexico City, we saw that almost all of them showed variations in color due to heat. However, all of these burials are primary and there was no evidence of coals that would show that a fire had been lighted either on top or under the corps. Furthermore, the alterations due to heat had been caused when the bone were dry. Some of the bones are burned more on one side that on the other.

When trying to explain these changes, we remembered that this site was abandoned when a volcano, the Xitle, erupted, and that all the village was covered with a leyer of lava that in some places was 8 m. deep.

In this paper we will explain the changes undergone by the burials due to the lava heat.

Assessing the utility of incisor morphology for discriminating fossil species.

V. Pilbrow. Dept. of Anthropology, New York University, New York Consortium for Evolutionary Primatology, New York, NY, 10003, USA.

The morphology of the anterior dentition has received scant attention for purposes of taxonomic discrimination. Recently, however, several Miocene hominoid species have been differentiated primarily on the basis of incisor morphology. Based on the premise that extinct and extant species share similar patterns of variation, this study investigates the nature and patterns of variation in lingual incisor morphology in 341 chimpanzees, 319 gorillas, 171 orangutans and 321 gibbons, thus assessing the utility of incisor morphology for differentiating fossil hominoid species.

The aim of the study is to examine (1) the types of morphological features encountered on the lingual side of incisors, (2) the nature of variation within species, subspecies and populations in such features, and (3) the correlation between morphological features and size, sex and diet.

Frequencies were calculated for different character states within species, subspecies and populations. Contingency tables and chi-square statistics were used to study associations. Results show that (1) lingual incisor morphology is remarkably dissimilar in the hylobatids and great apes, (2) no character state occurs consistently within species, subspecies or population, (3) morphological features do not correlate significantly with size or sex, (4) dietary correlation cannot be established because variable character states are recognized even within a single locality.

Species, subspecies and populations of modern hominoids can be differentiated using lingual incisor morphology but it is the frequency of occurrence of traits like continuous or discontinuous cingulum, and presence or absence of pillars that differentiates them. Lingual incisor morphology when used in conjunction with other dental traits improves species discrimination.

Patterns of craniofacial variation in primates.

J.M. Plavcan. Dept. of Anthropology, University of Arkansas, Fayetteville, AR, 72701, USA.

Metric variation plays an important role in species recognition in the fossil record. Key to this process is the identification of characters that consistently show low levels of intraspecific variation, such as molar teeth. The interspecific nature of cranial character variability for this purpose is not well established. Recently, Wood and Lieberman (2001) showed that mandibular, palatal and maxillary dimensions, hypothesized to be phenotypically plastic because of high masticatory strains, are more variable than basicranial, neurocranial, or upper facial variables. Their analysis was based on pooled-sex samples of five extant species.

This analysis tested and extended the Wood/Lieberman hypothesis with a craniometric sample of 35 primate species, with 40 dimensions from a minimum of fifteen specimens of each sex. Only wild-shot adults of known sex and locality were used. Dimensions were divided into palatal, basicranial, cranial vault, orbital, mandibular, and facial dimensions. CVs and variants of Levine's test were used to compare variability for separate-sex samples. There is a very consistent pattern of low variability in orbital and cranial vault traits, higher variability in facial and several mandibular traits, and intermediate variability in palatal and basicranial traits. Dimorphism inflates pooled-sex variability in palatal, lower facial, and several basicranial dimensions. It is suggested that developmental and functional patterns determine intrasexual trait variability. While the original Wood/Lieberman hypothesis is not consistently supported, the results reinforce their suggestion that the causes of patterns of variation must be considered in testing taxonomic hypotheses using trait variability. Supported by NSF SBR 9616671.

Directional asymmetry in joint surface size in a Mississippian sample.

J. Plochocki. University of Missouri-Columbia, Dept. of Anthropology, Columbia, Missouri, 65211, USA.

Directional skeletal asymmetry (DA) is often used as an indicator of physical activity patterns in archaeological populations. DA can largely be attributed to increased mechanical loading during endochondral bone growth. This study reports on patterns of skeletal asymmetry in the dimensions of upper and lower limb joint surfaces. The patterns are explored using two samples from the Lilbourn (n = 24) and Campbell (n = 56) Mississippian sites in Missouri.

Directional asymmetry in this sample can be characterized as follows: proximal limb bone joint surfaces tend to exhibit greater asymmetry than those of the distal limb bone for both upper and lower limbs, upper body DA is more marked than lower body DA, and the direction of the asymmetry for all the dimensions is consistent in each the upper

limbs and lower limbs. There were no significant differences in the levels of asymmetry between the Lilbourn and Campbell material. Recently, the effects of joint loading on joint surface size have been called into question, particularly in the lower limb. In these samples, external joint surface size is influenced by physical activity. The results suggest that physical activities requiring regular, unilateral loads passed through joint surfaces, especially at the elbow, produce measurable, patterned, and statistically significant asymmetries.

Limb proportions, body mass and joint postures in *Homo* and australopithecines.

J. Polk. Dept. of Anthropology, Harvard University, Cambridge, MA, 02138, USA.

Two fundamental differences between *Homo* and australopithecines are their body mass and relative proportions of their lower limb segments. *H. ergaster* and later *Homo* are both heavier and have relatively longer legs than earlier hominins. While these differences should correlate with differences in joint postures, there has been a lack of experimental evidence to corroborate this interpretation. To evaluate the functional consequence of changes in body mass and limb proportions for joint postures and joint moments, comparisons have been made between 3 semi-terrestrial monkeys (patas and 2 baboons) that have the same body mass but differ in body proportions, as well as through multiple regression analyses across a group of 6 monkeys (vervets, patas, and baboons) that differ in both body mass and proportions. Monkeys having longer limb segments or greater body mass were predicted to adopt more extended postures than shorter-limbed or lighter monkeys in order to moderate joint moments. 3D kinematic and kinetic data were obtained for the monkeys at SUNY Stony Brook. Results of the narrow allometric comparison revealed that limb-length differences can successfully predict differences in joint angles and moments, with longer limbed individuals having more extended joints and lower joint moments than shorter limbed individuals. In the multiple regression analyses, both body mass and proportions significantly influence limb kinematics with heavier and longer limbed individuals using more extended postures. As a result, members of the genus *Homo*, with their longer tibiae and larger body mass, probably used more extended knee postures than australopithecines, permitting these later hominins to use a more efficient striding bipedal gait.

Associations of changes in mood with changes in blood pressure and total cholesterol levels during a 17-month study: understanding the mechanisms linking psychosocial risk factors with cardiovascular disease.

T. Pollard[1], J. Schwartz[2]. [1]University of Durham, Durham, County Durham, DH1 3HN, UK, [2]SUNY Stony Brook.

Psychosocial factors implicated in the pathogenesis of cardiovascular disease (e.g. life events, job strain) are thought to act at least partly through their effects on mood, which may change blood pressure and serum lipid levels via neuroendocrine pathways. Previous studies have demonstrated that short-term increases in negative affect or arousal are associated with increases in ambulatory blood pressure over periods of hours or days. Here we investigate the within-person association of changes in reported tense arousal with changes in systolic blood pressure (SBP), diastolic blood pressure (DBP), and total cholesterol (TC) levels, each assessed 4 times over a 17-month period in 128 men and 154 women. We apply multilevel modeling, controlling for effects of changes in season and body mass index. Results show that SBP, DBP and TC were all significantly higher in winter than in summer ($p<0.001$), and that change in BMI was positively associated with changes in SBP, DBP and TC ($p<0.001$). Changes in levels of tense arousal were positively associated with changes in SBP and DBP (both $p<0.05$), but not with changes in TC. The results demonstrate a relationship between changes in mood and blood pressure over a much longer time scale than previous studies, greatly strengthening the suggestion that psychosocial risk factors for cardiovascular disease may act at least partly through the effects of mood on blood pressure.

Testing the malaria hypothesis for the case of Thailand: a genetic appraisal.

S. Poolsuwan. Faculty of Sociology & Anthropology, Thammasat University, Bangkok, 10200, Thailand.

This study, done under Professor Frank B. Livingstone's guidance, follows one of his main interests in tracing the evolution of red cell genetic abnormalities in the complex malarial and demographic situations of southeastern Asia. It provides statistical analyses of allele frequencies for 15 populations of Thailand, with an attempt to trace the roles of differential malarial selection and of genetic admixtures on the frequency variation of certain red cell genetic abnormalities (the two beta-globin variants, hemoglobin E and beta-thalassemia, and G-6PD deficiency), probably evolving under malarial endemicity.

Frequencies of hemoglobin E vary accordingly with those of G-6PD deficiency, and with diverse malarial ecology. The levels of genetic diversity are greater for hemoglobin E and G-6PD deficiency than for most other non-malarial related genetic markers, suggesting the evolution of these two genetic abnormalities under differential selection. Results of the Mantel's statistical test for correspondence between distance matrices suggest distinctive patterns of allele frequency differentiation between malarial related and non-malarial related genetic loci. A correlation between beta-globin and G-6PD genetic distances, as well as those between both sets of distances and the malarial distances, are statistically significant. On the other hand, a correlation between malarial distances and the genetic distances for non-malarial related genetic loci is not significant statistically. A correlation between the beta-globin genetic distances and the genetic distances for non-malarial related genetic loci is, however, statistically significant. The latter result could be attributed largely to the clustering of relatively high hemoglobin E frequencies among genetically closely related populations of northeastern Thailand, whose recent homeland was Laos. The consistently low frequencies of beta-thalassemia observed in most of the study populations are explained as a result of the replacement of this genetic variant by hemoglobin E under long-term malarial selection.

Mitochondrial DNA analysis of a small sample of prehistoric and protohistoric human skeletal material from northern Baja: Is there genetic continuity?

A. Potter[1], P.S. White[2]. [1]Dept. of Anthropology, University of Oregon/ Los Alamos National Laboratory, Los Alamos, NM, 87545, USA, [2]Los Alamos National Laboratory.

Archaeological, osteological and linguistic research suggest a complex pattern of prehistoric population migration and replacement within regions of southern California, Baja, and the Great Basin. Questions remain as to whether there is genetic continuity between the prehistoric inhabitants and ethnographically known populations within these regions. Molecular data can contribute to discussions of continuity.

I present results of a pilot study investigating whether ancient DNA can be recovered from skeletal material excavated from northern Baja, and whether these sequences are informative about genetic affinities between prehistoric and protohistoric northern Baja populations. DNA is extracted from two prehistoric and two protohistoric skeletons from separate sites within northern Baja. PCR is used to amplify the entire control re-

gion and haplogroup defining restriction sites of the mitochondrial genome. All reactions demonstrating positive results on a gel are sequenced and results compared with published sequences. Phylogenetic relationships are evaluated based upon single nucleotide polymorphisms (SNPs) in the control region.

A minimum of three sites amplified for each individual. However, not all fragments for all samples amplified, therefore analysis, at this date, is based on two amplicons for three samples. Phylogenetic analysis demonstrates clustering of a prehistoric and protohistoric sample, supporting genetic continuity between prehistoric and protohistoric Baja populations. These results demonstrate that ancient DNA can be extracted from skeletal remains excavated from diverse sites in Baja, and can illuminate the genetic history of the region. Nevertheless, these data are preliminary and, while supportive of continuity, further analysis of more informative sites is necessary.

Paleoenvironmental basis of cognitive evolution in great apes.

R. Potts. Human Origins Program, Smithsonian Institution, Washington, DC, 20560-0112, U.S.A.

A bias favoring tree-dominated habitats and ripe-fruit frugivory has persisted in great ape evolution since the early Miocene. This bias is indicated by fossil ape paleoenvironments, molar morphology, dental microwear, the geographic pattern of extinctions, and extant apes' reliance on wooded settings. The ephemeral aspect of high-quality fruit has placed a premium on cognitive and social means of finding and defending food sources, and appears related to the great apes' affinity since the Miocene for large, stable forests and woodlands. These habitats, however, underwent severe withdrawal toward low latitudes of Africa and Southeast Asia during the late Miocene, corresponding to a decline in great ape diversity since 11 Ma. Plio-Pleistocene records imply that wooded settings of Africa and SE Asia were prone to substantial fragmentation and coalescence. Once apes were confined to equatorial settings, therefore, habitat instability heightened the spatial and temporal uncertainty of ripe fruit sources. Prolonged learning, assigning attributes to distant places, mental representation, and reliance on fallback foods all were favored in this dynamic environmental context. These abilities helped sustain forest frugivory in most ape lineages. Fluid social grouping afforded opportunities to locate ephemeral foods in continuous and fragmented forest. Fission-fusion grouping also magnified the problems of object permanence (of individuals) and dispersion manifested in the ecological realm. In contrast with great apes, cercopithecoid monkeys expanded their plant diet and diversified in seasonal environments since the late Miocene. Early hominins eventually severed the habitat bias that had characterized great ape evolution and later expanded into diverse environments.

Advances in estimating age-at-death from cementum annulations and tooth root translucency.

D. Prince[1] , U. Wittwer-Backofen[2]. [1]Dept. of Anthropology, University of Tennessee, Knoxville, Knoxville, TN, 37996-0760, USA, [2]Max-Planck Inst. for Demographic Research.

Tooth cementum annulation (TCA) is one of the most reliable methods for estimating skeletal age-at-death in forensic anthropology. The validity of the TCA method was assessed in a validation blind study with a sample of more than 300 teeth, conducted by the Max-Planck-Institute for Demographic Research in Rostock, Germany (Wittwer-Backofen & Buba in press). The mean error is +/-2 years (95% confidential intervals), when the few outliers can be detected and eliminated. These teeth show the effect of cementum line doubling, which can lead to highly erroneous age estimates. This problem is solved by combining TCA analysis with Lamendin *et al*'s (JFS 37(5) 1373-1379 1992) dental aging method.

Lamendin's method utilizes tooth root translucency and periodontal regression to estimate skeletal age-at-death in adults. Lamendin *et al* (1992) reported a mean error of ± 10.0 years on their working sample and ± 8.4 years on their forensic control sample. The validity of this method was tested by Prince & Ubelaker (in press). This validation study reported a mean error of 8.4 years employing Lamendin's formula and a mean error of 7.7 years recalculating the regression formulae.

Doubling of cementum annuli is the main problem in the forensic application of the TCA method. Combining Lamendin *et al*'s dental technique with the TCA method will help diagnose and eliminate doubling cases occurring with TCA counts, while minimizing the standard error of age estimates. The authors suggest applying the combined methods of TCA and Lamendin *et al* as the most reliable multivariate age estimation method for skeletal remains.

The limitations of landmark-based morphometrics: fractal models of frontal sinus ontogeny.

H. Prossinger. Institute for Anthropology, University of Vienna, Vienna, A-1090, Austria.

Frontal sinus data sets are known to be very noisy (Prossinger & Bookstein, in press). We observe this noisy signal in both male and female adults as well as children of both sexes in frontal sinus cross sectional areas derived from roentgenograms. We are able to show that the cross sectional areas can be modeled with sex-specific sigmoid functions and the maximum-likelihood estimate shows that the model differences between males and females is statistically significant. Furthermore, we find that the estimated model parameters successfully estimate the population parameters found in other studies (Szilvassy 1973, Szilvassy 1982). We present statistical analyses (e.g., Elliptic Fourier Analysis) of the outlines of several hundred frontal sinus cross sections in order to compare the estimated parameters in both sexes. We are currently developing generalized Eden models (Percolation Cluster Models) of frontal sinus ontogeny and suspect that the outlines have fractal properties. If indeed so, then the sliding landmark algorithms are impossible to implement. This limitation has implications for applying Geometric Morphometrics to their shape analysis. Literature: Prossinger, H. & Bookstein, F.L. Statistical estimators of frontal sinus cross-section ontogeny from very noisy data (submitted).

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Testing caliper and wire frame measures against positional measures.

J.H. Prost. University of Illinois at Chicago, River Forest, IL, 60305-1039, USA.

Spread caliper and wire frame measurements on normal and head molded crania (housed at the Field Museum) are evaluated in answer to two questions: 1) How are head molded skulls different from normals? and, 2) How can one tell males from females? The same questions in different contexts are important to our science: Are crania from Kow Swamp molded (disproving multiregional continuity)? and, are *H. habilis* and *H. rudolfensis* crania female and male? Our data analyses shows that spread caliper and wire frame measurements are inadequate because: 1) None of the measurements have random distributions (bell curved) and should not be used in variance tests, 2) The measurements cluster into intercorrelated groups, making them useless as independent cladistic markers, and 3) None are direct measures of 3-dimensional shape variations. To circumvent these problems, a unique sys-

tem of measurements (3-dimensional positional measures), using bone contours, is described and applied to the same material. The application shows that the biological referents of morphological shape are the growth processes that produce the adults, not genetic or cladistic shape codes, giving a clearer picture of the causes of variation and reasons for phylogenetic change.

Competition between savanna chimpanzees and humans in southeastern Senegal.

J. Pruetz. Dept. of Anthropology, Iowa State University, Ames, Iowa, 50010, USA.

In the Tomboronkoto region of southeastern Sénégal, savanna chimpanzees coexist with humans belonging to the Bédik, Malinké, and Fulani groups. Four villages, ranging in size from <15 to >60 individuals occur within the 50 km2 core study area. Fifteen chimpanzees have been observed in a single party at this site. Preliminary data show that both humans and chimpanzees heavily utilize the fruit of the liana, *Saba senegalensis* during the driest months. As a part of a year-long study, from April-June 2001, data were collected on the number of *S. senegalensis* seeds voided by chimpanzees and on the number of *S. senegalensis* fruits collected by humans for export and sale in Dakar, the capitol of Sénégal. Data such as fruit size, seed size, and number of seeds were also collected on individual *S. senegalensis* fruits and on the distribution of this liana in gallery forest habitats used extensively by chimpanzees during the dry season. Humans were estimated to extract approximately 75,000 fruits per month during times when *S. senegalensis* was most abundant (May-June 2001). Based on these calculations, years of non-sustainable harvest of *S. senegalensis* fruits will result in scarcity of this important food item for both humans and chimpanzees. Chimpanzees may be compensating by utilizing unripe fruit and could begin to more heavily raid agricultural plots. This case study has important implications for theories of competition between hominoids in an open woodland habitat.

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Evolutionary diversification processes in Paleoamericans and Amerindians.

H.M. Pucciarelli[1], M.L. Sardi[2], W.A. Neves[3], J. Jimenez Lopez[4], C. Serrano[5]. [1]departamento Cientifico de Antropologia. Facultad de Ciencias Naturales Y Museo (UNLP). Consejo Nacional de Invest. Cientificas y Tecnicas (CONICET)., La Plata, Buenos Aires, 1900, Argentina, [2]Departamento Cientifico de Antropologia. Facultad de Ciencias Naturales Y Museo (UNLP). Argentina, [3]Instituto de Biociencias. Universidade de Sao Paulo. Brazil, [4]instituto Nacional de Antropologia E Historia. Mexico, [5]Instituto de Invest. Antropologicas (UNAM).

American Indian expansion and diversification was believed to be due to two factors, migration and gene flow. No evidence of adaptive process, such as selection, was found by genetic, morphological and/or any other methodology known. This may not, however, be the criterion supported by functional craniology. Cranial functional studies are useful for comparing populations from a biological basis. The present study showed how biologically-based results from Paleoamericans and Amerindians from Mexico, Brazil, and Argentina can be drawn. Two null hypotheses were tested: (1) "There are not significant differences in the craniofacial structure when different Paleoamerican crania are compared, since they proceeded from a single dispersal effect"; and (2) "The biological variability of Paleoamerican and Amerindian functional cranial components was produced by randomized diversification evoked by migration and stochastic evolution." Its acceptance will support a temporal discontinuity between Paleoamerican (11.000-8.000BP) and Amerindian (>8.000BP) populations, with high incidence of migration and genetic drift. Rejection will mean that Paleoamericans were not a morphologically homogeneous substratum, and that further populations were originated by non-stochastic -selective and adaptive- processes. Canonical scored clusters and ANOVA post-hoc LSD tests were calculated. Results lead to rejection of both null hypotheses, since size and/or shape changes were found in the neural-facial, respiratory, masticatory, and alveolar morphometric indices, suggesting that several adaptive trends from Paleoamericans to modern Amerindians happened. It was concluded that adaptation can explain great deal of the American Indian cranial variation, nondetectable by the classical craniometric methods and not better-explained by the "migratory-drift" model.

Nuclear gene phylogenies from Old World monkeys.

R. Raaum[1], K. Sterner[1], C. Noviello[1], T. Disotell[1], P. Karanth[2], A.P. De Koning[2], C. Stewart[2]. [1]Dept. of Anthropology, New York University, & NYCEP, New York, NY, 10003, USA, [2]Dept. of Biological Sciences, University at Albany, SUNY.

We are in the process of sequencing numerous nuclear loci for inference of Old World monkey (OWM) phylogeny to complement our studies of mitochondrial DNA genomes. Nuclear and mitochondrial DNA provide different perspectives for phylogenetic and population genetic studies. Moreover, nuclear loci often present different analytical challenges than encountered with mitochondrial DNA, including a slower rate of molecular evolution, multiple alleles within a species, and a higher probability of differential lineage sorting. Here we report upon our studies of multiple nuclear loci from the major groups of OWMs: the African colobines, Asian colobines, papionins, and cercopithecins. These results comprise a preliminary view of our ongoing effort to produce a statistically-robust molecular phylogeny of the OWMs. The loci analyzed include the first intron of the interstitial retinol binding protein (IRBP), the open reading frame of CC-chemokine receptor 5 (CCR5), portions of the Y-chromosomal genes TSPY and SRY, the lysozyme gene, and portions of the protamine locus. Within this set of loci, we find examples of lineage (or allele) sorting that confound the interpretation of gene trees as species trees. We also see variation in the rate of molecular evolution along some lineages, including examples of positive selection. With our results to date, we are able to suggest favorable loci for phylogenetic inference and divergence estimates. Furthermore, we have identified loci suitable for studies of concerted evolution, lineage or allele sorting, hybridization, and other evolutionary genetic processes within the OWMs. (Supported by NIH grant R01 GM60760 to C-BS and TRD).

Swing phase and the use of diagonal sequence gait in primates.

D. Raichlen, L. Shapiro. The University of Texas at Austin, Austin, TX, 78712, USA.

An important event in primate evolution was the origin of a diagonal sequence quadrupedal walking gait. Previous quantitative analyses of DS gait have focused on the timing of limb support phases, but the contribution of swing phase has been less well studied. Compared to other quadrupedal mammals, primates have more distally distributed mass on their limbs. This results in a large mass moment of inertia, which can be predicted to increase the duration of swing phase in primates, influencing gait choice during quadrupedalism.

In this study, swing phase durations were calculated for several primates (*Cebus, Papio, Erythrocebus*) and nonprimates (*Canis, Felis, Potos, Boselaphus*) during freely selected walking speeds. Primates (and *Potos* which also uses DS) were found to have relatively longer swing phases than mammals walking with lateral sequence (LS) gaits, at similar dimensionless speeds.

Diagonal sequence gait may be the most stable choice when swing phase duration is relatively long. During LS gait, the forefoot lifts *before* the ipsilateral hindfoot touches down. At that point the animal is supported by fore and hindlimbs on one side of the body, a potentially unstable position. For nonprimate mammals, this instability may be counteracted by adducted limb postures, positioned under the body. For primates, longer forelimb swing durations in conjunction with LS gait would result in a longer period of unstable, one-sided support, exacerbated by more abducted limbs. In a DS gait, the *contralateral* forelimb lifts while the hindlimb swings, and longer swing duration increases the period of more stable diagonal support.

An interactive database for primate morphometric studies.

D. Reddy[1], S. Frost[2], M. Friess[2], L. Marcus[3], E. Delson[3]. [1]American Museum of Natural History, Interdepartmental Laboratories, New York, NY, 10024, USA, [2]American Museum of Natural History, Division of Paleontology, [3]American Museum of Natural History, Division of Paleontology and, Queens College/CUNY, Dept. of Biology.

Preparation, organization, and screening of data is a major task in many conventional and geometric morphometric analyses. In addition, formatting data sets for use in various software packages for statistical and morphometric analysis can be very time consuming.

We have built a database that incorporates diverse formats of morphometric data from our sample of over 5000 measured primate specimens from worldwide collections. These data include linear dimensions collected by calipers on both cranial and postcranial elements, 2 and 3 dimensional landmarks, 3D space curves (connected sets of landmarks), laser-scanned 3D surfaces, photographs and other 2D images, and volumetric data such as CT images. Individual specimens are referenced by taxon, collection data, body part, locality coordinates and other geographic parameters.

The database interface uses an HTML browser to construct Structured Query Language (SQL) queries to the database, allowing subsetting, iterative refining, and assembling of morphometric data sets using forms-based web pages. Subsetted data sets then can be formatted for convenient analysis in morphometric and statistical analysis software packages. A demonstration version of this database is currently available over the world wide web [http://research.amnh.org/nycep]. This work was supported by NSF grants (ACI-9982351 to AMNH and BIR-9602234 for the NYCEP RTG).

Histologically derived canine crown formation times from a medieval Danish sample.

D. Reid[1], R. Ferrell[2], P. Walton[1]. [1]Oral Biology, Dental School, Newcastle upon Tyne, Tyne and Wear, NE2 4BW, UK, [2]Dept. of Anthropology, Pennsylvania State University.

Tooth crown formation times in extant and extinct hominids and non-human primates are useful for reconstructing phylogenetic relationships and life histories. Histological studies of teeth are costly and destructive; this study investigates ways to use existing histological data to estimate cross-striation periodicity from perikymata counts on the enamel surface.

100µm-thick ground sections of 82 canines from a medieval Danish sample are examined. Number of daily cross-striations between striae of Retzius (periodicity) and number of striae of Retzius reaching the enamel surface (perikymata) are determined for each individual. The number of striae of Retzius times the periodicity equals the number of days of imbricational enamel formation. Cuspal thickness and buccal surface height are also measured. Cuspal thickness data are used in a previously published formula (Dean and Reid, in press) to determine cuspal formation times, while buccal height indicates overall tooth crown size.

The periodicities in the sample range from 6-12 (mode = 8). Total number of imbricational striae ranges from 104-257, cuspal thickness ranges from 650-1200µm, and buccal height ranges from 8.80-13.8mm. Overall crown formation times were 1868± 65 (mean± s.d.) and 1625±62 (mean± s.d.) days for lower and upper canines, respectively.

Each tooth demonstrates a direct correlation between total number of striae and periodicity. Variation in tooth size has no significant relationship to number of striae or periodicity. There are two implications for future studies: periodicity and therefore imbricational formation times may be estimated from number of perikymata, and the timing of crown formation seems to be predetermined and unrelated to tooth size.

Summary of Brazilian human remains dating from 8,000 to 13,000 years before present.

K. Reinhard[1], S. Mendonça De Souza[2], A. Lessa[2]. [1]School of Natural Resource Sciences, Lincoln, Nebraska, 68502, USA, [2]Escola Nacional de Saúde Pública, Fundação Oswaldo Cruz.

Ancient human remains, including skeletons, teeth, and hair with human head lice have been excavated during recent years. We have completed an evaluation of the dates of ancient remains in the northeastern and southeastern regions of Brazil. For many of the finds, the direct association of burials with hearths facilitated accurate dating of the remains. Teeth from the site of Toco do Garrincho in the State of Piaui have been directly dated by AMS technique to13,870 to 13,895 y.a. Human hair with attached louse eggs from the site of Toco dos Coquiros, also in Piaui, were dated to 10,640 years ago. From the same site, a skeleton was dated by AMS analysis of carbon in contact with bone to 11,060 y.a. Other Piaui skeletons associated with hearths have been dated to 9,670 y.a. and 8,000 y.a. Ancient cremations have been found in two sites in the state of Minas Gerais. Ten individuals were found at the site of Lapa do Varal, 8,286 to 10,100 y.a. Fifteen individuals from Gruta do Gentio II have been dated between 7,295 to 10,190 y.a. Two skeletons from two separate sites in the state of Rio Grande do Norte have been dated to 9,400 y.a. The dates were obtained from radiocarbon analysis of carbon within the burials. We conclude that ancient human remains in Brazil are well dated. These dates support previous research indicating a great antiquity of human occupation of Brazil.

Dietary adaptations of late Miocene Colobinae.

J. Reitz. Dept. of Anthropology, Southern Illinois University, Carbondale, IL 62901-4502, USA.

Evidence for the diets of the earliest fossil colobines has implications for understanding the evolutionary divergence of the cercopithecid subfamilies Cercopithecinae and Colobinae. While a number of investigations of the functional morphology and dental microwear of Plio-Pleistocene colobines have been conducted, similar analyses of late Miocene forms have been exceedingly rare. Yet, the paleodiets of these early colobines bear directly on ecological and evolutionary hypotheses concerning colobine origins.

The present study utilizes molar shear indices and dental microwear data to test competing hypotheses of early colobine dental adaptation by investigating the dietary preferences of the late Miocene colobines *Mesopithecus pentelicus*, *Libypithecus markgrafi*, and *Colobus flandrini*. Preliminary analyses indicate shear indices for *Libypithecus* that fall out between extant cercopithecines and colobines and show greatest affinity to several Plio-Pleistocene colobines (*Paracolobus*, *Rhinocolobus*, *Colobus* sp.) inferred to be folivorous on the basis of dental microwear (Teaford and Leakey,

1992). The relatively low percentage of pits present in the microwear fabric of *Libypithecus* (18.2%) is consistent with this interpretation. On the other hand, shear indices for both *M. pentelicus* and *C. flandrini* consistently group with extant *Macaca* and fossil *Papio* suggesting dental adaptation to relatively generalized diets. Dental microwear preserved in both *M. pentelicus* (45.2% pits) *C. flandrini* (43.2%) is also highly suggestive of more frugivorous diets in these taxa. Results of the present study provide the first clear indications of both folivorous and more generalized diets in late Miocene Colobinae. Implications of these results for various ecological hypotheses for the cercopithecine-colobine divergence are discussed.

Apportionment of human genetic diversity using quantitative traits.

J. Relethford. Dept. of Anthropology, State University of New York College at Oneonta, Oneonta, NY, 13820, USA.

Studies of global genetic diversity based on classical genetic markers and DNA polymorphisms have consistently shown a pattern in levels of variation within and among populations. Roughly 10 % of global genetic diversity exists between geographic regions, 5 % among local populations within geographic regions, and 85 % within local populations. It has sometimes been assumed that physical traits show more variation among regions. This hypothesis was tested by developing a method to apportion variation in quantitative traits into three components: among geographic regions (*AR*), among local populations within geographic regions (*AL*), and within local populations (*WL*). This method was applied to a global database consisting of 57 craniometric measures and a global database on skin color (assessed as the percentage reflectance of light at 685 nm). Multivariate analysis of the craniometric measures shows results similar to those from neutral genetic markers and DNA polymorphism: *AR* = 13 %, *AL* = 6 %, and *WL* = 81 %. Skin color shows the opposite pattern with the majority of variation occurring between geographic regions: *AR* = 88 %, *AL* = 3 %, and *WL* = 9 %, a pattern shaped by natural selection. Objections to racial classifications based on earlier genetic studies can now be extended to craniometric variation. Skin color distribution is atypical; but even here, the high amount of variation among regions does not correspond to a "racial" model of diversity, because skin color shows a clinal, rather than discrete, pattern of geographic variation.

Scanning electron microscopic analysis of regional histomorphological variation within the physis of the primate proximal femur.

P.L. Reno[1], M.A. Kriz[1], M.A. McCollum[2], C.O. Lovejoy[3]. [1]Biological Anthropology Program, Division of Biomedical Sciences, Kent State University, Kent, OH, 44242-0001, USA, [2]Dept. of Anatomy, Case Western Reserve University, [3]Dept. of Anthropology and Biological Anthropology Program, Division of Biomedical Sciences, Kent State University.

Although strain transduction has traditionally been argued to be the primary determinant of cortical and trabecular architecture, there is now substantial emerging evidence that pattern formation is significantly more controlling of anatomical patterning. A case in point is the primate proximal femur which has a much more complex developmental history than is commonly assumed. While the greater trochanter and femoral head ossify separately within a common epiphyseal cartilage, in humans and some other mammals, a distinct intraepiphyseal nonsubperiosteal growth cartilage continues to operate throughout ontogeny, although it never undergoes vascular invasion and secondary ossification. Ogden (1979 In: JA Albright and RA Brand eds., *The Scientific Basis for Orthopaedics*) noted that this intraepiphyseal region exhibits higher amounts of interstitial growth than the trochanteric and capital regions of the growth plate, and was substantially more fibrocartilaginous in structure than the remainder of the proximal femur. Moreover, the existence of an entirely cartilaginous intraepiphyseal region is not universal in primates (MA Kriz et al., these meetings), and little comparative data currently exist for this crucial anatomical region. We therefore examined a diverse sample of juvenile primate and mammalian femora using Scanning Electron Microscopy. We show that SEM allows ready identification of both depositional and resorptive surfaces, as well as those that are subchondral versus subperiosteal. The unusually complex histomorphological structure and ontogeny of the primate femoral neck would seem to require substantial reassessment of current biomechanical models of its cortical and trabecular patterns.

Cranial deformation and measurement stability among prehistoric south central Andean populations.

M. Rhode. Anthropology Dept., University of Missouri, Columbia, Columbia, MO 65211, Columbia, MO, 65203, USA.

The analysis of cranial measurements continues to be a key source of data used to assess population affinities. Previous research has indicated that the consequences of deformation are primarily exhibited in the cranial vault with reduced alterations in the facial and basilar regions. These areas have been the focus of research efforts aimed at identifying measurements unaffected by deformation. Cocilovo (1978) was able to identify one such set of 10 measurements suggested to be relatively unaffected by deformation. These 10 measurements became the basis of numerous investigations addressing the biological affinities of prehistoric Andean and other South American populations.

This research tests the hypothesis that these 10 measurements remain stable across deformation types using a sample of 350 crania collected from a total of 18 archaeological sites drawn from the Azapa valley, of Northern Chile. The sample is composed of 120 (34%) normal, 107 (31%) annularly deformed, and 123 (35%) anteroposteriorly deformed crania. Results indicate that the hypothesis of stability must be rejected for six out of the 10 measurements. This in turn means that population relationships studies, conducted using measurement sets that include the six affected measurements, may be biased by the proportion of deformed individuals in a given sample.

Frequency of deformation type distributions may be associated with cultural group or status distinctions and possibly migrations. These 10 measurements then, are a mixture of genetic and cultural factors whose relations to reproductive isolation among populations require further study.

A humerus tale: humeral torsion and activity-related change in the upper limb.

