

Abstracts of Papers To Be Presented at the Meeting

Anthropometric assessment of the newborn in evaluating the effects of prenatal medical care. TROY D. ABELL University of Oklahoma Health Sciences Center.

Infants born to 103 women with little or no prenatal care are compared to those delivered to 103 women with excellent care as to birthweight, gestational age, and various anthropometric measurements. Infants were assessed within 12 to 30 hours of birth using the Dubowitz neurological and physical examination, and anthropometrically measured for crown-heel length, crown-rump length, head, chest, and thigh circumference, and mid-arm, thigh, and intrascapular skinfold thickness. Given the ultimate goal of developing an infant typology more precise in distinguishing types of intrauterine growth retardation, various combinations of infant birth weight, length of gestation, crown-heel and crown-rump length, and gender are investigated as outcomes. BWT , $BWT/C-H^2$, and $BWT/C-H^3$ are regressed on length of gestation and on known sociodemographic and biomedical determinants; these three indices are found not to be interchangeable in their associations with length of gestation, parity, pre-conceptual weight, socioeconomic status, income and utilization of prenatal medical services.

Gender comparisons of body mass indices and length of gestation suggest that for scientific, if not public health, purposes, serious attention to modeling infant characteristics at birth is a necessary step toward understanding the role of prenatal medical care in pregnancy outcome.

Dental enamel defects among contemporary nomadic and sedentary Jordanians. M. C. ALCORN, Hampshire College, and A. H. GOODMAN, University of Connecticut Health Center, Farmington.

Chronologic enamel hypoplasias, deficiencies in enamel thickness

resulting from a disruption in amelogenesis, are the result of systemic physiological stress. These defects have been successfully studied in prehistoric groups to determine patterns of infant-childhood stress. In this paper we compare the frequency and chronology of hypoplasias among contemporary Jordanian children from two villages and a nomadic group (n=308). The group from "village A", nearest Amman and most dependent upon its economy, has shifted from a nomadic to sedentary lifestyle within the last fifteen years. In contrast, the group from "village B" is less dependent on an outside economy and has been settled for a longer time.

Dental enamel defects were observed and recorded in the field (MCA). Photographs of the anterior teeth were taken, providing a permanent record, enabling us to confirm field scoring results. The frequency of enamel hypoplasias on maxillary central incisors is relatively low for children found in the nomadic group and village B (10-30%) in contrast to children from village A (greater than 50%). Defects found among children from village A peak between one and three years of age. These data suggest that the rapid changes experienced in village A has caused increased infant-childhood stress. The peak frequency of defects between one and three years suggests weaning-nutritional problems.

This study was supported by an ASOR/EBR Research Grant and NIDR Grant # T-32-DE07047.

The Role of Gums in the Diet of Baboons. S. ALTMANN, The University of Chicago.

The gum of fever trees (Acacia xanthophloea) is a major component of the diet

in the yellow baboons (Papio cynocephalus) of Amboseli National Park, Kenya. In a study of weanlings, fever tree gum ranked third in frequency among foods and among plant parts. By mass of intake too it ranks third among food types, exceeded only by reproductive parts, such as flowers, seeds and fruits, and by leaves. Fever tree gum ranks similarly highly among food types when they are ranked by time budget (minutes per day spent feeding on each food).

Analysis of the compositions of fever tree gum and of the other foods of baboons indicate the primary benefit of gum feeding: energy. It has by far the highest soluble carbohydrate concentration of any baboon food: 43-82%. Mean energy value is 12.1 kJ g⁻¹. Acacia seeds are the only other baboon food with caloric values above 12 kJ g⁻¹. The exudate of the one other common acacia in the area, the umbrella tree (A. tortilis) has a very different composition and is not eaten by the baboons.

Surprisingly, fever tree gum does not taste sweet to humans. This suggests that there may be some interesting relationships between the stereochemistry of acacia gums and the stereo-specificity of baboon taste buds and digestive enzymes.

In Amboseli, fever tree gum is also fed on extensively by vervet monkeys (Cercopithecus aethiops) and by kori bustards (Ardeotis kori).

Because the bark of fever trees is living, photosynthetic tissue, it is frequently eaten by large herbivores. In the resulting wounds on the tree, the high viscosity of the gum probably serves as a defense mechanism against invasion of the tree by insects and microbes.

Ecogeographic size variation among the living and subfossil prosimians of Madagascar. G.H. ALBRECHT and P. JENKINS, University of Southern California, Los Angeles and British Museum (Natural History), London.

The living and subfossil (<2500 yrs) prosimians of Madagascar represent a contemporaneous radiation whose diversity is measured by 36 species, 19 genera, and 8 families. Living taxa are found only along the coastal margins while subfossils are known from the south, west, and recently deforested central highlands which no longer support a primate fauna.

Madagascar is equally diverse in climate and flora. Briefly, the east coast is humid rain forest (no dry months), a small NW region is humid forest (Sambirano 3-4 dry months), the west coast is dry deciduous forest (5-8 dry months), the south is subarid forest (7-11 dry months), and the extreme north is similar to the dry west coast.

The association between size and ecogeographic distribution was investigated by comparing skull lengths among conspecific and/or congeneric sister taxa which inhabit the different ecogeographic zones as described above. The mean values given by Tattersall (1982) were the primary data supplemented by other published observations as well as our own measurements of museum specimens.

Central highland forms (subfossils which probably inhabited forests similar to but drier, more seasonal than the east) are generally the largest of all comparable Malagasy prosimians. Taxa from the humid east (all living) are larger than sister forms from the dry west and north. The smallest taxa (living and extinct) inhabit the subarid south. The apparent exceptions are Megaladapis edwardsi (largest of all prosimians) and Daubentonia robusta (as poorly known as its living congener) from the south/southwest. Problematic comparisons involve taxa from the Sambirana region which may be smaller or larger than sister taxa from other areas, taxa with small sample sizes, and taxa which inhabit more than one ecogeographic region but for which separate data on skull lengths are not available.

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Stresses of first freedom: 19th Century Philadelphia. J.L. ANGEL, J.O. KELLEY, M. PARRINGTON, and S. PINTER, Smithsonian Institution, Washington, D.C., Milner Associates and University of Pennsylvania, Philadelphia.

The congregation of the Reverend Henry Simmons (First African Baptist Church at 8th & Vine Streets) from 1823 to 1843 used a cemetery re-discovered through subway expansion and careful excavation by M. Parrington and S. Pinter in 1982-84; currently 56 people for study.

Historically 9% were slaves. Nutrition was starchy and lowish in pro-vitamin D and useable calcium, but adequate in calories. Recorded causes of death stress cholera and tuberculosis. Hard physical work was normal: laborers, draymen, a minister who rose from rag-man to clothier and for women onerous housework plus pregnancy (2.5 births per female).

As overall health indicator adult longevity at 35.5 years for 16 females and 39 for 18 males equates with Catoctin, Md., slaves, but survival is better--3 : 3.5 : 10 infant: child: adult death ratio compared with 5 : 6 : 10 at Catoctin.

For nutritional health, skull base height of 17.7 mm, pelvic brim index of 84.4%, stature of 161 and 172 cm (♀ and ♂), and teeth lesions at 12.7 per mouth scarcely advance over Catoctin (at 17.2 mm, 85.6%, 156 and 172-cm, and 13.5 lesions). Disease includes limb-distorting rickets in one child dying at age 8; also some anemia, but less arthritis than at Catoctin. Fractures are much rarer, affecting 20% of males vs. 50% of Catoctin slaves.

As at Catoctin, work stress shows in extreme deltoid and pectoral muscle crests, strong hand tendon marks, marked supinator crest in 44%. Bone robusticity and platymeria are the same but free Philadelphians show less quadriceps and soleus stress (lower pilastric and higher cnemic index); i.e. urban hard work without mountain-country stress.

Both groups have chiefly African traits. Genetic links show in details: os acromiale in 38%. This plus less violence (fewer fractures) suggests community strength developing.

Methods in the development of anthropometrically based sizing systems. J.F. ANNIS, Anthropology Research Project, Yellow Springs, Ohio.

Up to the present, anthropometric techniques in the development of sizing systems for clothing and personal protective equipment have been used almost exclusively for military and aerospace purposes. Today's technology has created new and more rigorous demands on the sizing and fit of similar items for personal and industrial uses. This suggests an increased role for physical anthropologists whose knowledge of dimensional diversity and statistical techniques can be applied to the development of sizing schemes for an increasing number of consumer items.

The analytic process used in the development of an anthropometric sizing system is based on the concept of dividing a selected population, for which appropriate measurements are available, into subgroups of individuals who possess a narrow range of values for one or more key dimensions, and then analyzing the remaining body size data for these persons in order to derive the design values which will accommodate the size variability within each group. The actual steps used in the development of such a system are: (1) select appropriate data base population; (2) select one or more key or basic sizing dimensions; (3) select a range limit for each key dimension for each size category; (4) determine the number of size categories required to accommodate the desired percentage of the population; (5) determine by regression analysis the "best" design value for all other variables within each size category; (6) adjust predicted values as needed to enhance functional characteristics of end item; (7) develop tariffs for each size category within the system.

Examples of sizing systems showing the statistical techniques employed and the interplay of practical considerations on the development of design values are presented.

The evolved limbic system: The human revolution. E. Armstrong, Louisiana State University Medical Center.

Most theories of brain-behavioral shifts during hominid evolution restrict their concerns to changes in rational and conceptual abilities and concomitantly look for neural changes which directly support these activities. Hand in hand with this emphasis is the idea that the neural structures involved with emotions have neither enlarged nor evolved during human evolution.

Neurobiological comparisons have not supported this particular picture. The volume of the human cortex is the size expected for a primate whose brain enlarged to human dimensions. Direct measurements of association regions in both cortex and thalamus show the human regions to be only as large as nonhuman data predict.

On the other hand, human limbic nuclei within Papez' circuit (anterior thalamic nucleus and medial mamillary body) show a definite increase in numbers of neurons over

that predicted for a nonhuman anthropoid with the same brain weight. These nuclei are implicated in emotions, memory systems and learning. They give a "dynamic vigilance by which environmental experiences are endowed with emotional consciousness," and may be of paramount importance in motivation and sustaining direct attention. A larger limbic input to cerebral cognitive processes may help engender the drives necessary for planning and executing long term projects. At the very least these documented changes show that motivational systems have changed and this alone undermines the theory that human evolution consisted of an increasingly rational animal being associated with a decreased limbic-emotional axis.

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Ontogenetic aspects of muscle phylogeny in human and nonhuman primates. M.A. AZIZ & S.S. DUNLAP, Howard University, Washington, D.C.

Investigations of forelimb myology yield data relevant to phenotypic definitions of human trisomies 13, 18 & 21. Of especial note is the high occurrence of supernumerary muscles, e.g. rhomboideus occipitalis, pectoralis minimus, pectorodorsalis, and extensor digitorum profundus, in these aneuploids. Our dissections of monkeys and apes suggest that these supernumeraries occur normally in monkeys and in some apes. The reappearance of extinct structures in a "higher" taxon is regarded as an example of "atavism" presumably caused by genetic and epigenetic factors. In an effort to establish homologues, we have studied the ontogeny of specific muscles in human and nonhuman primates. Others have reported "atavistic" muscles, e.g. platysma occipitalis (Gasser, 1967) and the contrahentes (Cihak, 1977), during normal human embryogenesis.

Since human aneuploidy is characterized by developmental retardation, it is not surprising to find that certain accessory muscles which are normally absorbed during embryogenesis are retained at the neonatal stage. We hypothesize that most supernumerary muscles found in humans, trisomic and others, are caused by delayed and/or arrested development. The significance of this phenomenon in the causation of myological variations plays an important role in our model for the evolution of primate musculature. We contend that human aneuploidy, its clinical significance aside, is a valuable tool for resolving questions regarding human evolution.

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Historical, chronological and paleoenvironmental background to the study of Oreopithecus bambolii. A. AZZAROLI, Museo di Paleontologia dell'Università di Firenze, Florence, ITALY and E. DELSON, Lehman College, CUNY.

The first specimen of Oreopithecus bambolii was described in 1872, and since then the diversity of opinion about its position among higher primates has been extreme. Early workers viewed it as either a relative of monkeys or of apes or perhaps as a link connecting these two modern groups. In the late 1940's, J. Hurzeler became interested and redescribed the known material, eventually arguing that it was a human ancestor. Szalay and Delson re-evaluated the material, arguing that Oreopithecidae belonged in the Cercopithecoidea. The present symposium grows out of a collaborative reanalysis of the nearly undescribed 1958 skeleton, as well as other available dental and postcranial fossils, seeking to clarify the systematic position and paleobiology of this enigmatic catarrhine.

Oreopithecus bambolii is known from five lignitic localities in Tuscany, central Italy. At one of these, Baccinello, three horizons yielding fossil vertebrates are intercalated with marine deposits of middle Late Miocene age. The oldest vertebrate level (V1) produced numerous remains of Oreopithecus, including the 1958 skeleton. The younger V2, dated to 3.5-8 MY BP by K-Ar yielded fewer fossils, including only one fragment possibly of Oreopithecus. It was long thought that the several sites were of equivalent age, but Hurzeler and Engesser have suggested that the type locality, Monte Bambolillo, is comparable to V2 on the basis of similar rodent, suid and bovid taxa, while Casteani may agree better with V1. The latter two sites units, which yield almost all known specimens of Oreopithecus, are thus approximately 9 MY old. The essentially relict, endemic V1 mammalian assemblage indicates an insular, swampy environment, but some rodent and bovid taxa suggest the presence of dry uplands nearby. Hurzeler and Thomas have recently emphasized the African affinities of some of the bovids, which fits expectations based on Oreopithecus.

Orodigital communalities in early human prenatal epidermal ridge development. W.J. BABLER, Baylor College of Dentistry, Dallas.

The epidermal ridges which form the configurations we term fingerprints first appear as localized cell proliferations in the basal layer of the epidermis around 10 weeks of gestation. These cell proliferations form shallow primary ridges that project into the superficial layer of the dermis. This epidermal-mesodermal inter-face is an integral element of epidermal ridge development. A similar interface between epidermal and mesodermal tissue is seen in the developing tooth bud. This presentation examines relationships between developing epidermal ridges and the developing primary dentition. Data were collected from 26 normal human fetuses ranging in age from 11-26 weeks post fertilization. Hands and heads from each speci-

men were histological prepared. Measurements of primary ridge width, inter-ridge distance and ridge depth as well as mesial-distal and buccal-lingual lengths of upper and lower deciduous teeth were obtained from serial thin-sections.

The results indicated that epidermal ridge formation, as seen on the digits, was highly correlated with primary tooth development. All tooth and epidermal ridge dimensions were significantly correlated with crown-rump length (CRL) as well as with each other. To adjust for the effect of increasing body size partial correlations were computed to adjust for effects due to increasing CRL. In general, partial correlations showed no digit to tooth correspondence. Correlations between tooth and ridge dimensions were similar for mandibular and maxillary teeth as well as buccal-lingual and mesial-distal tooth lengths. Significant tooth epidermal ridge correlations were found primarily for inter-ridge distances and ridge depth and not primary ridge width. These findings support a developmental association between the developing primary dentition and epidermal ridges.

Variation in body composition by altitude in Bolivian newborns. CAROL BALLEW, The Pennsylvania State University, University Park, and JERE D. HAAS, Cornell University, Ithaca.

In vitro research demonstrates that hypoxia reduces tissue growth by slowing mitosis, and that the sensitivity of different tissue to hypoxia varies. If hypoxia in utero is responsible for the observed reduction of birth weight and linear dimensions among human newborns at high altitude, it might also produce differences in newborn body composition by altitude.

This paper presents a comparison of newborn body composition among 175 infants from high altitude and 69 infants from low altitude in Bolivia. Crown-heel length was used as a representative skeletal dimension, brachial muscle area as a measure of skeletal muscle mass, and the sum of five skinfolds as an estimate of subcutaneous fat accumulation.

Newborns at high altitude were 350 gm lighter than those at low altitude, after controlling for covariation associated with ethnicity (Indian/European) and parity (first/subsequent infant). High altitude infants were 1 cm shorter than their low altitude counterparts, controlling for ethnicity and sex of the infant. In contrast, the sum of skinfolds of high altitude newborns was 4.5 mm greater than that of low altitude newborns, controlling for crown-heel length and parity. Brachial muscle area did not vary significantly in this sample.

These results suggest that the effect of high altitude on fetal growth varies according to the tissue examined. The enhanced accumulation of subcutaneous fat among the high altitude infants indicates that fetal under-nutrition is not likely to be the primary cause of reduced fetal growth at high altitude.

The results further suggest that hypoxia may affect the human fetus by depressing the growth of mitotically active tissues, but not the growth of facultatively hypertrophic tissue such as subcutaneous fat.

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Caste and terrain influences on the physical fitness of elderly Nepalese. C. M. BEALL and M. C. GOLDSTEIN, Case Western Reserve University, Cleveland, Ohio 44106

This paper examines the widely held notion that the elderly living in traditional mountain areas retain physical fitness in old age due to the additional lifelong daily exertion occasioned by the inescapable need to climb up and down steep slopes. Two hypotheses are tested using a quasi-experimental research design and measurements of physical fitness obtained during symptom limited bicycle ergometer tests of the physical work capacity of 102 rural Nepalese males aged 50-79, native residents of communities in rugged and in flat terrain. The first hypothesis is concerned with terrain differences and states that high caste Hindu farmers of the rugged terrain are more physically fit in old age than their comparable counterparts from a nearby flat plain. The data provide no support for this hypothesis. No differences in physical work capacity measured at submaximal workloads, at peak effort or during recovery from exercise are found. The second hypothesis is concerned with intracohort variation, takes advantage of the unique character of the Hindu caste system which approximates random assignment to high and low lifelong activity levels and states that elderly members of the caste engaged in heavy activity are more physically fit than those of castes engaged in light activities. The members of the Sarki caste, relative to members of other castes, have lower heart rates and systolic blood pressures at each of three submaximal workloads and during recovery from exercise. Thus intracohort variation in physical fitness and activity pattern is a function of birth into a socially defined group rather than self selection. All samples lie within the reported range of variation in physical fitness and indicate that neither a rural, unmechanized agricultural lifestyle nor mountainous terrain necessarily result in exceptional physical fitness in old age.

Anthropological applications of HOMPLOT cartography. K.L. Beals, C.L. Smith and D. Fuhrer, Oregon State University, Corvallis.

HOMPLOT is a computerized system created to rapidly produce geographically accurate distribution maps. Outlines are drawn by Tektronix plotter by operator selection of

SW/NE coordinates. Multiple-color data plotting is accomplished by interactive command. Associated files from HRAF include up to 50 variables for 1150 populations--which may be merged with the recently tabulated ecological and biological files. These later sets include data bases for morphological, genetic, climatic, and paleontological evidence. The system is compared to the SYMAP program. A transparent tint method allows simultaneous depiction of location and magnitude of observations. Examples of customized maps and statistical associations are shown for a variety of traits. In combination with multiple regression, the system can be used to reconstruct spatial variation of characters through the Pleistocene. The procedure is a research tool for evaluating models of hominid evolution. Physical anthropology files are now available in diskette form.

Morphological correlates of differential knee Joint Reaction Forces in primates. M.E. BEDFORD, C.O. LOVEJOY, Kent State University, Kent, OH.

In most mammals, the anterodistal femoral joint surface exhibits the highly unusual character of dual articular function, being shared with both tibia and patella during extension and flexion, respectively. Because maximum knee Joint Reaction Forces (JRFs) occur during the propulsive phase of the gait cycle, quadrupedal primates develop higher patello-femoral JRFs than do hominid bipeds. Conversely, bipeds develop relatively higher tibio-femoral JRFs. Bipedal primates should therefore have relatively greater tibio-femoral articular surface areas than quadrupeds, while the latter should exhibit relatively greater patello-femoral articular contact areas.

We examined the distal femoral articular surfaces of *Pan*, *Gorilla*, *Pongo*, various cercopithecoids, and *Homo sapiens*, in order to test the above hypothesis. Digitized tibio-femoral and patello-femoral contact areas of the distal femur in the above genera confirm the hypothesis as stated.

In light of recent suggestions that extension of the knee was not habitual in *Australopithecus afarensis*, identical procedures were applied to AL-129 and AL333-4, as well as to other fossil hominid femora. These specimens exhibit distal femoral patterning functionally equivalent to that of *H. sapiens*. These results, taken in conjunction with other morphological adaptations described previously for the early hominid hip, knee, and foot, indicate that locomotor habits of all known hominids were not substantially different from those practiced by modern humans.

The mathematical modeling of three-dimensional body surface data. Robert M. Beecher, University of Dayton Research Institute.

Data sets containing the three-dimensional coordinates of human body surface points for populations of adult men and women, and four anthropomorphic crash test dummies, were used in a series of projects seeking to model the physical properties of the bodies and summarize those properties statistically. Applications of the results have included the design specifications of an advanced anthropomorphic dummy, and body description data for computer simulations of aircraft pilot ejections and automobile crashes.

The availability of this data and access to the interactive minicomputer and computer graphics facilities of the Modeling and Analysis Branch of the Aerospace Medical Research Laboratory, Wright-Patterson AFB, have led to the development of new morphometric analysis and graphics display software. Data sets of individuals may be manipulated computationally - changing the scale of individual body segments and bending the segments at joints. The individual may then be graphically displayed from any perspective - with access to the coordinates of any point on the body or the orientation of any body segment. Because the body surface points provide information about shape, methods of comparing and modifying shapes have been developed.

First evidence of dental treatment in Denmark 5000 years ago.

PIA BENNIKE, University of Copenhagen, Denmark.

Human remains of 53 individuals from a Neolithic passage grave were studied. The passage grave had not been disturbed before the excavation took place, after it was finally closed at the end of the Neolithic Period.

As an interesting case during this study evidence of dental treatment was found in an upper jaw of an adult male, with both the skull and the mandible present. Large carious erosions were seen at the mesial side of the 7+ and at the distal side of the 6+. The carious erosion of the 7+ probably caused the formation of a dental abscess at the end of the distal facial root. This is seen as a smooth and regular cavity with a smaller perforation of the jaw.

About half of all molar roots were exposed as a result of heavy periodontal disease. In one molar a circular hole, 4 mm in diameter was seen at the exposed part between the two facial roots of the 7+. The hole did not affect the crown of the tooth. The depth of the conical hole was 6 mm.

In a Scanning electron microscope small amounts of calculus were seen on the surface of

the hole, indicating that the hole was made in vivo and by a drill.

One can conclude from this study, that the tooth must have been treated intra vitam with a drill, probably as a result of pain caused by the above mentioned pathologies.

Results from experiments using flint drills, the scanning of Neolithic animal teeth and amber with drilling holes, and also the scanning of calculus of other teeth of the same jaw, all seem to support this conclusion.

Evidence of another kind of treatment, trepanation, was also found in the skeletal material from this passage grave.

This study has been supported by the Danish Council of Medicine and the Danish Council of the Humanities.

Paleoclimatic and Paleobiogeographical Correlates of Hominoid Evolutionary Events. R.L. BERNOR, Howard University, N.T. BOAZ, Virginia Museum of Natural History and J.E. CRONIN, University of California, Los Angeles.

Morphological and biomolecular evidence demonstrates that the Asian ramapithecids, dating from 11.8 to 7.2 my BP, must be closely related to or on a lineage leading uniquely to Pongo. Pongo split from the other hominoids between 10 and 13 my BP based on biomolecular data. Faunal similarity cluster analyses indicate that Indo-Pakistan from the middle Miocene to the Pliocene showed a characteristic provincial woodland fauna. Thus, one does not expect, nor does one see, a high degree of exchange between sub-Saharan Africa and Asia during the period of hominid emergence, approximately 5 to 10 my BP. The orangutan is a product of the South Asian faunal province, and the African apes and hominids are products of one or more African provinces.

The DSDP oxygen-isotope curve provides a useful indicator of the timing of paleoclimatic changes that may have helped to effect not only the hominid-pongid split (see Boaz and Cronin, 1985 for terminology), but also lower taxonomic-level pongid, panid and hominid splits resulting from range disjunctions. In the absence of a fossil record for most of the former events, biomolecular evidence has been used. It is hypothesized that the pongid and panid patterns of speciation are the results of changing patterns of forest and woodland, while the hominid pattern is due to changing patterns of savanna and steppe.

To further test the hypotheses offered here, data are needed on the biotic history of the Sahara, the fossil record in West and Central Africa, and the relationship of world-wide temperature fluctuations to terrestrial paleoclimates in the Old World.

Submandibular salivary gland defects among prehistoric Tennessee inhabitants from the Averbuch site. H. E. BERRYMAN, University of Tennessee Center for the Health Sciences, Memphis.

Submandibular salivary gland defects typically occur on the medial surface of

the posterior aspect of the mandible, inferior to the mandibular canal. The defect was first reported by E. C. Stafne in 1942 and is now normally regarded as a developmental anomaly produced by the impingement of the salivary gland on the mandibular surface or an encroachment of salivary gland tissue during embryonic development. The clinical incidence ranges from 1/300 to 1/249 while the archaeological incidence has been reported as high as 1/30.

An examination of the mandibles from the Averbuch skeletal series—a fifteenth century A.D. population from central Tennessee—reveals 12 defects for an incidence of 1/19 for the adults. The defects appear quadrangular to elliptical in shape and range in size from 2mm x 4mm to 8mm x 15mm. The majority occur on the right side, and, of the complete mandibles expressing the defect, none appear bilaterally. The defects are not present among any of the subadult mandibles with the youngest affected individual being 20 to 24 years of age. Also, only 17 percent (2/12) are associated with females.

It is concluded that these defects are indeed developmental anomalies as opposed to being traumatic in origin. The findings in this study are basically consistent with that reported from other archaeological series. Unfortunately, the exact etiology (e.g., nutritional deficiencies, genetic) remains an enigma.

Growth of American Samoan children from birth to six years. J.R. BINDON, University of Alabama.

The influences of infancy and early childhood on subsequent growth have been demonstrated in many studies. It is the purpose of this paper to describe the pattern of growth and to analyze infant feeding and health influences on growth among children in American Samoa from birth to six years.

The sample for this study consists of 6,587 children born from 1976 to mid-1982 and residing in American Samoa. These children are represented in the records of the Well Baby Clinic of the LBJ Tropical Medical Center, Tutuila, American Samoa. Nearly 80% of all children born during this period are represented in the records. Measurements of weight, length or height, feeding notes, and diagnoses occur in the records. Most visits take place in the first year of life, but some of the children continue to be seen by the clinic up to the age of six.

The children from American Samoa have average weights that fall between the 50th and 75th percentile of NCHS standards for boys and between the 50th and 90th percentile for girls. The percentile value for weight tends to increase with age. The lengths and heights of the Samoans fall near the 50th percentile. Weight-for-height falls near the NCHS 75th percentile for boys, and between the 75th and 90th percentiles for girls. Infant feeding practices significantly influenced growth in

length and stature up to age three, and growth in weight and BMI up to age two. Breast-fed children tended to be shorter, lighter, and lighter-for-length than bottle-fed or bottle-supplemented children. Infant health under six months exerted a significant influence on BMI at age one year. Children with diarrhea, gastroenteritis, and intestinal parasites tended to be lighter-for-length than children without these problems.

Obesity is a major health concern in American Samoa today, and from these results it appears that this pattern may be set from early infancy.

A search for systematic finger ridge count variation among European groups. K.M. BINKLEY, University of Tennessee, Knoxville.

Finger ridge count variability has been shown to successfully differentiate major racial groups and in some instances, groups within a region or continent. However, little has been accomplished in the way of demonstrating patterned dispersion of finger ridge count variability. In this study, spatial autocorrelation is used to look for systematic among-group dispersion of finger ridge count variation in Europe with respect to among-group axes of variation defined by geography and language. Principal component scores for 48 male and 47 female European groups are obtained for each of ten components of finger ridge count variability, using the finger ridge count means of each group and a pooled within-group, within-sex covariance matrix having 5474 degrees of freedom. A binary adjacency matrix is used to define groups which are adjacent in terms of the class variables language, distance, and direction. An autocorrelation coefficient, Moran's I, is calculated from the principal component scores and adjacency matrix, for the adjacent groups. Correlograms are constructed for several conditions of direction and distance among the various groups. Results indicate that certain principal component scores exhibit marked geographical heterogeneity, some of which can be explained by the spatial and language variables.

Social policy, economics, and demographic change in Nanticoke-Moor ethnohistory M.L. Blakey, Howard University.

The Nanticoke-Moors of the Delmarva Peninsula emerged as a distinct ethnic group through the 18th century conjoining of Native Americans, Africans, and Europeans. Their physiognomic diversity and ethnic marginality exposed them to a particular combination of

social options and limitations. Demographic trends derived from cemetery data show some of the biological effects of social and economic change affecting the Nanticoke-Moors during their history.

A marked increase in population growth began in the mid-19th century with the acceptance of intensive agricultural methods and expanded commerce. Local economic development was subsequently threatened by growing racial antagonism on the part of neighboring whites. Segregation policy during the late 19th century aggravated these conditions and structured intra-group conflict and fissioning. With the growth of industrial employment in central and northern Delaware near the turn of the 20th century part of the community migrated north. This group began to integrate with mainstream Afro-American community, largely via religious and educational institutions. Concurrently, those who remained in the traditional community began to formalize an Indian identity which required dependence upon local agricultural economy and limited educational institutions. These social factors appear to have contributed to differences in life expectancy, fertility, and mortality in Nanticoke-Moor communities over time.

Historical demography provides material evidence of changes in health correlated with social change in the general "quality of life." These data enrich ethnohistorical accounts which, conversely, help to explain demographic trends.

Functionally adaptive biocultural diversity in the Coosa chiefdom of sixteenth-century Georgia. R. L. BLAKELY and A. B. BROWN, Georgia State University, Atlanta.

The King and Etowah archaeological sites, located only 40 miles apart and partially contemporaneous, comprised part of the sixteenth-century chiefdom of Coosa in Georgia (Hudson, 1984). Skeletal samples from the two sites (N = 189 and 247, respectively) exhibit marked biological differences. Trace element analyses indicate higher concentrations of magnesium, strontium, and zinc at King (Brown and Blakely, 1984). Anthropometric dimensions, including adult stature, show the King inhabitants were taller and more robust. Cortical bone thickness was relatively greater at King (Brown, 1984). Dental attrition and caries were reduced at King (Kestle, 1984), as was the incidence of infectious diseases (Koerner, 1984).

These differences, we argue, largely reflect dissimilar subsistence patterns, with King's residents practicing more gathering and hunting while the Etowah occupants relied more heavily on crop domestication. Because there existed few differences in the natural environment and level of technology between the two sites, we contend that the differences in food procurement represent an adaptive strategy in the Coosa province. King, a frontier village of the chiefdom, and Etowah, a central town of the chiefdom, were disparate

but functionally interdependent components of the redistributive society. We suggest that biological indices of cultural diversity can be used to identify and interpret adaptive strategies of larger social systems of the past.

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A New Classification of the Catarrhini. N.T. BOAZ, Virginia Museum of Natural History and J.E. CRONIN, University of California, Los Angeles.

As a result of biomolecular findings that Homo shared an ancestry with the Pan and Gorilla lineages past their common bifurcation from the Asian Pongo lineage, and as a result of fossil antecedents of Pongo having been recognized in the middle to late Miocene in the Siwaliks, the evolutionary reality and taxonomic composition of the taxa Pongidae and Hominidae has been in question. Various authors have suggested the inclusion of the extant African apes within Hominidae, a major disadvantage of which is the perversion of the widely used definition of Hominidae as referring to hominoids characterized by habitual bipedal locomotion and either ancestral to or collaterally related to Homo. An alternative suggestion has been the erection of the family Panidae, to include Pan and Gorilla, at the same taxonomic rank as Hominidae and Pongidae. This scheme has the disadvantage of not recognizing pongids as an out-group compared to the African apes and hominids.

The proposal here is to erect a new taxonomic level between the family and superfamily, the hyperfamily, ending in "-ites," (Greek for "similar to"). Hominidae and Panidae are included within the hyperfamily Hominites, distinct from the hyperfamily Pongites, which includes Pongidae, Gigantopithecidae and Sivapithecidae.

Following this pattern the infraorder Catarrhini is divided into 5 parvorders: Parapithecoidi, Propithecoidi, Oreopithecoidi, Cercopithecoidi, and Hominoidi.

Colloquial or "convenient" terms such as "ramamorph," "dryomorph," "australopith," and "habiline" are unrelated to formal taxonomic labels, may lack clear definition, and consequently should be avoided. In the present scheme these terms are most closely equivalent to "sivapithecoid," "dryopithecite," and "australopithecine," respectively, while the lattermost is not recognized above the species level.

Socioeconomic status and sex, but not ethnicity, determine body fat patterning of Guatemalan children. Barry BOGIN, University of Michigan, Dearborn.

Ethnicity, sex and socioeconomic status (SES) are each known to influence the amount and pattern of subcutaneous fat on the human body. In this paper, body fat patterning for three samples of Guatemalan children are analysed. Fat patterning is expressed as the

ratio of: triceps skinfold/ (triceps + subscapular skinfolds). The samples include, 1) high SES children of Ladino and European ancestry, 2) low SES Ladino children and 3) very low SES Cakchiquel Indian children. The total amount of triceps and subscapular fat is greatest in the high SES children, significantly smaller in the low SES Ladino children and the smallest in the lower SES Indian children. The decrease in body fat between the samples at the two skinfold sites is not equal. Significant differences in the fat patterning ratio exist between samples; the ratio decreases in size from the high SES sample, to the low SES Ladino sample, to the lower SES Indian sample. A smaller ratio indicates a relatively greater concentration of fat on the trunk of the body. In each sample girls have absolutely more fat than boys, but only in the high SES group is there a significant difference in fat patterning between the sexes; girls have relatively more arm fat than boys. Finally, the difference in fat patterning between European and Ladino children of high SES is assessed. There are no differences in fatness nor in fat patterning between the two ethnic groups.

These results indicate that, 1) SES influences fat patterning; low SES children of both Ladino and Indian ethnicity show greater reductions in arm fat than in trunk fat compared to high SES children, 2) sexual dimorphism in fat patterning is SES dependent; low SES children show no dimorphism, high SES children are sexually dimorphic, 3) ethnic differences in fat patterning are not demonstrable; neither for Ladinos and Europeans of high SES or Ladinos and Indians of low SES.

Effect of 15-year weight change on change in cardiovascular risk factors. G.A. BORKAN and D. SPARROW, Normative Aging Study, VA Outpatient Clinic Boston, MA.

Numerous studies suggest that overweight increases coronary disease risk by modifying the levels of other risk factors. These more direct risk factors include blood pressure, cholesterol, triglycerides, uric acid, blood glucose (fasting and 2-hour postprandial), and vital capacity of the lungs. There have been few studies which examine the changes in these risk factors which accompany different long term patterns of adult weight change. Fewer studies have considered whether the effect of weight change on coronary risk factors changes with advancing age.

Our investigation used 15 years of longitudinal data collected by the Normative Aging Study on 1,396 male participants. Multiple regression analysis was used to predict change in each of 8 risk factors from change in weight and the interaction between weight change and age. Change in weight was a significant predictor of change in each of the risk factors after controlling for initial levels of the risk factor, initial weight, age and smoking status. However, for triglycerides, systolic and diastolic blood pressure, fasting and 2-hour postprandial glucose, the weight change versus age

interaction was more significant than weight change alone. For these risk factors, an increase in weight had a greater and more deleterious effect with advancing age.

These results confirm that weight gain is consistently (and negatively) related to numerous physiological parameters considered to increase risk of cardiovascular disease and early death.

Shared energy expenditure and energy intake levels in familial resemblance. C. BOUCHARD, A. TREMBLAY and C. LEBLANC. Laval University, Quebec, Canada.

Habitual energy expenditure and energy intake have been estimated from 3-day records, including a weekend day, in parents and children from 375 families of French descent. Body fat from body density obtained through underwater weighing, subcutaneous fat from the summation of six skinfolds, fasting serum triglycerides, total cholesterol and high density lipoprotein cholesterol, and submaximal power output (PWC₁₅₀) derived from a cycle ergometer test were also determined in these subjects. Dependent variables were normalized through log₁₀ or square root transformation and scores were adjusted by generation for the effects of age and sex. Correlations with residual scores were performed with pairs of biologically unrelated sibs (N ≥ 148), pairs of parent and child (N ≥ 515), pairs of foster parent and adopted child (N ≥ 93), and midparent - midchild data from foster families (N ≥ 36). Coefficients were generally little affected by statistical control over energy expenditure (kJ per kg body weight) and/or energy intake (kJ/kg). Pairs of biological and cultural relatives were classified as either very similar (25% of pairs) or very dissimilar (25% of pairs) in terms of energy intake or energy expenditure data. Correlations performed with body fat, blood lipids and PWC₁₅₀ data revealed that similarity or discordance in energy intake or expenditure patterns had only a slight effect on resemblance between biological or cultural relatives.

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The application of in vivo bone strain measurement techniques to problems of skeletal growth and remodelling. M. BOUVIER, Louisiana State University Medical Center.

The shape of a bone and its microscopic structure have long been thought to be influenced both by genetic and functional factors. Two functional factors of particular significance for the skeleton, weight-bearing and muscle action, affect bone by deforming it slightly. Until recently, it was possible only to hypothesize about normal patterns of

deformation (or strain) on bone and how changes in functional factors might influence these strain patterns.

With the advent of *in vivo* bone strain measurement techniques, it has become possible to directly observe both normal and abnormal patterns of bone strain. Accumulating evidence from observations of a wide variety of normal and abnormal bone strain patterns has contributed greatly to our understanding of the relevant parameters of bone strain that affect the skeleton. Among strain parameters currently under investigation are peak bone strains, strain rates, number of strain cycles, and bone strain distributions. In addition, *in vitro* mechanical testing of bone specimens continues to add to our knowledge of the mechanical properties of bone.

Results of *in vivo* bone strain studies have shown that all of the above parameters most likely exert some influence on bone structure. For example, it appears that strain distribution may be a critical osteogenic factor in bone while number of strain cycles may provide a critical remodelling stimulus in areas of peak compressive strains. Finally, some popular concepts of bone adaptation to mechanical stresses currently are being challenged. The idea that a bone represents the minimum amount of material arranged with the maximum strain-reducing efficiency may no longer be tenable since, in some cases, bones seem to be arranged in fashion that tends to increase rather than decrease bone strain levels.

Punctualism, cladistics and the legacy of Mediaeval Neoplatonism. C.L. BRACE, University of Michigan, Ann Arbor.

The classification of Linnaeus was set up to reflect the entities in the world of living organisms created in the beginning by divine fiat. Post Darwinian classifiers have largely recognized the same entities although they have regarded them as the products of evolution. Recent attempts to remove the vestiges of Linnaean typologizing have unwittingly hampered their case by using the same techniques of argument that Linnaeus inherited from his predecessors. The use of *differentiae* by Aristotle to identify *genos* and *eidos* was adopted by Porphyry to create the first hierarchical tree. This in turn was the base for the scholasticism of Medieval Christianity and the use of pilpul in Talmudic dialectics. The recent semiotic demonstration of the fatal flaws in logic of the Porphyrean tree merits the attention of all who would attempt to use such an approach for purposes of biological classification.

Sampling for anthropometric surveys. B. BRADTMILLER, Anthropology Research Project, Yellow Springs, Ohio.

The representativeness of anthropometric data is almost completely dependent upon the sampling strategy used in their collection.

Despite the importance of sampling methods, little more than lip service has been given to the need for carefully considered sampling plans. This paper presents some of the factors which influence sample designs for anthropometric surveys, and some of the methods available for deriving sampling strategies.

For small surveys of local populations, a true random survey using a random number table may be appropriate. For larger populations, whose members are spread over vast distances a truly random survey would be unnecessarily cumbersome and expensive. A more rational approach is often to selectively sample particular subgroups which are known to vary on one or more anthropometric parameters.

Subgroup selection involves investigating a number of categorical variables--such as age, sex, race, or occupation and rank in the military--to determine which are the most important for the anthropometric variables of interest. Selection at this stage must be based on practical as well as statistical factors, because a large number of categorical variables may or may not affect each of 150 anthropometric variables in a particular way.

The final step in anthropometric sampling strategies is the selection of an actual sample size. While this is a simple statistical matter with a random survey, it becomes more complex when the sample size must be embedded in a subgroup sampling plan. Methods for achieving a complete sampling strategy, including size and subgroups, are analyzed.

Microevolutionary implications of differential survival and reproduction in Turkana pastoralists and farmers. J.M. BRAINARD, The Ohio State University, Columbus.

Demographic parameters of human populations may be considered to be the proximate determinants of the major microevolutionary forces of natural selection, gene flow and random genetic drift. As such they may often be profitably used to at least set limits on the operation of these forces, and they may therefore serve as substitutes for the logistically more difficult and expensive direct estimation of gene frequencies and selection coefficients. In particular, differential fertility and mortality among individuals determine the potential for the operation of natural selection, and may be estimated from readily collected census and reproductive history data.

This paper compares differential survivorship and reproduction rates for pastoral and agricultural Turkana, a Nilotic population living in a drylands habitat of northwestern Kenya. Pastoralists are shown to exhibit a greater degree of individual variability in mortality and fertility performance, though especially in the latter, with the implication that the potential for the operation of natural selection is greater for pastoralists than for farmers in this population. Comparisons of mortality and

fertility indices are also made between the two Turkana groups and a number of other populations living under a diverse range of environmental conditions and exploiting a variety of subsistence strategies. Drawing from these comparisons, shifts in the importance of natural selection which are likely to have been associated with major demographic transitions are briefly discussed.

Variation and changes of cranial morphology of African hominids during the Middle and Upper Pleistocene.
G. BRÄUER, University of Hamburg, West Germany.

The number of African hominid finds dating from the period between 600,000 and 30,000 years BP has currently climbed to more than 70 individuals. This comparatively large number of finds along with the increasingly clear datings for most of them, has admitted the possibility to attempt to analyze the diachronic morphological changes in the vault, face, and mandible. For this purpose, nearly all of the hominid finds from Africa were metrically and descriptively examined in detail. In addition to uni- and bivariate comparisons, the affinities between the hominids with regard to the various skull regions were also analyzed by means of multivariate procedures. In doing so, the general diachronic changes in the variables were considered along with their geographical variability (North, East, and South Africa) and sexual dimorphism. For Eastern and Southern Africa, the results indicate a development from a robust 'early archaic Homo sapiens' (middle Middle Pleistocene), via a what was already substantially more modern 'late archaic Homo sapiens' (upper Middle Pleistocene), to 'early anatomically modern Homo sapiens' (dating from the turn of the Middle to the Upper Pleistocene). In contrast, the diachronic changes which occurred in Northern Africa are not as clear.

True heel patterns of Middle Europeans.
H. BREHME and R.L. Jantz, Universität Freiburg, West Germany and University of Tennessee, Knoxville.

Using a combined sample of complete print sets of 6900 individuals originating from several parts of Germany and Austria, the study is based on 119 unrelated subjects with true patterns on one or both heel areas of the sole.

Main results are: among all pattern types tibial loops predominate;

the proportion of unilaterally occurring patterns left to right is about 43:52; all heel patterns are less frequent in males than in females, about 51:68. Tibial loops have ridge-counts ranging from 5 to 110; the means of both sides and sexes vary between 29.0 and 53.1. Generally, subjects with unilateral tibial loops have smaller ridge-counts than subjects with bilateral loops; significant ridge-count side differences seem to occur only in those males showing tibial loops on both sides with the left sole count less than the right count.

Comparison of the finger and toe ridge-counts of the sample of individuals with true calcar patterns with those of 155 German males and 148 females with no calcar patterns showed that the former group were higher in all ridge-counts. However, only the females differed significantly in two toe counts ($p < 0.05$).

Also, details are given on heel patterns of other populations. In a large Japanese sample heel patterns occurred unilaterally only, their mean ridge-count of tibial loops distinctly lower (28.9) than the overall mean of our European main sample (about 40.1).

Structural changes of the arms associated with habitual grinding of corn. P. S. BRIDGES, Hunter College, CUNY.

A number of ethnological studies have shown that primitive hoe agriculture is associated with an increase in workload over hunting-and-gathering. In support of this, the transition to maize agriculture in northwestern Alabama has been linked with increases in long bone shaft dimensions and strength. These increases are more widespread in the females than in the males. At the same time, they are more dramatic for the arms than the legs.

It is suggested here that the relatively large increase in female arm strength in Southeastern Indian agriculturalists is related to the female habitual activity of grinding corn. The humeri, radii and ulnae of 129 females (60 hunter-gatherers and 69 agriculturalists) were measured for length and shaft dimensions. A subset of 20 individuals was used in a biomechanical analysis of the humeral shaft.

Combined biomechanical and metrical data show: 1) significant increases in shaft dimensions in the agricultural group for all arm bones, 2) significant increases in bending and torsional strengths for the middle to distal humeral diaphysis, and 3) decreases in bilateral asymmetry due to relatively greater increases on the left side.

The greatest increases in both strength and dimensions can be related to an increase in flexion and extension at the elbow. The relatively larger increase on the left side suggests that both sides were subjected to similar levels of stress.

These findings are consistent with the method of grinding corn prevalent in historic Southeastern Indian societies. Corn was ground using a long wooden pestle and hollowed log as a mortar. The pestle was grasped with both hands and repeatedly thrust into the mortar, an action involving primarily the flexors and extensors of the elbow on both the left and right sides.

Pelvic index in Illinois Hopewell. R.A. BRINKER, Indiana University.

Measures of nutritional status of prehistoric peoples are useful in addressing questions of social status, subsistence, and demographics. Since such measures may be influenced by genetics or disease stress, employing multiple measures increases confidence in results.

Angel has proposed the form of the pelvic inlet as an index of nutritional status. The adequacy of this measure was tested by comparing two status groups in a genetically related population, the Hopewell burial population of the Klunk and Gibson Mound Groups. Individuals were assigned social status based upon treatment of the dead. Previous studies reveal statistically significant differences in status groups: Cook for striae of Retzius and dental hypoplasia, and Buikstra with male stature. In addition, trace element analysis indicates dietary differences between social statuses. If the form of the pelvic inlet is a good indicator of nutritional status, then significant differences in pelvic inlet form should be observed in these nutritionally distinct sub-populations.

The sample includes males (N=21), females (N=27), high status (N=33), and low status (N=15) individuals. Males and females differed significantly (T test) in stature ($p < .01$), and among females the status groups differ (T test) in stature ($p < .05$). For females significant correlations exist between age and the number of gestation pits ($p < .01$), and between the pelvic form and stature ($p < .01$). The transverse pelvic measure correlates with both the number ($p < .05$) and depth ($p < .01$) of gestation pits. A significant association (Chi square) is found between status and pelvic form ($p < .05$). No significant relationships are found for men. The form of the pelvic inlet differs significantly for females of different status and this index appears to be a good indicator of nutritional status among females.

Biomechanical Adaptation of Human Lower Limb Bones in the Prehistoric American Southwest. S.L. BROCK, University of New Mexico, Albuquerque.

The present investigation documents diachronic changes in human locomotor anatomy among archaeological populations in the eastern American Southwest. The relative bone adap-

tions among populations are related to shifts in activity levels with respect to four dimensions: time, topography, inter- and intra-sexual differences. The bone changes follow normal patterns of bone remodeling well documented through orthopedic research.

Femora, patellae and tibiae from 300 adults spanning roughly 1000 years (AD 550-1550) were analyzed. Adaptive bone remodeling was quantified using biomechanically relevant measures of whole bone proportions, articular dimensions, positionings and orientations, densitometry and diaphyseal cross-sectional geometry. Bone cross-sections of the femur and tibia were taken at two standardized locations by CT scanning. The CT scans were analyzed using an electronic digitizer and computer program SLICE, which calculates all relevant mechanical properties.

Statistically significant trends in relative geometric properties, bone density, cross-sectional stress distribution, articular surface dimensions and whole bone proportions are presented. The results reveal significant changes in the locomotor anatomy appropriate to changing activity patterns and social roles hypothesized from the archaeological record.

The role of females in primate provisioning. A.B. Brown, Georgia State University, Atlanta.

The primates are a K-selected order producing relatively few offspring. The comparatively helpless offspring require long periods of maternal care. This maternal care is necessary to provide the infant with breast milk, to protect the infant from environmental hazards, and to teach the details of feeding and reproductive behavior, including infant care.

A number of primate species also demonstrate strong maternal and sibling ties. These matrifocal units continue throughout the life of the mother and sibling ties continue beyond that. The long generation time of the great apes and humans and the enhanced social networks created by the matrifocal units provide the opportunity for females to learn reproductive and parenting behavior, thereby improving their reproductive success. The enhanced social network also increases the offsprings' chances for survival in the event of the illness or death of the mother.

Selection has operated on the primates to maximize the ability of the female to provision in order to increase reproductive success and infant survivorship. In general this is reflected in smaller female body size and female growth canalization.

In the course of primate evolution novel traits must have arisen in response to the helplessness of hominid infants. Bipedal locomotion frees

the arms to cradle the young hominid and permits the female to continue to participate in provisioning and in the social activities of the network without risking the safety of the infant.

Diet, sedentism, and demographic change: the identification of key variables. J. BUIKSTRA, L. KONIGSBERG, and J. BULLINGTON, Northwestern University.

The explanation of past demographic change is crucial in the study of human adaptation. Key issues include the relationship of sedentism and dietary change to population increase, and the relative importance of altered fertility and mortality patterns during human evolution. In this paper we first develop and then apply a method for estimating fertility in paleodemographic study. Using estimates which are derived from a ratio of life table parameters, specifically D_{30+}/D_{5+} , we establish a pattern of fertility increase in eight Woodland and Mississippian skeletal series from West-central Illinois. Late Woodland samples show an apparent elevation in rate above Middle Woodland, with all Woodland figures being less than estimates for the single Mississippian series in our study. Turning to the cultural context of diet, technology, and sedentism, we find that our inferred fertility increase is most closely associated with changes in diet and/or food preparation techniques. The absence of compensatory increments in juvenile mortality during this period suggests that changes in fertility best explain the regional population increase which has been hypothesized from other archaeological data.