J. Rhodes. Dept. of Archaeological Sciences, University of Bradford, Bradford, West Yorkshire, BD7 1DP, United Kingdom.

Repetitive movement of the upper limb during growth may lead to soft tissue and skeletal adaptations. Increased humeral torsion has been reported in professional handball players (Pieper 1998), as well as humeral hypertrophy in professional baseball pitchers (King et al. 1969) and professional tennis players (Jones et al. 1977). It is proposed that these and other 'architectural' modifications including bowing and lateral deviation of the humeral shaft represent a system of adaptation to habitual, strenuous activity. These plastic changes appear to confer a biomechanical advantage through alterations of robusticity and shape. By analysing these changes within the modern clinical record, a system may be developed that will help define the nature of plastic change within unilateral bone development and identify osteological indicators of activity in the humerus and

pectoral girdle. It is proposed that an analysis of the osseous signature of repetitive stress or strain syndromes together with an interpretation of movements using pathological responses can help elucidate actions and habitual activity from past populations. This provides a system that enables the classification of such skeletal modifications in terms of behavioural response over genetic predetermination.

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The prehistoric burials of Shum Laka rockshelter (North-West Cameroon): funerary practices, biological affinities, health status.

I. Ribot[1], R. Orban[2], P. De Maret[3]. [1]Dept. of Biological Anthropology, University of Cambridge, UK, Cambridge, Cambridgeshire, CB2 3DZ, United Kingdom, [2]Institut Royal des Sciences Naturelles de Belgique, Anthropologie et Prehistoire, [3]Universite Libre de Bruxelles, Institut de Sociologie.

Between 1982 and 1994, nine burials including eighteen human skeletons were discovered in the rockshelter of Shum Laka (Cameroon). As they are dated between 7,000 BP and 3,000 BP, they are the most ancient fossils in West Central Africa. Both archaeological and anthropological data of Shum Laka burials are analysed in detail, in order to present several aspects such as mortuary practices, biological affinities and health status.

The burial patterns (primary and secondary deposits, cremation) and their increasing diversity especially during the recent period are not comparable to any other Late Stone Age or even Iron Age site in Cameroon. According to anthropometrical data, both face and mandible of individual SE III show a relative similarity with modern West Central African populations. Stature estimations also suggest that the populations of the two burial phases could be biologically different. A diet rich in carbohydrates and low in proteins, including coarse food such as tuber roots was suggested by numerous caries, little calculus and dental wear. Children with two relatively rare pathological conditions (scaphocephaly and unhealed trauma caused by an arrowhead) were buried in the same place. This funerary practice could reflect particular social behaviours towards both "anomalous" children and deaths.

The various populations who occupied the rockshelter of Shum Laka could have been hunter-gatherers, agriculturalists or both, as they lived in a mixed environment. However, the isotopic analyses in progress for paleodietary reconstruction might help us to identify some subsistence shift during the Late Stone Age - Iron Age transition period.

Postcranial anatomy of *Ankarapithecus meteai* and the origin of the great ape and human locomotor skeleton.

B. Richmond[1], J. Kappelman[2], M. Maga[2]. [1]University of Illinois at Urbana-Champaign, Urbana, IL, 61801, USA, [2]University of Texas at Austin.

Postcranial fossils of *Ankarapithecus meteai*, recovered from the Sinap Formation of central Turkey, bear on debates over homology in the hominoid skeleton. The hominoid fossils were found *in situ* in the same locality (our Locality 12) that produced a lower face (MTA 2125) and a partial skull (AS95-500). Detailed geochronological work places the locality at ~9.8Mya. The fossils include a right femoral diaphysis, a virtually intact right radius, and distal segments of a proximal phalanx and middle phalanx. We compared the fossils morphometrically to a diverse anthropoid sample.

The femur is as large as the femora of large common chimpanzees. It has a relatively posteriorly oriented lesser trochanter and moderate anteriorly convex shaft curvature, unlike extant Asian ape femora. The radius, from a smaller individual, has a mildly oval radial head with a slightly enlarged (antero)lateral lip. The radius had a strongly tilted radial head, relatively short neck, moderately curved shaft, and a baboon-like sharp interosseous crest. The fragmentary manual proximal phalanx has only slight longitudinal curvature, and lacks strongly developed flexor ridges.

Together, these fossils indicate that *A. meteai* was a large-bodied pronograde quadruped that probably spent considerable time on the ground, but was more generalized than cursorially-adapted cercopithecoids. These fossils lack most of the specializations associated with suspension in extant great apes. The postcranial anatomy of *A. meteai*, as a stem great ape, supports the notion of substantial levels of homoplasy in hominoid evolution.

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Studying asymmetry with Euclidean Distance Matrix Analysis (EDMA).

J. Richtsmeier[1], T.M. Cole, III[2], E. Lindsay[1], C.D. Kreger[1], V. Deleon[3], K. Aldridge[3], S. Lele[4]. [1]Dept. of Anthropology, The Pennsylvania State University, University Park, PA, 16802, USA, [2]University of Missouri-Kansas, [3]The Johns Hopkins University, [4]The University of Alberta.

Bilateral symmetry is a characteristic of many complex organisms. If symmetry about 3 developmental axes is the default, as Palmer suggests, localization of asymmetries should enable us to investigate hypotheses about processes that break symmetry. Localization of asymmetry patterns is not possible with superimposition or deformation techniques because the choice of the "fit" (e.g., robust, generalized) or interpolation function (e.g. bending energy) employed changes the assessment of the patterns of asymmetry. To localize patterns of asymmetry a coordinate system-invariant method is required.

We present a specific application of EDMA to compare corresponding linear distances on right and left sides and compute marginal confidence intervals to evaluate patterns of two types of asymmetry, subtle and conspicuous. Our example of conspicuous asymmetry is unicoronal synostosis (UCS), where one coronal suture is closed prematurely. We define patterns of asymmetry of superficial soft tissue structures, bony anatomy and components of the central nervous system in UCS. Though the patterns of asymmetry in the various tissues correspond in some respects, differences are apparent. Patterns of subtle asymmetry are studied in a mouse model for Down syndrome. One hypothesis proposed to explain the Down syndrome phenotype holds that the correct balance of gene expression in pathways regulating development is disrupted by aneuploidy. We test this hypothesis by analyzing fluctuating asymmetry in Ts65Dn aneuploid mice and their normal littermates.

EDMA methods for addressing asymmetry enable unbiased localization of asymmetries without depending upon a coordinate system. These methods have wide application in many fields, including physical anthropology. Supported by PHS grant 1P60DE13078.

Allometric departures of the human brain: some methodological considerations.

J. Rilling. Emory University, Atlanta Georgia, USA.

Departures from allometry are among the most fascinating findings in comparative neuroanatomy because they provide evidence for neurobiological adaptation. Of par-

ticular interest to anthropologists is the issue of whether the human brain departs from non-human primate allometric trends, because any such departures could represent the neural foundation for cognitive adaptations that distinguish humans from the rest of the primate order. In testing for human departures from non-human primate allometric trends, several methodological issues must be carefully considered if accurate conclusions are to be reached. These include: 1) the importance of generating estimates of within-species variance so that human means can be statistically compared with allometrically predicted values, 2) the importance of generating an estimate of the error or uncertainty in the allometrically predicted value (i.e., with prediction intervals around the regression line), 3) determination of whether regressions should be fit through raw or log-transformed data, 4) determination of the appropriate taxonomic out-group for comparison (e.g., all primates, anthropoid primates, or hominoids), 5) determination of the appropriate variable to regress against and 6) removal of the effects of shared phylogenetic history. These points are illustrated with a comparative analysis in which temporal lobe volumes obtained from in vivo MRI scans are compared across a range of anthropoid species. The example shows how the above choices can have a significant influence on the conclusions one reaches with respect to whether specific brain regions have expanded disproportionately in hominid evolution.

Missing mammals: the affects of simulated fossil preservation biases on the paleoenvironmental reconstruction of hominid sites.

C. Robb. Arizona State University, Dept. of Anthropology, Tempe, AZ, 85287-2402, USA.

In using fossil faunas to reconstruct ancient environments of hominin, taphonomy is a confounding factor. Preservation bias affects not only the condition of the bones, but also which bones are preserved and which animals are represented. Thus, the ability to reconstruct the habitat or diet of the occupants of the site is impaired. Though recognized by many researchers as a relevant issue, little has been done to observe how preservation biases affect the outcome of paleoenvironmental reconstructions, and the precise effects of these biases on data collection and analysis is still largely unexamined. This study examines current habitat reconstruction methods of hominin sites using a database of modern mammalian analogs.

The modern data consist of lists of mammals from site-specific communities in Africa, India, and Southeast Asia. The information includes body size and behavioral data for each species. Simulations of fossil sites are created by systematically removing body size or behavioral categories, or by computer generated random removal of taxa. Ecological diversity analysis is used to reconstruct habitats for the simulated "fossil communities" and to compare them with the known environment. Fossil localities are then compared with the extant original and simulated data. Taphonomically biased data in particular categories like body size and dietary preference have been shown to indicate a habitat type different than that seen at the extant sites. The results indicate that significant differences can occur in the reconstruction of some sites if confounding factors are not considered.

Metabolic correlates of hominid brain evolution.

M. Robertson, W. Leonard, J. Snodgrass. Northwestern University, Evanston, IL, 60208, USA.

Large brain sizes in humans and other primate species have important metabolic consequences. Humans expend a relatively larger proportion of their resting energy budget on brain metabolism (~20%) than other primate species (8-9% of resting metabolic rate [RMR]). Primates, in turn, expend relatively more on brain metabolism than non-primate mammals (3-5% of RMR). The high costs of large brains are supported, in part, by diets that are relatively rich in energy and other nutrients. Among living primates, the relative proportion of metabolic energy allocated to the brain is positively correlated with dietary quality ($r = 0.63$; $P < 0.001$; $n = 25$ species). Humans fall at the positive end of this relationship, having both a very high quality diet and a large brain size.

Greater encephalization also appears to have consequences for other aspects of body composition. Comparative data on 28 primate species and 30 non-primate mammalian species indicate that primates are "undermuscled", having relatively lower levels of skeletal muscle than non-primate mammals. Human infants represent an extreme example of this, having high levels of adiposity (stored energy) and very high brain-body weight ratios.

These comparative data suggest that the evolution of large brain size in the genus *Homo* was likely associated with important shifts in diet, foraging behavior, physical growth and body composition. This paper will explore the links between these four domains.

Geometric morphometric analysis of extant hominoid mandibles: using mandibular morphology to differentiate hominoid species.

C. Robinson. New York University, NYCEP, Brooklyn, NY, 11231, USA.

Mandibles are important for understanding fossil hominin relationships because they are commonly preserved skeletal elements. Mandibular features are among the characters used in early hominin taxonomic and phylogenetic analyses. The reliability of many mandibular characters to differentiate hominoid taxa is not clear, as the pattern and extent of intra- and interspecific differences for these characters have not been well documented in extant taxa. Moreover, many mandibular characters have not been analyzed quantitatively.

This study examined 463 mandibles of all extant great ape and human species and siamangs. 3D coordinate data were recorded for 25 landmarks on the mandibular corpus and symphysis. Geometric morphometric techniques were used to analyze mandibular morphology. This enables quantitative data collection not possible using traditional instruments. Data were superimposed using a Generalized Procrustes Analysis in GRF-ND and then analyzed by PCA.

Preliminary results show a clear separation between *Homo* and non-human hominoids on PC1. This PC is most influenced by symphyseal landmarks. On PC2, *Symphalangus* is strongly separated from the other taxa, *Pan paniscus* is separated from *P. troglodytes* in the direction of *Symphalangus*, and *Pongo* is differentiated from all other taxa in the opposite direction. The landmarks that drive taxonomic separation on this PC relate to symphyseal base characters and mandibular corpus height. PC3 separates *Gorilla* strongly from all other taxa. This division appears to be driven by landmarks related to projection of the superior and inferior transverse tori. These results show that certain mandibular characters are effective taxonomic discriminators of modern hominoid species.

A 9.1kb insertion/deletion polymorphism with an ancestral origin: a study on Melanesian populations.

R. Robledo[1], L. Scheinfeldt[2], M. Siniscalco[1], D.A. Merriwether[3], J. Friedlaender[2]. [1]Coriell Institute for Medical Research, Camden, New Jersey, 08103, U.S.A., [2]Temple University, Philadelphia, PA, [3]University of Michigan, Ann Arbor, MI.

We recently described an insertion/deletion polymorphism of 9,100 base pairs located on chromosomal region 22q11.2 and overlapping with the Ig λ variable light chain

genes. By virtue of multiplex PCR, using a pair of primers located within the 9.1kb region and a pair of primers flanking the 9.1kb region, we are able to identify unambiguously the three possible genotypes. Pedigree analysis conducted on five CEPH families shows the polymorphism segregating as a simple Mendelian trait. Studies performed on several distinct populations show a worldwide distribution of the polymorphism, suggesting an ancestral origin. Sequence analysis at the endpoints of the insertion/deletion was conducted on individuals from diverse ethnic groups: the results indicate that the event likely occurred only once. Therefore, this marker could be a very powerful tool for population genetics studies.

During the population study, we analyzed a Nasioi (a non-Austronesian language) speaking population from the island of Bougainville, in Melanesia. Remarkably, we found that all 21 individuals genotyped were homozygous for the absence of the 9.1kb region. To date, this is the only example of a monomorphic population for this marker. We have expanded our study to other Melanesian populations located in the islands of New Britain and New Ireland, including both Austronesian speaking and non-Austronesian speaking populations. Preliminary data show a marked fluctuation among the populations tested. Our results provide insight into the contribution of physical (geographical) and cultural (linguistic) factors underlying human genetic diversity.

Niche differentiation in forest primates and origins of hominid bipedalism.

P. Rodman. Dept. of Anthropology, University of California, Davis, Davis, CA, 95616, USA.

New fossils suggest that hominoid bipedalism is ancient and that it evolved in a forested habitat. Age of the adaptation suggests that bipedalism may have evolved in a context of diverse arboreal hominoids. Coexistence of living *Macaca fascicularis* and *M. nemestrina* offers an analogy to coexistence of arboreal and terrestrial forest-dwelling hominoids in the past. The two macaques occupy continuous, "homogeneous" forest. Their niche differentiation includes segregation into arboreal and terrestrial travel between major food sources in the forest canopy. The "homogeneous" forest actually consists of two microhabitats. *M. fascicularis* (arboreal) travels shorter distances in smaller ranges in alluvial forest where ground cover is thick, the middle canopy is continuous, and fruit trees are dense. *M. nemestrina* (terrestrial) travels long distances in large ranges often on hilltops, where ground cover is thin, the middle canopy is broken, and fruit trees are sparse. Biomechanically, each joint of *M. nemestrina* facilitates efficient travel over long distances. Compared to *M. fascicularis*, *M. nemestrina* is a cursorial cercopithecoid. Biomechanically, each joint of the hindlimb of a bipedal hominoid facilitates efficient travel over long distances. Bipedalism is therefore not a puzzling pattern for a forest-living hominoid. Instead, it is likely that bipedalism facilitated a niche analogous to that of living *M. nemestrina*. Bipedalism is best interpreted as the appropriate cursorial adaptation for a hominoid that retained the typical hominoid pattern of climbing and forelimb suspension and occupied forests with sparse fruiting trees. This interpretation conforms to normal explanations of the functions of differing locomotor patterns.

Consistency and bias in morphometric methods.

F. Rohlf. State Univ. of New York, Stony Brook, NY, 11794-5245, USA.

Lele (1993) raised the issue of ability of different morphometric methods to estimate the mean form (shape + size) or shape consistently (i.e., whether the estimate is correct for infinite sample sizes). Kent and Mardia (1997) have shown that consistency depends upon the model. They showed that for isotropic errors the lack of consistency of Procrustes analysis in estimating the mean form was mostly due to its estimation of size not shape.

Using the isotropic error model, I have investigated bias (average difference between an estimate and its true value for finite sample sizes) and mean square error (average squared error in estimation for finite sample sizes) for different methods for estimating the average shape. These results and their implications will be discussed.

In vivo bone strain and finite-element modeling of the anterior root of the zygoma of *Macaca* .

C. Ross[1], D. Strait[2], B. Richmond[3], M. Spencer[4]. [1]Stony Brook University, Stony Brook, NY, 11794-8081, USA, [2]New York Institute of Technology, [3]University of Illinois, [4]University of Colorado at Denver.

The anterior root of the zygoma (ARZ) can be hypothesized to be of structural importance in the face because it connects the toothrow to the zygomatic arch and the postorbital bar, its morphology varies widely across primates, and it experiences high bone strain magnitudes during mastication. It is therefore of interest to know how it is loaded during feeding. Hypotheses regarding the nature of loading in the ARZ were evaluated in *Macaca* using in vivo bone strain data; hypotheses regarding the external forces responsible for these loads were evaluated using analyses of variation in relative timing of changes in a bite force surrogate (corpus strain) and estimates of forces generated by muscles of mastication (EMG). These data were then input into a finite-element model (FEM) of the face of *Macaca* in an attempt to replicate the in vivo results. In vivo bone strain data and the output of the FEM reveal maximum principal (tensile) strain to be oriented downwards and laterally, oblique to the midsagittal plane. This supports hypotheses that shear in a frontal plane is an important loading regime in the ARZ. The external forces most likely to be responsible for the shear are superiorly directed components of bite force acting on the toothrow and inferiorly directed components of muscle force acting on the zygomatic arch.

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Ontogeny of paranasal sinuses in the Platyrrhini.

J. Rossie. Dept. of Anthropology, Yale University, New Haven, CT, 6511, USA.

Anthropoid paranasal sinus anatomy provides a frequently used source of discrete morphological traits for phylogenetic analysis. While the anatomy of sinuses in living catarrhines is fairly well documented, those of platyrrhines have received little attention and virtually nothing is known of their ontogeny. Because the criterion of homology for sinuses is explicitly ontogenetic, this project employs computed tomography in order to visualize the patterns that characterize the development of the sinuses and associated intracranial structures in platyrrhines. This will allow homology to be assessed though detailed comparisons of the development of potentially homologous sinuses. Resolution of sinus homology will add useful data to current debates concerning the phylogenetic relationships among platyrrhine genera, and facilitate meaningful interpretation of sinus morphology in other fossil and extant anthropoids.

Computed tomography of the cranium was performed on postnatal ontogenetic series of *Cebus*, *Alouatta*, *Lagothrix*, *Cacajao*, *Aotus*, *Saimiri*, *Callicebus*, *Callimico*, *Saguinus* and *Leontopithecus* housed in the osteological collections of the National Museum of Natural History (NMNH). Large specimens were serially scanned at 1mm intervals at the NMNH, while smaller specimens were scanned at the High Resolution X-ray CT facility at the University of Texas, Austin.

Preliminary analysis of these data provides support for some commonly recognized clades within platyrrhines, and suggests that considerable paranasal pneumati-

zation may have characterized basal platyrrhines, and may be primitive for crown anthropoids. The significance of this ontogenetic information to questions of homoplasy in paranasal sinus anatomy is also discussed.

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Pandemic TB or not TB.

B. Rothschild[1], M. Hwlbling II[2]. [1]Arthritis Center of Northeast Ohio and Carnegie Museum of Natural History, Youngstown, OH, 44512, USA, [2]Arthritis Center of Northeast Ohio.

Not all tuberculosis manifestations are definitive. While certain forms of joint fusion are suggestive, the fused gibbus is perhaps most diagnostic in humans. New information in late Pleistocene bovids and proboscidia suggest that the first human immigrants entered a New World pandemic and that infection became rampant.

Vigorous testing of that hypothesis perhaps requires the most rigid criteria. If diagnosis is limited to only those skeletons with the classic tubercular gibbus, is there evidence for a human pandemic?

Gibbus formation was consistently observed clinically in 1-2% of individuals with untreated tuberculosis. If two cases of gibbus are found in a population of 500 individuals, one presumes 50-100 individuals (10-20%) of the population had tuberculosis. Logically, any cohort with a 1-2% frequency of gibbus is essentially 50-100% affected - a pandemic.

Such frequencies are repeatedly identifiable in sites from California, the Southwest, Midwest, the Northeast, and the Southeast. Were these isolated pandemic areas or was the problem universal in North America? Assessment of those sites where no gibbus was found is problematic. Even if one groups by area, the numbers that have been analyzed for pathology are less than 800 - in those limited areas where no sentinel lesions were found. Beta-error statistics document a 20% change of missing the diagnosis when sample size is less than 850.

The concept of pandemic North American tuberculosis cannot be discarded on the basis of samples studied to date. Perceived contact-attributed tuberculosis epidemics appear related more to stress-mediated disease reactivation (related to contact 'situations'), rather than to introduction of a new disease.

Ontogeny and allometry of mandibular fossa placement in African apes.

R. Rowley, R.J. Sherwood. Dept. of Anthropology, University of Wisconsin, Madison, WI, 53706, USA.

Recent discussions regarding the relative placement of the mandibular fossa have identified this measure's utility in understanding encephalization, and assessing taxonomic relationships, of early hominins. Sherwood et al. (2001) recently presented a new and reliable method for measurement of relative fossa placement. By measuring fossa breadth relative to the endocranial margin, the authors were able to verify, and remove, the influence of temporal bone pneumatization on measures of fossa placement. Results of this study confirmed a laterally placed fossa in adult African apes. This study also noted a possible allometric effect on fossa placement.

To further investigate aspects of allometry and ontogeny in African ape fossa placement, an age graded sample of gorillas and chimpanzees were CT scanned from the CMNH, UWZM, and UW Anthropology. Three landmarks were identified in a series of transverse, sagittal, and coronal scans; (1) tip of the entoglenoid, (2) lateralmost margin of the endocranial surface, and (3) lateral margin of the articular surface. These landmarks were projected onto a single plane and measured as described by Sherwood et al. (2001).

Fossa placement is negatively allometric relative to cranial size measures such as bicarotid distance. In other words, African ape infants are shown to possess a medial fossa that shifts laterally during growth.

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Weight for trunk frame size: an alternative index of fatness in populations of varying body proportions.

C. Ruff[1], P. Jamison[2]. [1]Johns Hopkins University, Baltimore, MD, 21205, USA, [2]Indiana University.

The body mass index (BMI), weight/height^2, is a commonly used measure of relative over- or underweight status. However, the general applicability of this index (or similar indices, e.g., weight for height) across individuals or populations with different body proportions has been questioned. Here we present evidence that BMI systematically overestimates the number of overweight children in an Inupiat (Eskimo) population sample when compared to normative US data, and suggest an alternate, less biased anthropometric index as a measure of relative fatness or leanness.

Anthropometric data for a total of 204 Inupiats between the ages of 5 and 20 years, collected in 1968-1971, were compared with similar data collected for a sample of 20 individuals of a similar age range measured longitudinally (mean 23 measurements/individual) as part of the Denver Growth Study. Both relative sitting height (sitting height/stature), and relative body breadth (bi-iliac breadth/stature), are significantly larger in Inupiat children (relative sitting height only in adolescence). When body mass is standardized over height^2, Inupiat children are always much larger than the Denver sample. However, differences between groups are considerably reduced when body mass is standardized over bi-iliac breadth sitting height, which we term "trunk frame size." Comparisons of skinfold data indicate that BMI greatly overestimates the number of "fat" Inupiat children, while body mass/trunk frame size provides a much more realistic appraisal of skinfold distributions.

These results suggest that trunk frame size may be more appropriate than stature in calculating body mass indices, when basic body proportions vary significantly.

Microevolution of the central European human vertebral column since the Neolithic: preliminary osteometric assessment and interpretations.

F.J. Rühli[1], M. Schultz[2], M. Henneberg[1]. [1]Dept. of Anatomical Sciences, Medical School, The University of Adelaide, Adelaide, South Australia, 5005, Australia, [2]Dept. of Anatomy, University of Göttingen, 37075 Göttingen, GERMANY.

Human evolution led to bone gracilisation (Trinkaus, 1997) with a decrease in body size (Henneberg and Steyn, 1995) and brain size (Henneberg, 1988) during the Holocene. Microevolutionary changes in the human axial skeleton have been shown for the incidences of spina bifida occulta (Henneberg and Henneberg, 1999) and of cervical ossification of the posterior longitudinal ligaments (Hukuda et al., 2000). Surprisingly, microevolutionary changes in the non-pathological human spine (Jankauskas, 1994) seem to be a mostly neglected research area. Therefore, any mismatch of such bony or peripheral neural tissue adaptation could help to explore the causative factors of lower back pain or radiculopathy, which are omnipresent symptoms and major cost factors in modern clinical practice.

More than 200 adult skeletons of the Neolithic, Bronze Age, Middle Ages and early 20th century of central European origin (France, Germany, Switzerland) were assessed osteometrically. For each individual, seven vertebrae (C3, C7, Th1, Th6, Th10, L1, L5) with 14 anatomical landmarks per vertebra were measured (mostly following Martin, 1928).

Our preliminary results show first indications of microevolutionary trends in some landmarks. A remarkable variability in the human spine since the Neolithic complicates the interpretation of the data which are matched by sex, age at death and

robusticity. Comparable data in the literature (especially of Late Upper Paleolithic and Mesolithic remains) help to validate the findings. Such microevolutionary trends can be explained with reference to different selection pressures on gene pools based on changes in lifestyle (hunter-gatherer versus settled community) and environmental factors such as nutrition.

Analysis of trabecular bone structure in the femoral heads of two Omomyid primates.

T. Ryan[1], R. Ketcham[2]. [1]Duke University Primate Center, Durham, North Carolina, 27705, USA, [2]Dept. of Geological Sciences, The University of Texas at Austin.

Quantitative analysis of femoral head trabecular bone morphology using high-resolution x-ray computed tomography (HRXCT) scan data has demonstrated significant interspecific differences among extant taxa. These differences appear to be related to variation in locomotor behavior and the loads produced during these behaviors. This study analyzed the femoral head trabecular bone architecture in two Eocene omomyids, *Omomys carteri* and *Shoshonius cooperi*, and compared the structure in these extinct animals to that of extant strepsirhines. HRXCT scan data were collected from one femur from each fossil taxon with slice thicknesses of 0.0298 mm for *Omomys* and 0.02557 mm for *Shoshonius*. Three cubic volumes of interest (VOI) were extracted from each femoral head covering superior, central, and inferior regions within the head. The bone volume fraction (BV/TV) and degree of anisotropy (DA) were calculated for each VOI using the software QUANT3D. BV/TV was calculated by dividing the number of bone voxels by the total number of voxels within the VOI and DA was calculated using the star volume distribution method. *Omomys* possesses a relatively isotropic trabecular structure throughout the femoral head and is most similar to modern generalized quadrupedal forms like *P. potto*. By contrast, *Shoshonius* displays a unique trabecular structure most like that of extant galagines with a distinct shift from relatively isotropic bone superiorly to relatively anisotropic bone inferiorly. Analyses of *Omomys* and *Shoshonius* demonstrate the utility of trabecular bone structural analyses for determining the possible locomotor behaviors of extinct taxa.

First mtDNA sequences from prehistoric people buried in the mound CH2D01-A, Rocha, Uruguay.

M. Sans[1], B. Bertoni[2], J. McDonough[3], C. Bluteau[3], G. Cabana[3], D.A. Merriwether[3]. [1]Dept. of Biological Anthropology, University of the Republic, Uruguay, Montevideo, Montevideo, 11200, Uruguay, [2]Dept. of Genetics, Medicine, University of the Republic, Uruguay, [3]Dept. of Anthropology, University of Michigan, Ann Arbor, MI 48109-1382.

The archaeology of eastern region of Uruguay is characterized because of the presence of mounds. Mound CH2D01-a radiocarbon dates approximately to between 2090 years BP and 340 BP. Archaeologists recovered bones from at least 17 individuals, buried in different depths from this mound. It is not clear if the individuals are contemporary with each other. 75% of the remains are adult males with only 13% younger than 15 years old. Primary burials are predominant, but at least three secondary burials were identified.

Thus far, five ancient sequences from the site have been determined. Three individuals belong to haplogroup C, one, to haplogroup B, and the other is still not assigned to any haplogroup. The first three have mutations that identify haplogroup C, and also a common T – C mutation at position 16325. Interestingly, two share another mutation at position 16288 (T – C) that is uncommon and it is probably related to an independent event; these two identical individuals are a 45 years old woman placed in the deepest part of the mound, and a similar age male placed in the upper part of it. This poses the question about familiar relationships among the people buried in the mound.

These sequences were compared with other Native mtDNA sequences from Uruguay and other areas. B and C haplogroups are the most common (around 70%) found in present day populations from northeastern Uruguay. Small sample sizes limit our options for analysis. Results of the comparisons are analyzed and discussed.

Quantifying the colonised/colonist relationship: suicide as a proxy measure for population stress.

L.A. Sawchuk, J. Padiak, J. Purcell. Dept. of Anthropology, University of Toronto at Scarborough, Scarborough, Ontario, M1C 1A4, Canada.

Increasingly anthropologists have taken an interest in the effects of marginalisation and transiency on individuals and populations. In particular, the relationship between the colonialists and the colonized has come under scrutiny. Absent from these discourses are methodologies that use health determinants that quantify this relationship and in some way measure the stress differential between the two groups. This research explores the rates of morbidity and mortality under the colonial system, using the British colony of Gibraltar as the study area and the Gibraltarian people and the British military garrison as the population under investigation. Power inequities led to differential allotment of essential resources, such as water and housing, and the hypothesis asks if these inequities are reflected in the indicators of health of the population. The basis for our data are the vital records collected by the colonial government from 1876 to 1939. In this study, suicide occurrence is used as a proxy measure for quantifying the stress the populations were enduring. After adjusting for age structure, Poisson distribution analyses indicate that the Gibraltarians suffered less than the military. The overall suicide rate of 21 per 100,000 persons for the military for the study period stood at 4 to 5 times the rate observed for the civilian community. We conclude that, contrary to much of the theoretical discourse on colonial power relationships, in turn-of-the-century Gibraltar the garrison suffered significantly more stress events than the marginalized civilians.

Does dental arch asymmetry in Adriatic Island populations reflect developmental instability?

K. Schaefer[1], T. Lauc[2], P. Mitteroecker[1], P. Gunz[1]. [1]University of Vienna, Institute for Anthropology, Vienna, 1090, Austria, [2]Institute for Anthropological Research, Zagreb, Croatia.

Developmental stability is reflected in the ability of a genotype to undergo stable development given the environmental conditions. Deviations from developmental stability may arise from the disruptive effects of environmental and genetic stresses; they can be measured by the statistics of fluctuating asymmetry (FA), the most sensitive indicator of the individual's ability to cope with these stresses during ontogeny. Consequently, in an inbred Adriatic island population we hypothesize that dental arch asymmetry is higher than in any panmictic reference population, and it to increase within this population with both poor environmental circumstances and the extent of inbreeding.

The data set consists of nearly 250 upper and lower dental casts from children (6–12 years of age), mainly from the Island of Hvar (Croatia). We digitized the 3D-coordinates of 40 landmarks on the arches. We used Geometric Morphometric methods for the statistical analysis quantifying overall asymmetry as the shape deviation (Procrustes distance) of a specimen from its mirrored form. The degree of asymmetry can be decomposed into 'directional' (DA) and 'fluctuating' asymmetry.

The results generally support our hypotheses. Furthermore, we find a high variance in lateral size differences. Surprisingly, size asymmetries are also not consistent in upper and lower arches but seem to fluctuate

independently, necessitating a novel modification of the decomposition algorithm.

Since we think that Geometric Morphometrics is the method of choice to deal with the topic of bilateral symmetry which is why we apply it to 3D landmarks in the facial region. The problems and suggested solutions are of fundamental interest to physical anthropologists.

Thyroid function and polychlorinated biphenyls (PCBs) in adolescents of the Akwesasne Mohawk Nation.

L. Schell[1], A. DeCaprio[1], M. Gallo[1]. Akwesasne Task Force On The Environment[2]. [1]University at Albany, State University of New York, Albany, NY, 12222, USA, [2]Akwesasne Mohawk Nation.

Endocrine disrupting environmental contaminants such as PCBs, are suspected of many human health effects including changes in reproductive function, and physical growth and development. Due to subsistence systems that involve local fish consumption and greater contact with the physical environment, Native Americans are at risk of exposure to environmental contaminants. This research investigates the effect of exposure to PCBs on thyroid function of 117 adolescents aged 10-16 years from the Akwesasne Mohawk Nation. Akwesasne is located on the St. Lawrence River in New York and Ontario and adjacent to hazardous waste sites that have contaminated the local environment. Overall, PCB levels at Akwesasne are moderate and comparable to chronically-exposed populations in Europe. Total thyroxine (TT4), total triiodothyronine (TT3) and free thyroxine (FT4) were analyzed for possible covariates (age, sex, and other toxicants). After correction of thyroid hormones for covariates, total PCB level is significantly correlated with FT4 (β = -0.14) and TT4 (β = -0.88), but not TSH or TT3. However, groups of highly chlorinated and di-ortho substituted PCBs are significantly, positively correlated with TSH and have stronger negative relationships with thyroid hormones (FT4, TT4, TT3). These results suggest that by changing thyroid function, PCBs could affect growth, development, and possibly cognitive function. Supported by NIEHES-ES0491309, and ES07231-07.

Regional patterns of sex-specific gene flow among the prehistoric Tewa Indians of north-central New Mexico.

M. Schillaci, C. Stojanowski. University of New Mexico, Albuquerque, NM, 87120, USA.

Although the social organization of prehistoric Southwest Pueblo Indian communities has received considerable attention in the archaeological literature, little research on this topic has been conducted by biological anthropologists. Here, we present results from our investigation of postmarital residence and inter-community gene flow using biodistance and determinant ratio analyses of craniometric variation. Specifically, we examine the between- and within-sex variation of 5 Pueblo IV (AD 1300-1550) period ancestral Tewa sites located in north-central New Mexico. Results from determinant ratio analysis indicate these Tewa communities were likely matrilocal. Males demonstrated a significantly greater average phenotypic distance between communities than did females (t = -2.264, df = 18, P = .039), as well as a greater, albeit nonsignificant, F_{ST} value as a pooled sample than did females (Z = .242, P = .810), indicating greater male genetic differentiation, possibly the product of nonrandom extra-regional male in-migration. Gene flow from extra-regional sources is also indicated for two communities by greater than expected within-group heterogeneity. Regression analysis indicated little if any relationship between phenotypic and geographic distances (slope = .097; r^2 = .023). These findings suggest the Tewa communities represented here likely prescribed to a pattern of female-based matrilocal residence with male migration from extraregional sources probable. The weak relationship between phenotypic and geographic distances invites speculation that sex-specific exogamy among prehistoric Tewa communities was structured on ritual organization, based possibly on clan or kiva group affiliation, rather than geographic proximity.

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Demographic and health reconstruction of the Santa Catalina de Guale Ossuary, Amelia Island, Florida.

C. Schmidt[1], C.S. Larsen[2]. [1]University of Indianapolis, Indianapolis, Indiana, 46227, USA, [2]The Ohio State University.