Correlations between maxillary and mandibular sequences of dental development and eruption in the Ceboidea. K.E. BYRD, University of Southern California School of Dentistry.

The purpose of this study was to determine the degree of correlation between maxillary and mandibular dental development and eruption sequences in ceboid primates. Sequences of dental development and eruption for 1,430 immature ceboids representing 8 subfamilies were initially determined by examination of radiographs using a Zeiss dissection scope (6-40X). Both developmental and eruptive sequences were then ranked prior to computer calculation of Kendall rank-order correlation of coefficients for mandibular and maxillary homologous tooth pairs. Kendall tau values and levels of significance were then calculated for both developmental and eruptive sequences.

Mean tau values indicated that mandibular and maxillary eruptive correlations ($\tau = .8511$) were higher than mean developmental correlations ($\tau = .6698$) for the 13 ceboid genera. Significance values for mandibular/maxillary develop-

mental correlations in Chiropotes (.003-.113), Brachyteles (.001-.500), and Cebuella (.008-.178) reflect their small sample sizes. All genera displayed high mandibular/maxillary correlations for M1 and I1 ($\tau = 1.000-.6911$). Cebid genera showed relatively low developmental correlations for M3 ($\tau = .7903-.3016$). Eruptive maxillary/mandibular correlation patterns were dissimilar from the developmental patterns for all genera.

Teeth demonstrating high developmental and eruptive tau values within their respective morphologic classes suggest stable loci of developmental and eruptive fields. Stable developmental (M1, $\tau = .7620$; I1, $\tau = .7402$) and eruptive (M1, $\tau = .8734$; I1, $\tau = .8530$) loci in Callithrix are significantly ($p < 0.01$) different from Saguinus loci (Development: I1, $\tau = .8438$; M1, $\tau = .7032$. Eruption: I1, $\tau = .9287$; M1, $\tau = .8993$). These differences are of taxonomic importance in that they provide further data supporting the proposal of separate subfamily status for marmosets and tamarins as presented in Byrd (1981).

Age trends in sibling resemblance and common sibling environment. P.J. BYARD, Case Western Reserve University, Cleveland.

Sibling pairs often exhibit greater phenotypic similarity than do parent-child pairs, although the amount of additive genetic variance shared is the same for both types of relationship. The influence of common environment shared by siblings during the formative years has received increased attention in recent work, however nuclear family data do not allow estimation of the effects of common sibling environment unless strictly polygenic transmission from parent to child is assumed. In addition, estimates of this effect vary with the ages of each sibling and with the difference between their ages, and are confounded with changes in gene expressions at different points in the growth cycle.

Study designs are presented which allow resolution of these problems. The use of longitudinal family data (where both members of a sibling pair are measured at the same chronological age) allows separation of age differences in gene expression from variation in sibling environment over time, whereas the inclusion of additional types of relationships, such as twins, cousins, half sibs, or adopted children, allows estimation of the effects of non-transmissible environmental similarities of siblings in addition to genetic and cultural transmission from parent to child.

Path analysis of anthropometric measurements using these designs indicates that significant age trends exist in each of the above components of sibling resemblance. For height and weight, non-transmissible sibling environmental effects are highest early in life, while transmissible factors appear to play a larger role in adulthood.

An odontometric evaluation of the mechanisms of craniofacial evolution in Nubia. JAMES M. CALCAGNO, Loyola University of Chicago.

When examining post-Pleistocene skeletal changes in Nubia in the context of biocultural continuity in the region, two primary mechanisms have been advanced to account for the observed patterns of craniofacial evolution. These may be labelled as the "masticatory-functional" and "caries resistance" hypotheses. Both models are dependent upon dietary change, and if in effect neither necessarily excludes the operation of the other.

Although a reduction in tooth size is predicted by each model, diachronic odontometric data to support such a claim have been absent. In addition to filling that void, this study permits an assessment of the relative contribution of each model through a comparison of dental and craniofacial changes. Under the masticatory-functional hypothesis, a reduction in the overall masticatory apparatus should precede dental reduction, and all teeth should be affected. According to the caries resistance hypothesis, dental reduction both in terms of size and occlusal surface complexity may precede craniofacial reduction, and the posterior teeth would be targeted for greatest change.

In this analysis, a marked reduction in the size of all teeth was observed between the Mesolithic and Agriculturalist phase (3300 - 1100 B.C.), which coincides with great craniofacial reduction and appears to be best explained by the masticatory-functional hypothesis. Subsequently, only molar size significantly decreased between the latter group and the Intensive Agriculturalists (A.D. 0 - 1400), a trend best explained by the caries resistance hypothesis.

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A morphological and functional analysis of lipotyphlan insectivore and primate basicrania: bone-conducted sound. C.CAMPBAS, Hunter College, CUNY, New York.

Previous morphological analysis of primate ear regions have been successful in providing new data on character states in this complex and in increasing our understanding of phylogenetic relationships within our order. Functional analysis, however, has not been so successful. Virtually nothing is known about the relationship between form and function in the ear. Our ability to predict what an animal hears based on its middle-ear morphology is nil.

This may reflect excessive pre-occupation with analysis of airborne-sound transmitted through the middle-ear membrane and ossicles. Bone conducted sound is a recognized scientific phenomenon, but few morphologists focus on this equally important means of transferring sound to the ear.

This study examines ontogenetic and phylogenetic changes in the ectotympanic, the semi-circular bone that surrounds the tympanic

membrane. Its character state was examined in a sample of 216 primates and 83 extant lipotyphlan insectivores (N=299) in the osteological collections of the American Museum of Natural History.

The function of this bone is generally considered to be to serve as a mooring or stabilizing element for the tympanic membrane. In fact, all bone is capable of undergoing vibration. Whether or not a bone vibrates depends on the relationship between its mass, elasticity and friction, and the frequency of the sound impinging on it.

By comparing mass, elasticity and friction (acoustical impedance) of this element with published audiometric data for the taxa analyzed, this study tests and supports the hypothesis that early in mammalian (and primate) evolution, this bone could be set into vibration by higher frequency sounds, and that in more derived taxa, it's ability to vibrate in response to higher frequency sound is reduced or lost.

Female competition and the secondary sex-ratio in Old World monkeys: a test of the Silk hypothesis. J.L. CAMPBELL and J.A. KURLAND, The Pennsylvania State University, University Park, PA.

The question of whether secondary sex-ratios can be facultatively adjusted by parents has been recently discussed by several authors. Although the results are mixed, there is evidence that adaptive modification of the sex ratio is possible.

Silk argues that where resources are limited and males, but not females, leave their natal groups, selection will favor facultative adjustment of the secondary sex-ratio in response to female dominance rank. In female-bonded primate populations, females aggressively compete with each other for limited local resources, but natal males are not targets of such aggression because they do not reproduce or compete locally. Consequently, in comparison to daughters, sons are less costly to rear because they require less protective maternal investment. Only dominant females can adaptively accept the added costs of rearing competitively successful and high-ranking daughters.

Data on infant sex, maternal rank, maternal age and habitat quality were collected from 92 births in four species of female-bonded cercopithecines. Thus we test Silk's hypothesis of facultative sex-ratio adjustment in nonhuman primates that were not provisioned or confined to artificial enclosures. Subordinate mothers do not produce a statistically significant high secondary sex-ratio. However, a nonstatistically significant trend toward a low secondary sex-ratio in dominant mothers suggests that Silk's hypothesis may have some validity. Methodological and theoretical problems make it difficult to test models of adaptive sex-ratio adjustment in nonhuman primates.

Locomotor and postural behavior of orangutan (Pongo pygmaeus) in Borneo and Sumatra. J.G.H. Cant, Duke University, Durham.

Field study of adult female orangutans in the Kutai National Park, Kalimantan Timur, reveals the following about locomotion during travel (% of travel distance): travel is concentrated in the understory and lower main canopy; brachiation (without grasping by feet) accounts for 11% of travel, quadrupedalism 12%, vertical climbing (up and down) 18%, tree-swaying 7%, and clambering 51%. In clambering the animal is orthograde and employs forelimb suspension and mixed hindlimb suspension and support. Brachiation is practiced on thinner and more negatively inclined substrates than is quadrupedal movement. Feeding tends to occur higher in the forest than travel and use of postures (by time) includes sitting 50%, suspension with body vertical 11%, and suspension by hand and foot with body horizontal 36%.

Observations of feeding behavior of adult male and adult female orangutans in the Gunung Leuser National Park, northern Sumatra, reveal the influence of marked sexual size dimorphism (males weigh 80 kg, females 40 kg). Data were collected on both sexes in the same Ficus trees on the same days to control for tree structure and food item dispersion. Males use larger substrates than females and favor above-branch postures (sitting and standing), whereas females exhibit more suspension. In one species of Ficus predominant feeding techniques differed, the male pulling in branches to detach fruit with the mouth, females plucking more fruit by hand.

The orangutan is by far the largest mammal exhibiting arboreal travel. Evidence from this study supports the view that suspension by the forelimbs was crucial in permitting the evolution of very large size.

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Socio-economic change and patterns of mortality in a highland Peruvian population. J.W. CAREY, L.A. LALIBERTE and R.B. THOMAS University of Massachusetts, Amherst

Changing patterns of mortality serve as one indicator of biosocial well-being in a population. Over the past decade pastoral communities in the Southern Peruvian Andes have been substantially influenced by agrarian reform policies, improved public health facilities, and rising wool prices. Ostensibly, this has resulted in a more equitable access to herding resources, potable drinking water, inoculation programs and a higher cash flow into these communities. It might therefore be expected that such changes would increase the overall quality of life, and be reflected in reduced mortality rates.

In testing this hypothesis, individual death records following the agrarian reform (1970-1984) are compared with those previously reported from 1940-1969. These

comprise approximately 6000 individuals from the Nuñoa District. Time series analysis is used to determine long term secular changes as well as seasonal patterns in mortality, sex-age and residence groups at highest risk are identified, and mortality patterns over the past 45 years are discussed in terms of socio-economic change.

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Cortical organization in Saguinus: phylogenetic implications for New and Old World primates. M. CARLSON, Washington University, St. Louis and J.H. KAAS, Vanderbilt University, Nashville, TN.

With an interest in the evolution of the hand and the brain of anthropoid primates we examined the degree of cortical complexity in Callitrichidae, considered by some to be the most primitive of anthropoids. A direct record of evolutionary changes can be obtained from postcranial remains or endocranial casts of fossil primates, yet neither provides complete evidence for interpreting hand use or somatic sensory function. In studies of living species it becomes possible to map the functional subdivisions of the cerebral neocortex, using microelectrodes to obtain detailed maps of the sensory input from the hand. Behavioral studies can be done to determine the tactile capacities of the hand in the same species. We have made such maps of the hand area in primary somatic sensory cortex (SI) in a variety of primate species. In all primates examined, the cortical hand area appears expanded relative to the cortical representation of the rest of the body. More important is the finding of separately-organized multiple hand areas within the cortical SI region of the Old World anthropoids, Macaca and Cercopithecus, and New World, Aotus, Saimiri and Cebus. These findings contrast with SI organization in the prosimians, Galago and Perodicticus, in which only a single cutaneous SI hand area was found. Our behavioral studies of species with multiple cutaneous hand areas in cortex indicate improved tactile discrimination capacities over those species with a single hand area. In our recent studies of the New World Saguinus, we have found only a single SI area as in prosimians. These findings suggest that the last common ancestor of Old and New World primates possessed a prosimian level of cortical organization and that Saguinus retains this primitive cortical organization. This implies an early divergence for this genus.

Analysis of family resemblance for systolic blood pressure in the Framingham Heart Study. C.L. CARTER, National Institutes of Health, Bethesda, Maryland.

Analysis of family resemblance on the distribution of systolic blood pressure (SBP)

levels reveals an important role for the influence of both genetic and environmental factors in several recent studies, reporting heritabilities in the range .12-.61. This report presents the application of segregation analysis methods to data from the Framingham Heart Study, to test several hypotheses about the mode of inheritance of the transmission of SBP. Three hundred 3-generational kindreds (n=2534) were first analysed using the Elston-Stewart likelihood method, following regression for age and sex effects and log transformation of the data. Hypothesis tests, using the likelihood ratio criterion, rejected the environmental hypothesis ($X^2_2 = 31.37$), indicating that the transmission of a person's SBP is not random, and in fact is independent on the parental SBP levels. Tests for a major gene were also rejected: dominant ($X^2_4 = 88.20$), recessive ($X^2_4 = 29.02$), and codominant ($X^2_3 = 20.59$). The most parsimonious explanation for the fit of the set of hypotheses to the data is that the transmission of SBP is under the influence of a number of genes acting additively. We further explored the sources of familial variation by analyzing these same data using the unified mixed model of Lalouel and colleagues. Tests of hypotheses were performed on 349 nuclear families, derived from the kindred data, using the POINTER program package. The data support hypotheses of both a polygenic transmission and a major gene; however, the data do not support mendelian transmission of a major gene effect. We interpret these findings to mean that SBP is a multifactorial trait with a polygenic component and a major effect due to the environment. Therefore, hypertension appears to aggregate in families and is due to the combined influences of genes and the environment.

Ethnicity determination by names: A case study of validity and reliability in admixed groups in Chile and Bolivia. R. CHAKRABORTY, R.E. FERRELL, S.A. BARTON, and W.J. SCHULL, University of Texas and University of Pittsburgh.

The importance of surnames in genetic studies has been recognized for a century or so. While the ethnic affiliations of individuals are ordinarily established in genetic studies by admixture analysis based on gene frequencies, often there are implicit assumptions in these attempts that are difficult to validate in the absence of detailed ethnohistories. In Northern Chile and Western Bolivia, where genetic admixture has been known to occur among the Aymara Indians and Spanish Caucasoids, the naming pattern (parental patri- and matri-nyms) allowed us to classify individuals on the basis of the frequency of Aymara names into 9 'ethnic' groups. From a sample of 2525 individuals it is shown that admixture occurred in lines implying assortative mating. We have detailed observations on genetic markers in nearly 1700 individuals. Admixture and genetic distance analysis on the basis of data on 31 systems reveal that there is almost perfect accordance

of ethnic classification of individuals by name and phenotype data on genetic markers. The Aymara-named groups are shown to be predominantly Amerindian in their genetic profiles. Individuals whose current naming pattern is basically Spanish also exhibit a substantial fraction of genes of Amerindian origin. Presence of some rare alleles not found in Amerindian nor Spanish Caucasoids in the admixed groups suggest infiltration of Negroid genes in the past.

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Human Evolution at the Molecular Level: β -Globin Gene Cluster. A. CHAKRAVARTI, K.H. BEUTOW, University of Pittsburgh.

In collaboration with Dr. H. K. Kazazian (Johns Hopkins Hospital) we have analyzed data on 15 restriction site polymorphisms (RSPs) in the human β -globin gene cluster in Greeks, Italians, Asian Indians, Chinese and U.S. Blacks. These RSPs are located in the β -gene itself (both in coding sequences and intervening sequences) as well as in flanking DNA. Approximately, 500 normal β gene containing chromosomes in these 5 populations were analyzed and showed extensive polymorphism at the DNA level with average heterozygosities of .91, .67, .76, .63 and .92 in Greek, Italian, A. Indian, Chinese and U.S. Black populations, respectively. From these data we also compute the heterozygosity per nucleotide site (π). On average, the π value was .0032 for coding sequences, .0014 for intervening sequences and .0011 for flanking DNA. Since the majority of the RSPs are in flanking DNA, the π value in this region were .0014, .0010, .0011, .0009 and .0012 in Greeks, Italian, A. Indians, Chinese and U.S. Blacks. Furthermore, we calculated that 10.6% of the DNA sequence variability could be accounted for by between population differences. Nei's genetic distance calculations from these data gives a dendrogram identical to that obtained by Nei and Roy-Chowdhury using blood group and enzyme loci. Our analysis also show that these RSPs evolve at the rate of approximately 2×10^{-9} /base pair/year.

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A quantitative genetic model for the evolution of traits affected by interactions with relatives. J. CHEVERUD, Northwestern University, Evanston.

The evolution of traits affected by interactions with relatives has received widespread attention with the development of kin

selection models. However, kin selection and altruistic evolution can be considered as special cases drawn from a general model for the evolution of characters affected by and affecting relatives. Such a model has recently been presented for the effects of mothers on their offspring (Cheverud, 1984). This is generalized to allow for any degree of relationship and any number of relatives among the interactants affecting one another's phenotypes.

For a single pair of interactants, the evolution of the recipient's phenotype follows the dynamics,

$$R_p = (h_o^2 + r_q^2 h_q^2 + (1+r)(\text{cov}(A_o, A_q)/s_p^2)) i_p s_p$$

where R_p is the response of the recipient's phenotype, h_o^2 is the heritability of direct effects, q^2 is the proportion of variance in phenotype p accounted for by interaction with kin (or kin performance), h_q^2 is the heritability of kin performance, $\text{cov}(A_o, A_q)$ is the genetic covariance between direct and kin effects, s_p is the standard deviation of the recipient's phenotype and i_p is the selection intensity. This model leads to several conclusions not demonstrated by previous theories, including a negative response to positive selection pressure and a decrease in kin performance even with selection for increase in the recipient's phenotype. The implications of this general model for kin selection will be discussed.

Comparison of measures of body density and anthropometry in growth hormone deficient boys. W. CAMERON CHUMLEA and MARIA D. URBAN, Department of Pediatrics Wright State University School of Medicine.

The study sample consisted of a small group of white boys 10 to 20 years of age, each of whom was diagnosed as growth hormone deficient. Before the onset of growth hormone therapy, an estimate of body density was made by underwater weighing. In addition, selected measures of body size, subcutaneous fat thickness and a skeletal age assessment of the left knee were collected also. All of these measures were repeated on a 6 monthly basis during a period of prescribed treatment of 1.7 units of growth hormone taken 3 times a week.

During the first 6 months of treatment, most boys had as increase in body fatness as demonstrated by positive increments in total body fat and skin-fold thicknesses. During the second 6 months and subsequent periods of treatment, there were decrements in body fatness but positive increments in lean body mass. Also after 6 months of treatment, increments in stature were

above the 90th percentile for age, but there was no clear indication of catch-up growth. Increments in skeletal age for each boy were appropriate for the time frame of treatment.

These data tend to indicate that for boys receiving growth hormone, increases in body size and body composition are not uniform. Body fatness appears to increase in the first 6 months, and muscle mass increases during later periods of treatment.

This research was supported by a Biomedical Research Support Grant from Wright State University School of Medicine.

Dermatoglyphic variation among various populations from India, V. P. CHOPRA, Anthropologisches Institut, Universita Hamburg, Federal Republic of Germany and K. C. MALHOTRA, Anthropometry and Human Genetics Unit, Indian Statistical Institute, Calcutta, India.

Dermatoglyphic variation among 12 endogamous groups of the north-western region of India has been studied. The variables consist of ridge-counts of the finger and palmar patterns. First of all, the present study gives an idea about the interpopulation variation of the ridge-counts of palmar patterns. The use of these variables in population studies is relatively new. Further, the ridge-counts of fingers and palm patterns are considered together to assess the population differentiation at the caste, ethnic and geographic level. Data analysis was carried out with the help of univariate and multivariate statistical methods. The results show that the inclusion of palmar pattern ridge-counts provides additional information and dermatoglyphic variation can be explained in terms of geographic and ethnic differences. Moreover, these results are evaluated against anthropometric and serological relationships.

Early growth disruption and its correlation with aging and mortality in the adult. G.A. CLARK, Normative Aging Study, VA Outpatient Clinic, Boston, MA.

Due to the high growth rate and relatively early maturity (infancy) the thymus gland and neuroendocrine system are extremely sensitive to environmental stressors. Normal thymic development is essential for lymphatic and neuroendocrine development. If growth disruption continues past infancy permanently impaired immune and neuroendocrine function occurs. Thus, adults who survive such stunting have less diverse T cells and a higher percentage

of immature T cells (still produced in the bone marrow).

The association was tested that younger adult age-of-death was systematically related to abnormally small vertebral canal size (VC) in prehistoric skeletons from Dickson Mounds (A.D. 950-1300). VC share the same growth curve as the thymus gland. Stunted VC should permit inference into stunted thymic development, because while thymic development is highly sensitive to environmental stressors--neuroosseous development is not. Therefore, it was presumed that if adults had stunted VC their thymic and lymphatic function was permanently compromised, leading to earlier adult age-of-death.

Analyses of 1,073 thoracic and lumbar VC, showed that individuals in the 15-25 year old age-of-death group had significantly ($p < .05$) smaller lumbar VC compared to survivors. Smaller thoracic VC were highly associated ($p < .01$) with younger age-of-death in both 15-25; 25-35 age-of-death groups. Presumably, this was because the thoracic develops earlier and more rapidly than the lumbar. These comparisons were made for entire segments and individual vertebrae within segments, and all were consistent showing the same direction. Indeed, variance was also considered using adjusted values (SAS T-tests). Moreover, VC were not sexually dimorphic.

Consequently, these results suggest aging is permanently compromised by poor health before infancy.

Distribution of howling monkeys (Alouatta palliata) in a dry, deciduous tropical forest. MARGARET R. CLARKE, Rollins College, Winter Park FL and EVAN L. ZUCKER, Loyola University, New Orleans.

Mantled howlers (Alouatta palliata) have periodically been the focus of behavioral and ecological studies at Hacienda La Pacifica, Guanacaste Province, Costa Rica since the late 1960's. About three-quarters of the 1330 hectares of La Pacifica have been cleared, but most of the remaining dry deciduous tropical forest is connected by a series of windbreaks, patches of upland forest, and riparian forest. It has been hypothesized that this population of howlers has steadily declined over the years. During July, 1984, a complete census of the remaining forest was carried out in order to estimate the total number of howlers, to determine the size and location of the remaining groups, and to determine the age-sex composition of each group. During the six-day intensive census, a total of 257 howlers were located. Of these, 248 howlers were found in 16 groups, and nine were solitary animals. Group size ranged from four to 29 individuals, and the mean group size was 15.5. The overall male to female ratio was 1:3.2, and the overall immature to adult ratio was 1:2.6. These numbers are comparable to the results of census work done at La Pacifica during 1972-1976. A conservative estimate of the actual howler population would be 350, based on survey samples where known and tagged animals were not located during the census. Although

it has been hypothesized that the La Pacifica howlers represent a stressed and rapidly declining population, these findings indicate that the number and composition of the groups have remained relatively unchanged over the last ten years.

Demography and pathologies of skeletons from New Orleans' first cemetery. G.L. CLEAVENGER, D.W. OWSLEY and C.E. ORSER, Louisiana State University, Baton Rouge.

A recent condominium construction project in the Vieux Carre District of New Orleans exposed coffins and human skeletal remains. Archival research identified this location between St. Peter and Toulouse Streets as the site of New Orleans' first official cemetery, which was used from A.D. 1725 to 1788. The land was then deconsecrated and following disuse and disrepair was subdivided into lots and sold. Historically the cemetery is recognized as the burial place of several noted individuals including early French revolutionaries (e.g. Nicholas Chauvin LaFreniere), as well as the city's artisans, laborers and slaves.

Salvage excavations at the Toulouse Street Cemetery (160R92) located 32 burials. Analysis of this sample has provided information concerning demographic composition, skeletal pathologies and urban eighteenth century burial practices. Most individuals were buried with few grave inclusions in the supine position in cyprus coffins with an east-west orientation. Head direction for all but two was to the west.

Osteological analysis revealed that most individuals were black. This sample comprised primarily of adults probably represents an urban slave population. Skeletal pathologies including evidence of traumatic injuries and pronounced arthritic changes reflect lifestyles involving strenuous physical activity. (Partially funded by the National Park Service and administered by the Louisiana Division of Archaeology).

BIOSTEREOMETRIC ANALYSIS OF HUMAN GESTURE BY INFRARED STROBOPHOTOGRAMMETRY

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A biostereometric analysis of movements was achieved using a three-dimensional (3-D) television system connected to a digital computer. Reflective markers fixed on anatomical landmarks of the right upper limb and torso of sitting subjects were illuminated by infrared stroboscopes, and showed up as bright spots in the television image. A TV-computer interface

generated the two-dimensional (2-D) coordinates of the trajectories of these spots for three synchronised cameras at fifty fields per second. An interactive software permitted 3-D reconstruction of marker's trajectories, and calculation of displacements, velocities, and accelerations.

A study of intra and interindividual variabilities of relative displacements of each anatomical segment involved in the movement, was conducted on a group of young males, for different sitting positions and gestures.

Kinematic aspects of each studied movement are in relation with :

- type of gesture : 3-D localisation of the objective relatively to subject,
- position of subject : sitting erected or inclined,
- morphology and equipment of subject.

These data are stored in a data bank of anthropometrics and movement, and used for dynamic representation of human body models.

Postcanine tooth size in female primates. L.R. COCHARD, Northwestern University.

The results of many allometric studies of postcanine tooth size in mammals have not corresponded to expectations of tooth size based on energy requirements and dental function. The purpose of this study is to investigate the relationship between postcanine occlusal surface area, body size, and the metabolic demands of pregnancy and lactation in female primates. Tooth and body sizes from 38 primate species were taken from the literature to test two hypotheses: (1) females should have relatively larger teeth than males in order to masticate additional food for the energetic costs of reproduction; (2) relative dental enlargement in females compared to males should be greater in strepsirhines than haplorhines because metabolic requirements of pregnancy and lactation are greater in the former.

The results show that relatively large female teeth are not found consistently across primate taxa. Females have more occlusal surface area than expected on the basis of the male tooth and body size regression in only 71% of the species, and female strepsirhines tend to have relatively smaller teeth than female haplorhines, counter to expectations.

The degree of female dental enlargement is most closely related to degree of sexual dimorphism in body weight. Species that are monomorphic in weight tend to be monomorphic in tooth size even though females apparently require more food than males. The correlation between degree of body weight dimorphism and relatively larger teeth in females than males is 0.71 among the 19 species of Old World monkeys, for example.

While it may be advantageous for females of dimorphic species to have relatively larger postcanine teeth compared to males, the hypotheses about female tooth size and function for primates in general are rejected. It is

concluded that dental dimorphism and post-canine tooth size in general cannot be viewed from a strict adaptationist perspective.

Quantitative evaluation of the cementum annulation aging technique in humans. K.W. CONDON, University of Illinois at Chicago, D.K. CHARLES and J.E. BUIKSTRA, Northwestern University, Evanston.

Cementum annulations have recently been offered as a precise new method of age determination for humans. In addition to its forensic applications, refinement of this technique could contribute to such varied topics as paleodemography, mortuary analysis, and maturation rates in fossil hominids. A preliminary study on cadaver material (Condon and Charles 1983; AJPA 60:183) demonstrated a weak relationship between age at death and annulation counts ($r=0.263$) and identified a possible sex difference in annulation formation or retention in individuals over 50 years of age. The present study incorporates both clinical and cadaver extractions to examine inter- and intra-observer error, intra-dentition variation and age-sex-annulation relationships in a sample of 200 individuals. Differences in methodology - e.g. demineralized versus ground sections, longitudinal versus transverse sections - are also evaluated. Although lacking the precision initially claimed (Stott et al. 1982; JDR 61:814-817), cementum annulations can provide a valuable adjunct to traditional aging methods. This work was supported by NSF Grant No. BNS-8318587 to Drs. J.E. Buikstra and J. Cheverud.

Endocranial volume determination of matrix-filled fossil skulls using high-resolution computed tomography. G.C. Conroy and M.W. Vannier, Washington University Medical Center, St. Louis.

Endocranial volume is one of the most important parameters derived from fossil skulls. Frequently however, stone matrix filling the cranial cavity hinders direct and accurate assessment of this parameter. We describe new techniques which provide direct, accurate, noninvasive endocranial volume measurements of matrix filled fossil skulls using high resolution computed tomography. Sequential high resolution, narrowly collimated (2mm) CT scans were produced for two 30-million year old fossil mammal skulls in which the cranial cavities were completely filled with a hard

sandstone matrix. By manipulating display window width and level controls, we were able to distinguish the mineralized bone from the underlying matrix. The matrix was then "removed" from the image by setting the window level to the CT threshold value separating mineralized bone from matrix. The procedure resulted in a sequential series of 2mm thick CT section of the complete fossil skull with the matrix "removed". As each 2mm skull section was displayed, the outline of the matrix "free" endocranial cavity was traced with a marker stylus on a resistor pad digitizer built into our CT viewing console. The computer automatically computed the volume of the cranial cavity section outlined by the operator. By summing the volume for each slice, total endocranial volume was determined. The accuracy of the fossil volume determinations was assessed by duplicating these procedures on several modern skulls of known endocranial volume. In all cases, values derived from the CT scanner were within 1-3% of the known endocranial volume. We are thus confident that the CT derived endocranial volumes for the matrix filled fossil skulls have acceptable accuracy for paleontological studies.

Treponematosi s in the Chirikof Island population. D.C. COOK, Indiana University.

Protohistoric skeletal remains from Chirikof Island, Alaska, show many lesions that are clearly treponemal in origin. Stellate scars of the cranial vault are common, especially in older adults; 35 percent of adults 50 years of age or older show stellate scars, whereas only 7 percent of younger adult remains present this lesion. Lesions of the nasal bones and palate are rare, and no dental defects attributable to treponematosi s were seen. Tibial periostitis is present in 40 percent of juveniles and 38 percent of adults.

While the cranial lesions seen in this series are clearly pathognomic of treponematosi s, the pattern of lesions by body region differs from that seen in the many studies of prehistoric New World series in which the presence of treponematosi s has been suggested. A review of these studies suggests that climatic factors may account for at least part of the difference. However, the similarity of the pattern seen in the Chirikof Island series to that in nineteenth century clinical materials suggests that the disease present in this population may have been more similar to venereal syphilis than to the endemic treponematoses of the prehistoric Americas.

Distribution of enamel hypoplasias in an early Caribbean slave population. R.S. CORRUCINI, K.P. JACOBI and J.S. HANDLER, Southern Illinois University, Carbondale.

Of 102 poorly preserved slave burials from Newton Plantation, Barbados, dating from 1660 to 1820 A.D., 93 have teeth. Of these specimens 53% show linear enamel hypoplasia (LEH), pitting (PIT), or major growth arrest (MGA) lines. Corrected for differential preservation of teeth, we estimate the true hypoplasia prevalence to be about 74 + 5 %; this rises to virtually 100% if mottling is included as a form of hypoplasia. Furthermore, the deep banding possibly representing MGA accounts for 55% of affected individuals and seems to exceed other described populations in severity of hypoplasia.

Modal age at hypoplasia formation, judging from distance to the cemento-enamel junction, is 3.25 yr for LEH, 3.5 for PIT, 4.25 for MGA and 3.25 for total hypoplasias. The distribution correlates with historical evidence for a relatively late weaning age among Barbados slaves of 2-3 yr. In the year following weaning, mortality and morbidity risk were at their post-natal peak, and this is where the mode for hypoplasia formation is centered. The residual distribution of defects may relate to other historically documented sources of periodic severe metabolic stress resulting from malnutrition and disease.

Mandibular condyle size in Haida Indians. R.L. COSTA, JR., University of Illinois at Chicago.

Mandibular condyle size was compared to age and sex and condyle asymmetry was compared to age and dental wear. The Haida sample studied was collected from burials around the turn of the century and is now housed at the Field Museum of Natural History in Chicago. 81 skulls, 51 of which are accompanied by postcranial material, were aged and sexed as part of this study. Condyle length and breadth were measured and multiplied to give a measure of condyle size. Dental wear was recorded using an eleven stage system similar to the eight stage system used by Smith (1984). This allowed wear scores to be averaged for each dental quadrant and compared from side to side.

Males displayed condyles 19.7% larger than females, probably due to males having larger craniofacial skeletons (Hinton, 1983). Condyle size increased with age until 30 years of age in females and 35 years of age in males, in contrast to the findings of

Carlsson and Oberg (1974) and Thilander (1976) who studied histological samples of Europeans and found that condyles stopped growing between the ages of 20 and 26 years. The overall correlation between condyle size and age was $r = .58$ for males and $r = .63$ for females.

Male condyles displayed an average asymmetry of 8.3%, and females 8.9%. 58.6% of the larger condyles were found on the right side. There was no correlation between the larger condyle and the side of the mouth with the most dental attrition, nor was there a correlation between age and condyle size asymmetry.

The skeleton of Smilodectes gracilis. H.H. COVERT, University of Massachusetts, Amherst.

The skeleton of Smilodectes gracilis, a middle Eocene notharctine, is known from a number of specimens. The nearly complete skeleton USNM 25686 is of particular interest and is the focus of this research.

The morphology of S. gracilis indicates that it was an arboreal primate with a body mass of approximately 2.0 kilograms. Forelimb and shoulder girdle morphology suggest that S. gracilis was an orthograde climber which possibly practiced some forelimb suspension. Elbow complex morphology indicates that S. gracilis frequently powerfully flexed its forearm and that its digits were capable of powerful grasping. This may indicate some habitual clinging behavior. Hindlimb and pelvic girdle morphology suggest habitual flexion and lateral rotation of femur on pelvis and flexion and medial rotation of tibia on femur. Additional hindlimb characters are probably indicative of frequent leaping. The hallux is large and was capable of powerful opposability. Extant animals which provide the best analogs for S. gracilis in posture and locomotion are some of the larger Malagasy primates, specifically Lepilemur mustelinus and indriids.

While limb morphology and intermembral index of S. gracilis closely resemble those of L. mustelinus and indriids, S. gracilis does differ from these extant strepsirrhines in a number of body proportions. The fore- and hindlimbs are relatively shorter compared to vertebral column length in S. gracilis. Further, S. gracilis has a humerus which is relatively longer compared to radius length and have pedal digits which are relatively longer compared to hindlimb length.

Smilodectes gracilis was in many respects quite similar to some of the larger extant Malagasy primates in postural and locomotor behavior. It is not, however, closely analogous to any one of these animals in body proportions.

Interactions of economics, religious preference, geography and migration on the population structure of Newfoundland. M.H. CRAWFORD, P. GENE TRAPP and T. KOERTVELYESSY, University of Kansas Lawrence, and Ohio University, Athens.

Most studies of human population structure focus either on historical demography or blood group distributions within subdivided aggregates. This is due to the paucity of accurate demographic records and historical documents in parts of the world. To date, there is little information on the relationship between predicted kinship, based on demography and genetic distributions in fishing communities. This paper examines the interaction of migration, economic factors, geography, and religious preference on the observed genetic variation of Newfoundland.

Fieldwork in two areas of Newfoundland, the south coast and Fogo Island, was conducted with the collaboration of the Canadian Red Cross during three consecutive summers, 1983-83. Church records were microfilmed and standard demographic pro formae were administered to all participants. Blood specimens were collected by the Red Cross personnel from approximately 1000 research subjects representing 11 villages.

Data analyses revealed that migration rates vary from 3% to 16% per generation in the villages of Fogo Island. The mean predicted kinship, ϕ_{ij} , from matrimonial migration is 0.00537, comparable to the values observed in the Aland Islands by Mielke et al (1982). The mean first passage time, t_{ij} , indicates that the town of Fogo is acting as a sink, with economic factors being the primary attraction. Fogo contains a fish processing plant and employment associated with tourism is also available. Religious preference plays an active part in mate selection with 96% of all Catholic, 87% of the Anglican, and 60% of the United marriages being restricted to those of the same faith. The observed genetic variation in the subdivided populations of Newfoundland can only be understood on the basis of the interaction of these social, demographic, and geographical factors. Grants from Wenner-Gren Foundation, Universities of Kansas and Ohio, and the Canadian Red Cross Society supported this research.

Size and Hominoïd Phylogeny. N. CREEL, State University of New York at Stony Brook.

Published hominoïd phylogenies based on molecular data of all types routinely feature an African ape-human clade. In contrast, the most parsimonious cladistic tree derived from a large series of size-adjusted cranial and dental variables groups African apes and the orangutan in a great ape clade that excludes humans when gibbons are employed as an outgroup. All trees with an African ape-human clade are considerably less parsimonious, despite the fact that orangutans are more distant from humans in total morphology than is any African ape.

Multiple discriminant analysis of the morphological variables revealed that one of the most important discriminant axes separates humans very clearly from apes, with orangutans

most distant and gibbons least distant from man. Characters contributing heavily to this axis include many reflecting differences in facial protrusion, cranial length relative to height and width, position and orientation of foramen magnum, neurocranial globularity and general rugosity. Separate interspecific allometric analyses of great apes and gibbons revealed that in both groups smaller species differ from larger ones in much the same fashion that humans differ from apes. As a result, gibbons, who are much smaller than great apes, seem more like humans than do great apes in respect to those characters driving the human-ape axis. No size adjustment eliminates this effect. Although the similarities have differing causes, quantitative cladistic procedures do not distinguish differences in their origins and thus find that trees with an African ape-human clade are less parsimonious.

Elimination of gibbons from cladistic analysis yields a shortest tree with an African ape-human clade, lending support to both the above interpretation and the view that African apes and humans share a more recent ancestor than either does with the orangutan.

Hypertension, Obesity and Mortality in American Samoa. D.E. CREWS, Department of Anthropology, The Pennsylvania State University, University Park, PA 16802.

Elevated blood pressure and obesity are commonly associated with an increased risk of death. Previous research in American Samoa suggests that these risk factors do not differentiate between those who died of cardiovascular disease (CVD) and those who died of other causes. The purpose of this study was to determine whether systolic and diastolic hypertension or obesity were associated with an increased relative risk of death from all causes, CVD or cancer in American Samoa.

In 1976, approximately 6,000 residents of American Samoa participated in two health screening surveys. Each participant's systolic and diastolic blood pressure, weight and height were recorded. By January 1982, 111 men and 56 women who participated in these two health surveys had died. Comparisons between hypertensives and normotensives, and between the obese and nonobese, were made using the odds ratio to measure relative risk.

Among men, only systolic hypertension significantly increased the relative risk of death; among women both systolic and diastolic hypertension increased the risk. Obesity was not associated with an increased risk of death in either sex. Systolic and diastolic hypertension were associated with an increased risk of mortality from CVD in both sexes. Obesity was not associated with an increased risk of death from CVD in either sex. Neither type of hypertension nor obesity were associated with an increased risk of death from cancer in either sex.

This study suggests that in American Samoa hypertension is an important risk factor for mortality from all causes and CVD. Obesity is

not a risk factor for death from any of these causes in American Samoa.

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Aspects of Prosimian behaviors: locomotor, environmental and dietary characteristics. R. H. CROMPTON, S. S. LIEBERMAN and C. E. OXNARD, Chinese University of Hong Kong, and University of Southern California, Los Angeles.

Much of primate morphology reflects locomotor and related activities. Early studies used locomotor classifications with broad categories such as climbers and leapers. Field studies show that behavioral diversity is too complex to be described by such terms.

Knowing that it is impossible to characterize structure fully using few features, but knowing also that structure can be well described using multidimensional approaches, we present a parallel, multidimensional, definition of function in prosimians. One of us (R.H.C.) has direct access to field data, has viewed third party video and film records, and has surveyed an extensive literature. From these we have derived quantitative evaluations for locomotor characteristics (e.g. style of leaping, of running), environmental features (e.g. canopy habitat, small branch milieu), dietary preferences (e.g. fruit, gums, animals). Body weight is known.

These raw data are then grouped multidimensionally to provide profiles for the comparison and clustering of individual species and variables.

Major clusters making obvious biological sense, such as, separately, lorises and galagines, are clearly demarcated. However, within such obvious groups are internal subgroups that also make biological sense (e.g. within *Galago* is a subgroup comprising only the species: senegalensis, zanzibaricus and garnetti).

These multidimensional behavioral profiles reveal unexpected information about function and permit much closer comparison with multidimensional assessments yielded by new studies of structure at the species and geographic locality levels.

Longitudinal growth in fetal and early postnatal life: continuity and relation to maternal size. C.E.CRONK and A.B. KURTZ, Drexel University and Thomas Jefferson University Hospital, Philadelphia.

While continuity and heritability of growth during postnatal life are well-documented, estimates of such relationships for prenatal size and growth are largely based on birth size. In the present study, 55 healthy, term infants 6 to 12 months old were select-

ed from those who had had two or more ultrasound measurements during gestation. Z-scores for recumbent length (RL), head breadth (HB), and head circumference (HC) were compared with their closest fetal analogs: femur length (FL), biparietal diameter (BPD), and head circumference (FHC). Correlations among the same prenatal measures at different fetal ages were lower than those observed among the same postnatal measures. Correlations between analogous pre and postnatal measures ranged from .3 for BPD/HB to near .5 for FL/RL and FHC/HC. Z-scores for birthweight (BWT) had correlations of .2 to .6 with fetal measures and .3 to .6 with postnatal dimensions. Z-scores for mother's height, HB and HC were only modestly correlated with prenatal measures of their offspring, and these correlations were lower than those observed with postnatal measures and BWT.

These findings are preliminary in that they are based on a small sample. However, they suggest that there may be less measurable continuity within pre than within postnatal growth; substantial continuity between pre and postnatal size; and a smaller contribution of maternal genes to pre than to postnatal size.

Supported by a Drexel Research Scholar Award.

Further observations on cribra orbitalia in British Columbia samples. J.S. CYBULSKI, National Museum of Man, Ottawa.

Cribra orbitalia, previously quantified in early historic period samples of the British Columbia coast (Cybulski, '77), is reported for prehistoric samples from three localities: the north mainland coast, the south coast Gulf of Georgia region, and a site on the Queen Charlotte Islands. For localities with samples from both time periods, higher incidences are apparent in the prehistoric samples, although the latter are smaller and the results may be complicated by biases in observation. Greater differences occur between north and south coast prehistoric samples, with cribra orbitalia more common in the south, although, again, recording biases may be influencing these results. Other factors that might indirectly be cited to account for temporal and regional variations in incidence include time-related differences in the incidence of injury (higher in the prehistoric period), regional differences in the incidence of chronic diseases (higher in the south than in the north), and regional variation in genetic homogeneity (greatest on the Queen Charlotte Islands). A general conclusion is that cribra orbitalia in British Columbia coastal samples and individuals probably does not reflect a common etiology beyond that of its immediate physio-

logical association with marrow hyperplasia and anemia.

Reference cited:

Cybulski, J.S. (1977) Cribra orbitalia, a possible sign of anemia in early historic native populations of the British Columbia coast. Am. J. Phys. Anthropol., 47: 31-40.

A new precise definition of epigenetic traits on the cranial and postcranial skeleton. A. Czarnetzki, University of Tübingen, Tübingen.

Since the starting of paleopopulation research with epigenetic traits during the early 1960s some students mentioned the unprecise definition of some of these traits. Other publications were concerned with the inter-observer divergence and a second group decided pathological changes like cribra orbitalia or exostoses (torus accust. ext.) in the outer ear as epigenetic traits.

On the other hand, some students seemed to have no serious knowledge of the skeletal and soft tissue anatomy when they found, for example, the asteric bone on the base of the cranium. Therefore two years ago the Arbeitsgemeinschaft Paläoanthropologie und Prähistorische Anthropologie (APPA) set up a commission that should give a new precise definition of all important epigenetic traits. The members of this commission are A. Czarnetzki (Univ. Tübingen), B. Kaufmann (Museum Nat. Hist., Basel) and N. Xirotiris (Univ. Frankfurt).

The most important task of this commission therefor was to determine a precise anatomical description of the different traits. This included to find out the ontogenetic and/or exogenic background to give photographs or drawings of each of them.

The aim of this work shall be to give each student the possibility of a trusting comparison with the results of other authors working with these definitions and a better understanding of paleopopulations' genetics.

Some of the most difficult traits shall be demonstrated such as the difference between interparietal, lambdoid, preoccipital, and Inca bone, the position of the asteric bone in contrast to lambdoid suture bones and the differentiation of double foramina.

A comparison of hominoid female reproductive physiology. N.M. CZEKALA, S.E. SHIDELER and B.L. LASLEY, San Diego Zoo Research Department, San Diego, CA.

Ovarian steroid excretion has been evaluated in four hominoid species. Sequential urine samples from human, orang-utan, gorilla, and gibbon females were analyzed by radioimmunoassay for major estrogen and progesterone metabolites during non-conceptive ovarian cycles. The mean

follicular phase length of the ovarian cycle which represents the time from the onset of menses to ovulation, ranges from 13 days in the orang-utan and gibbon, 14 days in the human, to 19 days in the gorilla. The mean luteal phase lengths which represents the time from the estrogen peak to onset of menstruation are 9, 12, 14 and 16 days in the gibbon, gorilla, human, and orang-utan, respectively. In the gorilla, a preovulatory rise in progesterone metabolites extends the functional luteal phase to 14 days. Progesterone metabolism measured as pregnanediol-3-glucuronide (PDG) is highest in the human (11 µg/mg creatinine) and considerably lower (0.7, 0.1 µg/mg creatinine) in the gorilla and orang-utan and below sensitivity of the assay in the gibbon. In the gibbon, progesterone metabolism appears to be more similar to cercopithecoids than to other hominoids. Placental estrogen production and metabolism were evaluated for the human, orang-utan, and gorilla during pregnancy. Estrogen excretion during pregnancy indicates that the human and orang-utan are similar in terms of qualitative and quantitative estrogen production and metabolism. In contrast, the gorilla pregnancy is associated with a quantitatively lower estrogen excretion profile. This lower profile is associated with a smaller fetal adrenal and decreased fetal zone as compared to the human and orang-utan.

Femoral cortical involution in a colonial Maya population. M.E. DANFORTH, Indiana University, Bloomington, S.L. BENNETT, M.N. COHEN and H. MELKUNAS, State University of New York, Plattsburgh.

Cortical involution results from a complex interaction of nutritional and degenerative factors and thus can reveal information about the ageing process in and health status of a skeletal series. In this study, involution was analyzed in a colonial Maya population from Tipu, Belize. The site had a Catholic church but was outside the sphere of direct Spanish influence. Cortical thickness and area were measured at the femoral midshaft of 114 adults, and results show good bone maintenance with little osteoporosis. Typical sexual patterns of degenerative bone loss are present.

Intrasite variation in cortical involution is seen which may be related to different levels of access to nutrition in the population. Males buried near the altar of the church average over 12% more cortical bone than do males of the same age group buried near the back and outside. Females showed much smaller differences between the three burial areas. Ethnohistorical sources suggest that males near the altar should have enjoyed the highest status in the population, thereby having the greatest access to resources, including protein in the diet. Such an explanation for the increased cortical bone area is supported by a lower caries rate and

significantly greater stature for this sub-sample as well. In contrast, females do not show a consistent pattern of differences for these same traits. These findings are discussed in light of results from trace element and isotopic analysis.

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The a-b ridge count in Down Syndrome. M.A. DAVEE, T. REED,* R. MEIER. Indiana University, Bloomington, IN, *Sch. of Med., Indpls.

A previous unconfirmed study (Fang, 1950) indicated that individuals with Down syndrome had a lower total a-b ridge count compared to a group of normals. The present study compares the total a-b count of 453 Down cases with 264 controls. The mean a-b ridge count for the Down cases is 81.5 while the mean for the controls is 85.0 (t-test p<.001).

We believe this decrease in total a-b ridge count in the Down sample is accounted for by the number of individuals with a pattern in interdigital area II (ID II). Only 20 of the 264 controls have a pattern or vestige in this area (7.5%) while 90 of the Down cases have a pattern or vestige in ID II (20%).

The effect of having a pattern in this area can be seen as follows. In the Down sample, the a-b mean for those cases with pattern is 72.5 while the mean for those cases without pattern is 83.7. The mean for the control sample with pattern is 80.2 and the mean for controls without pattern is 85.4. Comparisons of means between and within the two samples are all significant.

The 11.2 ridge difference between the means of the Down cases with and without pattern compared with only a 5.2 difference in the controls is best explained by the fact that 49% of the Down cases with pattern have a bilateral distribution, while only 20% of the controls have pattern or vestige on both hands.

This study suggests that patterns in ID II are associated with lower a-b ridge counts in both Down and normal individuals. Preliminary evidence indicates that an expected increase in a-b asymmetry, as a reflection of increased developmental instability in Down syndrome, is not present except for a few Down cases with a pattern unilaterally and a shift of the a triradius into the a' position on the other palm.

Adaptation of masticatory muscles to increased functional demands. P.C. DECHOW, P. GUELINCKX and D.S. CARLSON, The University of Michigan, Ann Arbor.

In the evolution of primate craniofacial form, the importance of muscle size and

strength is assumed. However, often overlooked is the ability of muscle to adapt to increased amounts of activity, which may also affect craniofacial form. An experimental design of surgical overloading was used to test two contrasting hypotheses of how the masticatory muscles adapt to increased demands. Masseter muscles were removed bilaterally in 5 young female rabbits and the temporalis and medial pterygoid muscles were allowed to adapt for an 8 week period following surgery. It was hypothesized that the muscles would adapt by (1) an increase in size and force or (2) a decrease in fatigability following frequent loading. Histochemistry, *in vivo* studies of contractile properties and occlusal force measurements were used to compare the muscles in the experimental animals with 5 control rabbits.