This study reports on a demographic and health reconstruction undertaken on a series of 62 mostly disarticulated individuals recovered from a 16th century Spanish mission—Santa Catalina de Guale—on Amelia Island, Florida. The remains of two fully articulated adult males in a coffin were located beneath the mass grave. Ossuary burial is a unique form of interment in this region; it likely pre-dates the period of full missionization that began in the early 17th century.

Excluding the coffin remains, the ossuary contained 41 adults and 19 juveniles, all of whom appear to have been Native Americans. Of the adults, 33 are female, seven are male, and one is indeterminate sex. There is no evidence of age- or sex-based placement in the ossuary pit. Skeletal elements show some evidence of non-random placement: crania, some phalanges, and some vertebrae were located in specific areas of the ossuary.

Porotic hyperostosis is present in 45.5% of subadult crania and 42.9% of adult crania. The frequency of periosteal reactions is also elevated: adult left fibulae, 48.4%; adult left and right tibiae, 44.7%. These frequencies suggest marginal living circumstances, at least as they are reflected in these pathological conditions. These findings are consistent with historical documentation showing declining health, even in the earliest period of the contact period.

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Proteomic analysis of extracellular matrix proteins from ancient bones.

T. Schmidt-Schultz[1], M. Schultz[2]. [1]Zentrum Biochemie der Universität, Göttingen, Lower Saxony, D-37075, Germany, [2]Zentrum Anatomie der Universität, Göttingen, Lower Saxony, D-37075, Germany.

Two-dimensional electrophoresis (2-D-electrophoresis) is a powerful and widely used method to analyses the complex protein mixtures extracted from cells, tissues or other biological samples. We used these techniques to analyse the proteins of the extracellular matrix (ECM) of ancient bones. It sorts proteins according to two independent properties in two discrete steps: The first dimensional step, isoelectric focusing (IEF) separates proteins according to their isoelectric points (pI); the second dimensional step, SDS-PAGE separates proteins according to their molecular weight (MW). Each spot on the resulting two-dimensional array corresponds to a single protein species in the sample. The ECM of bones contains about 200 different proteins (Boskey 1992). With our extraction method using ECM bone proteins and 2-D-electrophoresis, we separated more than 100 different spots from well- preserved ancient bones corresponding to more than 100 different matrix proteins of bones per individual. The individuals used in this study date between the Late PPNB and Early Modern Times. The efficiency of this method and its impact on bioarchaeology, in particular, the role of osteonectin will be discussed.

Gait mechanics in the common marmoset: implications for the origin of primate locomotion.

D. Schmitt. Dept. of Biological Anthropology and Anatomy, Duke University Medical Center, Durham, NC, 27710, USA.

Several features that differentiate the walking gaits of primates from those of most other mammals—the prevalence of diagonal-sequence footfalls, high humeral protraction, and low forelimb vs. hindlimb peak vertical forces—are believed to have evolved along with relatively long limbs and clawless, grasping cheiridia due to the requirements of locomotion on thin arboreal supports (Larson, 1998; Schmitt, 1999). I tested this proposed relationship between anatomy, behavior, and ecology by examining gait mechanics in the common marmoset, a primate that has the most claw-like tegulae of any callithrichid, relatively short limbs, and spends most of its time clinging on large trunks. Kinematic and kinetic data were recorded on two male *Callithrix jacchus* as they walked across a force plate on the ground and raised horizontal poles. Both animals moved easily on the ground and on a 1"diameter pole, walked competently on a 1/2" pole, but often fell from a 1/4" pole. The majority of all walking gaits (>80%) were lateral-sequence. During all steps at touchdown, the humerus was retracted (mean = 80° relative to a horizontal body axis). Peak vertical forces on the forelimb were higher than those on the hindlimb (FL/HL ratio = 120%). The locomotor mechanics of *Callithrix jacchus* are unlike that of any primate and most similar to that of small, nonprimate mammals. These data suggest a close relationship between anatomy and locomotor behavior. Furthermore, this supports the hypothesis that primate postcranial and locomotor characteristics are part of a basal adaptation for walking on thin branches.

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A contribution to health and disease in the pre-Columbian North American Southwest: The children from the Grasshopper Pueblo.

M. Schultz[1], T. Schmidt-Schultz[2]. [1]Zentrum Anatomie der Universität, Göttingen, Lower Saxony, D-37075, Germany, [2]Zentrum Biochemie der Universität, Göttingen, Lower Saxony, D-37075, Germany.

In the years 1975 and 1999-2001, the skeletons of 130 children excavated at the Grasshopper Pueblo, a Mogollon pueblo community in the mountains of east-central Arizona, were examined. The pueblo was used for less than two hundred years and dates to the 14th century. The skeletons were investigated by macroscopy and low power microscopy. Pathological changes of the skulls and long bones were proved by measurements, photographs and drawings. In this contribution, only the vestiges of diseases in the skull are presented.

The preliminary results are striking and characterize the living conditions of this pre-Columbian population. There is evidence of malnutrition: e.g. scurvy about 19.5% as a minimum, 27.2% as a maximum. Rickets was not diagnosed. However, the frequency of anemia is extremely high (45.7% as a minimum, 47.2% as a maximum). Some of the infectious diseases, for instance, otitis media (9.1 %) and sinusitis frontalis (7.7%) were relatively rare, whereas meningeal reactions (61.8% as a minimum, 64.0% as a maximum) and sinusitis maxillaris (47.1%) showed an even higher frequency. Thus, the health situation was not the best and similar to the results obtained in other Southwestern populations. The causes of these diseases will be discussed and compared with the results obtained from other pre-Columbian populations from the North American Southwest.

Modeling the ecology of subsistence change.

H. Schutkowski. Dept. of Archaeological Sciences, University of Bradford, Bradford, West Yorkshire, BD7 1DP, United Kingdom.

From cross-cultural studies it is known that the abandonment of a hitherto successful and adaptive mode of production and its replacement by a new subsistence strategy occurs, when ecological and/or socio-cultural circumstances change. From an ecosystemic viewpoint this corresponds to disequilibria between the human population and other components of the system.

The conditions of subsistence change will be introduced considering various historical and natural prerequisites with an emphasis on the transition from foraging to food production. By introducing a heuristic transition model, the processual dynamics of change can be broken down into three phases: preparation, substitution, and consolidation. Under ideal conditions, the re-installment of a temporarily disturbed dynamic equilibrium is achieved through a long preparation phase that allows testing a new subsistence technology as well as preparing and implementing a gradual adjustment of the socio-cultural basic conditions, followed by a short substitution phase. This is particularly important in the transition to subsistent agriculture, where the yield of agricultural production has to be big enough to compensate for fluctuations in resource supply and energetic uncertainties during the transition. Subsistence change, therefore, on the one hand serves the function of re-defining flows of matter and energy in the course of the establishment of a food procurement strategy; on the other hand, new culturally defined goals, such as property or status, can be achieved that are associated with improved resource control.

The transition model will be applied to major historic subsistence transitions in the Levant, the American Northeast and Southern Scandinavia, taking into account the bone chemistry and/or archaeological evidence.

Fishy diets?: Isotopic and chemical methods for testing.

H. Schwarcz. School of Geography and Geology, McMaster University, Hamilton, Ontario, L8S 4M1, Canada.

The possible components of the diet of ancient human populations can be inferred from associated food residues (bones, shells, seeds, etc.) but the proportions of these possible foods in the actual diet can only be evaluated from analysis of human remains, principally bones and teeth. The presence of aquatic and marine fish in the diet of riparian and coastal populations can be inferred from stable isotopic analysis of collagen reflecting the high nitrogen-15 content of larger carnivorous fish. Marine foods are also enriched in carbon-13, and marine consumers display higher $^{13}C/^{12}C$ ratios. Amounts of collagen adequate for analysis persist in bones up to age >50,000 y, but are generally less abundant in older bones. Carbon isotopes can be measured in human tooth enamel > 2 million y. old. Muscle tissue of marine fish display low barium/strontium ratios (due to insolubility of Ba in seawater); this is reflected in diet of marine consumers, and can be detected in tooth enamel. Other trace element and isotopic signatures are characteristic of marine consumers; aquatic fish consumers are less clearly recognizable, although fish from evaporitic lakes are also Ba-depleted. Isotopic studies show that the Mesolithic-Neolithic transition at coastal sites in Portugal is dominated by a shift away from use of marine resources. Other coastal sites will be discussed, to demonstrate use of trace element and isotopic methods.

Human Sacrifice at Punic Carthage?

J. Schwartz[1], F. Houghton[1], L. Bondioli[2], R. Macchiarelli[3]. [1]Dept of Anthropology, University of Pittsburgh, Pittsburgh, PA, 15260, USA, [2]Museo Nazionale Prehistorico Etnografico, [3]Lab. de Géobiologie, Biochronologie et Paléontologie Humaine, Université de Poitiers.

Biblical archaeologists have long maintained that the Carthaginians practiced infant sacrifice. Discoveries of small urns con-

taining cremated bones of young animals and/or humans seem to bear this out, leaving only questions of detail. Were the humans sacrificed singly or in groups? Were they first-born males? Was sacrifice before or through cremation?

Our 22 year study of the remains from over 450 urns from Carthage (excavated 1976-9) is revealing. Urns could contain bones of humans, animals, or both. Human remains might represent one individual or, using MNI, as many as seven; in the latter cases, duplicated bones or teeth often cannot be associated with other skeletal elements. Of the 79 ilia (see Schutkowski,1993 for sexing juveniles), 25 were definitively and 1 questionably classified as "male" and 36 definitively and 3 questionably as "female." Age was estimated using diaphyseal length and size and morphology of the basilaris, sphenoid, petrosal, ischium, and pubis (Faseka and Kósa, 1978) and various tooth growth and eruption criteria (Schwartz, 1995). Consistent with modern infant mortality data, most of the sample ranged between 2-12 postnatal months, clustering between 2-5 months. Another 20% at least (depending on skeletal element) was identified as prenatal. Recalculating for possible bone shrinkage (10 and 25%) did not eliminate prenates. di and 1 dm1 crowns representing 51 perinatal individuals were scrutinized for presence of a neonatal line, which would indicate survival for at least 2 postuterine days (not necessarily equivalent to term). Twenty-six individuals lacked these lines.

Infants were cremated, but not necessarily sacrificed.

The influence of socio-economic status on stature and body proportions in European archaeological populations.

M. Schweich. Dept. of Archaeological Sciences, University of Bradford, Bradford, West Yorkshire, BD9 4NJ, United Kingdom.

Stature and body proportions of humans are influenced by factors of the natural environment, such as climate, altitude, and latitude. However, since humans are cultural animals, other factors, such as social, economic and political status, general health, nutrition, and level of education, have a noticeable influence on stature and body proportions. Importantly, socio-economic status has a powerful influence on growth and development, and thus on stature and body proportions.

This research focuses on the influence of such cultural factors on growth and development; and on socio-economic status as a co-determinant of attained body proportions and stature. Populations from sites such as known *leprosaria* and medieval hospitals, rural and urban parish cemeteries, victims from the battle of Towton (UK) in AD 1461, and high status and lay individuals from monastic cemeteries are analysed. The data from these populations are viewed within their environmental, cultural, social, and economic context, to test for effects of social distinctions in state-level societies, effects of peasant life on growth attainment, and how the transition from less centralised early medieval societies to later medieval states affected growth and physical development. First results show a relationship between socio-economic status and body proportions, weight-to-height ratio, sexual dimorphism and general stature from Roman times to the post-medieval period. Stature and body proportions from human skeletal remains provide a time depth by which to study socio-economic inequality, thus extending documentary sources of more recent date.

The effect of time on levels of variation in Eocene primates.

J. Scott. Arizona State University, Tempe, Arizona, 85281, USA.

It has been hypothesized that temporal variation - variation among allochronic populations – can elevate levels of variation in fossil species beyond the ranges of extant taxa. However, empirical evidence demonstrating that temporal variation is a source of excessive variation in fossil assemblages is often lacking. The present study examines how levels of metric variation are affected by the mixing of allochronic populations in fossil primates.

Two samples from Eocene deposits in the Bighorn Basin, Wyoming are examined, representing the *Absarokius abbotti* lineage and the *Tetonius matthewi – Pseudotetonius ambiguus* lineage (Bown and Rose, 1987). Each sample is divided up into two sets of arbitrarily chosen stratigraphic/temporal intervals. Dental metric variation in the lower P3, P4, and M1 is quantified at each interval using the coefficient of variation (CV). The intervals are then recombined, creating larger intervals with progressively increasing temporal spans. CV's are then calculated for the combined intervals in order to determine if levels of variation increase as a result of temporal mixing.

In most cases, metric variability is only slightly elevated when intervals are merged. Some variables show no increase or even a minor decrease in overall variation when allochronic populations are combined, despite an estimated 1.0 million year time span for each sample. The lower P3 of the *T. matthewi – P. ambiguus* lineage is the only tooth substantially affected by temporal mixing. These results suggest that temporal variation should not be used as an explanation for excessive variation in fossil taxa unless it can be demonstrated.

The anthropology of malocclusion: crowding and anomalies in the Japanese.

N. Seguchi[1], H. Oe[2]. [1]Museum of Anthropology, University of Michigan, Ann Arbor, MI 48109, Ann Arbor, MI, 48109, USA, [2]Dept. of Statistics, University of Michigan, Ann Arbor, MI 48109.

Malocclusion has often been referred to as a "disease of civilization," and it is reported primarily in developed, urbanized populations (Corruccini, 1984, 1991). This study documented the prevalence of malocclusion from the prehistoric to recent Japanese.

Among the prehistoric Jomon populations (6,000-2300 B.P.), the dental arches are wide and display a nice spheroid form, and the tooth rows are regular. On the other hand, the modern Japanese dental arches are narrower and show various irregular curved forms, and the tooth rows show a lot of irregularity.

The prevalence of lower tooth crowding dramatically increases in the Edo (1600-1867 A.D.) and Modern Periods (after 1867). However, the incidence of upper tooth crowding increases in the Modern Period, and the frequencies of upper crowding are not greater than lower crowding.

In addition, tooth rotation in the lower and upper jaws appears in a greater variety of teeth in the Edo and Modern Periods. The number of impacted teeth, especially third molars, and the incidence of malformed teeth increases in the Edo and Modern Periods.

Overall, a dramatic increase in malocclusion occurs in the Edo and Modern Periods. Because the percentage of individuals with lower crowding is larger than with upper crowding we can conclude that the dental arch of the lower jaw reduced faster than the dental arch of the upper jaw. The differences in prevalence of malocclusion may suggest some changes in diet, cooking technology, eating habits, chewing stress, and dental health.

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Morphological integration 2: developmental interactions during ontogeny and phylogeny in the human cranium.

H. Seidler[1], K. Schaefer[1], H. Prossinger[1], P. Mitteroecker[1], P. Gunz[1], G.W. Weber[1], F.L. Bookstein[2]. [1]Institute for Anthropology, University of Vienna, Vienna, 1090, Austria, [2]Institute of Gerontology, University of Michigan.

Cranial base, vault and face derive from embryologically distinct regions but grow in a morphologically integrated manner

through numerous developmental and functional interactions which, far from being understood, have not even been satisfactorily described. Researchers have dealt with this topic for a long time using various metric and statistical methods in order to identify the morphological changes—methods that are inadequate for grasping the mutual influence of size and shape changes and the shifting processes between the regions during ontogeny and phylogeny.

Since traditional morphometrics fails to maintain all actual geometric relations of the regions throughout the analysis, we use geometric morphometric methods, including singular warps analysis. Our material is CT-scans and stereolithographic models of adequately complete archaic and modern hominoid crania (adult and subadult *H. sapiens, H. heidelbergensis, A. africanus* and *P. troglodytes*). Traditional exo- and endocranial landmarks were digitally set, and semi-landmarks distributed in the regions where unique, biologically homologous structures are absent.

We find interaction patterns between the respective regions—partly across species, partly only within individual groups. Some of these detected interaction patterns are at odds with published results, begging a discussion of implications.

Neural substrates of cognition in monkeys and apes: preliminary observations.

K. Semendeferi, N. Schenker, H. Poje. Dept. of Anthropology, University of California, San Diego, La Jolla, CA, 92093, USA.

Certain cognitive abilities of the primate brain, including mapping and memory skills, mental representations, and theory of mind, have long been debated on the basis of behavioral observations in apes and monkeys of various species. Such abilities involve to a large extent the temporal and/or frontal lobes. The study of these brain regions in primates can contribute to the debate surrounding species-specific cognitive specializations.

Volumetric estimates were obtained for the size of the temporal and frontal lobes and their cortex. We used MR brain scans of living subjects: 6 chimpanzees, 3 bonobos, 2 gorillas, 4 orangutans, 4 gibbons, 4 macaques, 1 baboon, 1 mangabee and 2 cebus monkeys. The lobes were outlined consistently across species and the cortex was segmented from the white matter throughout the hemispheres.

In great apes the frontal cortex occupies a larger percentage of total cortex than in monkeys or lesser apes and no overlap exists between the individual relative values of great apes and monkeys. The temporal cortex is relatively enlarged in monkeys and gibbons, but individual ape subjects are found within the monkey range.

Our preliminary data suggest that the relative size of some of the neural substrates of higher cognitive functions may be significantly enlarged in apes. However, other parts of the brain may have overlapping relative values across the anthropoids. Individual variation clearly exists across taxa.

Phylogenetic utility of higher primate craniodental morphology: an assessment using population genetic techniques.

D. Serdoz, M. Collard. Dept. of Anthropology, University College London, London, England, WC1E 6BT, United Kingdom.

Hominid cladistic analyses have so far yielded conflicting and weakly supported phylogenies. It has been suggested that this is because standard craniodental traits are not reliable for estimating relationships among primate species and genera. However, it is also possible that the analyses have failed to produce reliable phylogenies because cladistics is unable to retrieve phylogenetic signal from such traits. Here, we evaluate these hypotheses by applying an alternative phylogenetic method based on a population genetic parameter, Wrights Fixation Index (Fst), to craniodental data from extant primate genera whose relationships have been established using molecular techniques.

The data comprised values for 30 craniodental measurements recorded on *Gorilla*, *Homo*, *Pan*, *Pongo* and an outgroup, *Colobus*. After size correction and standardisation, the data were used to generate a matrix of intergeneric Fst distances. Next, phylogenies were derived from the matrix using two clustering methods, UPGMA and NNL. Lastly, the UPGMA and NNL phylogenies were compared to the consensus molecular phylogeny for the hominoids, which is widely considered to be accurate. Incongruence between the UPGMA and NNL phylogenies and the molecular phylogeny was taken as support for the hypothesis that primate craniodental traits are not reliable for phylogenetic inference at low taxonomic levels. Congruence between the UPGMA and NNL phylogenies and the molecular phylogeny was viewed as support for the hypothesis that cladistics is unable to generate reliable phylogenies from standard primate craniodental traits.

The UPGMA and NNL phylogenies suggested that the great apes and *Colobus* share an ancestor not shared with *Homo*. They also suggested that the African apes are not monophyletic, with *Gorilla* being more closely related to *Colobus* than to *Pan*. Thus, neither phylogeny agreed with the consensus molecular phylogeny. These results add weight to the suggestion that standard craniodental traits are of limited use in reconstructing the phylogenetic relationships of primate species and genera.

Influence of skin pigmentation as a risk factor for osteoporosis.

S.J. Shah, G.J. Armelagos. Dept. of Anthropology, Emory University, Atlanta, GA, 30322, USA.

Previous research has concluded that race can be used to determine the level of risk that a woman faces for developing osteoporosis and increased risk for fracture. However, understanding of the physiology of the disease, with respect to endocrine functioning and biochemical interactions, suggests that risk may be linked more directly to actual skin pigmentation and Vitamin D absorption than to racial background and so-called hereditary factors. Differences in the Vitamin D-endocrine system have been studied by Bell, et al, (*Journal of Clinical Investigation*. 76(2): 470-3. 1985) who conclude, "the results indicate that alteration of the Vitamin D-endocrine system […] may contribute to the increased bone mass in blacks." Light absorption from the sun induces biochemical pathways in the body that influence Vitamin D and subsequent bone reabsorption and formation. We hypothesize that the differences in Vitamin D are a result of increased absorption of light from the sun by individuals with darker skin pigmentation, rather than a result of a genetic predisposition to a particular Vitamin D physiology. To test this hypothesis, we statistically determined the relationship between skin pigmentation (as measured by a spectrophotometer) and progression of osteoporosis (as determined by a bone densitometer) in a population from suburban Atlanta. The relationship of skin color, bone mass and exogenous factors such as the uses of skin-block are considered in our analysis.

Lateralized Behaviors in *Lemur catta* .

M. Shaw. Dept. of Anthropology, East Carolina University, Greenville, NC, 27834, USA.

The origin of right handedness and the development of left-hemispheric language and speech mechanisms in the human brain may go back to the hominids of millions of years ago, including the australopithecines and *Homo habilis*. Nonhuman primates exhibit asymmetries that may be the evolutionary precursors of human laterality. This research describes the lateralized behaviors of a group of semi-free-ranging *Lemur catta* during daily activities and tests the hypothesis that individual hand preferences and other lateralized behaviors are found among *L. catta*. Focal samples were taken of 12 in-

dividuals at the Duke University Primate Center over a ten-week period. The 9 ha, open-air enclosure, which housed the lemurs, allowed for the observation of natural behaviors. Results of the analysis of the data reveal that individual preferences are present in *Lemur catta* for many behaviors. Variables of hand preference in this study include all use of hands: reaching for food, any hand to mouth event, foraging, grooming, holding and scent marking. Other lateralized behaviors that were recorded are the direction of whole body turns and the positioning of head, tail and body. Of the females, three were significantly right handed and one was significantly left handed. Four of the males were significantly left handed and two were significantly right handed. Two individuals showed no overall tendency for lateralized behaviors..

Evaluation of low dietary iron as a nutritional adaptation to infectious disease.

B. Shell-Duncan[1], T. McDade[2]. [1]University of Washington, Seattle, WA, 98195-3100, USA, [2]Northwestern University.

Evolutionary perspectives on resistance to infectious disease and human-pathogen interactions have led to a re-evaluation of "optimal" iron status. Low circulating iron levels (hypoferremia) associated with infection are now recognized as a non-specific immune response, withholding iron from invading microorganisms. Hypoferremia can also result from low dietary iron, potentially contributing to protection from infection through mimicry of the iron withholding response. A nutritional adaptation hypothesis posits that optimal disease resistance occurs in mild iron deficiency due to additional hypoferremic protection, whereas the benefits of hypoferremia are outweighed by iron-related cellular immunosuppression in severe iron deficiency. To test this hypothesis, data were collected from 314 school-aged children in northern Kenya. Sociodemographic and 24-hour dietary recall data were collected from the primary caretaker. Anthropometrics were obtained from each pediatric subject, as well as capillary blood to determine hemoglobin, zinc protoporphyrin:heme ratio (ZPP:H: indicator of iron deficiency) and C-reactive protein (CRP: indicator of current subclinical infection), and Epstein-Barr virus antibodies (EBV: marker of cell-mediated immunity). Iron deficiency was determined by subnormal hemoglobin and/or elevated ZPP:H.

Preliminary results show that 18.5% of children were diagnosed with mild iron deficiency, and 13.7% with severe iron deficiency anemia. 24-hour recall data reveal low iron diets, with average intakes (3-4 mg iron/day) significantly lower than the WHO recommended intake of 9-16 mg. EBV antibody level, indicating cellular immunocompetence, is not significantly related to any measure of iron status, or to other indicators of health and nutrition. However, levels of CRP, indicating current subclinical infection, do vary by iron status. Consistent with the nutritional adaptation hypothesis, we find the lowest levels of infection among children with mild iron deficiency (14.1%), as compared to children with normal iron status (17.0%) and severe iron deficiency (25.6%). Further investigations using a more specific measure of iron status (serum transferring receptor) are currently being conducted to confirm these preliminary findings.

Disease as detective: an analysis of severe skeletal pathology in a modern forensic case.

K.E. Sheridan[1], A. Mundorff[2]. [1]Binghamton University, Binghamton, NY, 13902, USA, [2]Office of the Chief Medical Examiner, New York City.

In December of 1997, a set of unknown skeletal remains was discovered in a wooded area on Staten Island, NY. Clearly a modern forensic case, the adult male skeleton displayed severe spinal pathology, including bilateral fusion of innominates to the sacrum, collapse and fusion of T4-T10 at a right angle, fusion of L2-L5 with calcitis growths, extensive osteophytic growths throughout the thoracic and

lumbar spine, and osteoporosis of the vertebral bodies. Via differential diagnosis, it was determined that the individual suffered from a severe case of Ankylosing Spondylitis (AS). Age of onset for AS is between 15 and 35 years, which predominantly occurs in males (recent studies indicate a 2:1 to 3:1 sex ratio). Epidemiological data suggests a genetic model involving genes of the major histocompatibility complex. A number of complications may occur as a result of spinal disruption, including lower back pain, loss of dexterity, neurological disorders (resulting from damage to the spinal cord), decrease in chest expansion capacity, and bowel and bladder disorders.

In this study, we have constructed a biological profile of the case within the parameters of AS, in order to help uncover the identity of the individual. In this respect, we have drawn upon epidemiology,

skeletal pathology, medical genetics, and rheumatology in order to illustrate the circumstances of the individuals life history as represented in the skeletal remains. Thus this study illuminates the necessity of a holistic approach to forensic anthropology, one that reaches far beyond skeletal biology in the study of human remains.

Hunting behavior of adolescent male chimpanzees at Ngogo, Kibale National Park, Uganda.

H. Sherrow[1], D. Watts[1], J. Mitani[2]. [1]Yale University, New Haven, Connecticut, 06520, USA, [2]The University of Michigan.

Chimpanzees in all known populations hunt and eat meat. Previous studies support the "male bonding" hypothesis, which proposes that males hunt and share meat largely to establish and reinforce alliances with other males. Hunting thus takes on considerable political significance for males. However, the development of hunting proficiency in maturing males has received little attention. We present data on the hunting behavior of adolescent male chimpanzees at Ngogo, Kibale National Park, Uganda that start to address this deficiency. The Ngogo chimpanzees mostly hunt red colobus and are extremely successful hunters relative to other known communities. Data from over 100 hunts show that adolescent males are present at most hunts and often pursue prey. Variation in pursuit frequency, prey-capture success, and meat acquisition all vary positively with body size, and presumably age. Larger males tend to receive more meat from other group members, although exceptions exist. However, most adolescents acquire meat less often than most adult males do. Smaller, adolescent males mostly get meat by scrounging for scraps dropped by others who control carcasses. These results confirm other reports that males develop hunting abilities slowly and that body size influences male willingness to participate in hunts and their hunting success. The data on meat sharing, like data on grooming and coalition formation between adult and adolescent males, also indicate that adolescent integration into male networks of social exchange and cooperation is a slow process.

Reproductive seasonality in wild chimpanzees: A new method of analysis from Kibale, Uganda.

D. Sherry. Dept. of Anthropology, Harvard University, Cambridge, MA, 02138, USA.

This research on reproductive seasonality in wild chimpanzees presents a new approach for analyzing the timing of the female reproductive cycle in relation to ecological factors. The study design follows the general theoretical framework proposed by Lancaster and Lee in 1965 to explain variation in primate reproductive seasonality: females will tend to coordinate seasonal resources with the particular stage of the cycle most crucial to the reproductive success of a given species. Although seasonal factors can include fluctuation in mating partners, predation and disease, I focused on food sup-

ply since reproduction requires substantial energy investment on the part of females.

I assembled demographic data based on long-term field records from the Kibale Chimpanzee Project during the study period 1988 - 1998. These records yielded 20 known births from 15 females and circular statistics showed the presence of a significant birth peak. I used feeding data, in conjunction with phenological records and nutritional analyses, to quantify and track chimpanzee-specific food availability and dietary quality throughout the study period.

To analyze the relationship between food availability and reproductive seasonality, I formulated the "alignment method" whereby food availability across the various stages of the female reproductive cycle could be evaluated to test leading hypotheses. The alignment method will be presented along with implications for future research in the area of primate and human reproductive seasonality and ecology.

Paleoanthropological survey of the Lake Rukwa Basin, Tanzania.

R.J. Sherwood[1], J.D. Kingston[2]. [1]Dept. of Anthropology, University of Wisconsin, Madison, WI, 53706, USA, [2]Dept. of Anthropology, Emory University.

The Rukwa trough is a northwest-southeast trending rift lying at the confluence of the western, eastern, and Malawi branches of the East African rift system. As early hominins have been located both north and south of this rift segment, it is likely that hominin populations also inhabited this region. Geophysical surveys indicate that fluvial, deltaic and lacustrine facies containing abundant volcaniclastic debris have been accumulating in the Rukwa basin since at least the middle Miocene. These comprise the greatest known thickness of Neogene sediments in the East African Rift (>11 km). Based on analyses of stratigraphic sequences of the basin, the potential for fossiliferous horizons is good – the only question remaining is the extent to which these sediments are currently exposed. Archeological and paleontological surveys in the area have previously focused on the southwestern portion of the rift basin, but exploration in the northeastern trough has been limited.

In June 2001 we began surveying the Rukwa Basin along the northwest margins of the trough, attempting to locate Mio-Pliocene sedimentary sections exposed along complex fault escarpments or dissected drainage patterns. Although sediments had been previously mapped as undifferentiated Neogene sediments, our investigations revealed that sediments exposed in the region are almost exclusively Quaternary lake, river, and alluvial fan deposits, with limited exposure of underlying older sediments. Erosion of these younger deposits at a few localities revealed coarse conglomerates and red sandstone facies, some of which are fossiliferous.

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Infectious disease in enslaved Africans from Newton Plantation, Barbados: bioarchaeology and ethnohistory.

K. Shuler. Southern Illinois University Carbondale, USA.

Newton Plantation, Barbados (ca. 1660-1820) is the largest and earliest Caribbean slave cemetery. Original excavations (1971-1973) provided cranial elements for study; unfortunately, postcrania were reinterred. In 1997-1998, 49 relatively intact individuals were excavated. This study will compare infectious diseases patterns among 169 enslaved Africans from Newton between 1796-1825 recorded in ethnohistorical resources with those observed in the recently analyzed skeletons.

Mortality by age and gender was reported in the Newton Papers (Handler and Lange, 1978:99) for illnesses including colds, fever, and dysentery. Infectious diseases accounted for 39.3% of all deaths. Diseases with potential skeletal involvement included tuberculosis (13%) and leprosy (6.5%), but skeletal rates should be lower. Children comprised 40% of deaths from infectious disease. Women (36%) were more commonly affected than men (24%).

Nonspecific periostitis was observed in 30% of the 49 skeletons. Of these, 10% were subadult and 16% adult. Only 2% displayed severe infections, and no cases of differentially diagnosed diseases were observed. Females had higher rates of infection (14%) than males (4%). Severe infections were noted in no females and 2% of males.

Historical and skeletal patterning both suggest higher frequencies of infection among enslaved women, but lower than expected child mortality from infection was observed in the skeletons. Lower rates of differentially diagnosed diseases in the skeletal sample were expected, and the overall rate of infectious disease closely follows predicted patterns from historical accounts. Thus, historical records provide a useful tool for suggesting health patterns in skeletons from Newton.

Age at menopause in Puebla, Mexico: methodological considerations.

L. Sievert, S. Hautaniemi. Dept. of Anthropology, UMass at Amherst, Amherst, MA, 01003-4805, USA.

Cross-population comparisons of age at menopause, and studies of change in age at menopause over time, are complicated by variation in the computation of average age at menopause. This presentation explores various methods used to determine average age at menopause using data drawn from a community study carried out in the capital city of Puebla, Mexico. Factors associated with age at menopause are also examined.

From June, 1999 through August, 2000, women aged 40-60 (n = 755) participated in interviews and anthropometric measures in markets, small stores, public parks, and outside of public buildings. The sample had a mean age of 50.0 years, 50% had six years of schooling or less. The majority were employed as saleswomen in small businesses. Mean parity was 3.6. Rate of hysterectomy was 23%.

Mean recalled age at natural menopause was 47.6 years. This average does not include the 21 women who reported a natural menopause before the age of 40. One point for discussion is whether, in countries such as Mexico, women with natural menopause before the age of 40 should always be excluded from computation of mean and median ages at menopause. Another question concerns who to include as censored observations in life table analyses of median ages at menopause.

Limiting the population to women with a natural menopause after the age of 34, more education and a higher socioeconomic status are associated with later ages at menopause. These and other results are discussed with an emphasis on the methodology of menopause research.

The phylogeny and taxonomy of plesiadapiforms.

M. Silcox. Pennsylvania State University, Dept. of Anthropology, University Park, Pennsylvania, 16802-3404, USA.

The question of the wider relationships of plesiadapiforms was addressed using a cladistic analysis. Data were gathered for members of all eleven plesiadapiform families, as well as representative dermopterans, scandentians, chiropterans, euprimates, mixodectids, plagiomenids and outgroups. 85 taxa were examined for 181 characters spanning the dentition, cranium and postcranium. These data were studied using parsimony techniques and rigorous character analysis was performed. Analyses were performed on the three regional data partitions separately, and on a pooled dataset including all characters. The results of this total evidence analysis concur with traditional views that euprimates and plesiadapiforms are more closely related to

one another than either is to any other archontan. Although Euprimates appears as a monophyletic clade, Plesiadapiformes is not monophyletic to the exclusion of Euprimates. This leads to the adoption of a classification that includes all plesiadapiforms in Primates as the most primitive members of that order. Volitantia is well supported and may be closely related to Scandentia. In the absence of a link between plesiadapiforms and dermopterans, the taxa Primatomorpha and Eudermoptera (both *sensu* Beard, 1993) are not considered valid.

This study highlights the importance of simultaneous analysis of multiple types of data in forming conclusions about phylogeny and taxonomy. This is particularly key in a clade that shows as much variability, convergence, and parallelism as Primates.

Phylogenetic distribution of craniofacial traits in papionin primates.

M. Singleton. Dept. of Anatomy, Midwestern University, Downers Grove, IL, 60515, U.S.A.

Traditional classifications of the cercopithecine tribe Papionini assumed monophyly of the mangabey genera *Cercocebus* and *Lophocebus*; however, molecular phylogenetic studies consistently have found *Cercocebus* to be the sister-taxon to *Mandrillus* with *Lophocebus* more closely related to *Papio* and *Theropithecus*. While a suite of post-cranial characters supporting the *Cercocebus-Mandrillus* clade has been identified, both traditional and geometric morphometric studies give little support to molecular findings and relatively few discrete cranial traits have been suggested as potential synapomorphies of the recognized molecular clades.

This study examines the distribution and polarity of craniofacial characters within the Papionini. The study sample comprises over 300 adult individuals of known sex and provenience representing all recognized cercopithecine genera. Both three-dimensional landmarks and standard dental measurements were collected. A series of qualitative characters emphasizing the sub-orbital and maxillary regions also was scored for each specimen and character state frequencies were calculated.