The results indicated a decrease in fatigability in the masticatory muscles of the surgicized animals. Experimental animals lost an average of 24 (s=9) newtons (65%) of incisal force by two weeks following surgery. This loss was maintained throughout the study. The masticatory muscle weights, twitch tensions and tetanic tensions of the experimental animals were not greater than those of the controls at 8 weeks postsurgery. An increase in the percent cross-sectional area of fast fatigue-resistant fibers (17% in controls versus 29% in experimentals, $t=2.1$; $p<.05$), a slower time-to-peak twitch tension (46 ms versus 41 ms; $t=3.2$; $p<.01$) and a lower fatigue index indicated an increase in oxidative metabolism. These results suggest that muscles that are used for highly repetitious activities with infrequent maximal loadings adapt to overloading by increasing fatigue resistant properties rather than by increasing maximal force producing capability.

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Sex differences in the development of morphological asymmetries in human fetuses. M.C. DE LACOSTE and D.S. HORVATH. University of Texas Health Science Center, Dallas.

Our overall goal in this laboratory is to delineate the ontogenetic and phylogenetic development of prosencephalic regional volumetric asymmetries in primate brain. In a previous study, we demonstrated clear regional volumetric asymmetries in the adult human brain. The current study was undertaken: (1) to investigate the patterns of hemispheric and regional volumetric asymmetries in developing human fetal brains and (2) to determine if there are characteristic sex differences in these patterns.

Our results suggest the following: (1) Asymmetrical development of the hemispheres can be seen as early as 13 weeks gestational age (GA). At this stage, the entire right hemisphere is larger in males. In contrast, in females pre-rolandic cortex is both larger and more developed on the left side. (2) Between 17-26 weeks GA, left temporo-parietal cortex overtakes right hemisphere development in males. In females, the same pattern pre-

sent at 13 weeks GA persists, i.e. regional volumes favor left prefrontal cortex and right temporo-parietal cortex. (3) At some point post 26 weeks GA, differential regional growth patterns are reversed in both males and females. Hence, in males at birth, left prefrontal cortex is larger than its right counterpart. Conversely right prefrontal cortex is larger in females. Temporo-parietal cortex, however, is larger on the left for both males and females, although this asymmetry is more pronounced in males.

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Reconstruction of the 1958 cranium of Oreopithecus bambolii and its comparison to other catarrhines. E. Delson, Lehman College, CUNY, and F. S. Szalay, Hunter College, CUNY.

In 1958, soon after Hürzeler's short monograph on Oreopithecus bambolii appeared, a distorted and flattened but nearly complete male skeleton was recovered in the Baccinello mine (VI horizon, age ca. 9 MY BP). Hürzeler (1960) graphically reconstructed the skull to have a large, globular vault. Szalay and Berzi (1972) showed that Hürzeler had mistakenly interpreted cervical vertebrae and a sagittal crest as part of the vault, giving their restoration a much smaller neurocranium. With technical assistance from Mr. Otto Simonis, we have now prepared the crushed skull and partly reconstructed it three-dimensionally. The mandible is nearly complete, although the symphysis is distorted and the corpora too low. The upper circumorbital region is almost intact, and while the maxilla and facial bones are damaged, the face is clearly wide and rather short. The zygomatic arch curves upward, confirming the strong chewing musculature which can be inferred from scars, crests and the much expanded gonial region. It was not possible to restore the neurocranium, but casts have been reset to provide an approximation of its shape. The compound temporal-nuchal crest produced a large, flat opisthocranial eminence. The atlas is intact and fits on both the single preserved occipital condyle and the damaged axis (C2), now crushed into other cervical vertebrae. At least one example of every tooth is present, allowing study of occlusion. Of the lower teeth, R M3 and parts of P3-M1 are missing, as are the upper R I1, most of R M3 and L M2 and parts of R P3-M1 and both canines. Few cranial features appear to be synapomorphic with other catarrhine taxa.

The influence of non-biological factors on human genetic characteristics. E.J. DEVOR, Washington University, St. Louis.

In recent years, students of Anthropological Genetics have come to recognize that non-biological factors unique to humans present a

complex set of interactions which must be accounted for in studies of genetic characteristics. These non-biological factors include environmental effects, social interactions, and cultural practices. Moreover, it has become clear that the influence of such factors is to be seen at all levels of human genetic study.

In this paper the role of non-biological factors will be discussed at the level of the individual family, the subdivided population, and the microevolutionary process itself. In addition, in keeping with a resurgent trend in physical anthropology, examples of specific human genetic diseases will be used at all three levels of anthropological genetic study: chronic obstructive pulmonary disease in families, adenocarcinoma of the gallbladder in a human isolate, and the evolution of the Huntington's Chorea gene.

Finally, some directions for future research in Anthropological Genetics in the context of this discussion will be suggested.

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Evolution of the petrosquamous and cranio-orbital sinuses. M.K. DIAMOND, University of Chicago.

An examination of bony sulci left by the petrosquamous sinus, cranio-orbital sinus and their tributaries reveals that the great majority of prosimians share a conservative sinus morphology which is probably primitive for the order. Both the cranio-orbital sulcus (COS) and petrosquamous sulcus (PSQS) are relatively large and there are wide communications with the orbit, the external jugular system and the sigmoid sulcus. Tributary sulci display little differential enlargement.

In anthropoids both the COS and PSQS tend to diminish in relative size and this is associated with an increase in intraspecific variability characterized by a high frequency of anomalies, "atavisms" and "anticipations". Despite this variability, species-specific modal morphotypes can be identified and these range from primitive to highly derived. Since all sulcal configurations develop from a common set of embryonic dural veins and seem to be functionally equivalent and adaptively neutral, there is likely to be a great deal of convergence, parallelism and reversal among anthropoid species.

Within the Hominoidea, Pongo proves to have a relatively primitive sulcal morphology as it typically retains, for example, a sizeable cranio-orbital foramen. Pan, Corilla and Homo share a number of derived characteristics, the most important of which is the complete migration of the COS to the floor of the middle cranial fossa. The lesser apes all seem to share a single derived modal morphotype which is quite different from the other hominoids.

The sulcal morphology of Homo is so highly derived that homologies with other primates have been overlooked. It is therefore time to

correct this oversight by discarding the anatomically unsound system that for the past 70 years has been used to describe the misnamed "middle meningeal grooves" and replacing it with a nomenclature that reflects ontogenetic and phylogenetic continuity.

The effect of age at marriage on selection in Halfmoon Township, Pennsylvania, 1850-1900. DOUGLAS DINSMORE, The Pennsylvania State University, University Park.

Changes in the mean age at marriage affect the opportunity for selection. In societies where there is substantial young adult mortality, potential fertility is reduced by mortality before reproduction occurs. Using mortality and marriage models, this study examines the effect on the opportunity for selection of changing age at marriage in a small agricultural community (n=700) in central Pennsylvania. The mortality and marriage data were calculated for the population at two times, 1850 and 1900, using historical records to reconstruct the population.

For each of the two periods, I identified a cohort of persons who turned age 39 in the preceding ten years, 1841 to 1850 and 1891 to 1900, respectively. The age at marriage increased for both men and women during the 50-year period, 24.9 years to 27.7 for men, and 22.2 years to 24.4 for women. All the marriages occurred within the age interval from 15 to 39 in both periods. Of the cohort which turned age 39 in the earlier period, 18 percent died. However, of the later cohort, only ten percent died. The figures for percentage married are reversed. In the 1850 cohort, 14 percent were unmarried, and for 1900 24 percent were unmarried. I calculated the probabilities of dying and being married in each five-year age interval. The higher mortality in 1850 removed more individuals from the marriage pool than in 1900, although the age at marriage was significantly later for both men and women ($p=.001$ for men and $p=.02$ for women). In addition, women were affected less than men because their mean age at marriage was less than that of men. The opportunity for selection was altered more by the decrease in mortality than the increase in the age at marriage.

This research was supported in part by the Hill Foundation and The Pennsylvania State University.

Sexual Dimorphism and Environmental Change in Samoan Adults. J.J. DRISCOLL. The Pennsylvania State University, University Park, PA 16802

Research in human sexual dimorphism suggests that males vary more than females in response to environmental change. This relationship has not been examined for adiposity, or for

populations experiencing substantial weight gain.

In association with modernization, Samoans have undergone secular increases in weight. Previous studies indicate that modernization affects Samoan males and females differently, particularly in measures of fatness. The purpose of this study was to examine the relationship between effects of modernization and sexual dimorphism in stature, weight, upper arm circumference, upper arm muscle circumference and triceps skinfolds among Samoans at various stages of modernization.

The samples were collected between 1975 and 1979 and consist of Samoan adults from Western Samoa (n=340), American Samoa (Manu'a, n=264; Tutuila, n=1464) and Hawaii (n=592). Men and women were divided into 3 age groups (18-35, 35-50 and 50+).

Stature in each sex, and sexual dimorphism in stature (male/female=1.07), did not differ appreciably among the four residence areas. Although modernization was generally associated with larger measures of weight, upper arm muscle circumference and triceps skinfolds in both sexes, no simple association between modernization and sexual dimorphism in these traits was found. Upper arm circumferences were larger in more modernized areas for both sexes, and this was associated with a lesser degree of sexual dimorphism in this trait.

These findings suggest that sex differences in response to modernization and associated weight gain are complex and follow no simple pattern.

This research was partially supported by NIGMS Grant No. 5-T01-GMO-1748.

Mid-facial tissue depths of caucasian children; an aid in facial feature reconstruction. ELIZABETH R. DUMONT, Indiana University, Bloomington.

Available standards for facial feature reconstruction are based on adult measurements. This presents mid-facial measurements on male and female caucasian children ages 9 through 15. Measurements were taken from lateral radiographs at glabella, nasion, mid-nasal, rhinion, inferior nasal spine, prosthion, chin fold, menton, and gnathion. Radiographs produced in an orthodontic practice were used. Radiographs were taken at a standard distance with the head placed in the frankfort plane. Tables of tissue thickness for both males and females are presented. Age is an important factor which should be taken into account when reconstructing facial features. Patterns of tissue thickness in relation to dental malocclusion (Class I, Class I with overjet, Class II division 1, Class II division 2, Class III, and Class III with overjet) are discussed.

Phylogenetic relations between Homo, Gorilla, Pan, and Pongo. S.S. DUNLAP & M.A. AZIZ, Howard University, Wash., D.C.

Our dissections of nonhuman primate limbs for comparison with the atavistic musculature of human aneuploids now includes the great apes: 1 Gorilla gorilla, 2 Pan troglodytes, and 1 Pongo pygmaeus. These limb dissections continue to be important for establishing homologies and polarities, correcting errors and inadequacies in the myological literature, and in providing taxonomic information.

Contrary to Schwartz's claim that, "Man shares uniquely few morphological features with either the chimpanzee or the gorilla..." (Nature, 308:501-505), our own great ape limb dissections and the large body of published limb dissection data suggest that Homo, Gorilla, and Pan share a significant number of characters which are not shared with Pongo. These include among others: a clavicular head of pectoralis major, flexor pollicis longus, extensor pollicis brevis, tensor fasciae latae, and peroneus tertius. Pongo retains primitive intrinsic hand and deep forearm extensor and flexor musculature as well as rhomboideus occipitalis.

Drawing from many sources (Biegert, 1963; Simpson, 1961; Mayr, 1969, 1981) we argue that limbs are particularly important in establishing phylogenetic relationships. Moreover, as classification is enhanced by a consideration of different kinds of characters, it is germane to point out that the most recent primate chromosomal and DNA hybridization studies (Dutrillaux, 1979; Sibley & Ahlquist, 1984; Yunis & Prakash, 1982) indicate that Homo is more closely related to Gorilla and Pan than to the Asian apes.

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Clinic data as a tool for studying morbidity patterns in traditional communities; an example from the southern Peruvian highlands. J. S. DUTT, University of South Alabama, R. B. THOMAS, and C. TUCKER University of Massachusetts.

Little systematic information is available on morbidity patterns among native high altitude Andean populations. Although several detailed epidemiologic studies have been conducted, these have generally been short-term, and have often focused on a specific aspect of health. As a consequence such studies do not give an accurate picture of morbidity patterns in traditional communities and temporal changes in these patterns.

A primary reason for the lack of such data is the difficulty and expense associated with conducting a longitudinal epidemiological study in a traditional rural community.

However, morbidity data is often available from local hospitals and health clinics. Although this data may be biased in some ways and not give an entirely accurate picture of the morbidity in traditional populations, analysis of such data may provide information on the diseases that have important effects on the population and give insight on the impact of seasonal climatic changes.

In the present study data was obtained from the hospital of the Province of Melgar in the Department of Puno, in southern Peru. Morbidity records from the hospital's outpatient clinic were collected for the past seven years. These data are analyzed and compared with morbidity and mortality data previously published from this area. Respiratory disease, gastrointestinal disease, nutritional problems, and accidents were the most frequently reported diagnoses. Distinct seasonal patterns appear to be associated with some diagnoses. These results are similar to preliminary findings from a detailed longitudinal study of morbidity being conducted in the province. Results of this study suggest that records from hospitals can be used as general indicators of morbidity and that such data can give useful information about seasonal changes in morbidity patterns in traditional populations.

This research is supported by NSF Research Grant BNS 83-06186.

A correlation study of the a-b ridge breadth to selected bodily dimensions. MARTHA J. EBLEN, University of Tennessee, Knoxville.

Several previous studies have suggested that there is a general correlation between ridge breadth and body size. This research employs the a-b ridge breadth and 12 anthropometric measurements to examine more thoroughly the relationship of adult ridge breadth to certain bodily dimensions. The data were drawn from 165 Armenians residing in Australia and 100 White North Carolinians.

Results of the analysis indicate that the a-b ridge breadth is significantly correlated to seven bodily measurements. In order of decreasing correlation, these are wrist breadth, weight, stature, bicondylar femur, upper arm circumference, biacromial diameter, and calf circumference. Bone is the component of body size that demonstrates a correlation to the a-b ridge breadth. It is evident that the transverse dimensions of bone are better correlated than linear dimensions. Fat and muscle are not significant body size components in the correlations of ridge breadth and bodily dimensions.

Rapid human evolution in an extreme environment: a model from the Andean highlands. R. B. ECKHARDT, The Pennsylvania State University, University Park.

Over the last six years members of a research team led by me have produced a series of reports as part of a continuing investigation designed to elucidate the various interactions among genetic and environmental factors in the development of the thoracic morphology characteristic of native high altitude Andean populations. In a large scale survey, using standard quantitative genetic methodologies we have demonstrated that in the study population (the Camacani Aymara, resident at 4000 meters above sea level) thoracic dimensions have heritabilities that are moderate (in the range of 0.1 to 0.3) and lower than either the same traits in lowland populations or different traits (such as stature) in the same population. These results are consistent with selection having operated to increase mean thoracic dimensions (and concomitantly to have reduced additive genetic variation underlying them) over the course of the ten to twenty millenia that populations have been exposed to the stresses of life at high altitude in South America. The findings gain independent confirmation from our demonstration that offspring of high altitude ancestry born and raised at low altitude duplicate very closely the thoracic dimensions of their non-migrant high altitude counterparts.

In adulthood the thoracic dimensions of Andean highlanders are markedly larger than those of lowlanders. For example, thoracic volume calculated from external dimensions is about 20% higher in native highlanders. An increment in volume of 20% over 20,000 years suggests an approximate average generational change in the range of 0.02% per generation. Such a rate is at least a full order of magnitude higher than that for the volumetric expansion of the hominid cranium over the entire known duration of our lineage.

Bioarchaeological perspectives on disease in a "marginal" Mississippian population. L. E. EISENBERG, New York U.

The level of prehistoric health and disease has been the subject of study in a number of Mississippian populations by both physical anthropologists and archaeologists. On the basis of the skeletal evidence, it has been argued by some that the health status of Mississippian populations was quite good; others suggest that disease played a significant role in the ability of Mississippian groups to adapt successfully to their environment during a period of increasing social complexity.

In an attempt to learn more about Mississippian adaptation, especially outside of the more spectacular mounded sites of the Southeast, the author has examined 887 human burials recently recovered from the Averbuch site. The site, located near Nashville, Tennessee,

represents a late Mississippian village occupation, dating to approximately A. D. 1350.

The location, distribution, severity, extent and state of pathologies within each individual and throughout the entire population are examined. Patterns of disease involvement are also investigated along age and sex lines to provide information regarding age of onset and to aid in a differential diagnosis.

Preliminary data from Averbuch suggest that the incidence of infectious disease is quite high, especially in infants and young children. While nutritional deficiencies appear to a lesser extent, they may have acted in a synergistic fashion with infection, creating a more direct and devastating impact on the population. Evidence for trauma and DJD is present, but in percentages too small to have had a major effect on overall adaptation.

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The role of sex in the evolution of intelligence. D. FALK, University of Puerto Rico School of Medicine, San Juan.

Early human evolution has traditionally been attributed to brain expansion and selection for various aspects of intelligence. More recent models of human origins emphasize the role of bipedalism. Both approaches share a tendency to assess early human evolution in terms of differential selection upon males: the locomotion model holds that bipedalism was selected for in males in order to provision females and their offspring (as part of a sexual and reproductive complex); brain models postulate that human intelligence is the evolutionary result of primary selection on males for various "prime movers" such as hunting, warfare, or tool production.

In this report, the above issues are explored in light of paleoneurological evidence. Cranial venous sinus configurations suggest that bipedalism was selected for once in basal hominids and that speciation into robust and gracile lineages occurred relatively soon after this event. The cranial capacities that are available for Australopithecus afarensis show that these hominids were smaller brained than subsequently living australopithecines; it is therefore premature to reject a relationship between the beginnings of brain expansion and selection for bipedalism. An endocast from two million year old ER 1470 (Homo habilis) reproduces an apparent Broca's speech area in the left frontal lobe and shows that this individual had a larger brain than did previously living australopithecines. In sum, paleoneurological evidence suggests that brain expansion occurred throughout the known hominid fossil record, that its importance for hominid origins therefore cannot be discounted, and that selection for language abilities (presumably acting on the entire gene pool)

may have been important for the origin of the genus Homo.

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Genetic polymorphisms and fertility parameters in the Aymara of Chile and Bolivia. R.E. FERRELL, University of Pittsburgh, R. CHAKRABORTY, S.A. BARTON, AND W.J. SCHULL, University of Texas Graduate School of Biomedical Sciences, Houston.

To determine whether increase fitness in natural populations is associated with heterozygosity, several studies have attempted to correlate heterozygosity at one or a few immunological and biochemical loci with fitness related quantitative traits. The results are at best equivocal. Furthermore, data on fertility related parameters and the extent of genetic polymorphism at a large number of loci in man are quite scanty. We have examined the association of three fertility related parameters (number of pregnancies, number of livebirths, and number of children surviving at least one year) with heterozygosity at 16 polymorphic immunological and biochemical systems in the Aymara of Chile and Bolivia. Women 45 years of age and above on whom complete fertility histories and phenotype data are available were included in the study (n=190). None of the fertility parameters seem to be correlated with heterozygosity as measured by the proportion of polymorphic loci. For some individual loci, however, an association between heterozygous state and fertility parameters exists. Even in these cases, heterozygosity did not always confer higher fertility. To see whether these negative results are due to heterogeneity in the data, the total sample was divided according to altitude of residence and ethnicity. The conclusions remained the same. Thus, the lack of association of these fertility parameters with genetic polymorphism is not due to population heterogeneity alone. These results are discussed in the light of recent laboratory experiments on non-human organisms.

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Population structure and altruism: a simulation study. A.G. FIX, University of California, Riverside.

A population structure favorable to the evolution of an altruistic allele is studied by Monte Carlo simulation. The model is based on the group structure of the Semai Senoi, a Malaysian swidden-farming society. Three hierarchical levels are recognized: 1) the ecologically isolated local group (hamlet) which may be composed of kin and/or unrelated

individuals; 2) the deme (settlement) comprising several such groups which interbreed; and 3) the set of demes (metapopulation) among which gene flow occurs. The simulation models genetic drift by a process of hamlet formation which may be random, or variously kin-structured. Hamlets may then become extinct based on a probability function of their gene frequencies. Individual selection within settlements is modeled deterministically and gene flow among settlements as two-dimensional stepping-stone migration of random or kin-structured groups.

Results of the simulations show that with realistic values for group sizes, moderate extinction rate, and high rates of migration ($m > 27\%$), disadvantageous alleles ($s = 10\%$ and 25%) may increase markedly due to differential hamlet extinction over the course of 50 generations. The greater the degree of kin-structuring of founder groups, the higher the variance among hamlets, and the faster the rate of increase of the altruistic allele. Nonetheless, even in some randomly founded groups, a clear increase in the altruistic gene frequency occurred. It is also notable that kin-structured group selection by hamlet extinction may be effective when the initial frequency of altruistic genes is very low (average of one per deme) and among a relatively small number of demes (25). Thus the process of group extinction in a hierarchically structured population allows rapid increase of an altruistic allele under plausible demographic conditions.

Skeletal anatomy of *Apidium phiomense*, an Oligocene anthropoid. J. G. FLEAGLE and E. L. SIMONS, S.-U.N.Y. at Stony Brook and Duke University.

The parapihthecid primate *Apidium phiomense* from the early Oligocene of Fayum, Egypt is now known from several dozen isolated skeletal elements which can be attributed to this species on criteria of size and provenance. These include several examples of all long bones, numerous tarsals, and a variety of digital elements from the hands and feet.

In overall proportions, *Apidium* appears to have had hindlimbs that were considerably longer than its forelimbs. This small (1300g) primate shows many detailed features in its hindlimb morphology, including shaft dimensions, joint surface morphology, and osseous records of muscle attachments that indicate leaping abilities. Its forelimb morphology suggests quadrupedal rather than clinging habits.

This early anthropoid shows more anatomical specializations related to leaping habits than are known for any other higher primate and few features that suggest close phyletic ties with any one group of living anthropoids.

This work was supported in part by Research Grants BNS 8210949 and BNS 8209937 and a Fellowship from the John Simon Guggenheim Memorial Foundation.

Birth seasonality in the Åland Islands, Finland - 1750 to 1849. K. H. FLEISS, University of Texas at Austin.

Birth seasonality, as with other demographic variables is a reflection of a population's adaptation to its environment. This adaptation can be viewed in essentially four ways: 1) adaptation to the natural environment, 2) adaptation to the cultural environment, 3) adaptation to the natural environment mediated by cultural factors, and 4) adaptation to the cultural environment mediated by biological and/or environmental factors.

This study examines birth seasonality in the Åland Islands, Finland for a 100 year period--1750 through 1849. The birth records for 11 of the 15 parishes which comprise the Åland Islands were examined. Six Main Island Parishes (MIP) and five Outer Island Parishes (OIP) were used. In this way, a general Åland pattern can be determined as well as two sub-patterns. While the MIP and the OIP exhibit similar seasonality schedules, there are differences which appear to be related to the mode of production; the MIP economies are based on agriculture while the OIP economies are based on fishing. Raw numbers of births for each parish were computed and then adjusted for the number of days in each month using the following formula: $N_i^* = 30.4375N_iD_i^{-1}$, where N_i^* - standardized number of births in an i th month, N_i = number of births observed in the month, and D_i = number of days in the month.

A general conclusion that can be reached is that birth seasonality in the Åland Islands during this period was basically a cultural adaptation mediated by environmental factors such as seasons of planting and harvesting and seasons when fish were running.

This investigation was supported, in part, by University of Kansas General Research allocation #3286-xo-0038; Samfundet Folkhälsans Genetiska Institut and the Sigrid Jusélius Foundation, Helsinki, Finland.

THE VISCOELASTICITY OF HUMAN TEMPOROMANDIBULAR JOINT DISCS
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Creep and stress relaxation tests were performed on human temporomandibular joint (TMJ) discs. Collectively, creep and stress relaxation are the features of viscoelasticity. The Kelvin model for viscoelasticity (eq. 1) was used to describe the observed creep and stress relaxation behavior of the TMJ disc.

$$\sigma + \tau_c \dot{\sigma} = E_R [\epsilon + \tau_\sigma \dot{\epsilon}] \quad \text{Equation 1.}$$

The TMJ is a ginglymo-arthrodial articulation that is load bearing during function. The TMJ disc is a white, dense, connective tissue, from 1 to 3 mm thick, that is interposed between the bony articulating ends in the TMJ.

Human TMJ discs were procured at autopsy placed in isotonic bacteriostatic saline, then refrigerated. Circular specimens of diameter 0.246 inch. were prepared. Mechanical creep and stress relaxation tests were

performed at room temperature in unconfined compression on specimens with a servomechanically controlled test system. Six specimens underwent creep tests and six specimens underwent stress relaxation tests. Specimen loading, in the form of a step function, was 3.0 lbs in the creep test. Specimen deflection, in the form of a step function, was 0.01 inch. in the stress relaxation test.

The derived viscoelastic parameters from the Kelvin model are presented below (shown are the average values with standard deviation):

τ_e (s.d.)	τ_σ (s.d.)	E_R (s.d.)	T (s.d.)
2.42 (0.38)	405 (101)	260 (49)	.070 (.010)

where, τ_e and τ_σ are the relaxation times in seconds for constant strain and stress, respectively. E_R is the relaxed elastic modulus in psi, and T is the average thickness of the disc in inches.

The results reveal that the TMJ disc behaves as a viscoelastic material. Because of its viscoelastic nature, the discs distributes stresses better than purely elastic materials. Hence, the disc functions biomechanically to reduce contact stresses (or strains) by creeping (or relaxing) under loading.

Dental allometry in the Platyrrhini and changes in a dwarfing lineage. S.M. FORD and M.M. BARGIELSKI, Southern Illinois University, Carbondale.

The Callitrichidae are now widely accepted as phyletic dwarfs within the Platyrrhini. Gould (1975) suggested that tooth size should not reduce at the same rate as overall body size and that, therefore, dwarfing lineages should exhibit different allometric relationships between tooth area and body size from those seen in increasing-size lineages. This is tested using platyrrhines.

Eighteen platyrrhine species, including eight callitrichids, were examined for allometric relationships between body size and occlusal area of various portions of the dentition, using published data. Incisor/canine area, total premolar area, total molar area, combined cheektooth area, and total area, as well as occlusal area of individual molar teeth, were all examined in combined and same-sex samples. The callitrichids exhibited significantly different allometric relationships for only a few portions of the dentition, and in some cases there was only a weak correlation between dental area and body size across platyrrhines. The roles of diet, body size, and phylogeny in determining these relationships are all considered. The maintenance of a fairly constant relative functional cheektooth area across platyrrhines, despite the loss of the third molar in callitrichines, is seen as support for Gould's hypothesis.

Measures of lateral functional dominance. K. M. FOX, C. C. PLATO and R. M. GARRUTO, National Institutes of Health, Baltimore and Bethesda.

Male and female participants of the Baltimore Longitudinal Study of Aging were evaluated for lateral functional dominance. The participants were tested for fifteen individual functions; ten related to hand dominance and five to foot preference, eye preference, digital interlocking, arm folding and foot overlapping. The results from the hand dominance study indicate that the frequency of left hand dominance is higher in males than females, and higher in younger than older adults. Furthermore, the results support the hypothesis that handwriting and the participants' own assessment of their handedness are the most reliable predictors of hand dominance. The battery of lateral dominance tests used in this study added very little to the overall determination of handedness.

The results of the analysis of the remaining five measures reveal a significant association between foot preference and foot overlapping in males and females and between these two functions and handedness. Eye preference, digital interlocking and arm folding were found to be independent of each other and of the foot functions and handedness. The frequency of left dominance for the foot functions was twice as high in males than in females. No other sex differences were observed. There is no evidence in this study to suggest that the frequency of left dominance for any of these five functions changes with age once adulthood is reached.

Evolutionary models and rates of change for traits undergoing structural reduction. D. W. PRAYER, University of Kansas, Lawrence.

Rates of change for tooth size reduction in post-Neanderthal European populations are presented. Associated with overall trends for decrease in tooth size are differential patterns affecting males and females. When the sexes are compared, alternate stages of stasis and change are apparent, leading to fluctuating levels of sexual dimorphism. These observations underscore the importance of analyzing evolutionary rates in the hominid fossil record with regard to the specific sexes.

Despite the fact that substantial reductions in tooth size occur over this 25,000 year time period, evolutionary rates measured in darwins or by generation are exceedingly low. Thus, selection intensities responsible for producing the observed changes are also very small. Application of Lande's models for detecting the amount of selectional culling per generation and the likelihood of genetic drift in causing these trends leads to the conclusion that random factors may be involved. Given the

difficulties in determining selectional factors which account for dental reduction and the low evolutionary rates, it may never be possible to determine the mechanism responsible for dental reduction.

Population distance arrays from the Solomon Islands. J.S. FRIEDLAENDER, Temple University, Philadelphia and J.G. RHOADS.

The eight groups surveyed by the Harvard Solomon Islands expeditions have yielded six different sets of population distances based on anthropometrics, blood polymorphisms, dermatoglyphics (male and female), and odontometrics (male and female). A comparison of these arrays by the Gower technique shows them all to be consistent and indicates that the dermatoglyphic variables yield the most stable and distinctive result. This is a finding contrary to some of our earlier conclusions and is due to our formerly insufficient list of dermatoglyphic variables.

The overall results indicate the importance of early migrational events in establishing the pattern of diversity in Melanesia, rather than genetic drift, and lead us to a different view of population diversity in earlier periods of human evolution.

The influence of dietary sodium and potassium on blood pressure of American blacks and whites. A. R. FRISANCHO and W. R. LEONARD, University of Michigan, Ann Arbor.

In a previous publication (Frisancho et al. 1984) we demonstrated that the higher blood pressure of American blacks was not associated with a higher consumption of sodium, but with a relatively low intake of potassium. Therefore, we postulated that the higher blood pressure of blacks was due to an increased sensitivity to the hypertensinogenic effects of sodium, and to a lower consumption of potassium. If this is the case, one would expect that blacks whose intake of sodium and potassium is equal to that of whites would still have higher blood pressure. On the other hand, if the difference in blood pressures is due solely to differences in sodium and potassium consumption, we would expect blacks and whites having the same dietary intakes of these nutrients to have comparable blood pressures. To test these two competing hypotheses we analyzed data on blood pressures and 24-hour dietary intakes of blacks and whites studied in the Second National Health and Examination Survey of 1976-1980 (NHANES II).

The sample consisted of 10,762 individuals ranging in age from 20 to 74 years, of which 9572 were whites and 1190 were blacks.

Comparison of blood pressures adjusted for the observed differences in sodium and potassium indicates that blacks consuming equal amounts of sodium maintain higher blood pressures than whites. However, increased blood pressure in blacks is diminished when potassium intake is increased to levels approaching that of whites. These findings support the hypothesis that the tendency towards higher blood pressure among blacks results from the combined effects of high sensitivity to sodium and disproportionately low intake of potassium.

Modeling and remodeling: two of the basic histologic activities of the bony skeleton. H.M. FROST, Southern Colorado Clinic, Pueblo

It should be useful to anthropologists and paleontologists to know that in the operational sense the bone resorbing and forming activities that occur in mammalian skeletons come in two different forms that arise in the skeletal intermediary organization. In the new bone lexicon they are named modeling and remodeling.

Modeling, as in sculpting in plaster, involves biologically separate resorption drifts in some places and formation drifts in others that model or sculpt the shapes of growing bones and recontour the shapes of malunited fractures during growth. The histological hallmarks are circumferential lamellae and associated arrest lines that occur primarily on cortical-endosteal and periosteal surfaces. Modeling occurs during growth in all bony vertebrates but not after skeletal maturity in species that do mature in that sense. Remodeling in the new lexicon is a form of packet-like bone turnover produced by basic multicellular units (BMU) that couple discrete resorption processes to discrete formation processes in the same location and in sequential order. This produces a quantized form of bone turnover that occurs on all four skeletal envelopes, and throughout life in man but in only trivial amounts in short-lived and small bony vertebrates such as rats and sparrows. Characteristic bone tissue balances are associated with remodeling on those envelopes. Its histological hallmarks include discrete moieties of lamellar bone separated by scalloped reversal lines from other bone.

Each of the two activities named above has its own physiological controls, its own kinds of malfunctions and each can cause its own group of bone diseases. They can act alone or together.

Ethnographic perspective on Tojolabal Mayan demography. LOUANNA FURBEE and ROBERT A. BENFER, University of Missouri-Columbia.

Anthropological populations present demographers with a characteristic set of problems having to do with smallness of sample and with unreliability of data. It may be that,

because they are statistically unreliable, data from such small samples may not be well suited to demographic projection. Such data may be more important for interpretation in ecologically oriented ethnographic studies.

Members of anthropological populations perceive actual, not theoretical, mortality and fertility. Sampling fluctuations are real events to a community. In such communities, the levels of success in adaptation may vary widely, even among small groups that are culturally similar. These adjustments may be demonstrated in mortality and fertility levels as their response to stress and their perception of previous mortality and fertility levels. Thus, mortality and fertility levels may be interpreted as adaptation to stress.

We compare three Tojolabal Maya communities in Chiapas, Mexico, which, although culturally similar, demonstrate levels of adaptation to stresses impinging on them. The high levels of stress endured by the Tojolabal Maya population is confirmed by cross-sectional growth studies of the Tojolabal and other Mexican ethnic groups. Differential responses of the individual communities are predicted by the demographic findings from them. These variations can be interpreted in terms of differences in access to human as well as natural resources in each community. These factors include land scarcity, political disorder, inadequate nutrition, disease, and access to health care. In response, the Tojolabal may have increased their production of children, a solution which may exacerbate their problems.

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The biological structure of mortality in the Caribbean. T.B. GAGE, Southwest Foundation for Biomedical Research, San Antonio.

Anthropologists often assume that all human mortality patterns are sufficiently uniform to apply model life tables based on national populations to the small populations that they generally study. A preliminary examination of several life tables from small Caribbean islands, however, suggested that the mortality pattern of island populations may differ significantly from that of national populations as represented by the Coale and Demeny model life tables. This paper examines these differences in detail and identifies their biological basis.

The differences in mortality pattern among 56 Caribbean life tables and the Coale and Demeny model life tables were determined using a recently developed competing hazards model. The model contains 5 parameters that partition mortality into 3 biologically interpretable components; immature, senescent, and exogenous mortality. All life tables and model life tables were fit to this hazards function using a non-linear regression routine to estimate the parameter values and their variances. The

advantage of this method over previously available methods is that it allows a statistical analysis of the biological differences among life tables.

Comparison of the mortality tables indicates significant differences in all three components between the Caribbean tables and the Coale and Demeny, West model table at the same level of mortality. In the Caribbean, immature mortality begins lower, but declines more slowly with age, exogenous mortality is lower, and senescent mortality begins higher, but increases more slowly with age. None of the other Coale and Demeny regional tables have all of these characteristics. The environmental correlates of these patterns are presented, and the biological basis and implications for demographic and biomedical research in the Caribbean are discussed.

This research supported by NICHD Grant No. 17133.

Enamel thickness and human evolution. D.G. Gantt, Emory University, Atlanta.

Bipedalism has been shown to be a diagnostic character state which separates hominids from other hominoids. Another diagnostic trait is enamel thickness. Studies of the thickness of enamel in Neogene hominoids have documented that the early to late, large, Miocene hominoids had thick enamel when compared to the African apes, Pan and Grollia. However, studies of the thickness of enamel in the Australopithecines document that these hominids had significantly thicker enamel than any extinct or extant hominoid. Fractured and broken teeth from the Omo, Garusi, Laetolil, and South Africa were studied to determine the thickness of enamel. The data obtained was then compared to that obtained from thin sectional analysis of extant primates as well as to the measurements obtained from Neogene hominoids. The average thickness of enamel among the Neogene hominoids was 2 to 2.5 mm, including Pongo. However, in the Australopithecines, the average thickness was found to be 4 to 4.5 mm, almost twice as thick as Miocene hominoids and if allometric considerations are taken into account they may be considered to have had hyper-thick enamel. This data suggest that the a marked adaptive shift occurred which clearly separates the Miocene to Pliocene hominoids from the Australopithecines.

This new dietary specialization require significantly greater masticatory loading during churning and grinding thereby requiring an increase in the thickness enamel to compensate for the increased rates of wear. Furthermore, this increase in the thickness of enamel would protect against fracturing of the teeth due to the grit in the diet.

Seed dispersal in two species of callitrichid primates: Saguinus mystax and Saguinus fuscicollis. P.A. GARNER, University of Illinois at Urbana-Champaign.

Data collected during a 12 month field investigation of mixed troops of moustached and saddle back tamarins in the Amazon Basin of northeastern Peru indicate that callitrichid primates play an important role in tropical forest seed dispersal.

The diet of S. mystax and S. fuscicollis is composed principally of ripe fruits, insects and plant exudates. Fruits consumed by these small bodied primates are characterized by relatively large seeds (seeds of up to 2cm in length) surrounded by either a thin aril (legumes of the genus Inga or Parkia) or a gelatinous and adhesive pulpy coat (drupes of various liana species).

Analysis of the fecal remains of over 40 wild trapped moustached and saddle back tamarins indicate that during bouts of fruit feeding, seeds are commonly swallowed with the pulp and pass unharmed through the digestive tract. Experimental planting of these seeds reveal a high rate of germination.

Although S. mystax and S. fuscicollis were observed to feed on the fruits of over 250 individual trees, the majority of feeding bouts were restricted to 10 species. Trees of these species appear to exhibit a pattern of staggered fruiting such that only a small amount of ripe fruits are available on each tree.

Tamarins regularly visit and revisit 4-5 individuals of a given tree species each day and in doing so range widely throughout their habitat. The relationship between the distribution of preferred tree species, forest phenology, tamarin feeding patterns, and the role of callitrichids as seed dispersers are discussed.

Relationship between birth size and subsequent growth. S.M. GARN, University of Michigan, Ann Arbor.

The relationship between birth-weight and subsequent growth has long been subject to debate. Sampling limitations, prematurity and postmaturity, and additive and subtractive measuring errors have complicated the search for an answer. However, 8907 term Black neonates followed for 7 years in the National Collaborative Perinatal Project (NCPP) clarify the relationship between birth-weight and short and long-term gains in both weight and length. The higher the birth-weight, the lower weight gains are in the first few months of life, but the higher they are after the 3rd year. In fact high birth-weight (p97.5) boys and girls gain 15% more weight over the 7-year period than do low birth-weight neonates (p 2.5) and the weight increments are systematically related to birth-weight percentile. In contrast, low birth-weight neonates of either sex gain more in length than their high birth-weight age peers and this inverse relationship is again completely systematic. In consequence weight for length is increasingly longer for

the low birth-weight Black neonates than for those of higher birth-weight, a finding that can be duplicated at a different level in white neonates as well. These findings help to elucidate the remarkable tracking and fanning-out of weight and length by birth-weight percentiles, and they demonstrate the need to take birth-weight into account in nutritional appraisal and growth evaluation in different populations. Though differences in maternal prepregnancy weight "explain" the birth-weight effect in part, the independent contribution of pregnancy weight gain to birth size and long-term size differences indicate that the high-weight neonate has a developmental advantage that lasts through the early school years at least.

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Trends in demography and pathology during the Late Woodland period of west-central Illinois. C.A. GARNER, Arizona State University, Tempe.

Previous research in both central and west-central Illinois has claimed a constant decline in the health of prehistoric populations between the Middle Woodland and Mississippian periods. The decline is hypothesized to be concomitant and causally related to the development of intensive agriculture. However, this gradual decline is often based on comparisons of single "representative" sites from each period and it is not clear that the decline between or within periods is as constant as claimed.

This study examines the demography and pathology frequencies in three geographically adjacent skeletal populations spanning the Late Woodland period in west-central Illinois: Kuhlman (A.D. 600-700); Joe Gay (A.D. 800); and Ledders (A.D. 1000). The sample comprises 518 individuals. Cumulative mortality does not differ between populations. Life expectancy at birth ($e(0)$) fluctuates through time with a median of 21 years; $e(15)$ remains constant at approximately 21 years. The frequency of periostitis increases from 0.48 to 0.53 to 0.74. Porotic hyperostosis fluctuates with a median frequency of 0.30. The frequency of linear enamel hypoplasia is constant with a median of 0.85.

Neither the demography nor frequencies of pathologies suggest major changes in population structure or health during the Late Woodland period.

The Nature of the Primate Grasping Foot
D.L. Gebo, Duke University, Durham, NC.

The grasping primate foot is one of the hallmark adaptations for the entire Order Primates. Prosimian muscle and joint analysis indicates that there are two distinct types of primate grasping feet. The I-V opposable grasp, where the hallux opposes the other four digits around a support, is the primitive grasp type utilized by cheirogaleids, lorisids, Daubentonina and tarsids. Lemurids and indriids on the other hand have a derived I-II adductor grasp between the hallux and the second digit. This grasp seems to be in response to increasing body size and the use of larger diameter vertical supports. The application of this anatomy to the North American adapids, which are large and possess the I-V grasp, indicates that adapids were not able to vertically cling on vertical supports. The recognition of this innovative adaptation, the I-II adductor grasp, which is unique to Madagascar, extends our appreciation of prosimian locomotor capabilities.

Problems with using ratios for scaling of morphometric data. B. R. GELVIN, California State University at Northridge, and G.H. ALBRECHT, University of Southern California.

Ratios are often used to scale raw data to eliminate size effects. Since this practice is controversial, we examine various scaling methods based on ratio transformations to form size-free shape variables. We discuss ratios (Y/X) of collinear data described by equation (1) $Y = a + bX^{k_{yx}}$ where Y is a morphometric variable, X is a size variable, k_{yx} relates to the curvilinearity of the X - Y relationship, b relates to the "steepness" of the X - Y relationship, a is the Y -intercept. It is known that simple ratios (Y/X) produce size-free results only for a linear, isometric X - Y relationship ($k_{yx}=1$) with zero Y -intercept ($a=0$).

Several published proposals address the problem of using ratios for nonlinear data described by the allometric equation (2) $Y = bX^{k_{yx}}$ ($a=0$ and $k_{yx} \neq 1$). These involve exponentiating Y or X to achieve linearity: (3) $Y/X^{k_{yx}}$, (4) $Y^{k_{xy}}/X$, (5) $Y^{k_{yx}}/X$, (6) $Y/X^{k_{xy}}$, (7) $Y/X^{1-k_{yx}}$, and (8) $Y/X^{k_{yx}-1}$, where k_{yx} and k_{xy} are coefficients from log-log regression of Y on X or X on Y , respectively. Only (3) and (4) linearize the X - Y relationship producing size-free shape ratios.

Other published proposals address the problem of using ratios when the data have a nonzero Y -intercept combined with allometric distortion ($a \neq 0$ and $k_{yx} \neq 1$). These involve subtracting the Y -intercept: (9) $(Y-a)/X^{k_{yx}}$ and (10) $(Y^{k_{xy}}-a)/X$. Only (9) produces ratios independent of size; to be correct, (10) requires subtracting a before exponentiating Y . However, in practicality, it is difficult to estimate the necessary parameters because nonlinear regression techniques must be used.

Our results might imply that ratios yield size-free shape variables if a , b , and k_{yx} can be estimated and if the proper ratio transformation is used. The problem then is how appropriate are ratios in terms of their

statistical properties. We concur with recent literature which emphasizes the statistical and conceptual difficulties of ratios.

Supported by NSF BNS-8307890 to GHA.

Heritability of Growth Rate and Adult Thigh Length in Macaca mulatta. D. T. GELVIN, Santa Monica College.

Post-natal growth of nonhuman primates has been examined in several species. From these investigations a phylogenetic trend in growth rates has been suggested. However, few of these studies were based on longitudinal data. Heritability estimates for growth rates of thigh length were computed using data from fifty-one individuals of known parentage. The regression of offspring of both sexes on father had the highest heritability estimate, $h^2 = .714$. Accounting for inbreeding in the sample changed the heritability estimates. Heritability estimates were calculated based on adult thigh length for three generations. The heritability estimate computed from the regression of sons on fathers was the highest, $h^2 = .660$.

Significant portions of the phenotypic variance in this sample are attributable to additive genetic variance. The differences in magnitude of the heritability estimates and the relationships in which these differences occur suggest that different gene systems are involved in the transmission of growth rate and adult length of the rhesus thigh. The magnitudes of the heritability estimates do indicate that these characteristics are under strong enough genetic control to support modification through selection.

Reduced tooth size: selection or probable mutation? K. R. GIBSON, University of Texas Dental Branch, Houston.

Hominid teeth have reduced in size since Pleistocene times. Brace has hypothesized an evolutionary mechanism, probable mutation effect, to account for this dental reduction. Evidence from dental practice, however, indicates that large teeth are frequently associated with dental crowding and malocclusion. These, in turn, predispose to negative sequelae such as premature tooth wear and oral infection. In the absence of the ready ability to soften foods, premature tooth wear may well have led to decreased survival. Bacterial endocarditis and infectious cerebral sinus thrombosis are not infrequent complications of untreated oral infections. Even in the modern antibiotic era, these infections are sometimes fatal. Data from the literature indicate that such sequelae also occurred during hominid evolution. Consequently, in the absence of pressures for an enlarged masticatory surface, natural selection would be expected to lead to reduced tooth size. Unique evolutionary mechanisms are not necessary to account for this phenomena.

The effects of race, sex, and socioeconomic status on growth patterns and physical fitness of Alabama adolescents. JANICE GILLILAND, The University of Alabama, Tuscaloosa.

Many studies have examined the relationships among sex, race, socioeconomic status and growth, but studies of rural southern adolescents are rare. The purpose of this study is to examine the influences of race, sex, and socioeconomic status on physical fitness, growth, body build and composition of rural Alabama teenagers.

The sample is comprised of 82 black and white high school students, ages 14-17. Nine anthropometric measurements were taken to characterize body build and composition. Physical fitness was determined by a 1½ mile timed run, sit-ups, and grip strength and flexibility measurements. Resting blood pressures were also taken. The influences of sex, race, and socioeconomic status on the anthropometric and fitness measurements were tested by analysis of covariance.

Age was a significant positive covariate for sitting height, grip strength, and flexibility. All measurements, except biiliocrystal diameter, diastolic blood pressure, run time, and sit-ups, were significantly different by sex, with males showing greater values on all measurements except skinfolds and flexibility. Sitting height, biacromial and biiliocrystal diameters, run time, and grip strength differed by race. Whites had greater sitting heights and biiliocrystal diameters but slower run times, while blacks had greater biacromial diameters and grip strength. Socioeconomic status was significant only for height and flexibility. High SES students were taller, but low SES students exhibited greater flexibility. The interaction between race and SES was significant for height and biacromial diameter. High SES blacks were taller with broader shoulders. The interaction between race and sex was significant for run time, with black males having the fastest times.

Support for this study was supplied in part by a grant from the Josiah Macy, Jr. Foundation.

Rates and models of molecular evolution. P. D. GINGERICH, University of Michigan, Ann Arbor.

The current consensus view of molecular evolution is the simplest of possible models. This simple exponential or "linear" model is based on probabilistic theory developed by Zuckerkandl and Pauling (1965) and calibrated by a single paleontological estimate of the time of human (primate) divergence from other mammals. The neutralist hypothesis of molecular evolution follows directly from the Zuckerkandl-Pauling model (indeed it is assumed implicitly in this model). Recent studies recognize variation in molecular difference/divergence time ratios, but this is assumed to reflect random variation about a linear trend, and single average values are used to calibrate linear models.

The appropriateness of a linear model (and the appropriateness of the neutralist hypothesis itself) could not be tested as long as single or averaged calibration points represented all that were available. Fortunately, six calibration points are now sufficiently well established molecularly and paleontologically to permit a test of the linear model. These points reflect difference/divergence values of: Cercopithecoidea-Hominoidea, Catarrhini-Platyrrhini, Anthropeidea-Prosimii, Primates-Eutheria, Eutheria-Metatheria, and Theria-Nontheria. Globin differences for these divergences yield a difference/divergence curve suggesting a more complex underlying sigmoid logistic model. All evidence bearing on the question indicates that rates of molecular evolution have not been constant over geological time. This example illustrates how estimates of rates of evolution depend critically on underlying models of change. Further evaluation of competing models of molecular evolution requires the continuing cooperation of molecular systematists and paleontologists.

Principal components analysis of anthropometric measures from savannah baboons aged between birth and 5.5 years. D.M. GLASSMAN and A.M. COELHO, Jr., Southwest Foundation for Biomedical Research, San Antonio.

The assessment of anthropometric patterning revealed by principal components or factor analyses has been used over the past 40 years as a way to describe the human physique. The derived axes of statistical variability (component structure) are interpreted as representing physical components of body size and fat distribution. Although multivariate methods are useful in analyses of human anthropometric data, there are few applications of these methods to data on nonhuman primates. The objective of this study is to examine anthropometric patterning in the baboon using multivariate methods.

Data consisting of 7 anthropometric measures (weight, crown-rump length, triceps girth, and skinfolds at the neck, subscapular, supra-iliac, and triceps sites) were collected on a sample of 118 male and 169 female savannah baboons of known age (birth to 5.5 years) and nutritional history. Application of principal components procedures to the data resulted in the extraction of two unrotated orthogonal components which accounted for greater than 88% of the overall variation. The first component was interpreted as a general body size component and the second as a contrast between body size (weight and length) and body fat distribution. Individual component scores were calculated for each subject for both components. A multiple analysis of variance of the component scores indicated that statistically significant age, gender, and age by gender interaction effects were present for both components.

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Revision of Hapalemur (Prohapalemur) gallieni.
L.R. GODFREY, M. VUILLAUME-RANDRIAMANANTENA,
and M.R. SUTHERLAND. University of Massachu-
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Antananarivo.

We examine cranial and mandibular fragments of the subfossil lemur Hapalemur (Prohapalemur) gallieni (Standing) from Ampasambazimba in Central Madagascar, and show that they belong to Hapalemur simus. These and additional subfossil specimens of Hapalemur simus from as far north as the Ankarana Massif demonstrate conclusively that, not long ago, Hapalemur simus enjoyed a wide distribution throughout the humid forests of Eastern Madagascar. Known today only from the region of Fianarantsoa, our sample of merely nine skulls from museum collections in Europe, Madagascar, and the United States considerably extends our knowledge of the distribution of this species.