Cranial and dental proportions are analyzed using size-adjusted linear measurements and ratio-based indices. Cranial shape features are explored via multivariate analysis of Procrustes-aligned landmark coordinates. Patterns of within-taxon variation are documented and character polarity is assessed in order to distinguish primitive retentions from shared derived features. Implications for the evolution of papionin cranial form are considered.

This research is conducted in collaboration with the Morphometrics Research Group of the New York Consortium in Evolutionary Primatology and is supported by NSF Research & Training Grant #BIR 9602234 (NYCEP) and NSF Special Program Grant #ACI-9982351 (E. Delson, L. Marcus, D. Reddy & N. Tyson, Principal Investigators).

Digital image analysis for osteological aging: a preliminary assessment.

M. Sitchon, R. Hoppa. Dept. of Anthropology, University of Manitoba, Winnipeg, Manitoba, R3C 1N8, Canada.

Traditional age estimation methodologies rely on the appearance of certain features of a bone that are visually compared to a set of published age-progressive stages developed from morphological changes in skeletal samples of known age. Inadequacies associated with visual scoring include the inability to accurately distinguish discernible aging features in older adults. To address this issue, we examine the application of image analysis techniques, such as superimposition, visualization, surface rendering, and feature analysis, for quantifying age-progressive changes in skeletal morphology.

Image analysis techniques have the potential to identify discernible morphological changes related to age more accurately and in detail than is possible with the human eye alone. The increased comparative capability of imaging analysis software addresses the issues associated with estimating the age of older adults by recognizing age-progressive traits overlooked by visual scoring.

The results of a preliminary investigation on image analysis techniques for estimating age from the pubic symphysis are reported. Measures of image pixel brightness and pixel intensity data translated into line plots represent the range of elevations on a surface. Elevation data correspond to the different textures and relief exhibited in the various age phases of the symphyseal surface.

This study suggests that imaging analysis may be a useful tool in age estimation methodology. Computer assisted analyses promotes increased standardization in methodology, benefiting the observer by improving the efficiency and accuracy of skeletal age estimation in comparison to actual chronological age. Future directions in this area are discussed.

Mathematical analysis of trabecular trajectories in apparent trajectorial structures: the unfortunate historical emphasis on the human proximal femur.

J. Skedros[1], J. Brady[2], C. Sybrowsky[2]. [1]University of Utah, Dept. of Orthopaedic Surgery, Salt Lake City, Salt Lake City, Utah, 84115, USA, [2]University of Utah.

Wolff's law emphasizes the "mathematical" correspondence of trabecular orientation in the human femoral neck with stress trajectories in a curved crane-like structure [Wolff, 1892]. In true trajectorial structures, trajectories form orthogonal (90°) intersections with axisymmetric paired trajectories (curves) at any point along a neutral axis. Wolff's view of the proximal femur as a trajectorial structure has become rooted in contemporary orthopaedics and physical anthropology. This view assumes that the femoral neck is habitually loaded in bending. Anthropologists are interested in interpreting loading history of the hip in anthropoid lineages. However, the nature of the prevalent loading condition(s) in this region remains controversial. This issue was examined comparatively by quantifying the angles subtended by paired trabecular tracts in modern adult human femoral necks (n = 12, normal neck-shaft angles), and fetal-to-adult artiodactyl (sheep n = 10; deer n = 10) calcanei [simple bending systems]. In each bone two-to-three sets of paired trabecular tracts were traced. Cartesian coordinates of each tract were fit to non-linear equations (TableCurve™ program). Calcaneal trajectories exhibited orthogonal intersections, while femoral intersections were acute (60-80°). This may represent adaptation for shear stresses in the complexly loaded femoral neck [Pidaparti & Turner, 1997, *J. Biomech.*]. Cranial trajectories yielded the equation $y\ exp(-1) = a+b/x$ (100% of sheep; 90% of deer; 33% of femora). Caudal trajectories: $y = a+b\ exp(-x/c)$ (80% sheep; 70% deer; 80% femora). Therefore these calcanei approximate "mathematical" trajectorial structures, while the human femora do not. Calcaneal trabecular patterns were consistent throughout the entire growth range, and caudal tracts corresponded exactly to the orientation of the growth plate, which may constrain their morphologic development.

Strategies for analysis of DNA extracted from skeletal material.

S. Smallwood[1], N. Tuross[2], J. Milanich[1], C. Mulligan[1]. [1]University of Florida, Dept. of Anthropology, Gainesville, FL, 32609, U.S.A., [2]Smithsonian Center for Materials Research and Education.

The origins, evolution, and interactions of prehistoric populations are the focus of considerable debate. Utilizing ancient DNA technology, we propose to address these issues in a molecular study of selected collections of skeletal remains from the Florida Museum of Natural History (FLMNH). The collections have been screened based on the

following criteria: condition of skeletal material, number of individuals (sample size), temporal representation, and geographic location of archaeological site. Five collections meeting the criteria were chosen and include three sites in Duval County, Florida, dating from St. Johns Ia (A.D. 100-500) to St. Johns IIb (A.D. 1050-1513) periods, and two sites on St. Simons Island, Georgia (A.D. 1200-early colonial period). These collections are relevant to questions regarding origin of and interactions between the St. Johns and St. Marys cultures.

Amino acid analysis was employed as a preliminary screening tool to determine the likelihood of DNA recovery. Results indicate that recovery may prove difficult. Kolman and Tuross (2000) reported that bone containing 5-62% glycine relative to a modern cow bone control did not yield amplifiable DNA. The best FLMNH sample contained 66% of the glycine in a modern control. Furthermore, previous studies (Hoss et al., 1996) indicate that intact, amplifiable DNA is difficult to recover from remains excavated in warm climates. Multiple methods were used to purify DNA and to reduce polymerase inhibition. Attempts to amplify mitochondrial DNA, however, have not resulted in verifiable positive results.

Forensic facial reconstructions: a test of two methods.

J. Smart. State University of New York at Buffalo, Buffalo, New York, 14226, USA.

While the technique of building facial reconstructions has been in practice for many years, it has only recently been accepted to any degree and utilized by investigative agencies. The goal of reconstruction is to approximate the appearance of an individual based on skeletal remains. Despite its use in investigations, the relative effectiveness of reconstruction has not been empirically tested. The purpose of this study is to examine and compare two techniques for facial reconstruction: clay sculpture and computer graphic manipulation.

The methodology for comparing the reconstruction techniques is modeled after the analysis conducted in 1970 by Snow, Gatliff, and McWilliams. Reconstructions of four skulls have been completed using both techniques, producing a total of eight reconstructions. Photographs displaying each reconstruction are mounted on posters which also display a "line-up" of five possible matches. For each poster, one possible match is a photograph of the reconstructed individual in life, the remaining are of individuals with a similar age, sex, and race. The study sample consists of responses from investigators from three local agencies whose comparisons between reconstructions and photographs are recorded as either a "Match" or "No Match." These responses have been tabulated and statistically analyzed.

The quantitative nature of this study offers a new dimension to the field of forensic facial reconstruction and addresses the common criticism that it is more art than science, and therefore cannot be tested.

Food shortages and the omnivore's dilemma.

D. Smay. Dept. of Anthropology, Emory University, Atlanta, Georgia, 30322, USA.

As omnivores, humans are faced with a dilemma: we have both a need for variety in our diet and a desire to be familiar with the foods we eat. This latter desire is known as "neophobia" and manifests as a reluctance to try novel foods. Most omnivores are neophobic, but a striking feature of humans is our ability to transform aversions to likings through the influence of culture. This ability is especially adaptive in the context of seasonal food shortage. There is abundant evidence to suggest that humans have faced periodic food shortages for the entire span of our evolution. Such shortages would require groups to range farther than usual to find food and to increase the variety of foods ingested. Information on all the plants and animals in the ecosystem that are edible (if not palatable), and methods of acquiring and preparing them would be vital in the event of a failure of the preferred food supply. Children learn this information through exposure and observation of others eating new foods, thereby learning that such foods and methods are safe and efficacious. In our evolutionary past, our ability to learn to accept new foods readily was adaptive, especially in the context of food shortage. However, in today's industrial food system, this ability has been used, not to ensure survival during the hungry season, but to maximize profits. In a society where 3 of 5 adults are overweight or obese, an understanding of the origins of this mechanism is vital.

New human remains from the Neander Valley, Germany.

F. Smith[1], R. Schmitz[2]. [1]Dept. of Anthropology, Northern Illinois University, DeKalb, IL, 60115, USA, [2]Institut fuer Ur- und Fruehgeschiche und Archaeologie des Mitelalters, Abteilung Aeltere Urgeschichte und Quartaeroekologie, Universitaet Tuebingen.

The original Neandertal skeleton was recovered in 1856 as the walls of the Neander Valley were literally being leveled to remove limestone for use in construction. It has often been assumed that Neandertal 1 was an isolated burial in a small cave, the "Kleine Feldhofer Grotte," devoid of any archaeological or faunal associations. After careful historical research, deposits removed from this cave at the time of Neandertal 1's recovery as well as those from the larger "Feldhofer Kirche," were located and excavated by one of us (R.S.) between 1997 and 2000. These excavations have yielded Paleolithic artifacts, Pleistocene fauna, and additional human skeletal remains.

We present a general discussion of these discoveries, with a focus on preliminary assessment of the 62 new human specimens recovered to date. Three pieces (a facial fragment, a portion of temporal, and a small piece of femur) fit conclusively on the Neandertal 1 specimen. All other cranial and mandibular specimens, as well as several postcranial bones and teeth, represent anatomical elements not present in Neandertal 1 and are thus possibly derived from this individual. There are other remains, principally a humerus and portions of two ulnae, that cannot derive from Neandertal 1. The morphology of these elements indicates Neandertal affinities. Evidence of a third individual (a single deciduous molar) is also present. Thus the original Neandertal locality is more complex and informative than previously thought.

Quantifying inhibition using real time-PCR in DNA extracted from the feces of wild savannah baboons.

K. Smith[1], J. Altmann[2], S. Alberts[3], P. Bender[1], J. Beck[1]. [1]Coriell Institute for Medical Research, Camden, NJ, 8103, USA, [2]Princeton University, Princeton, NJ, National Museums of Kenya, Nairobi, Kenya, Brookfield Zoo, Brookfield, IL, [3]Duke University, Durham, NC, National Museums of Kenya, Nairobim Kenya.

Recent techniques for extracting DNA from non-invasive sources such as hair and feces allow researches to ask questions about wild and/or endangered primate populations that were not previously possible. Despite their necessity, non-invasive DNA sources can be very challenging to work with because of degradation, low copy number, and, in the case of feces, PCR inhibitors. Quantifying target DNA, distinct from the DNA of ingested and gut organisms, may help predict which samples will yield reliable results (Morin et al. 2001), saving time, resources, and limited biomaterials. A fecal extract with a moderate amount of target DNA (0.05 – 0.4 ng/μL), may nonetheless be unreliable if it also contains many inhibitors. Quantifying the inhibitors in a fecal extract is therefore a second, and less-discussed method for predicting the reliability of a sample, one that may be a critical step for many samples. Fecal samples collected

from wild savannah baboons were used to develop an RT-PCR quantitative assay, in which varying amounts of baboon fecal DNA were added to 50 ng of high-quality human DNA to determine the strength of each sample's inhibition. Fecal samples varied in the degree to which they inhibited the amplification of high-quality DNA. Increasing template DNA may yield more robust PCR results if inhibitors are few, but will not if inhibitors are abundant. Hence, quantifying the amount of inhibition in fecal extracts may greatly increase efficiency during work with fecal DNA, in a way that quantifying the DNA alone does not.

Historical population structure of North Yorkshire coastal populations: the effects of distance and occupation on mobility.

M. Smith[1], S. Sherren[1], R. Williams[2]. [1]Dept. of Anthropology, University of Durham, UK, Durham, County Durham, DH1 3HN, United Kingdom, [2]Dept. of Computer Science, University of Durham, UK.

Within the coastal parishes of North Yorkshire, UK, there were in the nineteenth century a string of fishing settlements with a distinctive material culture, economy and society, which served to isolate them from the adjacent agricultural communities. Random isonymy and migration data from 6492 households, comprising some 31,000 inhabitants, transcribed from the enumerators' books of the 1851, 1861, 1871 and 1881 censuses, are used to test predictions about geographical and cultural correlates of population structure.

If migration and settlement are determined by isolation-by-distance, random isonymy between these populations is expected to be broadly consistent with their geographical distribution along the coast. This is confirmed in part, but inconsistencies between geographical and genetic distance are encountered, and are explained principally in terms of heterogeneous local immigration.

On the basis of earlier research on Fylingdales parish, it is predicted that the populations engaged in maritime occupations (sailors, fishermen, ship-owners) are more stable and more isolated during the second half of the nineteenth century than the corresponding populations of land-based workers (tradesmen, farmers, labourers, miners). It is shown that within-parish variation in isonymy over time is greater for land-based occupations than for maritime. It is also shown that between-parish variation in isonymy is greater for maritime than for land-based occupations, reflecting the isolation of fishing communities from each other.

Late Woodland/early Mississippian period evidence of intergroup violence: emerging temporal and spatial patterning.

M. Smith. Dept. Anthropology, Northern Illinois University, DeKalb, Illinois 60115, Sycamore, Illinois, 60178, USA.

Over 300 skeletons from a series of late Woodland/early Mississippian sites from the Chickamauga, Norris and Watts Bar reservoirs of East Tennessee were surveyed for a particular suite of warfare related violent trauma. These include inflicted projectile points, healed depression fractures of the cranium, and cutmarks indicative of trophy taking (e.g., scalping and limb dismemberment) as well as human bone grave inclusions which may be interpreted as trophy items. Particular attention was paid to the human remains from Hiwassee Island. This large site was one of few WPA era excavations to merit an extensive descriptive publication. In that 1946 report, approximately 7.5 percent of the sample was suggested to have sustained multiple inflicted projectile points, a frequency easily twice that observed in the eastern and western Tennessee River valley Archaic period and the now burgeoning data base from the late Mississippian period. Careful assessment of the skeletal evidence suggests that a distinction can be made between inflicted (not necessarily embedded) projectile points and burial inclusions. The discrimination revealed a mortuary pattern of differential male interment which varies between reservoir areas. Trophy taking is absent in the total sample which contrasts with the Archaic and late Mississippian data as well as published reports of the Woodland period from middle Tennessee. The pattern of head trauma from the Archaic, late Woodland/early Mississippian, and western Tennessee late Mississippian samples suggests that violent trauma from late Mississippian east Tennessee may be interpersonal and not intergroup.

Incremental features of pre- and postnatal enamel microstructure in pigtailed macaques (*Macaca nemestrina*).

T. Smith[1], L.B. Martin[2], J.E. Sirianni[3]. [1]Interdepartmental Doctoral Program in Anthropological Sciences, Stony Brook University, Stony Brook, NY, 11794-4364, USA, [2]Depts of Anthropology and of Anatomical Sciences, Stony Brook University, [3]Dept. of Anthropology, University at Buffalo.

A number of previous reports have suggested that incremental features are difficult to observe or may not be present in deciduous teeth, particularly in prenatal enamel. To date, only FitzGerald et al. (1999) have specifically examined these features in human enamel formed prior to birth. In this study, thin sections of mandibular teeth (dc, dp3, dp4, M1) from sixteen immature pigtailed macaques, representing various developmental stages, were examined using polarized, confocal, and fluorescent light microscopy. In a previous study, all individuals had been injected three to five times with one to three fluorescent labels (minocycline hydrochloride, xylenol orange, and DCAF (2,4Bis) N,N'Di aminomethyl fluorescein) during the final two months of life. Rates of enamel accretion were established from the spacing of these markers. In addition, the periodicity of several incremental features was determined between markers. The daily secretion rate (DSR) was observed to be greatest in the cuspal enamel, intermediate in the lateral enamel, and least in the cervical enamel. Within these regions, the DSR appeared to be fairly uniform, similar to the pattern of rates reported for human deciduous teeth. Rates of enamel extension were also determined where possible. Short period features, known as laminations, were commonly observed running parallel to the labeled developing front and/or Retzius lines. Laminations appeared to be the dominant incremental feature in prenatal enamel, while cross-striations and Retzius lines were detected much less frequently. This may indicate developmental differences between enamel formed *in utero* and enamel formed postnatally.

Gross, histological, and CT scan investigation of the maxillary-premaxillary suture and upper incisors in primates.

T. Smith[1], A. Burrows[1], E. Dumont[2], C. Bonar[3]. [1]Slippery Rock University, Slippery Rock, PA, 16057, USA, [2]University of Massachusetts, [3]Cleveland Metroparks Zoo.

Traditionally, the homology of primate upper dentition has been associated with location within one of two bones, the premaxilla and maxilla. However, conflicting data exist regarding the spatial relationship of upper teeth to the maxillary-premaxillary suture (MPS) in primates. No studies have attempted to examine the multiple influences of ontogenetic, phylogenetic and methodological factors on interpretation of this anatomical relationship. This study reports observations on 34 primates from 20 species (10 strepsirhines, 10 haplorhines) including prenatal (*Microcebus murinus* only), perinatal, and infant ages. The position of the MPS relative to upper dentition was examined using gross, histological and/or CT methodologies. Of these, histological preparations yielded the most detailed and precise positional information about the relative position of the MPS. The MPS was consistently found between the deciduous upper lateral incisor

(I^2) and canine (c) in all strepsirhines regardless of observational method or age. Among haplorhine primates, the MPS was grossly observed to intersect I^2 in perinatal *Colobus guereza* and *Saguinus geoffroyi* and variably passed more closely to either c or I^2 (rather than precisely between these teeth) in most infants. Histological sections and CT scans supported gross observations and showed that the MPS ran lateral to I^2 in infant haplorhines. Results suggest that haplorhines possess a more variable position of the MPS relative to the upper dentition compared to strepsirhines, particularly at early stages of ontogeny. Ultimately, these data suggest that the upper dentition and surrounding bones are ontogenetically decoupled, which may confuse issues of tooth homology.

Testing the energetics hypothesis for the origins of hominid bipedalism.

M. Sockol. University of California, Davis, California, 95616, USA.

It is commonly hypothesized that bipedal locomotion arose in the hominid lineage in response to a changing environment. In particular, the drying of Africa during the Plio-Pleistocene is proposed to have resulted in widely spaced patches of forest refugia. Accordingly, bipedality may have arisen as an energetically efficient means of traveling long distances to reach essential resources. Recent fossils suggest that bipedality arose in a forested environment, however, and perhaps much earlier than was once believed. If this is the case, it is still possible that some forest-dwelling species may have adapted to foraging on widely spaced food sources. Regardless of the environment in which bipedality arose, under this hypothesis, bipedal locomotion must have conferred some advantage facilitating terrestrial travel. While available literature on energetics and locomotion in eutherian mammals seems to point to a small percentage of total energy expenditure being devoted to locomotion, these data have underestimated the costs of locomotion. As a result, these costs remain a significant factor underlying the development of bipedalism as an energetically efficient means of terrestrial travel in any habitat. In this paper I examine the strongest alternative hypotheses for functions of bipedalism in forested or other habitats, the biomechanical details supporting the energetic hypothesis, the reasons for suspecting that estimates of costs of locomotion are too low, and the requirements for a study of appropriate analogs (e.g., living chimpanzees) for understanding the function of bipedalism as the earliest hominid adaptation.

Activity related pathology in the Albany County Almshouse Cemetery, Albany, NY.

M. Solano. University at Albany, SUNY, Albany, NY, 12222, US.

Almshouse skeletal samples can provide a great deal of information concerning the health and activities of the sick and indigent during the early industrial period of North America. An analysis of vertebral health in the Albany Almshouse skeletal collection (n = 27), dated to the late nineteenth century, resulted in the identification of a large number of activity and age related pathologies including osteoarthritis, trauma including spondylolysis, and diffuse idiopathic skeletal hyperostosis (DISH). The sample consists of a large proportion of older individuals (10 males and 6 females over the age of 50), with a pattern of progressive degenerative changes and trauma in the spine suggesting long-term occupational stress.

Moderate to severe vertebral osteoarthritis is observed in 22 (81%) of the skeletons. The pattern of degeneration is similar between males and females, and occurs in similar frequencies between vertebral regions. Traumatic stress fractures are also noted in eight individuals, further indicating a pattern of excessive mechanical stresses on the spine. Five individuals also possess enthesophytes characteristic of DISH, resulting in varying degrees of vertebral ankylosis and contributing to the deterioration in vertebral health in this sample.

Nineteenth century almshouses served as short-term residences for the sick and indigent. Since these vertebral pathologies were probably not the primary or only cause for admission to the almshouse, the frequency and severity of degenerative diseases of the spine in this sample may reflect the general state of vertebral health of the underprivileged urban classes of the Northeast United States during the late nineteenth century.

Cranial variation in the American white population: a temporal and geographic perspective.

C. Sparks[1], K. Spradley[2], R.L. Jantz[2]. [1]Dept. of Anthropology, The Pennsylvania State University, University Park, PA, 16802, USA, [2]Dept. of Anthropology, University of Tennessee-Knoxville.

Recent studies of cranial variation in the American population have documented an ongoing secular trend over the past two hundred years. This secular trend has arisen due to the dramatic increase in the quality of health care, nutritional intake, and reduction in infant mortality experienced from the early nineteenth century to modern times. To date, no studies have focused on the effect of these changes on cranial variation. This study also deals with the geographic pattering of cranial variation brought about by the regional differentiation of the American white population. If environmental effects are assumed to be a major factor in the cranial phenotype, then there should be some degree of interpretable regional pattering to the population.

Modern forensic data from the University of Tennessee Forensic Data Bank are subjected to a series of multivariate statistical analyses in order to detect any regional differentiation caused by adaptation to regional environments. This study also utilizes craniometric data from a variety of modern forensic, historic, and medieval European sources in order to ascertain the effect of the decrease in infant mortality over the past four hundred years on the amount of cranial variation in Caucasians.

Results indicate that there is no intelligible regional differentiation occurring in the modern American White population. The population, while displaying high regional variation, is unable to be classified accurately based on geographic region, indicating a negligible environmental effect on the phenotype. In addition, there is a marked increase in variation in Caucasian population from the medieval period to modern times. This increase coincides with the decrease in infant mortality most noticeable in the late nineteenth and twentieth century. This is interpreted as a response of the cranial phenotype to a reduction in stabilizing selection brought about by an increasingly heterozygous gene pool allowed by the drop in infant mortality.

What do we really know about the early hominid diet?

M. Sponheimer. University of Utah, Salt Lake City, Utah, 84112, USA.

Early hominid diets have received increasing attention of late. Previous studies suggested that early hominids such as *Australopithecus africanus* ate diets of fleshy fruits and leaves, but stable carbon isotope analysis has shown that C4 grasses or sedges, or animals that eat these foods, were a significant component of early hominid diets. While these analyses were important as they re-problematized early hominid diets, they have provided us with little concrete evidence of specific foods eaten due to equifinality problems. In this paper we revisit microwear, morphological, isotope, and elemental data that might shed further light on early hominid diets. We pay particular attention to recent evidence that hominids may have regularly consumed termites, and to possible niche partitioning among Plio-

Pleistocene hominid taxa.

A comparative study of Pliocene hominin fossils from Lomekwi, west of Lake Turkana (Kenya).

F. Spoor[1], L. Leakey[2], M. Leakey[2]. [1]Dept. of Anatomy & Developmental Biology, University College London, U.K, London, England, WC1E 6JJ, United Kingdom, [2]Division of Palaeontology, National Museums of Kenya, Nairobi, Kenya.

Field work in the Turkana Basin in 1998 and 1999 was focused on sites in the Nachukui Formation, west of Lake Turkana. The resulting hominin discoveries from Lomekwi, dated between 3.5 and 3.2 Ma, include a well preserved temporal bone, two partial maxillae, isolated teeth, and most importantly, a largely complete, although distorted cranium. These new finds, as well as two mandibles and isolated molars recovered previously, differ markedly from fossils of contemporary *A. afarensis*, indicating that hominin taxonomic diversity extended back well into the middle Pliocene. In a first announcement of these finds the cranium and one of the maxillae were assigned to a new hominin genus and species, *Kenyanthropus platyops*, on the basis of an unique combination of derived facial and primitive neurocranial features (Leakey et al, *Nature* 410, 433-440, 2001).

Following up on the initial inventory and interpretation of the Lomekwi finds a detailed descriptive and comparative study is now under way. Direct qualitative and quantitative comparisons have been made with large samples of Plio-Pleistocene hominin fossils from Ethiopia, Kenya, Tanzania and South Africa, which represent *Ardipithecus*, *Australopithecus*, *Paranthropus* and *Homo*. The distinct nature of the cranial, mandibular and dental specimens in the Lomekwi sample is confirmed. In particular, the enlarged comparative sample underlines the remarkable faciodental morphology of KNM-WT 40000, characterized by a tall, flat and relatively orthognathic subnasal region, a tall and anteriorly placed malar region, and small molars. It is this morphological complex that makes *Kenyanthropus* unique.

Investigating long-bone growth retardation in Forensic Data Bank subadults.

K. Spradley. Dept. of Anthropology, University of Tennessee, Knoxville, TN, 37996, USA.

Longitudinal studies have looked at long-bone growth and development and height for age data in healthy modern populations (McCammon 1970, Gindhart 1973, Tanner and Whitehouse 1978, Pomerance 1979) to assess standards for normal growth curves. Such studies provide comparison data to assess the growth and development of children. Research by the author has shown that currently used long-bone aging techniques either underage or overage a modern forensic sample of subadults from the Forensic Data Bank (FDB) due to long bone growth retardation in this sample.

In the present study, FDB subadult long-bone lengths are compared to several temporally different samples. Results indicate a secular trend for an increase in limb length in some long-bones in the comparative samples. However, FDB subadults do not follow this secular trend exhibiting the shortest lengths in all long-bones.

Research by Wales (1992) has shown that when children are abused or neglected they exhibit growth retardation in the lower limbs when compared to healthy children. The demographic data on the FDB subadults does not indicate direct evidence of child abuse, although several individuals are noted as "scapegoat", "runaway" and "growth retarded." Additional individuals have healing long bone fractures, which may be consistent with child abuse. While it is not possible to conclusively state that these fractures and poor growth diagnoses stem from child abuse or nutritional deficiencies, FDB subadults do not fall within "normal" parameters of growth and development reflecting the need for different aging standards.

Land use histories of rural landscapes in Japanese macaque habitats.

D. Sprague. Ecological Management Unit, Nat. Inst. Agro-Environmental Sciences, Tsukuba, Ibaraki, 305-8604, Japan.

Primate conservation strategies need to be formulated in the background of major changes in land use occurring in and around primate habitats around the world. In the case of Japan, the Japanese people have radically reformulated their relationship with the natural resources of their archipelago during the last 50 years. Present-day agriculture in Japan depends far less on local woodlands and grasslands for natural resources than traditional agriculture, altering how rural communities occupy the landscape. For primatologists, rural land use may help to address the dual issues of how to assess whether some populations of Japanese monkeys (*Macaca fuscata*) are endangered, and explain why Japanese monkeys have become a major agricultural pest since the mid-1970's.

The working hypothesis is that rural communities have withdrawn from the landscape immediately surrounding villages, allowing monkey habitats to approach farmland, while a large proportion of Japanese forests have been turned into conifer plantations providing little food for monkeys. This paper examines this hypothesis with available data on selected Japanese monkey habitats from studies in rural historical geography, vegetation maps, aerial photographs, and agricultural censuses, to examine whether recent changes in rural land use may have altered the distribution of broad-leaved forests that constitute important monkey habitats. The data show that rural grasslands have almost disappeared, conifer plantations have expanded dramatically, and the farming population has declined. However, no simple, national pattern of rural forest distribution emerged from the analysis. Highly variable amounts of broad-leaved and coniferous forests are distributed around fields and villages in various parts of rural Japan today.

The first documented occurrence of *spondylosis deformans* in an early hominin.

D. Staps. University of the Witwatersrand, Johannesburg, Gauteng, 2050, South Africa.

The Stw 431 partial skeleton from Member 4, Sterkfontein, South Africa, dates to approximately 2.6 – 2.8 million years. Stw 431 comprises parts of the axial and appendicular skeleton, including elements of the inferior half of the thoracic and the whole lumbar vertebral column, as well as the sacrum. The associated remains have been provisionally assigned to *Australopithecus africanus*, and represent the best preserved lumbar vertebral column of this species. During the course of examination, degenerative vertebral pathologies were noted in several of Stw 431's vertebrae.

Pronounced *spondylosis deformans* with osteophyte formation, as well as osteoarthritic changes of the facet joints were diagnosed at the level of the second-last lumbar vertebra through S1. The Stw 431 specimen therefore represents the oldest known example of *spondylosis deformans* in hominins. *Spondylosis deformans* in hominoids is typically associated with an individual's age, trauma or incipient orthograde posture. Given the fact that the degeneration is localized in Stw 431 and there is no evidence for age-related changes in the remainder of the skeleton, we propose that *spondylosis deformans* in Stw 431 is the result of trauma sustained during life.

The statistical basis for positive identifications in forensic anthropology.

D. Wolfe Steadman[1], B. Adams[2], L. Konigsberg[3]. [1]Dept. of Anthropology, Binghamton University, SUNY, Binghamton, New York, 13902-6000, USA, [2]Central Identification Laboratory Hawaii, [3]Dept. of Anthropology, University of Tennessee, Knoxville.

In October 1999, human remains were recovered from two locations in rural Iowa. The individual had suffered multiple fractures throughout his life, which can be useful for personal identification if antemortem records are present. However, forensic anthropologists rarely use probability theory when they "make positive identifications" from dental or pathological comparisons. Bone fractures cannot be assumed to be independent and consequently the "product rule" does not apply. Because of non-independence, data on frequencies of fracture patterns from the population at large are necessary but such data does not exist.

Dental data from populations are often available for comparison, but teeth are also not independent, despite a common assumption to the contrary. Thus, the methods employed for identification based on non-independent skeletal and dental data are identical to those for mtDNA. Additionally, because dental pathology/reconstruction does not follow a "coalescent model," the "heterozygosity" for dental records may actually be much higher than for mtDNA. We analyze "heterozygosity" (the probability of drawing without replacement two disparate dental records) for 19,422 dental records collected by the U.S. military. By scoring the presence of fillings on each of five dental surfaces as well as the presence of dental prosthetics there are 33 possible states for each tooth. As a consequence of this high possible polymorphism, the "heterozygosity" across all individuals is 0.9846, and excluding those 2,397 individuals with all "virgin" teeth the "heterozygosity" is 0.9998. For an individual with multiple fractures the likelihood ratio on identification should be very high.

Scientific discipline and intellectual freedom: Michigan in the late 1950s.

A.T. Steegmann. Dept. of Anthropology, University at Buffalo, Buffalo, New York, 14261, USA.

At mid-20th Century, American universities were enjoying boom-times. Growing enrollments, new buildings, expanding faculties and the beginnings of federal research funding supported an optimism that was both social and intellectual. In that sense, schools reflected the national spirit of the times.

In science, there was growing confidence that no problem was too complex; the environmental and health costs of running an industrial civilization were future worries. This rising intellectual tide was strongly expressed at emerging centers of anthropological and biological theory such as the University of Michigan. Anthropology graduate students entering the Michigan program were expected to gain strong foundations in all sub-disciplines, and many of us consider that to have been a lifelong gift.

While cultural anthropology was dominated by Leslie White's evolutionary models and Marshall Sahlins' functional-adaptive constructs, archeology was somewhat more conservative and methodologically driven. Nevertheless, the dynamic intellectual structures soon to emerge in American archeology had their roots in James Griffin's museum. Even linguistics, still in the grips of descriptive approaches, introduced us to historical applications and language evolution.

Physical anthropology, under the guidance of Jim Spuhler, Frank Livingstone and Ernst Goldschmidt was bio-behavioral in problem identification but committed to theory and methods of population genetics. Despite that, the faculty supported a broad range of student interests, from hard tissue studies to morphology-physiology experimentation. I remember Frank Livingstone's role particularly in applications of new biological thinking to human geographical variation, in applying cultural and historical data to genetic polymorphisms, and in offering the logical discipline and methodological leverage of statistics.

Analysis of Easter Island cranial collections: museum sample variation.

V. Stefan. Dept. of Anthropology, Lehman College, CUNY, Bronx, NY 10468, Bronx, NY, 10468, USA.

There is a history in physical anthropology of assessing human biological variation within individual skeletal samples with regards to temporal processes, but there is also a history of combining various museum samples to represent a single population, as well as combining samples of related populations into a sample representing a broader category of people without regard to intersample or interpopulation variation. This history has limited representation with Easter Island skeletal material as well. This study examined Easter Island crania curated at the Natural History Museum, London; the Musée de l'Homme, Paris; and the Museo Antropológico Padre Sabastián Englert (MAPSE), Rapa Nui to assess whether significant differences exist between the museum collections of Easter Island skeletal material.

The multivariate analysis procedures require that there be no missing data, therefore the NORM statistical program (Schafer and Olsen 1997) for multiple imputation of incomplete multivariate datasets was utilized. Five imputed datasets were created for males and females separately, with an average imputed dataset and variance/covariance matrix calculated. Each averaged imputed dataset was then compared to the original dataset without missing value estimates to determine if the two datasets were significantly different with a *D*-statistic. A variance comparison method, which utilizes variance/covariance matrices derived from hypothesis (Musée de l'Homme & Natural History Museum) and reference (MAPSE) samples (Key and Jantz, 1990a,b) was used to compare the museum samples.

The results indicate that no average imputed dataset was significantly different from its original dataset. It was also evident that the Musée de l'Homme and the Natural History Museum collection, male and female samples, exhibited little intrasample variability from the baseline MAPSE sample, though the samples were collected from different regions of the island and at different times. These results show the ability of the multiple imputation and variance comparison methodologies to predict missing variables while maintaining the inherent variance/covariance structure and to discriminate sample variation in artificially assembled samples. Upcoming data collection and analyses will enable the assessment of the American Museum of Natural History, New York and the National Museum of Natural History, Santiago, Chile, Easter Island skeletal collections.

Variation in the face of *Australopithecus robustus* .

C. Steininger. University of the Witwatersrand, Johannesburg, Gauteng, 2050, South Africa.

The allowable degree of variation within the craniofacial elements of early hominin species has been the focus of long-standing debate, yet the conspecificity of most hominins still remains in question due to inadequate sample size and preservation. This has been particularly so with the southern African robust australopithecine, *Australopithecus robustus,* as previous research suggests there is little variation within the species.