This paper examines the geographic context of cranial and dental variation in Hapalemur griseus and Hapalemur simus, as well as mistakes in the original diagnoses of Hapalemur gallieni. The subfossil sites of Madagascar contain numerous remains of extant lemurs, some of which have never been identified or catalogued. These data are especially important if we are to understand the ecology of animals now threatened with extinction. The need for a thorough examination of the remains of extant lemurs from subfossil sites in Madagascar is evident.

Childhood dental enamel hypoplasias as predictors of adult mortality in an industrial sample. A. H. GOODMAN, University of Connecticut Health Center, Farmington.

While it is often suggested that childhood stressors are component causes of adult health, this hypothesis is rarely tested. Testing such a hypothesis is assumed to involve either a longitudinal-prospective study or a retrospective evaluation of childhood stress. The former type of study is costly while the latter is likely to involve reporting biases. An alternative to these methods promotes the use of a biological memory of childhood stress which may be "read" in adults. The purpose of this paper is to test the hypothesis that dental enamel hypoplasias, a deficiency in enamel thickness due to systemic stress, is a predictor of decreased adult longevity.

The sample consists of 154 adults from the Hamann-Todd osteological collection and is derived from the greater Cleveland area (births 1854-1915). Frequencies of enamel hypoplasias were recorded for the gingival two-thirds of maxillary central incisors, a portion of the tooth which develops between 2.0 and 4.5 years.

Hypoplasias are more frequent among individuals who died before thirty (.87 per person) than in those who died after thirty (.59 per person). The association between hypoplasias (childhood stress) and adult longevity is strongest in males and for those who died from tuberculosis, pneumonia and mental conditions. These data suggest that patterns of adult disease and longevity may be initiated by childhood events.

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Rates of molecular evolution: the hominoid slowdown, fact or fiction? MORRIS GOODMAN, Wayne State University School of Medicine, Detroit.

In part to explain immunological data showing that very small protein divergences separate humans from other hominoids, a model of decelerating protein evolution was proposed (Goodman 1961). Its premise is that early in phylogeny a large proportion of amino acid substitutions were selectively neutral, but slowly accumulating adaptive substitutions over geological epochs decreased the number of sites on proteins where neutral mutations could build up, and this change markedly slowed the rate of protein evolution. More recently (Goodman 1981) the model was modified to have, on giving a larger role to positive Darwinian selection, recurring rate upsurges and downsurges during successive major adaptive radiations, leading eventually to the hominoid slowdown. In assessing whether findings from protein and DNA sequences support or oppose this slowdown hypothesis, it is pointed out that the hypothesis does not rule out late hominoid divergence times.

This research has been supported by NSF Grant BSR-8307336.

Easter Islander palmar dermatoglyphics: Sexual dimorphism, bilateral asymmetry, and family polymorphism. C.S. GOODSON, Indiana University, Bloomington.

The palmar prints of 297 male and female Easter Islanders were analyzed according to the Penrose and Loesch topological classification system. While the frequencies of most pattern elements were not found to differ significantly between the sexes, the placement of the axial triradius was found to be highly significant ($p < .01$). Both males and females were found to exhibit considerable bilateral asymmetry in the a-b count and in the atd angle, but there was no significant difference between the sexes in the amount of asymmetry expressed. Family data for a small subset of the sample (51 individuals) were subjected to further

statistical analysis, from which significant results ($p < .05$) were obtained both on Chi Square tests for frequency of pattern elements and ANOVA tests for a-b count, atd angle, and A-line exit.

The implications of these results are considered from a developmental perspective. It is suggested that a particular pattern combination (termed a formula) could be used to represent a default value and that other formulae might then be considered as deviations from this default value. Such variation, theoretically at least, might be traced to genetic interactions or to the embryological environment present during the time of dermatoglyphic formation.

Anthropometry, Allometry, and Sexual Dimorphism in the Design of Protective Clothing and Equipment. C.C. GORDON, US Army Natick Research and Development Center, Natick, Ma.

Research into the design and sizing of protective equipment such as helmets, respirators, gloves, and field clothing is rarely thought of as anthropological in scope. Nevertheless, optimizing the fit of protective equipment depends primarily on an understanding of the morphometric characteristics of the user population. The number of sizes needed is determined by the amount of variation present in body dimensions critical to fit and function. The selection of one or more size indicators (such as neck circumference and sleeve inseam for shirts) is determined by correlative relationships between the size indicators and other critical dimensions. Garment shape and the dimensional changes between sizes are determined by allometric relationships between the size indicator dimension(s) and other body dimensions critical to garment fit.

Naturally, such morphometric features vary among population samples of different ages, sexes, and races. In private industry, these differences are accommodated by catering to a particular subset of the market such as "juniors" or "tall men". Unlike the private sector, the Army must provide clothing and equipment for all body sizes and shapes in its user population. This paper discusses the ways in which research in anthropometry, allometry, and biomechanics has contributed to design and sizing solutions for morphometrically heterogeneous user groups.

Genetic demography of Denver, Colorado: Mexican-Americans are a distinct gene pool. K. GOTTLIEB The Pennsylvania State University, University Park, Pa.

In 1980, one out of every five newborns in Denver, Colorado was of Mexican ancestry, yet very little is known of the Denver Mexican-American gene pool. During July 1981, ethnic data and umbilical cord bloods were collected

from newborns of 100% Mexican ancestry born in the eight hospitals serving Denver (N=114). Six blood group loci (ABO, Rh, MNS, Fy, Kell and Diego) with a total of 15 alleles were typed. Allele frequencies for newborns of 100% Mexican ancestry were $A=0.227$, $B=0.063$, $O=0.710$, $Rz=0.0$, $R1=0.373$, $R2=0.201$, $Ro=0.059$, $ry=0.010$, $r1'=0.008$, $r1''=0.035$, $r=0.314$, $MS=0.273$, $Ms=0.341$, $NS=0.100$, $Ns=0.286$, $Di a=0.022$, $K=0.029$, $Fy a=0.575$, $Fy b=0.425$. Using the Chi-square test of homogeneity, these allele frequencies were significantly ($p < 0.01$) different from the allele frequencies in a population of European ancestry living in Denver (N=324). This is not surprising because multivariate admixture analysis shows a 35% Mexican Indian contribution and a 65% European Spanish contribution to the Denver Mexican-American gene pool. Genetic distance analysis using Harpending and Jenkins' method was done with Mexican-American, Mexican Indian, Southwest Indian and European ancestry populations. The Denver and California Mexican-American populations clustered with the European ancestry populations. However, the genetic distance between the Denver Mexican-Americans and the Denver European-Americans is $D=0.002$ using Nei's formula. This value falls within the range of distances for mammalian subspecies. This evidence of genetic distinctiveness for the Mexican-American gene pool is buttressed by information on Mexican-American mating behavior which shows a high level (four out of five couples) of endogamy. Given the genetic distinctiveness of the Denver Mexican-Americans, it is not correct to use European allele frequencies as a standard in the paternity or zygosity testing of Mexican-Americans in Denver.

Variation in mean numbers of potential mates and its implications for the study of genetic structure in small populations. M.I. GRADIE, SOREP, University of Quebec at Chicoutimi and A.C. SWEDLUND, University of Massachusetts, Amherst.

The degree to which mating, or failure to mate is random in small human populations has been shown to be a significant factor affecting the degree of inbreeding. Determination of randomness has usually been based on a comparison of randomly selected and empirically observed potential mate pools. However, little is known about variation in the number of potential mates, or how this variable relates to other population characteristics such as population size, mortality, or fertility rates. Nor is it known what relationship it bears to standard measures in population genetics such as effective size.

Using data from two historical populations, this paper examines change over time in the numbers of potential mates. Changes in the mean number of potential mates are shown to be dependent on variables such as age at marriage, the range of ages over which first marriages occur, and the degree of age correlation between mates, as well as population size. The implications for the use of potential mates analysis in studies of genetic structure are discussed.

An historical overview of porotic hyperostosis: some critical issues. A.GRAUER and M.C.HILL, University of Massachusetts, Amherst.

The pathological condition known as porotic hyperostosis has been noted in medical and scientific literature as early as the late 1900's. These early references described the lesions at great length and in most cases attempted a differential diagnosis. In 1965, Moseley presented a comprehensive list of possible pathologies associated with the lesions. Since that time numerous authors have explored the possibilities of this comprehensive differential diagnosis, with most coming to the conclusion that the pathology is associated with anemia caused by erythroblastic marrow hyperplasia. It has only been in the last 10 years that authors have explored the synergistic relationships between biological factors such as anemia, marrow hyperplasia, and factors from the extant cultural and biological environments, such as diet and disease, in order to go beyond mere description and diagnosis in attempting to understand processual issues pertinent to all studies of human populations.

As an introduction to a series of papers on this topic, this paper presents an historical overview of this progression in scientific thought.

The primate postorbital bar as a torsion-resisting helical strut. W. S. GREAVES, University of Illinois at Chicago.

Many mammalian skulls are asymmetrically loaded during mastication because the animals chew on one side at a time. This loading regime tends to twist the braincase relative to the rostral, tooth bearing, part of the skull at the narrow zone of potential weakness between the orbits. This torsional effect is exaggerated in animals like primates in which the lines of action of the jaw muscles act at large angles to the long axis of the skull, providing large components of force that twist the skull segments relative to one another. The effect is less important when the muscles act closer to the skull axis. The postorbital bar exhibits the predicted three dimensional spatial orientation necessary to resist torsional forces: it is a segment of an imaginary 45 degree helix that is wound around the skull, if the skull is idealized as a cylinder. This orientation is significant because in general, maximum compressive and tensile shear stresses lie along 45 degree helices on a cylinder loaded in torsion; to resist torsion material should be placed far from the axis of torsion and along a helix oriented at 45 degrees to the deforming forces. Supraorbital ridges are also segments of 45 degree helices that are perpendicular to the helices

representing the postorbital bars. This model suggests that the postorbital bar is loaded in compression on the chewing side and in tension on the nonchewing side while supraorbital ridges are loaded in tension on the chewing side and in compression on the nonchewing side.

Physical growth of European children at altitude. L.P. Greksa, Case Western Reserve University, H. Spielvogel and E. Caceres, Instituto Boliviano De Biologia de Altura.

Despite numerous studies, there are several aspects of physical growth at high altitude which are still unclear. For example, estimates of the magnitude of the delaying effect of hypoxia on linear growth vary considerably between studies, probably due to confounding by SES-related factors. Also, the accelerated growth in the chest size of Andean highlanders has been hypothesized to represent developmental adaptation but it has been difficult to assess the role of developmental adaptation independent of genetic adaptation. The present study was designed to clarify these issues by examining the physical growth at altitude of upper SES children of European ancestry.

The sample consists of 351 upper SES children of European ancestry (171 males, 180 females; 9.0 - 19.9 yr). These children were born and raised at high altitudes and were residing in La Paz, Bolivia (3600 m) at the time of the study. Stature for age in the La Paz children was a maximum of 3 cm less than in a comparable low altitude European sample. Since upper SES children tend to be healthy and well-nourished, this difference should reflect the independent effect of hypoxia on growth. Comparison of chest size between the La Paz and low altitude children and examination of the chest sizes of low-to-high altitude migrants indicated that residence at altitude is associated with an increase in chest size in European children. Since Europeans do not have a long history of residence at altitude, this pattern should represent the expected developmental response, independent of genetic adaptations, of children exposed to hypoxia during growth. The chest dimensions of the European children were significantly smaller, after controlling for stature, than those of Aymara children residing in La Paz ($p = .001$), however suggesting that the relatively large chests of the Aymara cannot be explained solely by developmental adaptation.

The ultrastructure of Oreopithecus bambolii tooth enamel: systematic implications. F.E. GRINE, D.W. KRAUSE, State University of New York, Stony Brook, and L.B. MARTIN, University College, London.

Ultrastructural details of the enamel of several Oreopithecus bambolii postcanine teeth have been examined for evidence pertinent to the debates concerning the systematic affinities of

this enigmatic Miocene primate. Oreopithecus enamel, which is of intermediate thickness, was formed through rapid amelogenesis, and the cross striation varicosities are evenly spaced. Prism developmental pattern 3 predominates throughout the thickness of Oreopithecus enamel, although occasional areas of pattern 1 configuration are encountered. Extant as well as extinct (e.g., Australopithecus, Paranthropus and Sivapithecus) hominoid taxa possess enamel in which pattern 3 prisms predominate. By contrast, pattern 2 prisms tend to characterize the enamel of most extant cercopithecoids, although pattern 3 configurations are evinced in varying degrees. Concomitantly, however, pattern 2 and 3 prisms tend to exhibit cross-sectional apicocervical distension in cercopithecoid species, whereas the prisms comprising hominoid enamels are apicocervically compressed. Metrical values that describe the degree of prism compression yield a distinctly bimodal distribution for catarrhine taxa. The values obtained for Oreopithecus fall within the hominoid range, whilst cercopithecoid values tend to differ markedly. The ultrastructural features of its enamel suggest the affinities of Oreopithecus to be with the Hominoidea rather than with the Cercopithecoidea.

Food preparation and consumption practices among southeastern U.S. aboriginals as a possible contributor to porotic hyperostosis. BEVERLYE HANCOCK, Wake Forest University.

Ortner and Putschar ('81) suggest that ethnohistoric data are important in specific etiologies of porotic hyperostosis. The ethnohistory on the N.C. Piedmont implicates practices of food preparation and consumption as contributors to this skeletal condition in early historic and, by analogy, late Woodland people in the southeastern U.S.

Environmental, geographical, and archeological data indicate that 1. hemolytic anemias were unlikely in Piedmont aboriginal populations, 2. parasitic infestations were unlikely or at most seasonal, and 3. primary maize subsistence probably did not occur in these areas even though maize was grown.

The process of first drying and then cooking meat with plant foods for extended periods of time at high temperatures would have significantly reduced the efficiency and availability of lipids as transporters of dietary iron and reduced the amount of available dietary iron before the food was consumed. The seasonal addition of maize to these pottages would have further reduced the absorption of dietary iron. The result of these food preparation procedures would have been chronic nutritional stress within the population, especially important to nursing mothers and weaning infants, even in the presence of seemingly abundant food resources.

A sample of 52 individuals from Donaha, a late Woodland site in Yadkin Co., N.C. was used to examine the likelihood that the ethnohistorically documented food preparation procedures used in the Piedmont at European contact may have created conditions encouraging high frequencies of porotic hyperostosis. Por-

otic hyperostosis is common in the Donaha remains, even in the virtual absence of evidence for maize. If the ethnohistorically known food practices were in general use in the southeastern U.S. during the late Woodland period, an alternative to the conventional hypotheses of the etiology of porotic hyperostosis must be considered in paleopathological diagnoses for the region.

Individual admixture estimates and genetic marker - disease associations. C.L. HANIS, R. CHAKRABORTY and W.J. SCHULL. University of Texas Health Science Center, Houston.

Increasing attention is being given to ethnic and geographic variation in disease rates as a means for inferring possible genetic mechanisms. Diabetes and gallbladder disease are examples where disease prevalence parallels the proportion of Amerindian ancestry. Highest rates occur among Amerindians, intermediate rates in those genetically admixed with them such as Mexican Americans, and the lowest rates in Anglos and Blacks. Traditional estimates of genetic admixture provide some insight, however within an admixed population, individuals will vary with respect to their probabilities that a gene selected at random will have been derived from a particular ancestral population. In the case of diabetes and gallbladder disease, it is possible that an individual measure of ancestral affinity will enable more accurate assessment of risk. To this end we have developed an estimation procedure based on an individual's genotype and gene frequencies in the purported ancestral populations. Individual admixture is taken as the maximum likelihood estimate of the mixing proportion. Since individuals are scored, maximization proceeds by simply searching the probability space of valid values. Clearly for one or two loci, the estimate is generally 0 or 1, but as the number of markers scored increases (and also depending on the degree of polymorphism), the individual values are more distributed.

Application of the method has been made on a sample of 177 male and 279 female Mexican-Americans above the age of 44 years. These individuals were sampled as part of diabetes study from which genetic markers, diabetes and gallbladder status were determined. Eleven genetic markers were used. For both diabetes and gallbladder disease there was a tendency for increased frequency in those determined to have highest Amerindian ancestry. (Supported in part by NIH grants AM 32895 and AM 27582)

Patterns of cortical and intracortical bone remodeling in three Woodland populations from the lower Illinois Valley. D.B. Hanson, Cornell University, Ithaca and J.E. Bulkstra, Northwestern University, Evanston.

Remodeling of adult compact bone consists of integrated organ and tissue

level responses to biomechanical and physiological demands. The adaptive goal at the individual level is to preserve the structural integrity of the bone while maintaining serum levels of metabolites (mobilized from skeletal tissues) appropriate to continued health and survival. Given this model, major shifts in diet and activity level associated with subsistence change should be reflected in the cortical and intracortical remodeling of adult bone.

This hypothesis was tested using cross-sections of the midshaft femur taken from skeletal samples representing the Middle Woodland (n=33), early Late Woodland (n=38), and terminal Late Woodland (n=29) cultures of the lower Illinois Valley. Middle and early Late Woodland subsistence in this region was based on hunting and gathering and Late Woodland subsistence was based primarily on maize agriculture.

Bone areas were calculated using a computer-assisted digitizer; histomorphological variation was evaluated using microradiographs of prepared thin sections. Analysis of variance procedures applied to these data resulted in statistically significant differences between cultural and age/sex-specific remodeling patterns at both the organ and tissue levels. The observed differences are interpreted as responses to variation in the proportions of animal protein consumed by populations with different systems of food procurement in the lower Illinois Valley.

Male mating strategies in patas monkeys.
Robert S.O. HARDING, University of Pennsylvania, Philadelphia, and Dana K. OLSON, University of California, Los Angeles.

Patas monkeys (*Erythrocebus patas*) have been described in the literature as a harem-polygynous species. This description is inaccurate as far as at least one population of patas is concerned: in the Laikipia District of Kenya, a heterosexual group studied since 1979 by Olson and Chism maintains a harem configuration for part of the year, but during the breeding season extratroup males join the group and take part in mating activities. Observations during the 1984 breeding season indicate that males employ different strategies, both in entering the troop and in securing access to receptive females. Some individual males practice a form of mate-guarding that closely resembles consorting in baboons, behavior that has not previously been reported in patas monkeys. This and other male strategies are described and their relative success in obtaining copulations is assessed. Limited observations of patas groups at times when only one male was present suggest that harem polygyny may not result in optimal mating conditions for males.

Social behaviors of *Tarsius syrichta* and *Tarsius bancanus*. D. M. HARING, P. C. WRIGHT and E. L. SIMONS, The Duke University Primate Center,

Social behaviors of the Philippine tarsier (*Tarsius syrichta*) and the Bornean tarsier (*Tarsius bancanus*) were studied for an 18 month period at Duke University Primate Center. The wild-caught animals were housed in pairs. Quantitative differences between species were found in frequency of social behaviors despite similar housing conditions. Both sexes of *T. syrichta* allogroomed, played, scent marked, and sniffed partners significantly more often than did *T. bancanus*. The loud call given by male *T. syrichta* was not given by *T. bancanus*.

Calling and social behavior of each of these species differs from the territorial dawn duets of wild *Tarsius spectrum* in Sulawesi (MacKinnon and MacKinnon, 1981). The differences in the degree of sociality among the three species may indicate variations in social system in *Tarsius*. The monogamous social system described for the spectral tarsier in Sulawesi may not hold for the other two species.

Maternal behaviors similar to those observed in wild *T. spectrum* have been noted in *T. bancanus*. *T. bancanus* mothers carry their infant with their mouths shortly after birth. An infant is then "parked" on a branch for 20-30 minutes, clinging immobile while the mother hunts for food. Carrying of infants with the mouth of the mother is found in several species of prosimians and in the Old World monkey *Colobus verus*. However, while some prosimians deposit infants in nests during the first weeks, this behavior has not been observed in either *Tarsius* or *Colobus*.

This research was supported by NSF grant BNS 81-20529.

Bone mineral content as a measure of skeletal maturity in chimpanzees. R.J. HARRINGTON, M.E. MORBECK, W.A. STINI, University of Arizona, Tucson, M.W. MARZKE, Arizona State University, Tempe, P. FRITZ, Primate Foundation of Arizona, Tempe.

The assessment of bone mineral content using techniques such as photon absorptiometry is a recent addition to the repertoire of methods employed for the evaluation of growth and development of both human and non-human primates. The bone mineral content of the left radius has been measured for a series of young chimpanzees to assess bone mass and rates of bone mineralization. The purpose of this study is to examine the nature of the correlation between rates of bone mineralization and rates of skeletal maturation in chimpanzees as determined by linear growth of long bones and epiphyseal union. This study represents one aspect of an on-going research project being conducted at the Primate Foundation of Arizona, Tempe, on chimpanzee growth, development, and aging. Incorporated into this particular study are the data obtained through monoenergetic photon absorptiometry, radiography, and anthropometry. 29 chimpanzees

($n_o=15$, $n_g=14$) were measured for bone mineral content, with follow-up scans obtained 10 to 14 months later for 14 of the individuals. All chimpanzees have been subjected to radiographic and anthropometric analysis at regular intervals covering more than 3 years. The results of this study are presented as baseline data for skeletal maturation in chimpanzees.

Tooth mineralization standards for Southern Blacks and Whites: Statistical considerations. E. F. HARRIS, J. H. MCKEE, and J. W. RUNYAN. University of Tennessee at Memphis.

"Dental age" is one of just a few measures of physiologic development that is uniformly applicable from infancy through late adolescence. This report describes the cross-sectional study of 1100 phenotypically normal children 3-15 yrs of age. Standardized panoramic radiographs were taken on each individual and mineralization stages were scored on one side. Ages were partitioned into half-year intervals; age-grades, races, and sexes were analyzed separately.

Data were analyzed using three techniques: a) arithmetic mean age for each mineralization stage; b) a multivariate regression method yielding overall dental age; and c) probit analysis by tooth and stage. The data are shown to more closely meet the assumptions of probit analysis, and median ages calculated by probits average one-half year earlier than mean ages. The difference in statistical treatments of the same dataset is greater than exhibited between American Blacks and Whites or between sexes in either ethnic group. Comparisons of data treated to different statistics would mask important patterns confirmed in our analyses: Blacks achieve mineralization stages earlier than Whites in each sex. Females differ more than males within each group, and crown formation differs more than root formation. Females are advanced over males, with Blacks exhibiting more (7%) sex dimorphism than Whites (4%). Mandibular teeth are advanced over their maxillary antagonists, lower incisors being most precocious. Even when techniques are comparable, there are significant racial and regional differences -- with these series from the Midsouth developing later than Northern standards. This regional difference in Caucasians is 2.5 times that between Blacks and Whites within our dataset.

African oreopithecids and the origin of the family. T. HARRISON, New York University, N.Y.

Recent paleontological collections at the Middle Miocene locality of Maboko Island in Kenya, dated at 15-16 M.Y., have yielded almost five hundred new specimens belonging to at least five species of fossil anthropoids. The most common species of ape, a medium-sized primate with a very distinctive dental morph-

ology, undoubtedly represents a previously undescribed taxon. When compared with other Miocene anthropoids from East Africa, it has closest affinities with the poorly known species Rangwapithecus vancouveringi from Rusinga Island, and, to a lesser extent, with Rangwapithecus gordonii from Songhor. The species from Maboko Island is considered here to belong to a new genus of fossil anthropoid, to which 'Rangwapithecus' vancouveringi is also referred. This new genus has a highly distinctive suite of derived characters of its molars and premolars which it shares with Oreopithecus bambolii from the Late Miocene of Europe. These derived dental features indicate a close phyletic relationship between the East African species and Oreopithecus, and form the basis for the inclusion of these taxa in a single family, the Oreopithecidae. In many respects, however, the East African forms are much less derived than Oreopithecus, and they clearly represent a more primitive grade. The new fossil evidence indicates that the oreopithecids originated from primates resembling the more generalized lower Miocene catarrhines from East Africa, and that the family has its closest phyletic relationship with Rangwapithecus gordonii, with which it shares a number of derived characters. There is therefore good evidence from the fossil record to indicate that the origins of the Oreopithecidae can be traced back to the early Miocene in East Africa.

Rotating sets of "homologous" points in multi-dimensional space to a mutual least-squares best fit. S.E. HARTMAN, State University of New York, Stony Brook.

In numerical taxonomic and other work it is often necessary to rotate and translate a number of independent sets of raw co-ordinate measurements to a single axis system. This is frequently done through registration, using specific landmarks from among those measured to define the origin and direction of axes (e.g. using left and right orbitale and left porion to define the Frankfurt Plane). Differences among taxa based on the positions of landmarks on axes so defined can be difficult to interpret. Also, points used for axis definition are rendered invariant in some dimensions. As a result, some information they may have contained about variation is lost (and perforce added in an undefinable way to other measurements).