Recent finds have questioned this assumption and have shed light on the amount of variation in this species. In 1999 a single molar from Gondolin was found to express dental size that significantly increases the range of variation of *A. robustus*, and in 2000 a small female skull from Drimolen attributed to *A. robustus*, further extended the observed morphological variation of the facial skeleton in this species.

More recently an upper facial skeleton from Cooper's Cave, COB 101 attributed to a male *A. robustus* has clearly demonstrated that there is considerable variation in dental robusticity and facial morphology in this spe-

cies. Whilst COB 101 has all the critical diagnostic features of *A. robustus* as demonstrated by the sample from Swartkrans, Kromdraai and Drimolen, it nevertheless, displays greater dental size and facially expresses non-metrical characters more robust in regions such as the supraorbital, infraorbital and zygomatic than has been observed in the sample of *A. robustus* thus far.

It may be concluded that *A. robustus* expresses a greater degree of variation than hypothesized based on new finds, and its degree of variation considered to be similar to that observed in other early hominin species.

Effects of branch orientation on quadrupedal walking in *Loris tardigradus* .

N.J. Stevens. IDPAS, SUNY-Stony Brook, Stony Brook, NY, 11794-8081, USA.

Primates are unique among mammals in that they are largely an arboreal radiation. One potential problem animals face in negotiating complex 3-dimensional habitats is an increased tendency to slide down or topple off obliquely oriented branches. Among primates, lorisids have some of the longest relative limb lengths. This potentially places their center of mass far away from a support, and may impose unique challenges for living in the trees. This study examines postural accommodations to changes in substrate orientation in the slender loris, *Loris tardigradus.*

Limb posture was recorded during locomotion on supports oriented horizontally, and at 30 and 60 degrees. Joint angles were measured at touchdown, midstance, and lift-off, and angular excursions were calculated. In addition, stride lengths and gait patterns were examined.

Relative to the horizontal, forelimb angles were higher at touchdown on 30 degree declines, while hindlimb angles were higher at lift-off on 30 degree inclines. On 60 degree supports, forelimb angles at touchdown and hindlimb angles at lift-off were higher on both the inclines and declines, reflecting a shift in the response of the limb placed superiorly on the branch.

These results demonstrate that lorisids alter postural accommodations in order to move about on increasingly oblique branches. Further work compares lorisid arboreal quadrupedalism with that of other prosimians of different body sizes and proportions.

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From behind bars: new anthropometric history data from Ohio Penitentiary records.

J. Stewart, N.E. Tatarek, M.P. Masters. The Ohio State University, Columbus, Ohio, 43210, USA.

The field of anthropometric history links estimates of health and nutrition via stature and body weight data with societal factors such as occupation, SES, education and place of birth. Additionally, anthropometric history highlights long-term changes in stature across the world. The majority of data utilized for such studies comes from slave manifolds, military muster rolls and military academies. Penitentiary records comprise a much smaller subset of anthropometric data (eg Riggs, 1994 and Johnson & Nicholas, 1997).

The current study consists of data from the Ohio Penitentiary in Columbus, Ohio for 991 males incarcerated between 1888 and 1899. Information collected includes height (in inches), age, ancestry, nationality, occupation and education. This study analyzes changes in stature over time in 10-year birth cohorts from 1810 to 1889 and examines social factors influencing stature such as nationality, place of birth, occupation and education. Regression analyses and ANOVA on height, birth cohort, ancestry, nationality, occupation and education indicate foreign born males and African-American males were shorter in stature than Caucasian or American-born males. Occupation and education also affected stature, however, there was no significant change in stature across time. These results correlate well with other anthropometric history studies and offer a new source of data for further research.

Hominid diagnosis in Late Miocene and Plio-Pleistocene fossils.

E. Stiner, E.E. Sarmiento. The American Museum of Natural History, New York, New York, 10024, USA.

Fossil hominid systematics has suffered from misconceptions that trace their roots to the origins of paleontology and human evolutionary thought:

(1) reconstructing whole animals based on fragmentary fossil remains, and attempting to correctly classify these at lowest taxonomic levels,(Cuvier's principle of correlation);

(2) assuming characters present in humans are always progressive and derived, seldom or never representing ancestral conditions, (Lamarck's *scala naturae)*;

(3) assuming all catarrhines with small canines and non-sectorial p3s are hominids,(Darwin's tool use, brain size, bipedalism and canine size complex).

Fossils with one or more human-like character(s), have traditionally been classified as hominids without questioning whether characters are primitive or derived for hominoids (see *Orrorin* and *Ardipithecus*). With each new 'hominid' African fossil found, the absence of African ape ancestors, or offshoots of either lineage, and/or of taxa predating the African ape-human split, becomes increasingly suspicious. Presence of small canines and non-sectorial premolars in early hominoids and platyrrhines, and reduced canines in cercopithecoid females demonstrate small canines are not diagnostic of hominids. Fossil australopithecines assumed to be hominids based on canine size can be African ape ancestors, or taxa predating the human-African ape split. From Sterkfontein type-site, Sts 5 has a primitive mid-meningeal vessel pattern. Its large entoglenoid process, petrous temporal set, and basicranial foramina relationships further indicate it predates the human-African ape split. The non-hominid status of Sts 5 questions the hominid status of taxa such as *Orrorin* and *Ardipithecus,* which exhibit even fewer human-like characters none of which are diagnostic of hominids.

Climate, terrestrial mobility and the patterning of lower limb robusticity among Holocene foragers.

J. Stock. Dept. of Anthropology, University of Toronto, Toronto, Ontario, M5S 3G3, Canada.

The gracilization of the skeleton is a significant morphological trend in human evolution. Interpretations of this trend are limited, because the relationships between skeletal morphology, habitual behavior and climate are poorly understood. The external morphology and robusticity of the lower limb have been the focus of numerous studies that have linked bone morphology to factors including terrestrial mobility and the long-term adaptation of body size and shape to climate. To better interpret the pattern of robusticity in the past, we must be able to differentiate the climatic and behavioral influences on lower limb morphology. To what extent is the pattern of robusticity in the lower limb influenced by climate and terrestrial mobility? This study investigates the relationship between general patterns of terrestrial mobility, climate, and lower limb morphology among proto-historic and prehistoric foragers from the North American Great Lakes (n = 14), the Andaman Islands (n = 31), the Tierra del Fuego (n = 18), and Southern Africa (n = 38). Comparisons of external osteometrics and diaphyseal cross-sectional geometry of the femur and tibia demonstrate morphological differences between the groups that are correlated with differences in terrestrial mobility. There is greater variability in diaphyseal strength of the femur than the tibia, a trend that is con-

sistent between groups and between sexes within each group. As a result, femoral strength appears to be more closely correlated with habitual behavior. The lower variability in robusticity of the tibia suggests that there are greater adaptive constraints on the morphology of distal limb segments.

Changes in phenotypic variability during the mission period of Florida.

C. Stojanowski. Dept. of Anthropology, Florida State University, Tallahassee, FL, 32301, USA.

In this paper, I evaluate the effects of missionization on Native American population variability in the Spanish colony of La Florida. From an ethnohistoric perspective, the mission period can be typified by three processes: 1) reduction in population numbers; 2) aggregation and reorganization of remnant populations at mission centers; and 3) intermarriage between colonial and resident populations.

I approach the question of phenotypic variability from a diachronic perspective and evaluate two hypotheses: 1) phenotypic variance decreased through time as a result of the effects of genetic drift in populations experiencing demographic collapse; or 2) phenotypic variance increased through time as a result of either population aggregation at the missions (increasing variability of the archaeological death assemblage) or genetic admixture with previously genetically distinct populations (increasing variability in the mission populations).

I evaluated these hypotheses using 16 dental dimensions on a series of 26 samples divided into three provinces: Apalachee (n = 6), Timucua (n = 10) and Guale (n = 10). Each province contains precontact, early mission period, and late mission period samples. I evaluated differences in sample variability using univariate and multivariate statistical tests and developed a matrix decomposition model for differentiating population aggregation from genetic admixture. For Apalachee, variation increased through time probably indicating genetic admixture with Spanish colonists during the late mission period, for Timucua, no change in variability was observed, and for Guale variation increased during the early mission period due in part to population aggregation followed by limited change in the late mission period.

Tetracycline in a Meroitic Population (0 CE-350 CE) from Sudanese Nubia.

T. Stokol, G.J. Armelagos. Dept. of Anthropology, Emory University, Atlanta, Georgia, Atlanta, GA, 30306, USA.

The presence of tetracycline has been reported in bones from Sudanese Nubia, Egypt and Jordan. Tetracycline, a broad-spectrum antibiotic, was produced as a by-product of a beer brewing process using grains colonized by the *Streptomycetes* bacteria. The pattern of tetracycline in these populations suggests different levels of ingestion.

A sample from a Meroitic population (site 6B-16, 0 CE-350 CE) from the Wadi Halfa area of Sudanese Nubia was prepared. Femoral samples were taken just below the lesser trochanter, thin sectioned and polished to a 100-micron thickness. Methods that insure only measuring *in vivo* incorporated tetracycline were established. Digital photomicrographs using unfiltered light, polarized light, and ultraviolet light with barrier filters to insure the appropriate 490 nm wavelength that is diagnostic of tetracycline. Each section was sampled using the Frost Triple Surface System. The number of labeled osteons was then assessed along with the number of unlabeled osteons. The mean percentage of labeled osteons was 6.4%, indicating a significant level of tetracycline ingestion comparable to that found in the X-Group. This confirms that the consumption of tetracyclines occurred over a thousand years.

Tetracyclines possess significance non-antibiotic properties. Tetracycline appears to inhibit the breakdown of collagen by inhibiting the action of collagenase and gelantinase. It is very effective in inhibiting matrix metalloprotienases (MMPs) . The MMPs are involved in the pathology of connective tissue diseases such as osteoarthritis, rheumatoid arthritis, periodontal disease, and osteoporosis. We are assessing the potential of tetracyclines in inhibiting cortical bone loss.

Counting the children: demography and health of subadults from a collective Bronze Age tomb, Tell Abraq, United Arab Emirates.

P. Stone[1], J. Rhodes[1], D. Martin[2], D. Potts[3]. [1]Western Michigan University, Mattawan, MI, 49071, USA, [2]Hampshire College, [3]University of Sydney.

Excavations of a large Umm an-Nar tomb at Tell Abraq revealed a great quantity of disarticulated commingled adult and subadult human remains. This tomb was used over a period of 300 years (2000-2300 B.C.) and the conditions of the remains are relatively good. As reported in an earlier study (Margolis et al. 2000), the minimum number of individuals (MNI) of the collective tomb is approximately 250, with all age categories well represented. Analyses conducted on the remains from this tomb have focused on adult remains, and have reported on taphonomic processes as related to mortuary behavior.

This poster focuses on the demography and health of the subadults (newborn through 18 years). There are approximately 97 subadults (45 neonates to 2 years; 52 children aged 2 to 18). The data suggest that these children were subject to an endemic form of infectious disease, as many of the long bones exhibit varying degrees of periostitis. Cranial fragments revealed virtually no forms of porotic hyperostosis, although there is some evidence for signs of malaria.

Finite element analysis of a macaque skull: applications for functional morphology.

D. Strait[1], B. Richmond[2], C. Ross[3], M. Spencer[4]. [1]Dept. of Anatomy, New York College of Osteopathic Medicine, Old Westbury, NY, 11568, USA, [2]Dept. of Anthropology, Univ. of Illinois, Urbana, IL, 61801, [3]Dept. of Anatomical Sciences, SUNY, Stony Brook, NY, 11794-8081, [4]Dept. of Anthropology, Univ. of Colorado, Denver, CO, 80217-3364.

Many facial features in primates and fossil hominids are thought to be designed to resist the stresses imposed by chewing hard foods. However, attempts to test hypotheses of facial function are confounded by the fact that the geometry of the facial skeleton is extremely complex. This paper introduces a research program in which these hypotheses will be tested using an engineering method, finite element analysis (FEA). The functional relationships of a simple character, palate thickness, are examined so as to demonstrate how FEA can be applied to evolutionary questions.

A three-dimensional finite element model of a complete macaque skull was constructed by digitizing 61 CT-scans using reverse-engineering software. The digitized images were linked using a smoothing function to produce a realistic model preserving both internal and external geometry. The model was then meshed, and forces were applied representing the superficial and deep masseter, temporalis and medial pterygoid muscles. Nodes on the articular eminences were constrained from moving, except to allow rotation. Such constraints simulate a hinge joint at the TMJ. In separate analyses, bite points were fixed at the molars and incisors. The model was tested by comparing the resulting strain pattern to bone strain data obtained from published and unpublished *in vivo* studies.

The functional relationships of palate thickness were examined by comparing the palatal strain patterns in the macaque model to those obtained in a modified model in which the palate was artificially thickened. Preliminary results suggest that the palate does not experience high stresses during molar mastication.

Applications of geometric morphometrics to the study of growth in the facial skeleton: partial and full faces.

U. Strand Vidarsdottir[1], P. O'Higgins[2]. [1]Dept. of Anthropology, University of Durham, Durham, County Durham, DL12 8HW, United Kingdom, [2]Dept. of Anatomy and Developmental Biology, University College London.

Our earlier research has shown the unequivocal value of geometric morphometrics in charting, comparing, and contrasting ontogenetic allometries in the hominoid facial skeleton. Despite this success, such analyses of facial growth are often made difficult if not impossible by the fragmentary nature of much juvenile material. This paper extends the work, looking at the extent to which more limited facial material might provide information about overall facial variation. It does so by analysing the allometries of three facial units: the maxilla; the frontal; and the zygomatic, and comparing them to those of the face as a whole. The study also assesses the extent to which each unit can be used to predict (dental) maturation of individual specimens.

The results show that ontogenetic allometries for two facial units (maxilla and frontal) are similar to those for the full facial skeleton, and that the arrangements of specimens within the tangent space in the analyses of all facial units are highly correlated with that based on the face as a whole. The magnitude of the correlation coefficient was greatest in the comparison between the full face and the frontal bone, indicating that the frontal is well, and most highly suited to predicting facial maturation.

The results of these analyses indicate that the development of the face as a whole can to some degree be predicted from the form of individual facial bones. This finding may prove useful in the analysis of fragmentary juvenile material, whether in an archaeological, anatomical or forensic context.

Adaptive fertility behavior in an agricultural population.

B. Strassmann[1], B. Gillespie[2]. [1]Dept. of Anthropology, University of Michigan, Ann Arbor, MI, 48109-1382, USA, [2]Dept. of Biostatistics, University of Michigan.

According to life history theory, inclusive fitness maximizing organisms face a trade-off between female fertility and offspring survivorship. This trade-off has been shown in birds and other species, but explicit tests in humans have found a positive linear, rather than quadratic, relationship between fitness and fertility. We present clear-cut evidence for the predicted quadratic relationship between female fertility and reproductive success in an agricultural population, the Dogon of Mali. The predicted maximum reproductive success of 4.3 ± 0.3 surviving offspring was reached at a fertility of 8.6 livebirths. Seventy percent of the women achieved a fertility level (6 births or higher) for which the predicted mean reproductive success was within the confidence limits (3.7 to 4.8) for reproductive success at the optimal fertility level. Our results support the hypothesis that adaptive fertility behavior did not cease with the transition from foraging to agriculture. They also demonstrate the pros and cons of three alternative methods for measuring reproductive success (lifetime, Kaplan Meier, and age adjustment). It is often assumed that is preferable to count grand-offspring instead of offspring. However, in any given study most grandparents will not yet have a complete tally of their surviving grandchildren. We discuss the biases that result from incomplete tallies and conclude that in most circumstances it is preferable to measure fitness in the offspring generation.

Raymond Dart as a primatologist.

G. Strkalj, P. Tobias. Dept. of Anatomical Sciences, University of the Witwatersrand, Parktown, Gauteng, 2198, South Africa.

Raymond Dart (1893-1988) is best known today for his groundbreaking research in palaeoanthropology. It is often forgotten, however, that Dart, like many of his colleagues from the first half of the twentieth century, was a scientist of many interests, who made significant contributions to various disciplines. One of these is the study of living non-human primates.

Dart became aware of the importance of primate studies and their relevance for research in other disciplines early in his career. In the late 1920s Dart established a colony of captive baboons in the Anatomy Department, University of the Witwatersrand, Johannesburg. He did not personally conduct much research on these animals but members of his Department, most notably Joseph Gillman and Christine Gilbert, carried out a number of significant behavioral and endocrinological works. Dart used the results of these studies in his research in physical anthropology.

Dart was also active in primate field studies. In 1957 he and Phillip Tobias founded a Witwatersrand University Uganda Research Unit for the study of the Virunga mountain gorillas. The unit produced pioneering studies, conducted by Jill Donisthorpe, on the behavior of these primates in their natural habitat, even before the advent of George Schaller, John Emlen, Kinji Imanishi and Dian Fossey. At the same time Dart was actively engaged in conservation of the mountain gorillas. He also studied South African chacma baboons in the wild.

In the field of primate studies Raymond Dart figures prominently as a pioneering catalyst as well as researcher and conservationist.

Morphometric analysis of Northwestern Plains Amerindian crania.

L.J. Stuart, R.L. Jantz. University of Tennessee, Dept. of Anthropology, Knoxville, TN, 37916, USA.

The Northwestern Plains encompasses all of Wyoming, and portions of Montana, Idaho, North Dakota, South Dakota, Nebraska, and Colorado. The region covers over 200,000 square miles and is recognized for its extraordinary ecological diversity. Throughout the more than 11,000 years of human occupation on the Northwestern Plains the environment dictated that human groups remain mobile and practice a broad range of hunting and gathering subsistence activities. Cultural patterns consistent with small bands of highly mobile people are reflected in the amount and distribution of skeletal material representing Northwestern Plains Amerindians. Remains are typically found in isolated locations scattered across the region and largely represent individual interments. Therefore, the development of a large Northwestern Plains Amerindian skeletal series has been a gradual process.

The slow accumulation of skeletal material is reflected in the limited morphometric work of Northwestern Plains Amerindian crania. This poster examines the relationship among Northwestern Plains crania spanning a period of approximately 5,000 years, and addresses the question of how much variation exists and whether the series can be treated as a single population. Secondly, comparisons between Northwestern Plains crania and recent Amerindian populations are made to examine similarities and differences in craniofacial morphology. These comparisons allow associations to be made between historic and recent populations, and ultimately inferences concerning patterns of migration and gene flow into the Northwestern Plains.

Consideration of fatness in body mass estimation from skeletal indicators.

P. Stubblefield. C.A. Pound Human Identification Laboratory, University of Florida, Gainesville, Fl, 33526, USA.

Palaeoanthropology and more infrequently forensic anthropology are challenged with estimating body mass from skeletal remains. The challenge is made more

daunting by incomplete and/or fragmentary remains, so anthropologists are equipped with a toolkit of predictive equations featuring various skeletal locations or attributes. As part of a larger project of adding to this toolkit, cranial and postcranial measurements were obtained from a sample of modern humans drawn from American populations. In light of the trend toward fatness in American adults, an attempt to adjust for fatness was made by estimating fatness from triceps and subscapular skinfold measurements. A sample of 45 males of European descent provided known body weights, cranial and postcranial skeletal measurements, triceps and subscapular skinfolds, and an additional measurement of body fat. These data were used to examine the relationship of the skeletal measurements to body mass with and without adjustment for fatness. In this way modern humans of known body weight will become more useful as sample subjects in studies of body mass, even if subjects are drawn from an American or similarly Western population, especially as an estimate of lean body mass is more apropos to palaeoanthropological studies. On the other hand, forensic anthropology would be better served with estimates based on a realistic American body image.

Female reproductive strategies in chimpanzees of the Taï Forest, Côte d'Ivoire: Do females exhibit preferences for particular males?

R. Stumpf, C. Boesch. Max Planck Institute for Evolutionary Anthropology and SUNY Stony Brook, North Cambridge, Massachusetts, 02140, USA.

Relative to males, female chimpanzees have fewer gametes, a shorter lifetime reproductive potential, and a considerably larger investment in the gestation and care of offspring. Consequently, females should carefully select potential fathers to enhance survival of their offspring and maximize their reproductive success. However, chimpanzees have a promiscuous mating system in which females copulate with the majority of males over the course of their tumescence. The question arises whether females are so sexually indiscriminate as to risk leaving paternity to chance. The aim of this study is to examine if female chimpanzees exhibit sexual and social preferences for males, and if so, to determine how and when these preferences are expressed. Over 2200 hours of focal observation were collected on 14 estrous females from two communities. All stages of their reproductive cycle were sampled. For each female, detailed sexual and social behavior were recorded, as well as responsibility for both association and proximity to the adult males. Female sexual preferences were measured by quantifying female proceptive and receptive behaviors. Female social preferences were measured by determining which individual was responsible for maintaining association and proximity, as well as the frequency of dyadic interactions such as grooming, play, etc. Preliminary results suggest that females show distinct preferences for particular males over others. Females show a trend toward more selectivity during the peri-ovulatory period, and less selectivity outside of the peri-ovulatory period, suggesting a mixed reproductive strategy whereby females may influence paternity, while maintaining the benefits of promiscuous mating.

Human incisors and molars from the Late Middle Pleistocene locality of Hoedjiespunt 1, South Africa.

D. Stynder[1], J. Moggi-Cecchi[2], L. Berger[3], J. Parkington[1]. [1]University of Cape Town, Cape Town, Western Cape, 7701, South Africa, [2]Universita di Firenze, [3]University of the Witwatersrand.

Hoedjiespunt 1 (HDP1) is an archaeological and paleontological site located at Saldanha Bay on the West Coast of South Africa. In 1993, a brief survey of exposed fossil material from the late Middle Pleistocene paleontological layers yielded several fragments of a human left maxillary second molar. Subsequent excavations of these layers have yielded additional human remains – a right maxillary third molar found in 1994, a left central mandibular incisor and a left lateral mandibular incisor found in 1996, and a tibia found in 1998. The context in which these remains were found is discussed, and a description and analysis of the dentition is presented. Based on their stages of development, it is likely that all four teeth belonged to a single sub adult individual. Surprisingly, despite this individual's young age, its incisors already display early signs of a wear pattern that is commonly seen in people pursuing a hunter-gatherer lifestyle, and attributed to the habitual nonmasticatory utilization of the anterior teeth. The crown diameters of the HDP1 incisors and molars are larger than those of modern and archaeological African dentition. The incisors are particularly large, comparing most closely to a dental sample dating from the Plio-Pleistocene boundary. The molars however are comparable in size to other Middle and Lower Pleistocene hominids, thus following an apparent trend for size reduction in posterior teeth during this time period.

The response of white-bellied spider monkeys to the vocalizations of sympatric frugivores.

S. Suarez. Interdepartmental Doctoral Program in Anthropological Sciences, SUNY at Stony Brook, Stony Brook, New York, 11794-4364, USA.

The challenge for frugivorous primates is two-fold: to locate the few trees in the forest that are at the fruit-bearing stage of their phenologies, and then to visit those trees when they yield sufficient numbers of ripe fruits. The vocalizations of sympatric frugivores can provide information on the location and/or status of fruit-bearing patches (Olupot et al., 1998). This project investigates the possible use of frugivorous bird and mammal vocalizations by a ripe-fruit specialist, the white-bellied spider monkey (*Ateles belzebuth belzebuth*) in the Yasuni National Park in Amazonian Ecuador.

I evaluated the responses of spider monkeys to calls from nine species of sympatric frugivorous birds and mammals (whose diets overlapped that of *Ateles*) during a four-month period in order to test whether the monkeys approached the direction of the callers. I recorded location and time of each of these bird and mammal calls (n = 160) relative to the location of the monkey subjects at the time of the call, and at intervals of 10, 30, and 60-minutes to detect potential approaches.

Results indicate that the monkeys did not immediately approach the caller, nor were their locations at 30 and 60 minutes biased in the directions of the callers. This suggests that although the use of calls made by sympatric frugivores has the potential to increase feeding success, such information does not seem to play a significant role in the foraging decisions of spider monkeys.

Monkey see monkey learn: macaques learn 3-item lists by observing experienced subjects.

F. Subiaul[1], J. Cantlon[2], R.L. Holloway[1], H. Terrace[2]. [1]Columbia University in the City of New York, Dept. of Anthropology and NYCEP, New York City, NY, 10025, USA, [2]Columbia University, Dept. of Psychology.

It has been suggested that observational learning, whereby one individual learns through the actions of another, is evolutionarily recent and only present in great apes. However, most experiments on observational learning have involved complex motor sequences. To avoid that bias we trained two rhesus macaques (*Macaca mulatta*) on a 3-item serial task in which they had to obtain information about the ordinal position of list items that could not be encoded as motor responses. All list items were pre-

sented simultaneously, in a different configuration on each trial. The task was to respond to the items in a particular sequence irrespective of their position on the monitor. In earlier experiments, subjects had extensive experience learning new 3-item lists by trial and error in as few as 10 trials at a greater than chance level (0.017). In this experiment, one monkey (the "teacher") was first given a list to gain "expertise" in isolation. Following this *Initial-Learning Phase*, subjects were placed in adjacent testing chambers separated by glass partitions. During the "*Observational Phase*," the "teacher" was, again, presented with the same list, while the "student's" screen remained off. Once the "teacher" finished, the "student's" screen was activated and the "teacher's" list was presented. "Student's" performance on a novel list was positively affected by observing a "teacher." The "student's" discovery of the correct sequence for a novel list was significantly faster during sessions in which he could first watch the teacher than those in which he was not given that opportunity ($p<0.01$).

The relative fatness of street children in Guatemala.

T. Sullivan. State University of New York at Buffalo, Tonawanda, New York, 14223, USA.

Children are living and working on the streets of large urban centers. Fifty one street children (ages 5-15) associated with a street school in a highland city in Guatemala were measured. They are found to be shorter and to weigh less than NCHS values. Z-scores were developed based upon the NCHS values. The z-scores for the boys' weights average -0.90 and their heights are a -2.6. The girls' z-score values for weight is -0.9 and for height is -2.0. This reflects the similarity of the previous life experiences shared by the regional indigenous communities especially their nutritional and disease histories. Their relative weight for height [$Wt(kg)/Ht(m)^2$], Body Mass Index (BMI), however compares similarly with NCHS values. The boys' BMI z-scores are 0.5 above the NCHS values and the girls' are 0.0. This suggests that the present conditions for these children is more optimal for survival and that "homelessness may be an appropriate response to circumstances of poverty" (Panter-Brick et al., 1996).

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Social behavior and aggression among ringtailed lemurs.

R. Sussman[1], O. Andrianasolondraibe[2], T. Soma[3], S. Ichino[3]. [1]Washington University, St. Louis, St. Louis, MO, 63141, USA, [2]University of Antananarivo, [3]Kyoto University.

In a recent review of literature on activity budgets of free-ranging primates, Sussman and Garber (2001) found that little time was spent in social behavior in contrast to individual maintenance behaviors. Generally, less than 5% of the time was spent in any type of social interaction and less than 1% in aggression. This was true regardless of taxonomic level. In various studies of ringtailed lemurs, for example, 2-7% of the time was spent in social behavior and only 0.5-1.4% in aggression.

In order to examine how these results compared to studies of individuals in naturally-occurring groups of ringtailed lemurs, and to establish a method to examine such data, we collected focal, all day samples on two males and two females (40 hours) in Madagascar. Activity was noted every 5 minutes and all occurrences of social bouts and events were recorded throughout the day.

These samples supported the conclusions of the literature survey. All four animals spent between 0-4.3% of the day in active social behavior and less than 1% in agonistic interactions. Males were much less social than females. The context of both affiliative and agonistic bouts and events were noted.

We do not mean to imply that social behavior or aggression are unimportant in these group-living, highly social animals. However, we hope that these data will begin to put social and aggressive behavior into the larger context of the total activity cycles of free-ranging individual primates and primate social groups.

Reproductive parameters and asynchronous reproduction in wild hamadryas baboons.

L. Swedell. Dept. of Anthropology, Queens College-CUNY and NYCEP, Flushing, NY, 11367-1597, USA.

Previous studies of hamadryas baboons have reported reproductive synchrony among females within one-male units, both in the wild and in captivity (Kummer and Kurt 1963; Kummer 1968; Schwibbe et al. 1992; Zinner et al. 1994). Here I report a pronounced lack of synchrony, as well as several other reproductive parameters, for a population of wild hamadryas baboons in Ethiopia. Observations were conducted between October 1996 and September 1998. The study group numbered about 170 baboons and the number of reproductively cycling females ranged from 45 to 55. The mean overall cycle length was 41 days and the mean per-female cycle length was 39 days (38.5 days for adults and 40.7 days for subadults). The minimum number of cycles to conception averaged 2 for adult females and 6 for subadult females. Interbirth intervals averaged 17 months for the four females who gave birth to two successive infants during the study period. Only five of 25 OMU's contained pairs of females whose estrus cycles overlapped (i.e., who cycled simultaneously at least once) during the study period. Four of these pairs were in units of four or more females and three of these pairs included at least one adolescent female. It has been suggested that it may be disadvantageous for hamadryas females to reproduce synchronously due to the limited sperm supply of the leader male (Zinner et al. 1994). I suggest that ecological variables may also play a role and may underlie the differences between these results and those of previous studies.

Discriminant function analysis of distal humeral morphology and locomotor adaptations in extant and fossil primates.

W. Sweitzer. Dept. of Anthropology, Arizona State University, Tempe, Arizona, 85287-2402, USA.

The relationship of primate distal humeral morphology to locomotor adaptations has been discussed extensively in the literature, but statistical approaches have been applied less frequently. Several recent studies attempt to correct this situation and robustly analyze correlations of morphology to locomotion in extant primates species. The preliminary research presented here extends one of these studies to include the fossil record.

Based on the methodology developed in Senturia (1995), this study attempts to use the results of discriminant function analyses on extant taxa to predict locomotor behavior in extinct taxa. Data on distal humeral morphology, body size, and locomotor behavior were gathered for extant and extinct species (including hominins). Size-corrected residuals were derived from allometric analysis. These residuals were used in discriminant function analyses of the locomotor behaviors of extant species. The resulting functions were then applied to the fossil sample. In an attempt to separate the effects of function and of phylogeny, taxonomic group memberships were analyzed in a similar manner.

The results of this preliminary study indicate that specialized locomotor behaviors (such as suspensory and terrestrial behaviors) are clearly distinct from each other and more generalized behaviors in extant taxa. Taxonomic analyses reveal a similar pattern: more recent radiations appear more distinct than basal primate groups. These results may indicate that phylogeny is more evident than function in the distal humerus. The prediction of locomotor behavior in extinct taxa was consistent with these conclusions.

Short backs and small pelves in modern females.

R. Tague. Dept. of Geography and Anthropology, Louisiana State University, Baton Rouge, LA, 70803-4105, U.S.A.

Relative to Old World monkeys that typically have seven lumbar and three sacral vertebrae, hominoids have "assimilated" one or more lumbar vertebrae into their sacrum. Humans modally have five lumbar and five sacral vertebrae; on average, the great apes have assimilated more lumbar vertebrae than humans. Why did humans limit this assimilation to two vertebrae? This study evaluates the effect on the pelvis of assimilation (i.e., fusion) of a lumbar vertebra. Previous studies have shown that fusion of the fifth lumbar vertebra (L5) to the sacrum in humans is associated with narrow transverse diameters of the pelvic inlet and outlet and a short anteroposterior diameter of the outlet. This assimilation may result in obstetric complications. This study uses black and white females from the Hamann-Todd and Terry Collections who were 25 years of age or older at death. Three groups are compared by ANOVA in their pelvic measures, those with a: (1) normal five segment sacrum, (2) fused L5 to the sacrum, and (3) fused coccyx to the sacrum. The results show a significant difference in both blacks and whites for the length of the sacrum, and anteroposterior diameter and posterior space of the outlet. For these three variables, t-test analysis shows that individuals with a fused L5 have significantly smaller means relative to the other two groups. The results are discussed in terms of evolution of the vertebral column in humans.

Morphology of frontal bone of *Amphipithecus*.

M. Takai, N. Shigehara, N. Egi, T. Tsubamoto. Primate Res. Inst., Kyoto Univ., Japan, Inuyama, Aichi, 484-8506, Japan.

In 1999 and 2001 field seasons, two frontal bones of *Amphipithecus mogaungensis* were discovered from the latest middle Eocene Pondaung Formation, central Myanmar. Both specimens are nearly the same portion of skull, the frontal trigon and the anterior part of a sagittal crest. The bone is very thick and robust, and slightly bigger than that of *Cebus*. The frontal trigon is not concave but slightly convex. The olfactory bulb is large and hemispheric. The postorbital process is rather robust, protruding laterally, and temporal lines converge posteromedially to form a well-developed sagittal crest. The metopic suture is not fused in one specimen but firmly fused in the other, suggesting that the frontal bones became fused during its growth in *Amphipithecus*.

The postorbital septum is likely to be incomplete because a smooth natural bone surface is observed just distal to the root of the postorbital process in one specimen. At the superomedial wall of the orbit there is a distinct foramen, which is not an ethmoidal foramen but should be called "Superior Intraorbital Foramen (SIF)" based on its position within the orbit. SIF is usually present in many extant lemurs, in extant tarsiers, and in *Apidium* (Parapithecidae) from the lower Oligocene Fayum sediments, but is usually absent in extant anthropoids. The frontal bone does not show strong postorbital constriction, which is usually seen in all adapoids.

Further analysis of utilizing the human patella to determine sex in forensic contexts.

N. Tatarek, L. Lease. Ohio University, Athens, OH, 45701, USA.

Recent work has explored sexual dimorphism in the patella as a possible method for estimating sex of partial or fragmentary human remains. Wendi O'Connor (1995) demonstrated a statistically significant dimorphism in patellae measurements collected from the Terry Collection and radiographs of college students. Introna et al. (1998) also established that patellar maximum width and thickness resulted in high accuracy in determining sex. The current project has two main objectives. O'Connor's methodology will be tested utilizing two documented skeletal samples. The methodology will then be applied to a skeletal sample of Native Americans where sex has been estimated from the pelvic bones to test for convergence of estimation techniques. Transverse and vertical diameter and thickness of right and left patellae were taken from 350 individual skeletons in the Hamann-Todd, Terry Collections and a Native American sample. Statistical analyses consisted of tests of normality, homogeneity, ANOVA and discriminant function. The ANOVA tests indicated that for all patellar dimensions, sex and ancestry significantly affected the measures, however, the interaction did not. Discriminant functions resulted in accuracy rates from 67%-80% for the left and right patellae individually (all three dimensions) and 67%-80% for both patellae together (all three dimensions). The current data did not result in accuracy levels previously reported, and the variable accuracy rates imply that utilizing these equations to determine sex on a single patella (as in forensic contexts) could result in error. The patella should be utilized as a sex determinant in conjunction with other diagnostic skeletal elements.

Evaluation of bone mineral density in Great Ape mandibles using high-resolution computed tomography.

A. Taylor[1], D.J. Daegling[2]. [1]Dept. of Community & Family Medicine and Biological Anthropology & Anatomy, Duke University, Durham, NC, 27710, USA, [2]Dept. of Anthropology, University of Florida, Gainesville, Florida.

Numerous studies have applied theoretical biomechanics to cross-sectional morphology in order to evaluate the ability of the mandible to resist certain masticatory forces. The application of this "strength of materials" approach relies on the assumption that compact mandibular bone is of uniform density. We begin preliminary tests of this assumption by evaluating bone mineral density as determined from CT numbers (Hounsfield units) in the mandibles of Great Apes using high-resolution quantitative computed tomography (QCT). QCT measurements were performed with a GE-9800 scanner on CT sections (1.5 mm thick) of mandibles of *P. pygmaeus*, *P. troglodytes* and *G. gorilla*. Using Region of Interest analysis software (MRVision, Winchester, MA), CT numbers were computed at the mid-buccal and mid-lingual corpus, lateral and medial alveolar process, and corpus base of sections at M_3, M_1, P_3 and symphyseal sections using a 9-pixel square. An analysis of variance was performed using a factorial design to evaluate the effects of species, sex, section and regions within sections on Hounsfield unit values. Higher order interactions are found to be significant, precluding assessment of regional and sectional variation without consideration of sex and species affiliation. In light of our results, the hypothesis that alveolar bone is invariably less dense than the inferior basal bone is not well supported. It is also possible that QCT is poorly suited to evaluating such variation.

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Patterns of dental wear and disease in the Middle Archaic of the Texas Gulf Coastal Plain: an example from the Ernest Witte Site.

M.S. Taylor. Texas Tech University, Kempner, TX, 76539, USA.

The Ernest Witte Site (41AU36) is a large multicomponent cemetery located on the Gulf Coastal Plain in Austin County, Texas. The oldest burials in the site, Group 1, date to the Middle Archaic (3500-1500 BC) period. Forty-two adult dentitions were selected from Group 1 for study. Attrition is moderate to severe throughout the sample. Mild alveolar bone loss was found in 80.9% of adults, antemortem tooth loss in 40.5%, abscesses in 38.1%, and caries in 28.6%. Most

periodontal diseases do not differentially effect one sex over another, except for antemortem tooth loss, which is found almost twice as often among females as males. Abscesses, periodontal remodeling, and antemortem tooth loss are probably the result of heavy dental wear creating an oral environment conducive to infection. It is proposed that the rate and pattern of wear is the result of behavioral activities, lifestyle, and diet associated with the Middle Archaic populations living on the Texas Gulf Coastal Plain. Implications for health, adaptation, and quality of life are examined.

Molar microwear and diet of *Praeanthropus afarensis* : preliminary results from the Denan Dora Member, Hadar Formation, Ethiopia.

M. Teaford[1], P. Ungar[2], F. Grine[3]. [1]Functional Anatomy & Evolution, Johns Hopkins University, Baltimore, MD, 21205, USA, [2]University of Arkansas, [3]SUNY Stony Brook.

Occlusal microwear on the molars of living primates is correlated with their dietary habits, such that species that process hard, brittle foods exhibit higher percentage frequencies of pits than taxa that process softer, tougher foods. Thus, microwear can be used to infer some aspects of paleodiet. We here report on six individuals of *Praeanthropus afarensis* from the Denan Dora Member of the Hadar Formation that date to 3.20-3.18 Myr. Paleoenvironmental reconstructions for this member envision woodlands, riverine forests and nearby edaphic grasslands.

Epoxy replicas of the molars were examined by scanning electron microscopy. Hypoconid Phase II facets were imaged at 500x magnification; the micrographs were analyzed using Microware 4.0.

Praeanthropus afarensis exhibits a high ratio of striations to pits, and the pits are rather small, approximating the size of cross-sectioned enamel prisms. The incidence of pitting falls below that of extant primates (e.g., *Cebus apella*) whose diets include substantial amounts of hard objects, or who forage terrestrially (e.g., *Papio ursinus*), and suggests comparison to soft, tough food consumers (e.g., *Gorilla*). *Praeanthropus afarensis* microwear contrasts with that of *Paranthropus robustus*, which evinces a notably higher incidence of larger pits. It more closely resembles that recorded for *Australopithecus africanus*, although the latter exhibits a slightly higher incidence of somewhat larger pits. While these comparisons are tentative given the differences in analytical techniques among studies and the small size of the *Praeanthropus afarensis* sample, it appears that these individuals did not exploit hard food items during Denan Dora times.

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Evidence for dental hygiene in early medieval Northern Germany: traces of tooth picks.

W-R. Teegen[1], M. Schultz[2]. [1]University of Leipzig, Institute of Prehistory, Hameln, Niedersachsen, 31787, Germany, [2]University of Goettingen, Dept. of Anatomy.

The skeletons of two early medieval populations from northern Germany were studied. The individuals belonged to two different ethnical entities and to different social settings: The population from 9th century Höxter represent rural Saxons, the population from 10th century Starigard-Oldenburg kings of a western Slavic tribe. In Slavic Starigard-Oldenburg, three of 33 adult individuals showed approximal grooving in the teeth. The individuals affected were older than 60 years. Two of them belonged to the wealthiest burials. In Saxon Höxter, one (a 20-29 year old female) of 13 adult individuals showed these traces.

Selected teeth of each individual from Starigard were used for scanning electron microscopy. The SEM pictures showed, in every case, horizontal striations, caused by mechanical devices. It is very likely that these traces were caused by use of toothpicks over many years. The presence of dental calculus in these individuals clearly shows the need of toothpicks as a form of dental hygiene.

Approximal grooving has never been reported for early medieval populations from Central Europe. However, tooth picks made of silver or bronze were not un-common in Roman times or in the early Middle Ages: Sometimes they were found in burials of the elite. Additionally, in the case of the female from Höxter, an explanation hat teeth were used as tools seems possible.

Accuracy and precision of body size estimation using the W. Montague Cobb Collection.

C.J. Terranova. Dept. of Anatomy, College of Medicine, Howard University, Washington, DC, 20059, US.

Various routines exist for the estimation of size based on measurements of the skeleton or dentition. Recently, rigorous testing of estimator performance has become standard practice in paleobiological and anthropological investigations. Here, I examine the performance of several long bone measurements in estimating the height of known-height individuals included in the W. Montague Cobb Collection.

Of the over 700 individuals comprising the Cobb Collection, nearly 100 have associated height and other external dimensions. These data were coupled with long bone lengths and breadths. CT scans were also performed to better describe diaphyseal structure. Linear and geometric variables were used to develop a variety of regression models. The accuracy and precision of estimates are compared by anatomical region and measurement type. Further, contrasts are made among the Cobb-based models and a variety of standard estimation models to assess the nature and extent of variation attributable to sex, age, occupation and ethnic origin.

Estimates of height are generally precise, although accuracy can vary by as much as 60%. Average errors center around 25%, although cross-sectional variables tend to perform better than bone lengths. Because of the variation inherent in the sample, which is likely characteristic of most adult intraspecific samples, group effects (age, occupation, and ethnic origin) do not usually reach statistical significance. The significance of these findings as regards the use of separate models for age or ethnic groups is discussed.

Strategies to cope with the lack of a clear boundary between *Australopithecus* and *Homo*.

F. Thackeray. Transvaal Museum, Pretoria, South Africa, 1, South Africa.

When the first australopithecines fossils were found at Taung, Sterkfontein, Swartkrans, Kromdraai and Makapansgat in South Africa, they were recognised as species belonging to at least one genus (*Australopithecus*), clearly distinct from *Homo*. As the sample size of hominid fossils increased, more genera and species were described, to the point that boundaries between hominid taxa appear to have become blurred. It is suggested that there is no clear boundary between *Homo* and *Australopithecus*. Strategies to cope with this problem need to be identified.

Dynastic funerary ritual and body treatments of sacrificial companions among the Classic Maya. A case study from the sarcophagus tomb of Temple XIII, Palenque, Mexico.

V. Tiesler Blos[1], A. Cucina[2], A. Romano Pacheco[3]. [1]Universidad Autonoma de Yucatan, Mérida, Yucatan, 97000, Mexico, [2]University of Missouri, [3]Instituto Nacional de Antropología e Historia, México, D.F.

The placing of sacrificial victims in the graves of the *elite* was common practice in ancient Maya society, as accounted for by various historical sources, prehispanic iconography and the archaeological record of the region. Companions in dynastic tombs have been observed at many Classic Maya sites such as Tikal, Calakmul, Copan, Ek Balam and Palenque. For lack of direct clues as to the form of death and mortuary treatments of these attendants, scholars have so

far had recourse to contextual evidence in their identification, such as irregular and simultaneous positioning, age profile and lack of associated objects.

This study describes the taphonomy, anatomical distribution and *peri-* and *postmortem* attributes observed in the remains of the two persons that accompanied the occupant of a recently discovered sarcophagus tomb from Temple XIII of Palenque, Mexico. The skeletal disposition and the several cut marks recorded on the remains of the two individuals, provide direct evidence on the way they were sacrificed (form of their death) and the sequence of pre-depositional and depositional body treatments the two sacrificial victims underwent.

The present results, which provide new direct insights on dynastic mortuary practices of the ancient Maya, are interpreted and discussed in terms of Maya ritual and belief systems during the Classic Period.

Evidence of Y chromosome clines in Europe: post-glacial re-colonization from Upper Paleolithic refugia?

C. Tillquist[1], M. Kaplan[2], F. Blackmer[2], T. Karafet[2], H. Jarjanazi[2], M. Remigereau[3], E. Arnason[4], H. Sigurgislason[4], M. Hammer[1]. [1]Dept. of Anthropology, University of Louisville, Louisville, Kentucky, 40292, *USA* of America, [2]Division of Biotechnology, University of Arizona, [3]Universite Pierre et Marie Curie, Paris, France, [4]Institute of Biology, University of Iceland.

Variation on the non-recombining portion of the Y chromosome (NRY) is used to elucidate patterns of colonization of Europe following the Last Glacial Maximum. A set of 52 biallelic polymorphisms (SNPs) and 11 microsatellites (STRs) were genotyped in a sample of 807 individuals from 18 European and West Asian populations. The overall pattern of variation was characterized by a series of clines involving several SNP lineages (NRY haplogroups). We performed analyses to infer the population processes giving rise to these clines, and to distinguish Upper Paleolithic colonization events from more recent Neolithic demic diffusions across the Paleolithic genetic landscape. We determined that three of the six NRY haplogroup *frequency* clines resulted in corresponding *diversity* clines in associated Y STR variation. Assuming that the greatest diversity occurs in proximity to the source of the expansion, we hypothesize that two of these patterns resulted from post-glacial expansions from Pleistocene refugia near the Mediterranean and the eastern European steppes into essentially unpopulated territories, while one probably represents a recent migration by a distinct population. It appears that initial frequency clines have been quite stable in the face of more recent migrations, perhaps reflecting a rapid and cohesive colonization process across the geographic landscape.

In addition to supporting several hypotheses in the literature concerning European population origins, our results provide more clarity with respect to the timing and the impact of prehistorical and historical population processes shaping patterns of genetic variation in Europe.

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Human genetic diversity in East Africa: implications for modern human origins and recent biocultural history.

S. Tishkoff. Dept. of Biology, University of Maryland, College Park, MD, 20742, USA.

East Africa represents one of the most culturally and linguistically diverse regions in the world. Over 100 languages are spoken, representing each of the four major language families present in Africa: Afro-Asiatic, Nilo-Saharan, Niger-Congo, and Khoisan. East Africa is also the likely origin of migration of modern humans out of Africa within the past 100,000 years, as evidenced by archeological, mtDNA, Y-chromosome and autosomal haplotype data. A number of recent short-range and long-range migration events have played an important role in shaping bicultural diversity in modern East Africa (eg. the migration of Nilotic- and Cushitic-speaking people from Northern Africa). The ancestors of Khoisan- speaking Hazda and Sandawe populations in Tanzania are speculated to be the source of migration of Khoisan speakers into Southern Africa. The presence in Tanzania of peoples speaking languages representing all four of the major linguistic families in Africa makes this nation a logical place to sample a wide range of the genetic diversity likely to be present in East Africa. Therefore, we have initiated a study of genetic diversity among linguistically diverse Tanzanian populations (Khoisan-, Bantu-, Cushitic-, and Nilotic- speakers). We present our initial results of mtDNA, Y-chromosome, and autosomal genetic variation and discuss implications for modern human origins and biocultural history of East African populations.

Three dimensional quantitative analyses of human pubic symphyseal morphology: can current limitations of skeletal aging methods be resolved?

M. Tocheri[1], A. Razdan[2], T. Dupras[3], M.S. Bae[2], D. Liu[2]. [1]Arizona State University, Tempe, AZ, 85287-2402, USA, [2]PRISM, Arizona State University, [3]Dept. of Sociology and Anthropology, University of Central Florida.

During the past century, several aging methods based on pubic symphysis morphology have been introduced. Many of these methods represent modifications of the original method described by Todd (1920). Recently, Hoppa (2000) has explored some of the problems and challenges associated with using modern reference samples to estimate the pattern and rate of age related changes in bone morphology observed in past populations. His results outline the current limitations of skeletal aging methods, in particular, those that rely on changes to the pubic symphyseal face.

In this paper, we introduce a novel approach that may, in future years, help alleviate some of these methodological problems. We present the results of quantitative analyses of the age-related morphological changes displayed by the Suchey-Brooks pubic symphysis casts. All twenty-four male and female casts were scanned using a 3D laser scanner and geometrically modeled. The resulting virtual 3D symphyseal faces were analyzed using various geometric analytical techniques enabling the extraction of quantitative data best representing qualitative features of interest.

Preliminary results suggest the ability to quantitatively describe the age-related changes to the pubic symphysis may provide potential for future method refinement. Continuing research is committed to developing a computerized, web-accessible database of 3D pubic symphyseal faces from individuals of known age-at-death, sex, and biological affinity. It is hoped that this work will lead to further refinements of the pubic symphysis aging method, especially in regard to differences between populations, as well as serving as an education and research tool.

The Kebara 2 Neandertal hyoid and speech capacity revisited: size and shape relative to mandibular dimensions.

C. Toll, R. Franciscus. University of Iowa, Iowa City, IA, 52242, USA.

Comparative studies of the hyoid bone of the Kebara 2 Neandertal (KMH2) (Arensburg and colleagues, 1989, 1990, 1991; Laitman et al., 1990; Kennedy and Faumuina, 2001) have not included direct comparisons with the associated mandible. There is virtual consensus that the KMH2 hyoid is similar in size and shape to recent humans in *absolute* terms. However, since there are clear mandibular size and shape differences between Neandertals and recent humans, the question arises: to what extent is the KMH2 hyoid similar to recent humans when scaled to the dimensions of its mandible?

8 hyoid, and 20 external and internal mandibular measurements available for KMH2 were collected on documented recent humans (Euroamericans, n = 42; African-Ameri-

cans, n = 56). Univariate and multivariate modeling of *log size & shape* and *log shape* variates was used to: 1) explore the degree to which the size and shape of the hyoid conformed to overall mandibular size and form, especially in internal mandibular dimensions; and 2) test whether the KMH2 hyoid followed the size, shape and scaling relationships relative to the mandible observed in our recent human samples.

While some measurements of the KMH2 hyoid fall near the limits of the range for our comparative samples, its overall size and shape relative to mandibular size and form (especially internal mandibular dimensions) falls well within our comparative samples, and often on mean or centroid values. Thus, when scaled to appropriate measures of mandibular size and form, the hyoid of KMH2 is very similar to that found in modern humans.

Prehistoric population movements in southern coastal and highland Peru: Bone isotopic evidence.

P. Tomczak[1], S. Ambrose[2], D. Blom[3]. [1]University of New Mexico, [2]University of Illinois - Urbana, [3]University of Vermont.

Isotopic variation between populations located in the Osmore Valley of Southern Peru is used to assess population movement within the coast and foothills region, and between coastal lowland and Andean highlands. The primary focus of this study is the Late Intermediate Period Chiribaya Baja population. Andean highland Tiwanaku populations are included in this study because a highland origin for the Chiribaya has been proposed.

Carbon and nitrogen isotopes are used to assess dietary consumption and patterning among individuals from a site. Resources consumed within a site are usually produced or extracted from the local environment. Isotopic signatures of dietary resources that are not locally available suggest trade, long distance resource extraction, and/or migration. Oxygen isotope ratios of bone apatite carbonate reflect those of meteoric water, which are in turn controlled by temperature, elevation and amount of rainfall. Oxygen isotopes are used here to distinguish coastal desert inhabitants (near sea level) from highlanders (>3000 m ASL).

Carbon and nitrogen isotope analyses indicate that while the majority of individuals from Chiribaya Baja consumed local resources, five individuals had a distinctly different diet, similar to that of highland populations. Oxygen isotopes fall clearly within the Tiwanaku population range, supporting a recent migration to the coast by these five individuals. During this period in the Osmore Valley, there is little archaeological evidence for vertical movement from the highlands to the coast. This research provides new insight into individual movements within the Osmore Valley of Southern Peru.

Skeletal and mortuary evidence for cultural diversity in the Late Intermediate Period Chilean Atacama.

C. Torres-Rouff. University of California, Santa Barbara, Santa Barbara, CA, 93106, USA.

The Andean Late Intermediate Period (LIP) (AD 1000-1450) was a time of regional developments during which no single culture dominated the Andes. Some archaeologists have argued that in the Atacama Desert of north Chile two separate cultures existed where there had previously been cultural homogeneity. A series of 256 crania from four LIP sites were analyzed in order to investigate this hypothesis. One site, Caspana (n = 58) is from the Loa River area, while the other three are from the San Pedro de Atacama oases located slightly to the south (Coyo 3, n = 33; Quitor 6, n = 21; Yaye, n = 144). The skulls were examined for cranial vault modification, which is an indication of cultural affiliation. Additionally, mortuary practices were studied in light of the possibility of the existence of two distinct ethnic groups.

These results suggest that the LIP population of the Loa River differs markedly from the neighboring San Pedro populations. This is particularly evident in cranial vault modification. The Caspana series overwhelmingly displays annular forms (84%) while throughout time tabular forms of deformation characterized the San Pedro population. This evidence of a cultural difference is consistent with the occasional appearance of *chullpas* or burial towers instead of simple burial pits in the Loa River area. This supports the hypothesis that two distinct populations occupied the Chilean Atacama during the LIP. One is represented by the San Pedro oasis cemeteries, which were contemporary and culturally homogenous. The occupation of the Loa region, in contrast, may reflect influences from the Bolivian Altiplano.

Genetic architecture of the timing of the pubertal growth spurt and skeletal maturity during puberty.

B. Towne[1], D. Duren[1], S. Czerwinski[1], E. Demerath[1], A. Roche[1], J. Blangero[2], J. Parks[3], M. Brown[3], R. Siervogel[1]. [1]Wright State University School of Medicine, Dayton, OH, 45420, USA, [2]Southwest Foundation for Biomedical Research, [3]Emory University School of Medicine.

Little is presently known of the nature of shared genetic influences on skeletal growth and skeletal maturation during childhood. In this study, individual growth curves were fitted to serial stature data from 158 boys and 205 girls in 105 families in the Fels Longitudinal Study using the triple logistic method implemented in the program AUXAL (Bock et al., 1994), and their age at minimum height velocity before puberty (AMHV) and age at peak height velocity during puberty (APHV) were obtained. These 363 boys and girls also had hand-wrist radiographs taken within one year before and after their AMHV and APHV from which skeletal age (SA) assessments were made using the FELS method (Roche et al., 1988). Estimates of SA@AMHV and SA@APHV were derived by linear interpolation. Heritabilities of AMHV, SA@AMHV, APHV, and SA@APHV were estimated using SOLAR (Almasy and Blangero, 1998); additive genetic correlations between AMHV & SA@AMHV, and between APHV & SA@APHV, were estimated using a modified version of SOLAR. The heritabilities are: AMHV = 0.82, SA@AMHV = 0.67, APHV = 0.82, and SA@APHV = 0.56. The genetic correlation between AMHV & SA@AMHV = 0.53, and the genetic correlation between AGE-PHV & SA@AGE-PHV = 0.36. These findings reveal the timing of the pubertal growth spurt, and measures of skeletal maturity during the pubertal growth spurt, to be highly heritable traits, but there are incomplete pleiotropic effects of genes on the timing of pubertal growth and skeletal maturity during puberty.

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Did the australopithecines crawl?

D. Tracer. University of Colorado-Denver, Denver, Colorado, 80217-3364, USA.

Among his many contributions to biological anthropology, Frank B. Livingstone was one of the first researchers to identify the profound and synergistic roles that culture and infectious disease may play in canalizing the course of human adaptation. In addition whether dealing with modern human variability or hominid evolution, Livingstone has always shown a singular willingness to question and critique the most widely-accepted, normative views. In this tradition, the present paper questions the widely-held view that quadrupedal crawling is a ubiquitous locomotor stage in the human species and a necessary prerequisite to bipedal locomotion. It also examines the role of culture and infectious disease in mediating the course of early locomotor and neuromuscular development.

Data from Papua New Guinea are presented showing that high levels of infant carrying and restraint canalize neuromuscular development such that infants are delayed in attainment of horizontal locomotor skills

and also do not crawl. Moreover, it is shown using data from Bangladesh that these patterns of infant handling are adaptive, decreasing oral-to-ground contact, parasite transmission, and diarrheal disease risk. The virtual absence of infant caching and the near ubiquity of high levels of infant carrying among both traditional human societies and our closest non-human primate relatives suggest that rather than being normative throughout hominid evolution, crawling may be a relatively recent phenomenon.

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Object manipulation in a population of semi-free ranging *Macaca fascicularis* in Bali, Indonesia.

W. Truce, A. Fuentes. Dept. of Anthropology, Central Washington University, Ellensburg, WA, 98926-7544, USA.

In this study we report on object manipulation behaviors exhibited by individuals within a food-enhanced, semi-free ranging population of *Macaca fascicularis* located at Padangtegal, Bali, Indonesia. This behavior is poorly documented in other populations of this species. Preliminary research on object manipulation in this population in 1992 and 2000 suggested that this behavior might lack an overt fitness enhancing function. This current study consists of 420 observations of object manipulation recorded during the months of June and July, 2001. The behavior was predominantly exhibited by adult and sub-adult females, but was also observed in all other age/sex classes. A total of 492 objects were manipulated, with 61% being non-food items. Additionally only 41% of food items manipulated were ingested. The most common manipulation consisted of objects rubbed on the ground or between the individual's hands. However, pounding, fulcrum, mouthing, and bouncing manipulation were also observed. Two instances of object stacking were also recorded. These macaques exhibited no distinct handedness during manipulation, but a slight right-hand preference was noted.

Preliminary analysis suggests that this behavior may have no direct fitness enhancing function. While Macaques are known to be highly manipulative, and object manipulation is typically linked to food preparation or procurement, this behavior may have lost its functionality within this population as provisioning increased. It is our contention that the object manipulation currently observed in these macaques may be best described as similar to other proposed cultural behaviors in nonhuman primates (McGrew 1998, Huffman 1996).

Biodemographic structure of an ancient population: the cholera epidemic of 1837 in Alia (Palermo, Sicily).

S. Tulumello[1], R. Bigazzi[1], S. De Iasio[2]. [1]Dipartimento Di Biologia Animale E Genetica. Laboratori di Antropologia, Firenze, Italy, 50122, Italy, [2]Dipartimento di Biologia Evolutiva E Funzionale, University Of Parma, Italy.

Changes due to epidemics, droughts and other environmental inputs can affect the history of human populations. A rare opportunity was afforded to conduct a study that integrated skeletal biology, population genetics, historical demography and biodemography by the discovery of a cave containing skeletal remains from 300 individuals who died during the cholera epidemic of 1837 in Alia, Sicily, and by the existence of complete and well-preserved registers of birth, marriage and death, from 1800 to 1890 for the same population. Alia is a village of 3000 inhabitants, located in the center of Sicily. The main purpose of the research is to make observations on changes of demographical parameters of a ancient population, in relation with environmental stresses such as a cholera epidemic. The 30.000 records of births, marriages and deaths have been inserted in the program WinFamy, elaborated by Sergio De Iasio, University of Parma.

The results show two peaks in the rate of mortality during the epidemic, one in early July and the second at the end of August, and changes in other demographic parameters: decrease of births (25%) and marriages, higher mortality rate for women of reproductive age (30%), children less than 10 years and peasants (60%).

The study of the surnames, with their frequencies and variations, allow us to investigate the presence of migration. In Alia there are 1150 different family names in birth registers and 525 in marriages registers; the 20 more frequent names represent 1/3 of the total. This is characteristic of an isolated population with low level of immigration and high level of consanguinity.

From heels to height: estimating stature based on the talus at Tell Abraq, U.A.E.

B. Turner[1], A. Goodman[2], D. Martin[2], D.T. Potts[3]. [1]Dept. of Anthropology, Emory University, Atlanta, Georgia, 30329, [2]Dept. of Natural Science, Hampshire College, Amherst, MA, [3]Dept. of Archaeology, University of Sydney, Australia.

Achieved height is a useful tool to assess the cumulative impact of stressors such as diet, climate and disease on growth and development. In archaeological populations, stature is often estimated indirectly, from linear measurements of long bones. Yet in sites with fragmentary skeletal remains, long bones may not be available. This is the case at the site of Tell Abraq, a Bronze Age (~2200-2000 BCE) fortress and port, in the United Arab Emirates. Here, the skeletal remains of approximately 400 individuals are fragmented and commingled, but tali are plentiful. The purposes of this study are to estimate statures based on talar lengths and from there interpret ecological and social conditions.

All intact adult right tali (n = 163) were measured for maximum length; stature was estimated for each using the most general formula from Holland (1995). The resulting mean estimated stature was 170.3 cm (SD +/- 18.6 cm), with some individuals estimated to exceed 180 cm. Comparisons of mean statures from contemporaneous sites in the region suggest that many inhabitants were fairly tall, some ranging in height from 165-169.5 cm. Yet based on the data collected here, it appears as though the Tell Abraq sample was taller.

The diet at Tell Abraq included numerous sources of protein and carbohydrates; it is suggested here that this balanced diet may have been a contributing factor in the observed "tallness." A closer look at the dietary patterns of surrounding sites in the region may provide useful information in testing this hypothesis.

Human migration in the archaic.

N. Tuross. Dept. of Anthropology/MSC, National Museum of Natural History, Smithsonian Institution, Suitland, MD, 20746, USA.

The evidence of human migration can be retained in the hydrogen isotopes of bone collagen. Hydrogen isotopes vary as a function of latitude, altitude, movement of air over landmasses, season, and rainfall. The differences in the amounts of hydrogen and deuterium in precipitation are due to equilibrium fractionation factors between water and vapor that are temperature dependent, and a hydrologic cycle that leaves depleted water vapor in clouds as they move inland and north. In addition, evaporation of standing water can result in an enrichment of deuterium in the remaining source. Based on ethnobotanical evidence, it was suggested that the humans from the Windover site in east central Florida may have been seasonal migrants (Tuross et al., American Antiquity, 59(2), 1994). Hydrogen isotopic values in the bone collagen of humans and fauna from the Windover site support with this interpretation, and, in addition, indicate that the human population utilized a highly evaporitic water source for part of the year. The mag-

nitude of the difference in average ∂D from Windover human versus the faunal bone collagen is greater than can be obtained through a seasonal migration of humans to the Caribbean, but could be the explained by the seasonal use of evaporated lake sources such as those found inland in Florida today.

Elevated sequence divergence of baboon endogenous virus (BaEV) in a natural population of hybrid anubis and hamadryas baboons.

M. Uddin[1], J. Phillips-Conroy[2], C. Jolly[1]. [1]New York University and NYCEP, New York, NY, 10003, USA, [2]Washington University.

Baboon endogenous virus (BaEV) is a simple retrovirus containing characteristic *gag, pol* and *env* open reading frames when complete. Multiple copies of BaEV are believed to persist in stably integrated, vertically transmitted forms in the baboon genome. BaEV distribution, however, is not limited to *Papio*: viral fragments have been detected in most papionins and some cercopithecins, indicating that horizontal transfer of this genetic element accounts for its present-day distribution.

Here we report the first attempt to investigate full-length BaEV genomes obtained from a natural hybrid baboon (*P. hamadryas* x *P. anubis)* population. Long-range PCR and large insert cloning techniques were used to isolate clones containing the three major BaEV genic regions. Each of these regions was then amplified and sequenced from a subsample of these clones. Average pairwise distance analyses within and between individuals indicate that the *env* region has the highest degree of sequence divergence, followed by *gag* and *pol*. Neighbor joining, parsimony and maximum likelihood analyses performed on concatenated sequences indicate that genomes isolated from the same individual do not necessarily group together. When compared with average pairwise distances within and between anubis and hamadryas baboons, the hybrid baboons show an elevated amount of sequence divergence, (1.18% vs. 0.67% in the *env* region), as well as a higher Ka/Ks ratio. Revised estimates of the separation time between the two main forest and savannah strains of BaEV suggest dates of between 5,000 and 200,000 years ago, indicating that the virus was circulating exogenously much more recently than was initially thought.

Energy and effort in Papua New Guinea.

S. Ulijaszek. Institute of Biological Anthropology, University of Oxford, Oxford, Oxfordshire, OX2 6QS, UK.

The potential impacts of female work scheduling on household food and nutrient availability and child nutritional status have been little considered in Papua New Guinea. The Baroi of the Gulf Province have a subsistence economy based on palm sago, a starchy staple devoid of other nutrients, with fishing and the cultivation of roots and fruit and nut-bearing trees as subsidiary activities. Sago-making is predominantly a female activity, involving hard physical work, but generally producing adequate starch to subsidise other subsistence activities. In this analysis, variability in productivity of palm sago processing is examined for 16 Baroi women, and related to food and nutrient availability and anthropometric nutritional status of their households. Time allocation and energy expenditure by the diary method of each woman were determined from minute-by-minute observations of sago-making, and sago energy produced estimated by weighing and dietary conversion. Household food and nutrient intakes were determined by 3 day weighed dietary intake, conversion to nutrients, and relationship to age-specific nutrient requirements. Daily time spent in sago-making is not associated with household availability of dietary energy, but is positively associated with intakes of protein and calcium, and negatively associated with anthropometric nutritional status of children. While the high energy returns from sago making subsidise other energetically less efficient but nutritionally important food-getting practices, women that spend fewer hours making sago per day spend more days obtaining the starchy staple for their households, and fewer days in subsistence activities that maintain the nutritional quality of the diet for their household.

A dental reconstruction of biological relationships in the Late Bronze and Early Iron Ages of the Southern Levant.

J. Ullinger. Arizona State University, Tempe, AZ, 85281, USA.

This study examined the degree of genetic diversity and biological relatedness in the southern Levant during the important Late Bronze-Early Iron transition period (1400-1000 BCE) by analyzing dental nonmetric traits. The dental remains were examined from two sites: Tel Dothan, a Late Bronze Age site in the northern-central foothills of the southern Levant and Tel ed-Duweir (Lachish), an Early Iron Age site located on the periphery of the Philistine occupation in the southwest foothills near Gaza.

Dental morphological traits scored on over 2,000 loose teeth from Dothan and on approximately 350 individuals from Lachish suggest that the two groups are different, but not markedly so. Individuals from Lachish have a more simplified dentition; they have very low frequencies of shoveling, Carabelli's cusp, upper molar cusp 5, and lower molar cusps 6 and 7. Individuals from Dothan are more complex dentally; they demonstrate higher frequencies of these same traits. However, both groups exhibited frequencies that fall within the range of other groups from the same area.

Interestingly, the individuals from Lachish have several anomalies that suggest that the city may not have been as cosmopolitan as previously suggested. Multiple individuals possess several dental traits that are extremely rare, suggesting that they are closely related, and that some may even be members of the same family.

In conclusion, the individuals of Lachish and Dothan were more closely related to each other than they were to groups outside of the region although they exhibit significant differences.

Quantification of tooth crown shape by dental topographic analysis.

P. Ungar[1], J. Dennis[1], F. Kirera[1], J. Wilson[2], F. Grine[3]. [1]Dept. of Anthropology, University of Arkansas, Fayetteville, AR, 72701, USA, [2]Center for Advanced Spatial Technologies, University of Arkansas, [3]Dept. of Anthropology and Anatomical Sciences, SUNY Stony Brook.

Dental topographic analysis is an approach to quantifying tooth shape in three dimensions using Geographic Information Systems technology. Results provide measures of surface area, relief, slope, and other variables for whole occlusal tables, or individual cusps and basins. We here describe methods used to derive such data.

A crown surface is digitized using a Surveyor 500 (Laser Design) laser scanner; wherein data are collected as a matrix of x-y-z points separated by 25.4 microns. Resulting data are imported into ArcView GIS 3.2a with Spatial and 3D Analyst extensions (ESRI), and interpolated to create a grid-based digital elevation model. Areas of interest are delineated with the help of contour lines, and slope, aspect and surface angularity are measured. Finally, the grid theme is converted to a triangulated irregular network to calculate planometric area, 3D area, and volume.

Repeatability of results for a given specimen is very good (most values varied less than 1% during repeated measurement) and both inter- and intraobserver error are minimal. To compare specimens, crowns must

be oriented in a consistent manner. Analysis of human molar cross-sections suggests that the plane defined by the midpoints of the mesial, distal, and lingual (lower molars) or buccal (upper molars) cervical margins provides an adequate proxy for the occlusal plane. Thus, crowns are oriented with this "cervical plane" coplanar to the x-y plane of the laser scanner. Consistency of scans is confirmed within ArcView with image registration (georeferencing) tools to determine exactness of fit.

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Can we determine kinship systems? Testing models of genetic patterns for cemetery analysis.

B. Usher, J. Weets, C. Wanglund. State University of New York College at Potsdam, Potsdam, New York, 13617, USA.

Anthropologists attempt to reconstruct kinship from skeletal remains found in cemeteries. Kinship is important to understanding the social structure of pre-industrial communities, and reconstruction of nuclear and extended families has been attempted using a variety of contextual and skeletal traits. More recently, ancient DNA (aDNA) methods have been used to resolve the problem of identifying related individuals. The drawbacks of aDNA methods are that they are expensive, time-consuming, destructive of skeletal material, and sometimes unreliable. Therefore, while aDNA methods have the potential to determine relatedness, models of genetic patterns expected in pre-industrial societies must be created and tested before embarking on these difficult projects. For this poster, the authors have developed models of the distribution of genetic markers both within individual cemeteries and between cemeteries in a regional context that are applicable to analysis of patterns of ancient DNA extracted and analyzed from human remains found in archaeological excavations of cemeteries. The models predict of the expected spatial distribution of male (Y chromosome) and female (mitochondrial DNA) markers for the three most common inheritance and residence patterns found in pre-industrial populations: patrilineal/patrilocal, matrilineal/matrilocal, and matrilineal/avunculocal. This project validates these models by comparing the models to simulated distributions of genetic markers in cemeteries using spatial statistics to determine the ability of the models to discriminate between the different cemetery configurations. Early results show that the models easily differentiate between patrilineal and matrilineal genetic patterns.

Contemporary mtDNAs reveal pre-Columbian migrations to Puerto Rico.

P. Valencia-Rivera, E. González-Bonilla, J. Startek, M. Rivera-Vega, A. Román-Colón, J.S. Ramírez-Lugo, J.C. Martínez-Cruzado. [1]Dept. of Biology, University of Puerto Rico at Mayagüez, San Juan, Puerto Rico, 00920-4318, USA.

We aim to contribute to the knowledge on the historical migrations that peopled the Caribbean region through detailed analyses of mitochondrial DNAs (mtDNAs) of Native American origin from Puerto Rico. The mtDNA haplogroup of 804 residents from 28 municipalities making up a representative sample for the island is being identified by means of RFLP analysis. From 787 mtDNAs that have been identified, 483 have been shown to belong to any of the four main Native American haplogroups. No mtDNA belonging to the fifth Native American haplogroup X has been found. Haplogroups A (52.6%) and C (35.8%) represent 88.4% of the Native American mtDNAs. Seventeen restriction sites that had previously been shown to be variable in haplogroup C mtDNAs of the New World were tested in 79 haplogroup C mtDNAs. Only two haplotypes representing 49 and 30 mtDNAs were identified. These differed at two sites, one of which was the site known as the most variable in mtDNA, suggesting that haplogroup C represents one or two very recent migrations to the island that originated in the deep region of the Amazon Basin. Median network analysis of DNA sequences from regions HV-I and HV-II of 40 haplogroup A mtDNAs revealed two haplotype clusters that represent at least two haplogroup A migrations to Puerto Rico; one much older than the other. The average number of sites differing from any sequence to the root in the older cluster suggests that the first migration occurred shortly before the disappearance of the land bridge that connected Cuba with the Yucatan Peninsula.

Physical activity, body size, and body proportions of Portuguese and Cape Verdean-Portuguese pre-menarcheal girls.

M. Varela Silva, B. Bogin. University of Michigan-Dearborn, Dept. of Behavioral Sciences, Dearborn, MI, 48128, USA.

Levels of physical activity are sometimes estimated from body size and body composition. The purpose of this study is to examine the relationship between physical activity (measured by energy expenditure), weight, and body composition of 53 pre-menarcheal Portuguese (P) and 42 Cape Verdean-Portuguese (CV-P) girls (10 to 13 years old). We assess the energy expenditure using the categories of physical activity and the formulae found in Ainsworth et al. (2000). We measured height, weight, arm circumference, tricipital, subscapular, suprailiac and geminal skinfolds using standard methods. Body mass index (BMI), sum of skinfolds (SS), total upper arm area (TUA), upper arm muscle area (UMA) and arm fat index (AFI) were calculated. The CV-P girls have a significantly higher mean weekly energy expenditure than the Portuguese girls. The CV-P are also significantly taller and heavier, and their greater size explains part of the difference in energy expenditure. However, when we do not consider the weight of the individual, the difference in energy expenditure rate remains. The differences in BMI, SS, TUA, UMA, AFI are not significant. The CV-P girls practice a greater number of informal physical and perform more domestic activities. These activities seem to account for their greater energy expenditure, but these have no significant impact on body composition and BMI. Body composition, then, cannot be used to infer levels of physical activity in this sample.

Ainsworth BE et al. (2000). Compendium of Physical Activities: an update of codify codes and MET intensities. *Med. Sci. Sports Exer., 32* (9), supplement. S498-S516.

Diet of a 300-member Angolan colobus monkey (*Colobus angolensis*) supergroup in the Nyungwe Forest, Rwanda.

A. Vedder[1], P.J. Fashing[2]. [1]Living Landscapes Program, Wildlife Conservation Society, Bronx, NY, 10460, USA, [2]Center for Envir. Res. and Conservation, Columbia University, NY, NY.

The Angolan colobus monkey (*Colobus angolensis*) population in the Nyungwe Forest, Rwanda is the only colobine population in Africa in which groups are known to include more than 100 individuals. From April 1987 – March 1988, this study investigated temporal variation in the diet of a >324-member group of Angolan colobus in the montane rainforest at Nyungwe. Dietary data were collected using the frequency method on 4-6 days each month during 10 months. A total of 13,558 feeding records were obtained and the study group was observed consuming at least 45 different species. The group's diet was composed primarily of leaves (38%), lichen (32%), and seeds (20%). Whole fruit (3%), petioles (2%), bark (2%), flowers (1%), and soil (1%) were additional minor components of the diet. 78% of the leaves consumed were mature leaves while only 18% were young leaves. Inter-monthly variation in the contribution of the three primary food items to the diet was considerable: 20%-61% for leaves, 12%-57% for lichen, and 0%-49% for seeds. There were significant negative correlations between leaf consump-

tion and seed consumption (r_s = -.705, P = .034) and between lichen consumption and seed consumption (r_s = -.705, P = .034). The heavy reliance on lichen by Angolan colobus at Nyungwe mirrors that exhibited by snub-nosed langurs inhabiting the montane temperate forests of China. Unlike snub-nosed langurs, however, Angolan colobus live in tropical forests where leaves are always available, yet they choose to subsist primarily on lichens during some months of the year. Their ability to subsist on lichen may at least partially explain the ability of Angolan colobus to live in unusually large groups at Nyungwe. However, the selective pressures that lead to the formation of these large groups remain a mystery.

Locomotion dependent variation in the trabecular pattern of the hominoid proximal femur.

T.B. Viola. Institute of Anthropology, University of Vienna, Vienna, Vienna, A-1090, Austria.

The assessment of cancellous bone architecture with the goal of correlating architecture with positional behavior is getting more and more attention. As the positional behavior of the *Hominoidea* is quite well known, we decided to use the hominoid proximal femur to test the assumption that more stereotypical loading regimes result in more structured and more anisotropic trabecular patterns.

Our sample consists of 10 specimens each of *Hylobates sp.*, *Pongo pygmaeus*, *Pan troglodytes* and *Gorilla gorilla* (only *G.g.g.* and *G.g. graueri*).

Conventional radiographs of the femurs were taken in a standardized position, then digital image processing methods were used to enhance image quality to facilitate assessment of the trabecular patterning. For the measurement of structural anisotropy the Line Fraction Deviation index (Geraets, 1998) was used.

The trabecular patterning shows differences between the species, which are in part probably related to differences in positional behavior and also seem to be correlated with the collodiaphyseal angle.

It seems that the structural anisotropy increases with increasing body mass. This could be related to the known size related differences in hominoid locomotion, but findings of a similar trend in Cercopithecoids support the assumption that there is an influence of body mass on structural anisotropy.

There seem to be some differences in anisotropy between *Pongo pygmaeus* and *Pan troglodytes*, with *Pan* showing higher anisotropy, especially in the area of the arcuate bundle. These differences are not size related, but probably related to positional behavior, resulting of the more stereotypical loading from the proximal femur in *Pan*.

A number no greater than the sum of its parts: the use and abuse of heritability.

V.J. Vitzthum. Anthropology, Binghamton University (SUNY), Binghamton, NY.

Though rigorously quantitative in his scientific inquiries, Frank Livingstone nonetheless objected to the reification of simplistic metrics or taxonomies to represent complex human behavioral and physical variation, or the factors underlying that variation. Based upon a sophisticated understanding of evolutionary processes, he rejected the notion of race, making the case that the concept of clines better captures the nature of intraspecific variation, and argued persuasively against reductionist models of biological determinism. In addition, Livingstone tackled the intersection of these two debates, the erroneous assertion that genetic differences among "races" determine differences in "intelligence."

Though of considerable usefulness in quantitative genetics, perhaps no metric has been more improperly employed in the service of this assertion than heritability. The most notorious misuse is the fabricated claim by Cyril Burt of having tested dozens of various pairs of relatives to estimate the heritability of intelligence. Yet despite the non-existence of these data, Burt is still cited by adherents to biological determinism in articles in reputable journals (e.g., by Bouchard et al. in *Science*). Burt aside, while data may be collected in contemporary studies of the heritability of human variation, the interpretation of the metric is, nonetheless, frequently grossly mistaken. All too often these misinterpretations are in keeping with notions of biological determinism and, in the most egregious cases, ideologically driven racial hierarchies.

This presentation discusses the meaning of heritability, the methods for its estimation, the fallacies underlying its misuse, and its utility for inquiries in evolutionary anthropology.

Clavicle morphology and Neandertal shoulder architecture.

J-L. Voisin. Insitut de Paléontologie Humaine, Paris, France, 91220, France.

The clavicle is a very slightly known bone in spite of is importance for the arm movements outside the sagittal plane.

In this work I compare curvatures between apes, modern man and neandertal. When the clavicles curvatures are projected on two perpendicular planes (superior and posterior), they split on elementary curvatures.

When clavicle morphology is projected on the posterior plane, three groups appear. The first one includes only human, the second one: all great apes and the third one: gibbon. In the great apes, clavicles exhibit two curvatures: an inferior one at the lateral extremity and a superior one at the medial extremity. The human clavicle shows only the inferior curvature and gibbon only the superior one. Neandertal clavicles show a peculiar pathway because they have two curvatures like great apes.

The presence of the superior curvature as we find in apes allows the medial end to be parallel to the manubrium with a high scapula in regard to the thorax without any elongation of the costoclavicular ligament. An elongation of this ligament will involve a greater risk of a sternoclavicular joint luxation and a greater muscular control.

The neandertal clavicle morphology in posterior view shows that its scapula was higher in regard to the thorax than in modern man. This feature gives a new explanation of the great length of the neandertal clavicle. For the same thorax width, the length of the clavicle depends on the scapula position in regard to the thorax.

Female chimpanzee allogrooming behavior at Ngogo, Kibale National Park, Uganda.

M. Wakefield. Yale University, New Haven, CT, 06520-8277, U.S.A.

Allogrooming helps members of many primate species to develop, maintain, and strengthen social bonds. Past research on wild chimpanzees has demonstrated that social grooming is an important part of affiliative relationships among males. However, only a few studies have focused on allogrooming in wild female chimpanzees, and these have concentrated mainly on mother-offspring grooming relationships. I present results from a preliminary study on the social grooming behavior of female chimpanzees from the Ngogo community in Kibale National Park, Uganda, the largest known chimpanzee community (150 members).

All-occurrence allogrooming data recorded during observations of females from May-August 2001, show that females groomed most frequently with their own offspring, as expected. However, female-female grooming dyads were also common, and individual females appear to groom with certain other females preferentially. In contrast to early research at Ngogo (Ghiglieri 1984) anestrous adult females rarely groomed with adult or adolescent males. Adult and adolescent males, however, frequently groomed estrous females.

These results suggest a need to re-exam-

ine the assumption that cooperation among females is unimportant, or at least unlikely, except given forced association in captivity. I will conduct further research on this and other aspects of female social relationships in chimpanzees at Ngogo, Kibale National Park.

A Western Hemisphere perspective on the history of violence.

P. L. Walker[1], R. Steckel[2], [1]University of California, Santa Barbara, Santa Barbara, CA, 93106, USA. [2]Dept. of Economics, The Ohio State University, Columbus, Ohio, 43210, USA.

The effects that European contact had on the patterns of violence and warfare among Native Americans are a matter of considerable debate. Some argue that Native Americans were relatively peaceful and non-violent before their societies were disrupted by the introduction of firearms and epidemic diseases. Others note the considerable amount of osteological evidence for pre-Columbian violence, which suggests that, at least in some pre-Columbian populations, warfare and interpersonal violence was in fact prevalent.

The Health and Nutrition in the Western Hemisphere database provides empirical data that bears directly on this issue. The project participants recorded standardized information for a suite of health related skeletal indicators, including skeletal injuries. These data allow us to directly assess changes in the incidence and pattern of trauma associated with the arrival of Europeans in the New World. The Native American sample consists of data on 3375 pre-Columbian and 1165 post-Columbian individuals. Injuries were significantly more frequent in males (14.70%) than in females (10.45 %).

Traumatic injuries were present in 11.05% (n=373) pre-Columbian and 16.91% (n=197) post-Columbian individuals. The higher frequency of trauma during post-Columbian times is highly significant statistically (χ^2= 27.1, p = <0.0001). This difference between periods is explained almost entirely by a markedly higher (χ^2= 10.60, p = 0.001) injury rate among males (19.38%) during the post-Columbian period than during the pre-Columbian (13.04%). Female injury rates, in contrast, do not increase significantly during the post-Columbian period (11.70% vs. 9.97%, χ^2= 1.26, p = 0.26). Much of the increase in trauma during the post-Columbian period can be attributed to a relatively high frequency of cranial trauma in post-Columbian males. These data suggest that significant differences in patterns of violence were associated with the arrival of Europeans in the New World.

Analysis of phase II movements during the power stroke of chewing in Papio.

C. Wall, C. Vinyard, K. Johnson, S. Williams, B. Hylander. Dept. of Biological Anthropology and Anatomy, Duke University Medical Center, Durham, NC, 27710, USA.

The occlusal portion of the power stroke in primates has two components thought to be important for food breakdown: phase I (shearing and crushing) followed by phase II (grinding) (Kay and Hiiemae, 1974). Hylander et al. (1987) suggested that phase II may not be nearly as significant for food breakdown as phase I because mandibular bone strain, and by inference adductor muscle force, is negligible during phase II. The intent of this study is to analyze simultaneous jaw movements and muscle force during phase II.

We recorded the EMG activity in the masseter muscles and high-speed (250 fps) video images of jaw motion in the frontal plane during chewing in an adult male baboon (*Papio*). The data are used to test the hypothesis that transverse motion (i.e., that required for grinding) occurs in concert with significant adductor muscle force during phase II.

The data show that during phase II there is negligible or no force generated by the superficial and deep masseter muscles (and based on other EMG data, in the other adductors). Furthermore, transverse mandibular motion is small during phase II. This suggests that in cercopithecids phase II is relatively unimportant for food breakdown, and that food breakdown on the phase II facets occurs primarily at the end of phase I (during crushing). The extent to which these conclusions can be generalized to other primates needs to be determined.

Research supported by the NIH and the NSF.

A note on the relative minimum frontal breadth with especial reference to the taxonomic status of *Homo erectus* .

Q. Wang, P. Tobias. Sterkfontein Research Unit, School of Anatomical Sciences, University of the Witwatersrand, Johannesburg, Johannesburg, Gauteng, 2193, South Africa.

The frontal bone showed a distinctive development in the process of human evolution both morphologically and metrically. The purpose of this study is to view the general pattern of change in cranial form in light of the relative frontal breadth. Three indices are used: ratios of the minimum frontal breadth (ft-ft) to the basic dimensions of the cranium – maximum length (g-op), maximum breadth (eu-eu) and basi-bregmatic height of the neurocranium (ba-b) respectively [Index I = ft-ft/g-op x100, Index II = ft-ft / eu-eu x 100, Index III = ft-ft/ ba-b x 100]. The mean values for these indices could be roughly grouped into five categories: (i) australopithecines (40/50/60); (ii) early *Homo* complex (*H. habilis*, *H. ergaster* or African *H. erectus*, Asian *H. erectus*) (45/60/80); (iii) Archaic *H. sapiens* complex (Afro-European *H. heidelbergensis* and Asian Early *H. sapiens*, including Solo) (50/70/85); (iv) Neandertals (54/72/83); (v) modern humans complex (Late Pleistocene and Neolithic populations, modern humans) (50/65/75-70-65. Index III varies regionally). These indices show remarkable diachronic changes of relative frontal breadth and further reflect tempo, rate and pattern of change in cranial form. The patterns of change in cranial form altered at least four times, coinciding with the onset of some but not all of new human taxa. From Late Pliocene to Middle Pleistocene, human crania maintained the same pattern of change in general form, showing a dynamic stasis from *H. habilis* to *H. erectus*, which supports neither the claim to split *H. ergaster* from *H. erectus*, nor the lumping of *H. erectus* into *H. sapiens*.

Ecogeographical patterning in the human fetus.

M. Warren[1], T. Holliday[2], T. Cole[3]. [1]Dept. of Anthropology, University of Florida, Gainesville, FL, 32611, U.S., [2]Dept. of Anthropology, Tulane University, [3]College of Medicine, University of Missouri-Kansas City.

It has been well established that human body form complies with the ecological rules of Bergmann and Allen – that is, within a broadly dispersed homeothermic species, both body mass and relative limb length exhibit a clinal pattern with climate and geography, the ultimate effect of which is a significant positive relationship of the body surface area: body mass ratio with temperature. Studies of postnatal growth and development of children of migrant populations have demonstrated that body proportions are largely genetically controlled and are under low selective rates, however, few proportional studies have been conducted on fetal samples.

This study examines the proportionality of a contemporary sample of 69 spontaneously aborted fetuses based on radiographic measurements of diaphyseal length and recorded crown-heel length. The sample is divided by the self-identified race of the mother; the "African-American" sample is assumed to represent a population of primarily west African (and therefore, tropical) ancestry, while the "white" sample is assumed to represent a population of primarily European (temperate) ancestry. A nonparametric bootstrap is used to compute marginal confidence intervals for the differences

between the first-eigenvector coefficients. Measurement-specific differences in scaling are indicated by confidence intervals that exclude zero.

We find significantly different allometry vectors between the "African-American" and "white" groups corresponding to the body of literature supporting conformity to ecogeographical rules of proportionality. Differing limb proportions during fetal development contradict the hypothesis that populational differences in adult body proportions are acquired during growth as a response to environmental stress, rather than determined by genetic differences via natural selection.

Context and burial rescue in northern Sonora, Mexico.

J. Watson. University of Nevada Las Vegas, Las Vegas, NV, 89154-5003, USA.

Archaeological investigations over the past five years at La Playa (Son F:10:3) in northern Sonora, Mexico have yielded many problematic human skeletal remains. La Playa is a rapidly eroding site, the result of decades of biannual rainfall and sparse vegetation on the playa surface. As a result, a burial rescue program was initiated in 1998 to record and collect the human skeletal resources of the site. The project, a joint venture between Centro Instituto Nacional de Archaeologia e Historia, Hermosillo (INAH) and the Universidad de las Americas, Puebla (UDLA), has recovered approximately 175 individuals dating between the Late Archaic and the late Formative periods. The burials consist of inhumations, unburned bone scatters and cremations, all of which vary widely in degree of completeness. Despite these taphonomic differences, preliminary analysis of the material has yielded a great deal of useful information on the skeletal population.

Understanding burial context is the greatest challenge at the site. The position, condition, and completeness of each burial are the direct result of erosional forces acting on the playa and its cultural deposits. La Playa is a dynamic site with a wealth of cultural resources; it holds great potential for a better understanding of prehistoric populations in northern Sonora.

Interchange of grooming and coalitionary support by wild male chimpanzees.

D. Watts. Dept. of Anthropology, Yale University, New Haven, CT, 06520-8277, USA.

Allogrooming is the most common affinitive behavior in most nonhuman primates. Besides its hygienic function, grooming helps individuals to develop and maintain social bonds and may be exchangeable for other social services like agonistic support. Most models of, and research on, grooming reciprocity and social exchange has focused on female cercopithecines. Such research generally supports the hypothesis that females often exchange grooming and coalitionary support. The same models ought also to apply to male chimpanzees. However, while qualitative and some quantitative data on captive populations support the hypothesis that male chimpanzees exchange grooming and agonistic support, this hypothesis has not been tested in a wild population. Here, I use data from a chimpanzee community at Ngogo, Kibale National Park, Uganda, to examine the relationships among grooming, coalition formation, and male dominance rank. Males in this unusually large community show group level reciprocity in grooming and in the frequency of coalition formation. They also exchange grooming for agonistic support. This exchange is independent of positive relationships between male dominance rank and grooming and between rank and coalition frequency, and it is independent of changes in the dominance hierarchy. These data thus provide the first strong support for the hypothesis that males exchange grooming and agonistic support in the wild. I discuss them in the general context of cooperation and exchange in male chimpanzee social relationships.

Glasnost for paleoanthropology.

G. Weber, H. Seidler. Institute for Anthropology, University of Vienna, Vienna, Vienna, A-1090, Austria.

While a remarkable amount of fossil material was excavated within the last decades, the potential to analyze the material was growing simultaneously as a methodological inventory evolved to extract critical information about fossilized specimens, including so far unrevealed anatomical structures. Virtual Anthropology (VA) allows the investigation of the complete morphology within a computational environment. The digital 3D-data sets of fossil and modern hominoids are guaranteeing permanent availability on the desktop and far-reaching exchange between researchers. The study of hidden features, accurate and reproducible measurements, the possibility to produce physical copies, the electronic preparation, the electronic re-assemblage of fragments, and many more became reality.

What has not changed is our way to deal with virtual and real specimens. Access to fossils is still limited by time, distance, or simply benevolence. On the other hand, it is increasingly obvious that knowledge about diversity is an imperative component for the assessment of specimens and the reconstruction of our phylogenetic tree.

Therefore, a "glasnost for paleoanthropology" is suggested. The foundation of an electronic data archive of digitized fossil and modern hominoids will certainly contribute to a more transparent way of research. Considering the fact that fossils are the heritage of all mankind it should be worth concentrating and distributing this material–a relatively easy task dealing with virtual objects. The cultural achievement of such a project could be comparable to that of the Human Genome Project. The related scientific, financial, and administrative problems will be addressed in this paper.

Nonmetric population variation in perinatal human skulls.

S. Weinberg, D. Putz, M. Mooney, M. Siegel. University of Pittsburgh, Pittsburgh, PA, 15206, USA.

One of the major challenges in forensic fetal osteology has been the ability to determine population affinity from skeletal remains. Literature suggests that there may be diagnostic differences in the craniofacial morphology of African- and European-derived fetuses. These studies, however, have yet to provide any useful criteria, which might aid forensic anthropologists in cases where the affinity of a fetus/perinate is uncertain. To this end, 18 nonmetric craniofacial traits where analyzed in a sample of 72 perinatal African-derived (n = 36) and European-derived (n = 36) specimens obtained from the Smithsonian Institution's fetal osteology collection. Ages in the study sample ranged from 6 months prenatal to 1 month postnatal and roughly equal numbers of males (n = 37) and females (n = 35) were included. Chi-square analysis revealed significant ($p<0.05$) differences between African- and European-derived perinates in 5 of the 18 nonmetric traits analyzed. European-derived perinates possessed significantly narrower supra-occipital portions of the occipital squamous, more circular temporal squama, longer and lower vomers, more prominent anterior nasal spines (ANS), and more marked nasal sills. While some of these differences have been noted in studies on adult skulls from different populations, many appear to be unique to the pre- and perinatal periods of craniofacial skeletogenesis. The statistical evidence that at least some population differences in the craniofacial region arise so early in development, may be of great use to forensic anthropologists who encounter unidentified material from this age range.

Chest shape in human skeletons from high and low altitudes.

K. Weinstein. Dept. of Anthropology, Dickinson College, Carlisle, PA, 17013, U.S.A.

Hypoxic conditions pose severe physiological challenges to all organisms that live at high altitudes. Living human populations indigenous to high altitudes exhibit physiological and morphological responses that enhance oxygen consumption and delivery under the stress of hypoxic conditions. In particular, highland Andean populations have antero-posteriorly deep and mediolaterally wide chests relative to stature compared with closely related lowland groups and adult migrants to altitude. High altitude adaptations, however, have never been examined in Andean prehistory. Given the longevity of human settlement in the Andes, pre-Contact human populations ought to also have developed deep and wide chests as a response to high altitude hypoxia. I compare thoracic shape in two groups of pre-Contact human skeletons from the Andes in order to determine whether chest shape varies with altitude.

The pre-Contact human skeletons inhabited two regions in the Atacama Desert of northern Chile: individuals from coastal environments (n = 117), and individuals from highland regions (n = 99). I reconstruct chest shape by measuring manubrial and sternal body length and breadth, lengths of the clavicle and forelimb, bi-iliac breadth, and length and curvature of the left ribs. I compare chest shape in individuals from high and low altitudes via bivariate regression models of sternal length and breadth, manubrial length and breadth, clavicular and humeral length, and bi-iliac breadth and forelimb length. I also compare rib length and curvature using bivariate regression and principal components analysis.

Thoracic shape differs in individuals from different altitudes. Compared with their lowland counterparts, the highland individuals have absolutely and relatively wider manubria, longer clavicles and wider bi-iliac breadths relative to forelimb lengths, and less curvature at ribs 1-3 and ribs 10-12. These features may be skeletal representations of mediolaterally wide and antero-posteriorly deep chests, particularly at the superior and inferior levels of the thorax.

The mystery of muscle markers: aggregation and construct validity.

E. Weiss. Environmental Dynamics Program, University of Arkansas, Fayetteville, AR 72701, USA.

Musculoskeletal markers are frequently used to reconstruct past lifestyles and activity patterns. Concerns have been raised, however, that muscle markers are unreliable, failing to correlate (as they should) with cross-sectional properties and exercise patterns, and that they are confounded by body size and healed injuries. The present study used aggregated muscle markers based on seven insertion sites (4 humeral, 2 radial, 1 ulnar) and examined the effects of size (an aggregate of humeral length, head diameter, and epicondylar breadth), age, sex, and cross-sectional properties (an aggregate of humeral areas and inertias).

A sample of 91 (66 males, 25 females) Native British Columbians (3500 to 1500 yrs BP) and 18th Century Quebec Prisoners from the Canadian Museum of Civilisation in Ottawa was analyzed. Muscle markers were measured using 3-point observer rating scales (Hawkey and Merbs, 1995); size was measured by methods described by Buikstra and Ubelaker (1994); age and sex were determined through pelvic, cranial, and dental morphology; and, cross-sectional properties were calculated from humeral radiographs using Biknevicius and Ruff's (1992) formulae.

Muscle markers correlated with: (1) size, $r = 0.38$; (2) age, $r = 0.49$; (3) sex, $r = 0.40$; and, (4) cross-sections, $r = 0.38$; ps < 0.001. Muscle markers increased in those with larger humeri, in older individuals, in males, and in those with stronger cross-sectional properties. Based on partial correlations and regression analyses, age was found to be the best predictor. Previously reported null findings result from a failure to use aggregate measures, which reduce error variance and enhance construct validity.

On critical thinking in science or 'Did you see what they said in the Times!?'.

K. Weiss. Penn State University, State College, PA, 16803, USA.

Frank Livingstone contributed over many decades to our understanding of population genetic processes and the relationships between human genetic variation, culture, and history. A strong proponent of the modern synthesis and its genetic view of evolution, his work on the nature and origins of mutations related to African culture history set a standard for thinking about adaptation, and was influential for a long time and even now is cited in relation to new genetic work. Frank was by nature a lone scholar (trudging through the midnight snow with Irving and a stack of punch cards) whose influence on his students was not that he set them up as a set of clones in hemoglobin genetics. Rather, he inspired us to think on our own, creatively, and to be critical, self-sufficient readers of the literature. A major part of his legacy is the influence his students have subsequently had on the field. To me, nothing exemplifies his approach better than the way so many of his lectures were pre-empted from their nominal topic so that he could talk (rant and rave?) about something, not necessarily well thought-out but that had just appeared in the professional or popular media (heavens! even the New York Times!), to stimulate our thinking about it. He could intimidate students until they realized that his apparent criticism of them was really that he treated us from the beginning as peers. Through all the beer and bluster, no one could have asked for a better mentor in science.

Patterns of use in leaf source species by mantled howler monkeys (*Alouatta palliata*).

B. Welker. SUNY at Geneseo, Geneseo, NY, 14454, USA.

Feeding selectivity in herbivorous primates is not well understood. Many studies have examined interspecific selectivity but none have systematically examined within species selectivity. This paper presents preliminary data on differences in patterns of use for three focal tree species as part of a larger study focusing on proximate mechanisms affecting intraspecific folivorous feeding selectivity in mantled howler monkeys.

The study site is located in the Area de Conservacion, Guanacaste, Costa Rica. Observational data were collected from one group of mantled howler monkeys during two dry seasons in 1997 and 1998.

The patterns of use for each of the three tree species (*Astronium graveolens*, *Machaerium biovulatum*, and *Hymenaea courbaril*) differed. Many *Astronium graveolens* trees were fed from each year but there was almost no overlap between years in particular trees used. The pattern of use in *Machaerium biovulatum* differed in that there was a high degree of overlap between years but with no apparent preference for particular trees versus others. The third species, *Hymenaea courbaril*, was the most interesting in that the animals appeared to prefer leaves from particular individuals. The monkeys were repeatedly observed to pass through trees that possessed leaves at the preferred developmental stage to feed in neighboring conspecific trees. There was a moderate amount of overlap between years in trees used and not used.

These results are of interest in illuminating differences in patterns of use within and between species and as a first step in understanding the processes involved in feeding selectivity by focusing within species.

Terrain and subsistence strategy effects on long bone diaphyseal structure.

D. Wescott. University of Tennessee, Knoxville, TN, 37996, USA.

Mobility patterns associated with subsistence strategy have long been considered one of the most important factors influencing the structure of long bone diaphyses, especially the femoral midshaft. More recently, the effects of geographical terrain have also been put forward as a significant factor affecting femoral midshaft structure. This study analyzes the effects of terrain, mobility, and activity level on femoral and humeral robusticity, shape, and sexual dimorphism in American archaeological populations. The sample is drawn from sites in the Texas Gulf Coast, Central Lowlands, Great Plains, Southwest, and Great Basin. Populations from which the sample is derived includes broad spectrum, coastal, and equestrian hunter-gatherers, incipient and village horticulturalists, agriculturalists, laborers, and modern industrialists. Two types of data are used: computed tomography cross-sectional scans and long bone external measurements. Diaphyseal shape and robusticity were examined separately for males and females. Analysis of the data does not show the clear trends in diaphyseal shape, robusticity, or sexual dimorphism expected based on work by other researchers. Femoral subtrochantic platymeria is correlated with the ruggedness of the terrain in both sexes, but femoral robusticity is not. Furthermore, in males, while there is a slight trend towards increased femoral midshaft anteroposterior bending strength with increased mobility, this trend is not at all statistically significant. Sexual dimorphism also does not correlate well with terrain, mobility, or activity level.

Foreign relations and economics at Teotihuacan: Isotopic evidence from the Merchant's Barrio.

C. White[1], M. Spence[2], F. Longstaffe[1]. [1]Dept. of Anthropology, The University of Western Ontario, London, Ontario, N6A 5C2, Canada, [2]Dept. of Earth Sciences, The University of Western Ontario.

This study investigates the structure of trade and economic organization in the ancient city of Teotihuacan, Mexico, using oxygen isotope-ratios in skeletal phosphate of 29 individuals from the Merchant's Barrio from Late Tlamimilolpa to Late Xolalpan time periods (circa 350 A.D. to 650 A.D.). Oxygen isotope ratios vary by geographical location. They are primarily incorporated into the skeleton through the embibement of water, creating chemical signatures for geographic identity.

Artifactual data indicate that members of this neighbourhood were traders who had multi-ethnic affiliations, but the nature of their relationships with homelands and the city is unknown. The isotopic data are compared with baseline data from local Teotihuacanos, and a diversity of sites from Guatemala, Belize and elsewhere in Mexico. The isotopic variation that exists within the Merchant's Barrio is extreme and supports the hypothesis that these individuals came from many locations. Males exhibit greater variability than do females, suggesting that men did most of the relocating and frequently selected local females for marriage. Foreign born individuals are associated with special mortuary treatment and secondary burials. There also appears to be ethnic patterning by structure within the site. When isotopic values from teeth are compared to those from bone, it is apparent that many individuals had moved to Teotihuacan a long time before their death. Thus the trade model supported best by the data is that of long-term sojourners acting as trade "ambassador", rather than continual movement across the landscape as practised by the "pochteca" in later Aztec times.

Analysis of cerebellar shape and asymmetry in extant primate and African fossil hominid endocasts using 3d digitizing technology.

D. White[1], D. Falk[2]. [1]University at Albany, SUNY, Albany, NY, 12222, USA, [2]Florida State University.

Medical imaging studies have shown that the right lateral cerebellar hemispheres in human subjects appear to be activated when asked to do verbal searching and fluency, word completion, planning, and attention shifting tasks. It is hypothesized that language and higher cognitive tasks require more intensive information processing and connectivity which may result in larger and more complex cerebellar hemispheres (Leiner et al., 1995). The object of this work is to quantify cerebellar shape and size in extant primate and fossil hominid endocasts in order to determine the phylogenetic development of the cerebellar hemispheres as well discern individual asymmetries.

Data from endocasts were collected with a Microscribe 3d digitizer and Rhinoceros 1.0 modeling software. The digitizer records *x*, *y*, and *z* coordinates taken directly from a three-dimensional object. Endocasts were digitized in *norma basilaris* and *norma lateralis* to quantify endocast dimensions.

The data set includes 60 *Macaca* (30 male, 30 female) endocasts, 13 *Hylobates*, 10 *Gorilla*, 10 *Pan*, and 10 *Homo sapiens*. Fossil hominid endocasts include specimens from *Australopithecus*; *Paranthropus*; *Homo habilis*; *Homo erectus*, Neandertal, and early archaic *Homo sapiens*.

Univariate and multivariate (Hotellings T^2) tests of significance were calculated to compare specimens and groups. Preliminary results suggest that no statistically significant lateral asymmetries exist between the cerebellar hemispheres of individuals within any of the groups including humans. While multivariate analyses show a complex array of shape differences between all great apes, modern humans, and African fossil hominids, there doesn't appear to be any expansion of one hemisphere over another.

Recent forest destruction and its impacts on critically endangered primates in the lower Tana River, Kenya.

J. Wieczkowski, D.N. Mbora. Dept. of Anthropology, University of Georgia, Athens, Georgia, 30602, USA.

This study investigated the current status of the critically endangered Tana River red colobus *Procolobus rufomitratus*, the critically endangered Tana River crested mangabey *Cercocebus galeritus galeritus*, and their riverine forest habitat in the lower Tana River, Kenya. Prior to this study, the last complete forest evaluation and primate census was undertaken in 1994. We visually estimated forest size and collected forest product use data in belt transects in 32 forests. We conducted primate censuses in 36 forests, counted 30 colobus groups in 11 forests, and counted 17 mangabey groups in 10 forests. Visual estimations of forest size indicate that a minimum 30% of the total forest area of the lower Tana River has been lost in the years since 1994. All measures of forest product use (e.g. percentage of felled trees and topped palms) vary greatly by forest. Our censuses found the same number of groups in 1999-2001 as there were in 1994. Mean group size in the colobus significantly ($p<.02$) decreased, from 12.6 animals pre-1994 to 8.6 in 1999-2001. Mean group size in the mangabey increased from 20.5 pre-1994 to 30.4 in 1999-2001. Observations indicate that the mangabey may be responding to the forest destruction with changes in residence and ranging patterns, crop raiding, and overall behavioral flexibility. We recommend increased forest protection, community-based conservation projects, and investigations into safeguarding actions for the more threatened primate groups. This study documents an increased threat to two critically endangered primates, and outlines strategies to better protect this important primate conservation area.

Functional genetic differences among humans, chimpanzees, and their closest relatives.

D. Wildman, L. Grossman, M. Goodman. Center for Molecular Medicine & Genetics, Wayne State University, Detroit, MI, 48201, USA.

We have analyzed over 70 kb of coding sequence from >75 genes in humans and chimpanzees. Chimpanzees and humans are more than 99% similar at these loci. Because of selective pressure, coding sequence comparisons between humans and chimpanzees are predicted to show more similarity than total genome comparisons between the two taxa. Our results indicate an average nonsynonymous substitution per nonsynonymous site (Ka) over synonymous substitution per synonymous site (Ks) ratio of 0.39. The results also show that while most genes are undergoing the pressures of purifying selection, a few show evidence of possibly adaptive positive selection.

The sequences were combined and analyzed phylogenetically with the addition of gorilla and orangutan sequences. Representative Old World monkey species were used as outgroups. Results of this analysis are congruent with previous cladistic studies that show humans and chimpanzees to be sister taxa to the exclusion of gorillas. The results are strongly supported by high bootstrap percentage values (>95%) and other measures of support regardless of phylogenetic method employed. The topology is also obtained when only second position and other nonsynonymous sites are analyzed. Thus, from a functional genomic standpoint, humans and chimpanzees are more similar to each other than either is to gorillas. This finding rejects the traditional assumption that chimpanzees, gorillas, and orangutans comprise a functional evolutionary grade. Our results predict that humans and chimpanzees will ultimately be shown to be not only phylogenetically, but also functionally and phenotypically, more similar to each other than either is to gorillas or orangutans.

My data are better than yours: Comparing the relative utility of data partitions in reconstructing evolutionary history.

B. Williams. Dept. of Biological Anthropology and Anatomy, Duke University, Durham, NC, 27708, USA.

The relative utility of various data partitions has been called into question recently by researchers interested in ape and human phylogeny (e.g. Collard and Wood 2000, PNAS, 97:9), supporting the superiority of molecular data over morphological data. Those researchers assume that molecular data sets for extant primates are correct and because morphological phylogenies don't match molecular phylogenies, they conclude that morphological data is less reliable.

The generality of such claims is called into question by other lines of inquiry that examine levels of homoplasy. Homoplastic characters confound our reconstructions of evolutionary history. We assume that low levels of homoplasy imply the maximum confidence in the data. Comparisons of levels of homoplasy in molecular versus morphological data using the consistency index (CI) as the measure of homoplasy show that molecular data is not more homoplastic than morphological data (Sanderson and Donoghue, 1989, Evolution 43:8).

Similar assumptions about the relative utility of dental, cranial, and postcranial data for mammals have led researchers to make *a priori* choices about the inclusion of particular kinds of data in their phylogenetic analyses. In this study I use the consistency index to compare levels of homoplasy in primates. Results of this study suggest that the levels of homoplasy are virtually the same.

Claims about the validity of various kinds of data can be evaluated in different ways. Results of this and other similar studies emphasize the need to be very cautious in generalizating about the relative utility of particular kinds of data in reconstructing evolutionary history.

Posterior migration of the mental foramen during Neandertal and modern human mandibular growth.

F.L. Williams[1], G.E. Krovitz[2]. [1]Dept. of Anthropology and Geography, Georgia State University, Atlanta, GA, 30303, USA, [2]Dept. of Anthropology, George Washington University.

Previous researchers have documented that the mandibular mental foramen is more posteriorly located in adult Neandertals relative to adult modern humans. It has been suggested that the posterior location of this structure in Neandertals is related to overall mandibular size, and that its posterolateral migration may be tracking dental development. This study quantifies the relationship between mental foramen position, dental development and growth in Neandertals and modern humans. We explore whether the difference in mental foramen position between the two taxa emerge early in development, and whether they stem from changes in the rate and/or duration of growth. We collected linear distances between the mental foramen and four additional mandibular landmarks, as well as corpus width at the mental foramen, from geographically diverse ontogenetic samples of modern humans (nonadults = 173; adults = 112) and Neandertals (nonadults = 6; adults = 5). These distances, along with dental age, were used to construct growth models using the four coefficients (per comparison) obtained from a second order version of piecewise regression. The results suggest that in Neandertals, relative modern humans, the posterolateral migration of the mental foramen proceeds at a faster rate, and continues for a longer period of time during mandibular growth. Neandertals may also exhibit a more lateral placement of the mental foramen early in postnatal development. Additionally, our growth model addresses the relationship between mental foramen position and dental development in both taxa.

Trophic level and macronutrient shift effects associated with the weaning process in the Maya Postclassic.

J. Williams[1], C.D. White[2], F.J. Longstaffe[3]. [1]Dept. of Archaeology, The University of Calgary, Calgary, Alberta, T2N 0Z3, Canada, [2]Dept. of Anthropology, The University of Western Ontario, London, ON, [3]Dept. of Earth Sciences, The University of Western Ontario, London, ON.

The weaning process was investigated at two Maya sites dominated by Postclassic remains: Marco Gonzalez (100 BC to 1350 AD) and San Pedro (1400-1650 AD), Belize. Bone collagen and apatite of sixty-seven individuals were analyzed for stable carbon and nitrogen isotopes (N = 5 yrs = 12, N > 5 yrs = 55). Four isotopic measures were used to reconstruct diet and weaning: nitrogen and carbon isotope ratios in collagen, carbon isotope ratios in apatite, and collagen to apatite spacing. Nitrogen isotope ratios in infant collagen from both sites are distinct from adults, indicating a trophic level effect. Collagen to apatite spacing in infant bone from Marco Gonzalez is distinct from adults, indicating a shift in macronutrients. Among infants, carbon and nitrogen isotope ratios vary, indicating death during different stages in the weaning process. Ethnohistoric and paleopathological literature on the Maya indicates the cessation of breast-feeding between the age of three to fours years. However, at Marco Gonzalez and San Pedro isotopic values for some children up to five years old indicate the consumption of breast milk. By contrast, low nitrogen isotope values for some infants younger than two years indicate the supplementation of breast milk by a plant-based pap. Variability in age for the cessation of breast-feeding could be an artifact of small sample size, health problems, or diachronic change in feeding practices. This data set is not only important for understanding the weaning process during the Postclassic, but also demonstrates the potential use of collagen to apatite spacing as an indicator of macronutrient shifts associated with weaning.

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Hemoglobin and HLA-A: patterns of molecular evolution.

R.C. Williams. Dept. of Anthropology, Arizona State University, Tempe, Arizona, 85287-2402, USA.

The sickle cell mutation at position 6 of the human Beta globin gene is the most famous amino acid substitution in evolutionary biology. Its discovery occurred at a time when traditional, 19th Century, principles of natural selection were being joined with the newly discovered mechanics of DNA structure and protein synthesis to produce Neo-Darwinian theory. When combined with the epidemiology of malaria in Africa, differential mortality for both homozygotes, and the resulting advantage of the heterozygote, sickle cell became the classic balanced polymorphism.

Human HLA-A has 225 molecular alleles. The histocompatibility system has as its primary function the presentation of peptides to T-cell receptors and plays an essential role in the immune system. Nearly all of the alleles are codominant and fully functional. Despite almost 30 years of disease-association studies with HLA-A, there is no convincing evidence for differential fertility or mortality at this locus. Yet the dogma in the histocompatibility field is that this extensive human polymorphism is maintained by "balancing selection."

Explaining HLA-A polymorphism is what one might call the sickle cell effect. This one mutation, coming as it did at the historical convergence of Darwinian theory and modern genetics, and carrying with it the strong relationship between mutation, disease, and allele frequency, has conditioned our discussion of human genetic variation and population genetics. Has the strength of this early idea made evolutionary biologists uncritical of systems like HLA-A and retarded the search for new mechanisms of molecular evolution? Is it now time to move away from a focus on mutation and polymorphism in evolutionary genetics and toward a systems theory that would explain the origin and evolution of hemoglobin and HLA-A and the biochemical pathways that surround them?

Ranging behavior of Nicaraguan howling monkeys (*Alouatta palliata*) as evidence for within-group competition.

K. Williams-Guillen, C.M. Mccann. New York University & NYCEP, New York, New York, 10003, USA.

Evidence from many primate species suggests that individuals in larger groups or in groups with less productive ranges face higher levels of intra-group feeding competition, which should result in either lower individual food intakes or increased ranging to meet the energetic needs of group members. Studies confirm that for a variety of species group size tends to correlate positively with home range size and day journey length. Patterns within groups over time are less clear, although theoretically primates should experience more intense feeding competition during periods of food scarcity or increased food patchiness, which could result in increased travel.

During a 14-month period we studied the ranging behavior, feeding patterns, and food availability of three groups of mantled howling monkeys (*Alouatta palliata*) in a Nicaraguan shade coffee plantation. We determined home range sizes and day journey lengths (DJL's) based on locations of feeding trees. Home ranges averaged 17.1 ha and DJL's 617 m. Consistent with socioecological theory, larger groups had larger home ranges and longer DJL's. DJL's also varied significantly with season, with groups traveling farther and using peripheral areas of their ranges more during the wet season. During this period, the abundance of fruit – a preferred food – peaks. Fruit, unlike the young leaves that comprise most of the dry season diet, are less plentiful and more patchily distribute. The switch to this high-energy resource is also a switch to a less-abundant resource; the concomitant changes in ranging that take place during the wet season may reflect increased intra-group competition.

Canalization and developmental stability in craniofacial development in the Brachyrrhine mouse.

K. Willmore[1], S. Lozanoff[2], B. Hallgrimsson[3]. [1]University of Calgary, Dept. of Graduate Studies, Faculty of Medicine, Calgary, Alberta, T2N 2B3, Canada, [2]Dept. of Anatomy and Reproductive Biology, University of Hawai'i School of Medicine, [3]University of Calgary, Dept. of Cell Biology and Anatomy, Faculty of Medicine.

In his classic work on canalization, Waddington argues that morphological components that exhibit functional importance tend to be under stronger canalizing selection. He further predicts that perturbations, resulting from either mutations or environmental change will uncover genetic variation that has been suppressed as the result of canalizing selection. The Brachyrrine (Br) mouse has a mutation which results in the shortening of the sphenoid bone and the expression of midline cleft palate. Using procrustes analysis of macerated adult crania, we compared the level of fluctuating asymmetry and variability of the basicranium, palate, and facial skeleton of Br mice with the 3H1 wildtype controls. As the mutation targets the sphenoid bone we expected to find increased fluctuating asymmetry and variability in the basicranium of the Br mice. Contrary to this prediction, we found there to be no significant differences in fluctuating asymmetry between heterozygotes and controls, and significant elevation of variability was found only in the palatal and facial regions of the Br mice. Recent work has shown that the cranial base is a central and tightly integrated developmental module that has widespread influences on patterns of variation throughout the skull. Our findings therefore, confirm this view and are consistent with Waddington's prediction that functionally important elements will be less effected by environmental or genetic perturbations. The increased variability found in the palatal and facial regions of Br mice demonstrates the uncovering of accumulated "hidden" genetic variation in less well canalized structures, when developmentally related structures are perturbed by a mutation.

Reexamining variation in Early Pleistocene fossils from East Africa.

J. W. Wilson, A. Van Arsdale. Dept. of Anthropology, University of Michigan, Ann Arbor, Michigan, 48109-1382, USA.

Morphometric analyses have been used to distinguish Early Pleistocene hominid conspecific males and females. Variation in fossil samples might be explained by taxonomic differences or sexual dimorphism. In this study, we attempt to show that observed variation among the Early Pleistocene African remains represent the presence of dimorphic traits in males and females.

Thackeray and coworkers have developed a procedure that has been successful in distinguishing male and female individuals of a population without assumed distributions of sexually diagnostic traits. This technique relies on the slope derived from a linear regression analysis of cranial measurements. We have applied this technique to ER 3733, ER 3883, and OH 9, in order to test the null hypothesis that ER 3883 and OH 9 are conspecific males. A prediction of this hypothesis is that ER 3883 and OH 9 will have similar slopes. We also examine the possibility that ER 3733 and ER 3883 are members of the same sex.

Additional sources of variation are also considered as possible explanations of the observed results. The standard error of the slope is used to explore the degree of morphological variability among these samples and to address their taxonomic status.

A study of linear enamel hypoplasia in a Middle Mississippian population.

J. Wilson, D. Wolfe Steadman. Binghamton University-SUNY, Binghamton, New York, 13905, USA.

The prevalence of Linear Enamel Hypoplasia (LEH) has been well documented in numerous Middle Mississippian archaeological populations including Dickson Mounds and Moundville. This study builds upon past research on LEH in Middle Mississippian populations by examining the skeletal and dental remains (N = 45) from Orendorf, a Middle Mississippian Site (~AD 1150) from the Central Illinois River Valley. While LEH is considered a non-specific indicator of metabolic and dietary stress, the enamel defects produced provide a permanent record. An estimation of the age of occurrence may be based upon the relatively standardized chronological process of amelogenesis. This study of LEH also poses several unique avenues of inquiry as a dating method for dietary and metabolic insult.

The goals of this research project are twofold. First, the mean age(s) of LEH prevalence was calculated for the permanent dentition of 20 adult males and 25 adult females in the Orendorf skeletal population. The findings were then subsequently compared to the prevalence and average age of onset of LEH in Dickson Mounds and Moundville populations. The second aim of the project is to test the theory that there is varying susceptibility to the rate of hypoplasticity in the permanent dentition. Several factors may contribute to the varying rate of hypoplasticity in Middle Mississippian populations. These factors include biological gradients and the time at crown development according to tooth type. Findings indicate a correlation between intra- and inter-population demographic variation in Middle Mississippian populations, as well as varying susceptibility to hypoplasticity for different teeth.

A comparison of fission-fusion patterns in two communities of mantled howling monkeys (*Alouatta palliata)*.

L.A. Winkler[1], E. Janney[1], G. Peter[2], R. Sohn[3], J. Croskey[1]. [1]University of Pittsburgh, Titusville, PA, 16301, USA, [2]Parke-Davis Pharmaceutical, [3]Wildlife Veterinary Consulting.

Recent studies of *Alouatta palliata* have suggested flexibility in social group organization ranging from cohesive to a fission-fusion pattern. The fission-fusion pattern is characterized by variability in subgroup composition and time periods in which subgroups are isolated from each other. The present study examines fission-fusion grouping patterns in 2 communities (with 4-5 groups) of mantled howling monkeys in separate and disparate home ranges at Ometepe Biological Field Station, Nicaragua in order to assess and compare variability in group composition (including subgroup patterns and size) and related ecological variables.

The home ranges of both communities were surveyed and mapped and 29 adult members of the community groups (total population ranged from 55-65) were tagged as part of capture-release projects. A total of 317 hours of group composition and proximity data was collected during five field seasons (1998-2001) using a combination of group scans and focal sampling. Both communities demonstrated flexible group composition with subgroup fission (group size ranged from 1-21), but the degree of fission varied over the 4 years depending on total group size and composition. One male generally formed the core of each subgroup and some animals appeared to affiliate more frequently than others in the subgroups. The communities in the two areas differed in the pattern of fission-fusion most notably in the amount of time subgroups remained intact and separate (several hours – 14 days or longer). These differences appeared related to ecological parameters (barriers to group movement, resource availability), community size, and reproductive factors including sex ratios.

The species of humans at Dmanisi.

M. Wolpoff. Dept. of Anthropology, University of Michigan, Ann Arbor, MI, 48109-1382, USA.

"There are detailed morphological differences to be noted: for instance, in cranial outline and cross section; in the supraorbital, mastoid, and nuchal regions; and in the course of the vault sutures that would reflect intertaxic rather than intrapopulational differences. Perhaps future studies will conclude that D2280 and D2282, and the mandible if it cannot be associated with either cranium, add even more to the picture of human evolutionary diversity than expected." (J.H. Schwartz [2000] Taxonomy of the Dmanisi Crania, *Science* 289:55-56)

Reading in *Science* that the two crania and the mandible at Dmanisi might reveal the unexpected presence of multiple taxa, possibly as many as one for each specimen, (and perhaps even more as additional materials have been discovered since) heightened my interest in studying these important remains (their faces as reconstructed by Elisabeth Daynes are the man and woman on the cover of another *Science* issue, March 2 of 2001). With the kind permission of Dr. David Lordkipanidze I had the opportunity to study the two crania and mandible first discovered, and I report here on the results of this research, and comparisons with other early Pleistocene human remains. They are indeed unexpected.

Comparative context of radicular variation in fossil hominins: methodology and variation in premolar root form.

B. Wood, S. Abbott. CASHP, Dept. of Anthropology, George Washington University. Washington DC 20052, USA.

Tooth roots are relatively well represented in the hominin fossil record and their morphology has been exploited both for taxonomy and phylogenetic analysis. There is, however, a dearth of comparative information about the size and shape of tooth roots in extant hominoids. This study reports the results of an investigation of the form and size of the tooth roots, together with an assessment of the size of the related crowns and jaws.

The sample comprises a single side (usually the right) of the dentition of *Homo sapiens* (N = 34); *Pan troglodytes* (N = 31); *Gorilla gorilla* (N = 40), and *Pongo pygmaeus* (N = 34). Conventional, parallel-film, radiography was used where possible. When this was not possible a perspex-mounted grid made of fine copper wire aligned at one mm. interval was placed as close as possible to the root being radiographed and parallel to its long axis. The degree of distortion of this regular grid was used to correct any distortion of the root images. A maximum of 182 root, crown and jaw measurements were taken on each specimen, and up to twenty-four measurement termini were defined for the radicular system of each tooth.

The form of maxillary and mandibular premolar roots was recorded for each taxon. Variation in the form of the roots of hominoid mandibular premolars is effectively limited to the P_3s of *Pan*, whereas the P^3s of *Homo, Pan* and *Pongo*, and the P^4s of *Pan*, all show significant variation in root number and form.

The role of infectious disease in human populations: New findings from the Black Death.

J. Wood, R. Ferrell, S. DeWitte-Avina. Dept. of Anthropology, Pennsylvania State University, State College, PA, 16803, USA.

Frank Livingstone is justly famous for his work on malaria and the human hemoglobinopathies. What is perhaps less well known is his long-standing insistence on the wider importance of infectious disease in human populations, both as a force of selection and as a factor in pre-modern population dynamics. At least one of his former stu-

dents (J.W.) has recently returned to this lesson learnt at the Livingstonian knee.

Our research group is undertaking a major re-evaluation of the demography and epidemiology of the Black Death in fourteenth-century England. Several contemporary sources – manorial court records of heriot payments and frankpledge obligations, inquisitions *post mortem* into deaths among tenants-in-chief, and diocesan registers of institutions to vacated benefices – allow reconstruction of a surprising amount of detail about the epidemic, so long as the data are analyzed using special-purpose statistical methods that account for the idiosyncrasies of the medieval records. Here we review preliminary findings on three topics: (1) the geographic diffusion of the epidemic, with special attention to hierarchical patterns of disease spread, (2) the temporal dynamics of the epidemic in particular locations, and (3) variation in mortality rates across different subregions and social groups. These preliminary findings suggest that the Black Death was unlikely to have been a zoonosis such as yersinial plague. In other words, a century's worth of historical thought about the cause of the epidemic has probably been wrong.

Complexity of human cranial sutures: are they fractal?

R. Wright[1], M. Williamson[2], J. Yu[3], J. Braselton[4]. [1]Dept. of Sociology and Anthropology, Georgia Southern University, Statesboro, GA., 30460, USA, [2]Dept. of Health and Kinesiology, Georgia Southern University, Statesboro, GA., 30460-8076, USA, [3]Section of Plastic Surgery, Dept. of Surgery, Medical College of Georgia, Augusta, GA. 30912, [4]Dept. of Mathematics and Computer Science, Georgia Southern University, Statesboro, GA. 30460.

The process of craniofacial morphogenesis is poorly understood, however, what is known is that the amount of information necessary to dictate the spatial position and function of every cell during the growth of a cranial suture is more than can be possibly stored by DNA. It is also known that many, if not all, biological structures are complex products of repeated iteration functions. As such, they demonstrate characteristic, scale-invariant features. Current research on the cranial sutures of some mammals suggests that their pattern is fractal. Fractal objects have self-similar features, that is, repeating details emerge as the scales change, such as Sierpinski's triangle and Von Koch curve. Mathematically, fractal objects are defined as objects having a greater Housdorff-Besicovitch dimension, or box counting dimension, than their topological or Euclidean dimensions. Therefore, the purpose of this paper is to determine if human cranial sutures demonstrate self-similarity and, if they are fractal, to measure their fractal dimensions. Data was collected from 107 skulls of the Terry Collection at the Smithsonian Institution in Washington D.C. using a digitizing pen. The sagittal sutures were traced and each point was saved using its Cartesian coordinates. The raw data was then analyzed utilizing Benoit, a computer program that calculated the fractal dimension. Preliminary results indicate that the log-log plots are linear indicating that human sagittal sutures possess scale-invariant features and thus are fractal. The mean D_b, box dimension, a measure of the self-similarity, was 1.44676 S.D. 0.0743813. At 95% confidence the D_b is between 1.42442 and 1.46911.

Intertrait association: measuring correlations among dental discrete traits within and between tooth classes in a Maya skeletal collection.

G.D. Wrobel. Indiana University, Bloomington, Indiana, 47405, USA.

One assumption implied by biological distance statistics is that most crown features are expressed independently of one another. However, several studies by Scott (1977, 1978, 1979) and others (Mizoguchi 1985, Scott and Turner 1997) show significant positive correlations among various non-metric dental morphology traits. The present study tests for correlations between pairs of traits that Scott and Turner (1997: Table 3.2) report as having the most consistent associations not involving within-field correlations for single traits, i.e., between members of two tooth districts for single morphological traits or between two different traits. Using the Arizona State University scoring system, six traits (shoveling, tuberculum dentale, canine distal accessory ridge, hypocone, Carabelli's trait, and protostylid) were scored on sixty-nine dentitions from the pre-Columbian Maya site of Chau Hiix, Belize. The significance and degree of interclass correlations of ranked data generated from the highest antimere score for each tooth were calculated using nonparametric statistics, including Spearman's (r) and Kendall's (*tau*) rank order correlations.

Significant correlations (a = .05) were found in pair-wise comparisons of shoveling between the upper and lower incisors, the tuberculum dentale between the upper central incisor and upper canine, and some pairings of the hypocone, protostylid and Carabelli's trait. The significance of the intertrait correlations found within different tooth classes at Chau Hiix does not support models of tooth morphology based on analyses of other samples and thus the potential population-specific nature of these data should be considered when applying them.

Foot use in *Propithecus verreauxi* during bipedalism.

R. Wunderlich, M. Sinopoli, J. Schaum, P. Kilkenny. James Madison University, Dept. of Biology, Harrisonburg, VA, 22801, USA.

The indrid foot is characterized by a short, mobile midtarsus, long digits, a long hallux, and a fourth-digit morphological axis; it has been described as designed for grasping rather than leverage (Gebo and Dagosto, 1988; Gebo, 1985). Although indrids are known for their specializations for vertical clinging and leaping, Propithecus is one of only a few primates to regularly and almost exclusively use bipedalism when moving on the ground. In order to quantitatively assess foot use during bipedalism, we examined plantar pressure distribution and hindlimb kinematics in 6 *Propithecus verreauxi* moving bipedally at the Duke University Primate Center.

Indrid bipedalism is very different than that seen in other primates. Indrids use high hip and knee excursions, consistent with their high proximal angular excursions during "thigh-powered" leaping, and exhibit a saltatorial type of bipedalism. The highest plantar pressures are seen at the first two metatarsals and the medial midfoot. Pedal kinematics differ for the lead and trail limbs. The lead limb generally touches down at the first digit and toes-off the third and fourth digits, while the trail limb touches down laterally but pushes off medially (first and second digits), as do hominoids moving bipedally. We suggest that there are mechanical constraints inherent to bipedalism that make the use of the medial side of the foot advantageous despite the laterally-positioned pedal axis in Propithecus. Further study should address morphological and energetic adaptations to this unique form of terrestrial locomotion in Propithecus.

Seasonal variations in nutritional components of diet in two lemur species in Madagascar.

N. Yamashita. Dept. Cell & Neurobiology, Keck School of Medicine, University of Southern California, Los Angeles, CA, 90089-9112, USA.

Seasonal variations in dietary constituents reveal the importance of certain plant parts during the year. A parallel analysis of nutritional constituents of these foods provides further information on underlying patterns of consumption of these plant parts.

The diets of two lemur species, *Lemur catta* and *Propithecus v. verreauxi* (sifakas), were studied for one year in the dry forest site of Beza Mahafaly in southwestern Madagascar. The plant parts that comprised their diets were tested for nutritional properties (protein, free amino acids, and sugars) and for two potential deterrents, plant toughness and chemical phenolic levels.

Both species demonstrate strong seasonal effects in their diets that are related to availability of key foods. *Lemur catta* alternates fruits with leaf material, whereas sifakas, which are obligate folivores, alternate mature with immature leaves. Nutritional levels either fluctuate for both species seasonally (free amino acids) or maintain a consistent level throughout the year (protein, sugars). The actual levels and contributing food parts differ for each species. *Lemur catta* maintains a high level of sugar intake all year, whereas sifakas have relatively low levels that are obtained from different plant parts.

These nutrient levels are tied to the major plant parts composing the diets. Certain parts, however, contribute disproportionately to the nutritional content of the diets. Sifakas appear to supplement the protein content of their diet with seeds when leaf material is not readily available.

The two species may have different physiological requirements that are met by reliance on different foods and the nutrients they contain.

In vivo masticatory strains in a retracted mammalian face.

F. Yates, D. Lieberman. Dept. of Anthropology, Harvard University, Cambridge, MA, 02138, USA,

Mechanical stimuli from mastication have major influences on growth in the mammalian face. Experimental studies have documented varying degrees of craniofacial growth in response to masticatory forces, and significant correlations between bite force magnitude and maxillary arch length. These responses are hypothesized to occur in proportion to a strain gradient in the face which decreases relative to distance from the tooth row. However, masticatory strain patterns in humans remain unknown, largely because of structural differences with nonhuman primates. Whereas previous strain studies used mammals that have a rostrum, the human face lacks a rostrum and is oriented in the coronal plane.

This study tests the relevance of strain gradients in the primate face using experimental *in vivo* strain data from the rock hyrax (*Procavia capensis*). Rock hyraxes have a retracted postcanine tooth row which lies almost completely beneath the orbital portion of the face, making it more similar to humans than most other primates in terms of facial retraction. To test the hypothesis that strain patterns differ in mammals with retracted versus protracted faces, rosette strain gauges were applied to six hyraxes at seven different locations on the face, and strains were recorded for different diet types. As expected, mastication of hard food generated significantly higher strains than for soft food. Strain patterns in the lower and middle parts of the face are relatively similar to published data on macaques. However, twisting strains in the caudal interorbital region of the upper face are much higher than documented in non-human primates.

Archaic and modern human distal humeral morphology.

T.R. Yokley, S.E. Churchill. Dept. of Biological Anthropology & Anatomy, Duke University, Durham, NC, 27708, USA.

Aspects of the elbow, namely the proximal ulna, have previously been shown to effectively discriminate archaic and modern humans. Accordingly, adjacent aspects of morphology may be able to distinguish these two groups as well. The present study tests the taxonomic utility of another portion of the elbow, the distal humerus. In order to do so, canonical variates analysis (CVA) was utilized to examine differences between Neandertal and modern human distal humeri. In addition, the morphological affinities of Broken Hill E/898, a distal humeral fragment from the Middle Pleistocene of Africa, were assessed. The morphology of the Broken Hill humerus is assumed to represent that of the last common ancestor of Neandertals and modern humans. By assessing its morphological affinities, the polarity of Neandertal and modern human distal humeral morphology can be evaluated. The results of this analysis do not support an archaic-modern human dichotomy. The Neandertal and modern human samples were effectively differentiated by the CVA. However, the Broken Hill humerus falls well within the range of modern human distal humeral morphology. As a result, the morphology of Neandertal distal humeri is believed to be derived while that of modern humans is believed to be primitive. Differences between Neandertals and modern humans appear to be related to size of the olecranon fossa. Relative to modern humans, Neandertal humeri had mediolaterally wide and proximodistally tall olecranon fossae and small distodorsal medial and lateral pillars.

Prehistoric health and social status in a population from the Moche Valley, Peru.

B.Y. Yoshida. University of California, Santa Barbara, Santa Barbara, CA, 93106, USA.

The Moche Valley on the north coast of Peru was one of the key centers for the development of social complexity and with the Moche, the advent of state level social organization in the Andes. Although Moche civilization has been relatively well-studied archaeologically, much less is known about the rise and collapse of societies that preceded the Moche in this region, and how these earlier transformations influenced the process of state formation. Specifically, little is known about how the changing socio-political organization of this population affected the relationship between social status and health. This research seeks to address these issues with bioarchaeological analysis of a collection of prehistoric burials from Cerro Oreja, a large multi-component site in the Moche Valley with an occupation estimated to date from 400 BC-200 AD.

In this study, the remains of 370 individuals (153 adults and 217 subadults) were observed. Preservation of the remains ranges from very poor to good. The sample was seriated into elite and commoner groupings based on associated grave goods. The health status of individuals classified as elites and commoners are compared to assess the proposition that high status individuals are better buffered against the effects of nutritional deficiency, disease and other stressors. Frequencies of enamel hypoplasia, porotic hyperostosis, periosteal lesions, and measures of juvenile growth are compared between the social groupings. Preliminary analysis indicates that those individuals identified as high social status do not generally exhibit lower rates of nutritional stress or infection than those of low status.

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Brain reorganization in hominid evolution: histological confirmation in chimpanzee.

M. Yuan[1], D. Broadfield[2], R.L. Holloway[1]. [1]Columbia University, Dept. of Anthropology, New York, New York, 10027, USA, [2]Florida Atlantic University, Dept. of Anthropology.

The direct fossil evidence of brain size and reorganizational changes, and the comparative neuroanatomical evidence are important ingredients in understanding human brain evolution. There no longer is any major controversy regarding the facts of the changes, but there remains the question of when such changes occurred. These changes could have occurred early by australopithecine times, or later in some more recent *Homo* species only after brain size had increased.

We report two unusual chimpanzee brains ("Frank" and "Chuck"), which show a clear reduction in the extent of Brodmann's area 17, the primary visual striate cortex, based on gross morphological study. We demonstrate that the histological evidence from these and surrounding tissues undoubtedly show the Stripe of Gennari. This indicates that the neurogenetic basis for volumes of Area 17 do vary in chimpanzee without enlargement of brain size. We suggest that since such variation clearly exists in both modern *Homo* (Australian Aborigines and Caucasians) and in chimpanzee, it most probably existed in *Australopithecus*.

Our previous interpretations of the most probable position of the lunate sulcus, both in the Taung and Hadar AL 162-28 australopithecines as being more posterior in position relative to any of the living apes, is fully concordant with this newer evidence. The relative reduction of the primary visual striate cortex implies a concomitant increase in the posterior parietal association cortex. We believe such a correlation relates to the australopithecine's increased competency in visuospatial integrative tasks, which were selected within the paradigm of their expanding ecological niches.

Population and migration: the Nile Valley during the Predynastic and Early Dynastic Periods.

S. Zakrzewski. Dept of Archaeology, University of Durham, Durham, DH1 3LE, UK.

The change in subsistence strategy, from hunting and gathering to agriculture, and the associated development of social hierarchy form a series of changes of particular biological interest. There are two main aspects to these changes, which interact and modify each other; the first relates to human biology and human variation, and the second to the history of population movements along the Nile Valley.

The data consist of 55 cranio-facial variables from 560 Egyptian individuals, from seven periods, ranging in date from 5000 to 1200 BC. Significant sexual dimorphism was found in all but a few variables. 23 variables exhibited statistically significant interaction between sex and time period, indicating that the relationship between the sexes varied through time. ANOVA results suggest that males exhibit greater heterogeneity than females. GLM statistical analyses revealed that many variables exhibited significant differences between the time period groups, and that most of these differences remained statistically significant after correction for sexual dimorphism. Discriminant function analyses allowed morphological patterns to be developed describing temporal differences between the populations.

These results suggest some local population continuity exists within Egyptian populations, but with changes in population structure, reflecting immigration and admixture of new groups. The composition of the morphological groups was compared with archaeological evidence for social groupings, to further understand Egyptian social differentiation. Of particular interest was the changing role of women in the development of the Egyptian State, and the possibility of sex-specific migration along the Nile Valley.

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Growth and development of the fetal craniofacial complex in humans (*Homo sapiens*) and pigtailed macaques (*Macaca nemestrina*).

M. Zumpano[1], J. Richtsmeier[2]. [1]New York Chiropractic College, Dept. of Anatomy, Seneca Falls, New York, 13148, USA, [2]Dept. of Anthropology, The Pennsylvania State University.

This study compares fetal craniofacial growth patterns of macaques and humans to determine if a common growth pattern exists. The fetal populations consist of 16 male pigtailed macaques (mean age 21 weeks) and 17 humans (9 males and 8 females; mean age 29 weeks). The macaque population completed 86% of their gestation and the human population completed 72%. For each individual, three-dimensional coordinates of 20 landmarks on the skull were collected from 3D-CT reconstructed images and 2D axial slices. Early and late groups were created from the human (early mean age 25 weeks, N = 8; late mean age 34 weeks, N = 9) and macaque populations (early mean age 16 weeks, N = 7; late mean age 23 weeks, N = 9). To determine if macaques and humans share a common growth pattern, human growth estimated from a comparison of early and late groups was compared to the pattern of growth estimated between early and late macaque groups. Euclidean Distance Matrix Analysis (EDMA) was used in all comparisons. Comparisons between macaques and humans indicate that the growing fetal skull displays the greatest amount of change along mediolateral dimensions. Changes in shape during human growth are primarily localized to the basicranium and palate, while macaques experience localized change in the midface. Interspecific comparisons indicate that the two fetal populations differ due to the large midface in macaques. Results of a statistical comparison of growth patterns indicate that the two primate species do not share a common fetal craniofacial growth pattern. The macaque pattern is characterized by increased midfacial growth relative to humans. Our results suggest that morphological differences in the craniofacial skeleton of these species is in part established by differences in fetal growth patterns. Supported in part by PHS grant 1-P60-DE13078 (JTR) and SBR9601027 (MPZ).

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