These problems can be circumvented by rotating and translating individual matrices to a least-squares best fit with one another, rather than registering all matrices on certain points. I have written and tested a program which performs the necessary operations on any number of matrices of co-ordinate data of two or more dimensions (with or without missing values) following the iterative procedure of Gower (1975). Procrustes analysis (rotation with iterative individual scaling of matrices to maximize fit) is included as an option. Several uses for this program in physical anthropology are demonstrated. Full documentation and Fortran code are available.

Quantitative evaluation of actual intensity of natural selection through differential fertility in human populations.

MACIEJ HENNEBERG, The University of Texas, Austin

Evaluations of the total opportunity for selection through differential fertility (Crow's I_f) yield confusing results, especially with respect to modern populations. These evaluations are based on unrealistic assumption of the full heritability of fertility differentials. Estimation of the actual intensity of selection requires knowledge of the share of genetic variance in the phenotypic variance of fertility (strictly: heritability - h^2): $AI_f = I_f \cdot h^2$. In order to obtain estimates of h^2 , data on 7503 births occurring during 19th and 20th C. to 3902 Polish women from 12 local groups in both Poland and the U.S. were analyzed. Birth intervals corrected for the effects of birth control and of selected social factors influencing fertility were used as a measure of fecundity. Heritability was estimated in two ways: 1. correlating age+parity standardized lengths of birth intervals of the same woman (repeatability) 2. correlating age+parity standardized average lengths of birth intervals of biological relatives. Results obtained for the first method by group and through correlations between relatives are consistent pointing towards low heritability of fecundity ($h^2 = 0.10$ to 0.15). No significant correlations were found between in-laws indicating that observed correlations have biological basis and are not a result of socio-environmental factors.

An attempt was made to partition out the portion of variance due to additive genetic effects from the values of I_f indices for examined groups as well as for 68 groups reported in the literature. This variance constitutes less than 1% of the squared total fertility rate ($AI_f=0.01$); thus the actual intensity of selection through differential fertility is orders of magnitude lower than the opportunity estimated with Crow's I_f indices. This is not a surprise within the context of evolutionary theory since fecundity is a characteristic directly and closely related to darwinian fitness and as such cannot maintain a considerable genetic variability over a number of generations.

The influence of chronology on perceptions of evolutionary rates and patterns of hominid phylogeny in the Pliocene and Pleistocene. T. HETRICK and R. B. ECKHARDT, The Pennsylvania State University, University Park.

Many paleoanthropologists are still very interested in the number of species of Pliocene and Pleistocene Hominidae, even though the evolutionarily meaningful question concerns not the number of hominid species, but the number of lineages. Although in the literature this matter is commonly treated as if there were broad general agreement on the coexistence of two contemporaneous lineages being represented during at least the half million year time band from 2.0 to 1.5 million years ago, this consensus is based on several questionable assumptions, and in actuality represents no more than one possibility among several tenable a priori models.

Here we address this problem by analysis of data on hominid tooth sizes, with particular reference to surface areas of 169 early hominid premolars and molars. Because of the imprecision inherent in the chronometric dates associated with these specimens, many assignments by previous researchers of available fossil material to given half million year time bands are inherently arbitrary; in fact, depending on the weight given to error terms in the chronometric dates, dozens to hundreds of permutations of specimens and time bands are supportable, with many of these alternatives markedly changing within-band measures of dispersion.

Further, even if conventional assignments of specimens to time bands are accepted, the dental feature (M_2 surface area) demonstrating the greatest quantitative dispersion (from 140 mm^2 to 340 mm^2) could be included in a single lineage if mean tooth surface area shifted by an average of only 0.008 mm^2 per generation. This very small rate of implied change is exceeded by many accepted examples of micro-evolutionary and macroevolutionary change.

The potential of dentine for taxonomic and phylogenetic studies. C.F. HILDEBOLT, G. BATE, and G. C. CONROY, Washington University, St. Louis

With the advent of the scanning electron microscope, there has been a great deal of interest in the ultrastructure of enamel in taxonomic and phylogenetic studies. However, researchers have found it difficult to satisfactorily characterize enamel prism patterns since patterns vary according to the plane, depth, and location of the viewing area and can be affected by differences in etching agents. These problems can be either eliminated or minimized in comparative studies of dentine; yet no one has pursued such research. This study addresses the potential of dentinal ultrastructure for taxonomic and phylogenetic problems.

Dentinal tubules were exposed on the mesial root surfaces of twelve dog, eleven baboon, and twelve human mandibular first molars. These tubules were examined with a scanning electron microscope and photographed at 1250 magnification. The positions of the tubules were then digitized. The number of tubules in the sample area of each photograph ranged from twenty-six to one hundred and three. Using the variables of density and distances to first and second nearest neighbors, a discriminant function analysis was performed.

Eighty-six per cent of the teeth were correctly classified by the discriminant functions, with 100% accuracy for dogs, 83.3% for humans, and 72.7% for baboons. For the incorrectly classified human teeth, two were classified as baboon; for the incorrectly classified baboon teeth, one was classified as human and one as dog. The power of resolution may be improved by including variables representing tubule and peritubular dentine morphology in the discriminant analysis.

We believe this study demonstrates the potential of dentine for resolving phylogenetic and taxonomic problems.

Porotic hyperostosis: a question of correlation vs. causality. M.C.HILL, University of Massachusetts, Amherst.

Human populations are classified as open systems, with an infinite number of elements and relationships among these elements. However, in order to critically analyze such systems, the researcher is forced to artificially "close" the system by selecting those elements, in exclusion of all others, which are considered to be pertinent to the questions being asked.

This paper presents data on individuals (N=200) from several sites in Alabama which represent a prehistoric cultural continuum from Archaic through Protohistoric time periods. The analysis focuses on the construction of a basic theoretical model derived from General Systems Theory in which elements considered to be of primary importance to all human systems are analyzed in terms of their roles in positive and negative feedback relationships within the larger system.

Porotic hyperostosis is analyzed on a macroscopic level in terms of appearance (i.e., size, shape, and other physical characteristics such as age of onset, duration, and location). The role of stress response is also explored, and correlated to other stress indicators such as enamel hypoplasias and Harris lines.

Anthropometry of children 6-11 years born to mothers who smoked during pregnancy. DENISE C. HODGES, LAWRENCE M. SCHELL, State University of New York at Albany, Albany, N. Y. and JOHN H. RELETHFORD, State University of New York, College at Oneonta, Oneonta, N. Y.

The effect of cigarette smoking during pregnancy upon postnatal growth is investigated among 228 children from suburban Philadelphia, Pennsylvania. Ten anthropometric dimensions were measured following U.S. Health Examination Survey guidelines. Parents were interviewed to learn of social and biological factors that can affect growth, including cigarette smoking during pregnancy. The sample families are working or middle class families of European ancestry.

Multiple regression analysis indicated that the change in size with age was not significantly different between the smoking and nonsmoking subsamples. With the subsamples combined, and age in the regression analysis, mother's cigarette smoking was significantly related to triceps (partial $r=-0.132$) and subscapular (partial $r=-0.089$) skinfold thicknesses, bizygomatic breadth (partial $r=-0.109$) and upper arm circumference (partial $r=-0.136$). Inspection of residuals suggested that for these four variables, the difference between children of mothers who smoked and those that did not, arose in later childhood and that there was little difference among the younger children for these four variables.

Parental investment in sons versus daughters. SARAH BLAFFER HRDY, University of California, Davis.

Theoretically parents should benefit from being able to manipulate sex ratios prior to birth, and indeed this seems to be the case for many animals. Among humans however, secondary sex ratios (with a few exceptions) are remarkably conservative and parents must rely on such metabolically costly post-natal adjustments of the sex ratio as sex-preferential infanticide and widespread practices involving discriminatory allocation of resources within the family in order to adjust parental investment in sons versus daughters. Cross cultural surveys by Minturn and Shastak and by Whyte suggest that roughly nine percent of human cultures preferentially kill daughters, fewer than two percent, sons. Feeding discrimination and inheritance patterns indicate even more widespread biases in favor of sons, though the record may be skewed by focus on elites and on evidence from patrilineal societies. Competing hypotheses to explain differential investment in sons and daughters, and especially the widespread preference for sons, are evaluated.

The effect of disease on height and weight in a longitudinal sample from Colorado. J.R. HUMMERT and A.H. GOODMAN, University of Connecticut Health Center, Farmington.

The effect of disease on physical growth and development has received less attention and is less clearly understood for children in developed nations than for those in developing nations. A consensus of opinion seems to have been reached that, in contrast to developing nations, the common childhood diseases found in developed nations have a trivial effect on growth. Many of the studies undertaken in developed nations, however, have been very short term, have had small sample sizes, or have concentrated on ages during which growth is normally quite slow.

The present research readdresses this question using data collected from 1927 to 1967 by the Denver Child Research Council's longitudinal growth study (McCammon, 1970). Annual increments of gain in height and weight as well as adult stature and weight were examined in the context of the yearly frequency of: (1) minor infections, (2) moderate to severe infections, and (3) "other" systemic illnesses.

The results of these data do not conclusively demonstrate an association between disease of any variety with either incremental increase in height and weight or adult height and weight. There is, however, some indication that a greater disease load in the first two years has an effect on growth from ages one to two as well as on adult stature and weight. The impact of disease on growth in males was also found to be greater. Our data are consistent with data collected in developing nations in suggesting that disease has the greatest impact on growth during the pre-

school years. Of particular interest is the possible effect of disease in these early years on long term growth potential.

This research was supported by NIDR grant # T-32-DE07047.

Dental emergence and transition zones of development of the facial skeleton in rhesus monkeys, common chimpanzees and human beings. E. E. HUNT, JR., Pennsylvania State University.

The evolutionary loss of prognathism in the human face has been accompanied by changes in the schedule and variability of dental emergence. Here, these dental phenomena are compared in male and female Macaca mulatta, Pan troglodytes, and Homo sapiens. These findings are then analyzed in the context of developmental events in the adjacent facial skeleton.

This dental analysis uses an age scale which is the natural logarithm of age from conception. This scale is used because curves of dental emergence tend to be log-normal. In each primate species, several classes of teeth share a common standard deviation (s') on this logarithmic age scale, with no significant sex difference in each dental class. Classes of teeth with a common value of s' differ in rhesus monkeys, chimpanzees and human beings. Median ages of dental emergence in log units show allometric differences between sexes in a species, and between species. In each species, these dental features can be explained in terms of patterns of development in the facial skeleton; especially transition zones where these patterns change. All of these phenomena are related to the loss of prognathism in the human species. This evolutionary transformation is also related to other morphogenetic concepts; notably dental field theory and the relative neoteny of human dental and facial growth and development.

Seasonal patterns of birth and conception in highland Lesotho. R. HUSS-ASHMORE, University of Pennsylvania, Philadelphia.

While a number of human biological processes show seasonal variation, one of the most widely noted is the seasonality of birth and conception. This phenomenon has been shown to apply (although with variable timing) to populations in varied ecological and economic contexts, from desert foragers to modern European nations. However, patterns of birth seasonality seem especially pronounced and unambiguous in societies of peasant cultivators. Reasons commonly advanced to explain this phenomenon include seasonality of temperature (hot and cold), rainfall (wet and dry), marriage, migration, workload, and food supply, as well as shifts in anxiety levels, libido, and culturally preferred season of birth.

Fertility data are presented here for a group of peasant cultivators in the highlands

of Lesotho. Based on total fertility histories, the bi-modal pattern of birth seasonality seen differs substantially from that reported for neighboring groups in South Africa. Other seasonal variables, including climate, diet, workload, marriage, and migration are examined for their potential impact on seasonality of conception in this population. Suggestions are offered for the differences in birth timing between this population and its neighbors. Because of the articulation of such agricultural populations with regional and international economic networks, the factors that influence their fertility are complex. Older, single-cause models of seasonality and birth (i.e., climate) are accordingly naive.

(Portions of this research were supported by a grant from the Wenner-Gren Foundation for Anthropological Research.)

The Role of African Admixture in the Etiology of Hypertension. J. HUTCHINSON, University of Houston.

The genetic contribution to blood pressure variance has been examined by studying a selected group of genes. Because a large proportion of black Americans are hypertensive (22.8%), investigators have hypothesized an African component for blood pressure. MacLean *et al.* (1974) demonstrated an association between diastolic pressure and degree of African admixture and Boyle (1970) showed that darker skinned people have a greater propensity for hypertension than lighter skinned subjects. On the other hand, Krieger *et al.* (1965) used a number of blood systems to measure admixture, including the most sensitive measure of African admixture, Gm, and did not reveal an association between degree of admixture and blood pressure.

The Black Caribs of St. Vincent present an opportunity to study the relationship between African admixture and blood pressure. Admixture is estimated using a program written by Elston (1965), which includes two measures: Roberts and Hiorns and "true least squares". Eleven blood group systems were used to measure admixture. The basic equation is $Q_n = M^n Q_0$ where Q_n is the matrix of gene frequencies for the hybrid group and M^n is the amount of admixture after n generations. These estimates can range from 0 to 100% African contribution. Individual estimates of M were calculated by treating each person as an independent hybrid gene pool. Of 368 individuals, 48.1% received 1/2 or more of their genes from an African ancestor and of this group 18.1% and 17.0% exhibit systolic and diastolic hypertension, respectively. Gene frequencies and blood pressure distributions by age and sex were compared to black Americans, South American Indians and West Africans. A chi-square test was used to examine the dependence of blood pressure on percentage African ancestry. The chi-square values were not significant for systolic or diastolic pressures.

The hypothesis that admixture influenced pressure level failed to consider the low prevalence of hypertension in African groups.

Towards a new (dermato)glyphological paradigm. E.R. IAGOLNITZER, Institute of Anthropobiometry and Genetics, Paris.

Beyond large overall similarities, dermatoglyphic features differ in size and shape from finger to finger. (i) Factor analysis (FA) of the ridgecounts of the 5 fingers of a hand gives a single common size factor. (ii) Principal component analysis (PCA) of the same data, or FA of the ridgecounts of the 10 fingers of an individual show that the thumb is somewhat independent from the others, while fingers II to V are anatomically ordered along a unidimensional continuum. (iii) PCA of the radial and ulnar counts of the 5 or 10 fingers demonstrate two separate continua, one for the ulnar counts (I-II-(III-IV-V)) and one for the radial counts (II-(III-IV-V)-I). The simplicial approach, with the two hypercubes of whorls vs any other pattern-types and of arches vs loops or of arches+radial loops vs ulnar loops, confirms and comprehensively illustrates the foresaid findings. Correspondence analysis also demonstrates the latter order.

Twin and family studies show that the size factor is genetic; two additional factors affect the patterns: ulnarization, ie loss of radial ridges changing ultimately a whorl into an ulnar loop, and radialization, ie loss of ulnar ridges, ultimately changing a whorl into a radial loop or an ulnar loop into an arch. The former is present in virtually all normal individuals. The latter is interpreted as the result of mirror imagery happening in the twinning process taking place in the development of the hand where the partner of the thumb is finger IV and its neighbors; it affects the fingers closest to the separation line (II and III).

This model accounts for most qualitative as well as quantitative features of the fingers observed in normal populations; but also for some features of the palm, especially those related to the twinning process. For extreme or pathological groups it gives hints about the specific mode of development of the extremities. In population studies, it should add biological meaning to the mere observation of dermatoglyphic differences. It also provides a particular approach to the more general problem of segmentation.

Dental pathology of the Fort Center, Florida Indian population. R. ISLER, J. SCHOEN, M.Y. IŞCAN, Florida Atlantic University, Boca Raton.

The dental health of a population can reveal important information about their subsistence base and dietary habits. This paper presents a descriptive analysis of the dental pathology of a prehistoric southeast Florida Indian population from Fort Center. This inland site is located in the Lake Okechobee basin. Archaeological evidence suggested that the Fort Center group existed from 200 A.D. to 600-800 A.D., practiced an early form of agriculture, and served as a ceremonial center for the surrounding area. Thus it is possible that this population may have had better health than their contemporaries. This study presents the preliminary results of an examination of nine dental lesions of a sample of 75 individuals. Hypoplasia occurred at the same frequency in both sexes

and was about 1.5% in the moderate to heavy categories. Caries were 2.5% with no sexual differences, however 33% of the caries were advanced while 67% were early defects. In considering alveolar resorption as measured from the cemento-enamel junction, the Fort Center group had 2% over 6 mm, 16% with 3 to 6 mm, and 32% with up to 3 mm. The rate of attrition was 3% at the "dentin visible only" category and 32% at the "dentin visible and enamel" level and 47% at the "enamel only" level. These results are generally in agreement with those of similar precontact early agricultural American Indian populations.

Reproductive cycles in Tarsius bancanus. M. K. IZARD, P. C. WRIGHT, AND E. L. SIMONS, Duke University Primate Center, Durham, NC.

The reproductive condition of three pairs of Tarsius bancanus was documented for twelve months. Each pair was housed separately under constant photoperiodic conditions (L:D: 12.5:11.5), similar to those in the native habitat. Reproductive cycles were monitored in the females using vaginal smears and measurements of external genitalia. Progressive proliferation and cornification of vaginal epithelial cells was accompanied by an enlargement of the external genitalia. Cycle length averaged 22.5 ± 3 days. Genitalia were swollen each cycle for a period of nine days, with estrus and copulations occurring on the sixth day of swelling.

Our results indicate that T. bancanus does not menstruate. There was no evidence of seasonality of estrous cycles under these photoperiodic conditions. In addition, testicular measurements of males showed no seasonal changes. The data indicate that T. bancanus has estrous cycles similar to prosimian primates and New World monkeys and that these cycles occur throughout the year under constant photoperiodic conditions.

(This study was supported by NSF grant BNS 81-20529 to E. L. Simons.)

Differences in catecholamine excretion, eating behavior, stimulant intake and activity among Western Samoan men. G.D. JAMES, Cornell University Medical Center.

Catecholamine output increases with alterations in diet, stimulant intake, activity, or psychological arousal. Dietary and activity patterns as well as the psychosocial environments are modified as a consequence of cultural change. This study examined the relationship between catecholamine excretion and eating behavior, caffeine and cigarette consumption, and activity among 4 groups of young Samoan men that differed in occupation in Western Samoa.

The 123 men in the study included 31 residents of a rural, traditionally organized village, 28 manual and 33 non-manual workers from

the capital city, Apia, and 31 college students also from Apia. The rates of catecholamine (adrenaline and noradrenaline) excretion were assessed from urine samples collected after the first 2 to 4 hours of morning activity. Eating behavior over the morning was classified as fasted or not. Caffeine consumption was measured as the number of 6 ounce cups of coffee or tea and cigarettes as the number smoked. Activity was defined by the percentage of time spent in tasks requiring mental, physical, and no effort.

The villagers had lower excretion rates ($p < .05$) than the three Apia groups. Smoking was associated with high adrenaline ($p < .01$) and noradrenaline ($p < .0001$) excretion. Caffeine consumption decreased the excretion of both compounds ($p < .05$). Subjects in physical effort activities had generally higher noradrenaline excretion than those in mental effort or non-taxing activities ($p < .05$). A multivariate analysis also showed that when eating behavior, stimulant intake and activity are controlled, the excretion rates of the villagers remain lower than those of the Apia groups ($p < .01$). These results suggest that cigarette consumption, activity and psychosocial factors have both independent and interactive effects on increasing the stress response of Samoans.

Methodology for degreasing the Hamann-Todd osteological collection. L. JELLEMA, J. AICHER, I. MATELSKY and B. LATIMER. Cleveland Museum of Natural History, Cleveland, Ohio.

Human skeletons in the Hamann-Todd Collection, like many other osteological samples derived from cadaver populations, are externally coated with a variably thick layer of bone grease. Owing to the diffusion of fats from the medullary cavity, this grease coating has worsened over time and has resulted in the obliteration of surface morphology in many specimens. In some individuals this continuing accumulation of lipids has attracted insects and/or mold growth which is potentially hazardous to the entire collection.

We have recently devised a method to safely and efficiently degrease the Hamann-Todd Collection. This method is superior to other techniques such as NH_3 , various bleaches and detergent solutions which can result in surface chalking and cracking. Our method involves defatting of the skeletons by a vapor degreasing process using the chlorinated solvent 1-1-1 trichloroethane. The skeleton is subjected to three ten minute baths in heated solvent (74°C) in a Tronic immersion vapor degreasing machine (Cemini Series 2014). Each immersion is followed by a 5 minute draining period to allow the saturated solvent to flow from the bone's interior. After a similar treatment in cool solvent (50°C), the defatted specimens are stored in a ventilated drying cabinet for 48 hours. This methodology has proven highly effective in removing 10 to 20% of fat (by weight) per skeleton. Moreover, it insures specimen safety, because it allows the technician to closely monitor each skeleton's

progress. In our judgment, the cleaning and degreasing methods discussed herein can be applied safely to other large skeletal collections. This project is supported in part by NSF grant BNS 8200983.

Biocultural interactions in growth retardation among children in Papua New Guinea. C.L. JENKINS, Papua New Guinea Institute of Medical Research, Goroka.

Numerous studies indicate that infants grow adequately on breastmilk alone up to 4-6 months, even in marginally nourished populations. In Papua New Guinea, the rate of growth begins to fall off by 3 months of age even in populations with demonstrably good nutritional status. Variations in growth rates may reflect evolutionary adaptations to types of diets, levels of morbidity or past availability of resources. The regulatory mechanisms involved are frequently behavioral and coded into caveats concerning proper times for weaning and food introduction schedules. This paper presents results of a series of micro-studies on growth patterns and weaning beliefs and practices among the Amele (lowlands), Bundi (highlands), and Simbai (marginal highlands) peoples of Madang Province. National Nutrition Survey data on the East Sepik and Enga provinces are also compared.

Findings indicate that between 3-10% of all children surveyed are fed solely breastmilk as late as 3-5 years of age. Solid foods are not introduced to nearly half of the Amele children ($N=159$) until 1 year. Weight-for-age, falls off accordingly, from within 90-100% during the first 6 months to 80-90% at 1 year. Weight-for-length continues to drop throughout the first 3 years of life. In the East Sepik ($N=2018$), 38% of the children at 9 months, decreasing to 10% at 30 months, are fed solely on breastmilk. Highlands patterns are markedly different with 88% of Enga children ($N=1343$) receiving solids by 9 months and having consistently heavier body weights. Both Bundi and Simbai occupy marginal positions ecologically. Their growth patterns appear affected by factors other than weaning patterns, which in both cases show a normal distribution starting at 6 months with a median age of introduction to solids at 24 months.

Growth and Development
Human Adaptability

Nutritional status and IQ in urban Guatemalan children. F.E. JOHNSTON, S.M. LOW, University of Pennsylvania, Philadelphia, Y. deBAESSA and R.B. MACVEAN, Universidad Del Valle de Guatemala.

The effects of nutritional status upon cognitive development were investigated in a longitudinal sample of 412 economically disad-

vantaged Guatemalan children from 3 birth cohorts. Children were examined annually over 3 three years, beginning either at 3, 5, or 7 years. Nutritional status was evaluated anthropometrically and IQ determined by the WISC Test (WPPSI at 3 years of age). Socioeconomic differences were controlled by using a composite measure of SES and stimulation within the home by application of the HOME inventory.

After correction for SES and home stimulation, a nonlinear relationship of IQ and nutritional status was detected. IQ was reduced significantly only among the smallest 25th percent of the children. Since such children are highly likely to display chronic protein energy malnutrition, this suggests that malnutrition, after correction for other environmental factors, exerts a significant effect upon cognitive development.

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Effect of breastfeeding on amenorrhea attrition rates in rural Indonesia: An application of Cox's proportional hazards model for time-dependent, censored survival data. R.E. JONES, State University of New York, Binghamton.

Few studies have been undertaken in which the pattern of infant feeding in breastfeeding women has been related to return of menses postpartum and fertility. This paper reports on the results of a prospective study carried out in rural Indonesia where the pattern of suckling frequency during the day and night, the duration of suckling bouts and return to menses postpartum were studied in 444 breastfeeding mothers for a period of 2 years. An index of breastfeeding intensity reflecting the known physiological relationships between the frequency, timing, and duration of suckling bouts and suppression of postpartum ovulation and menstruation was developed and tested. While the population as a whole had an average survival time for amenorrhea of 16.8 months, low, medium and high intensity breastfeeding were found to have 12.6, 15.7 and 19.4 months respectively. Other background variables were found to be significantly related to amenorrhea survival rates as well. This study used the Cox proportional hazards model that simultaneously adjusts for censoring, inter-correlations among variables and situations in which influences on attrition rates are conditioned on time. The estimated models permit the demonstration of the relative magnitude of both biological and social effects on return to menses postpartum.

This research was supported by a NSF Research Grant (#NSC 8115586) and the East-West Center Population Institute.

Genetic Structure of the Utah Mormons: Isonymy Analysis. L.B. JORDE, University of Utah School of Medicine, Salt Lake City, and K. MORGAN, University of Alberta, Edmonton.

Isonymy analysis was done on 188,895 marriages extracted from the Utah Genealogical Database. 1284 of these marriages were isonymous, yielding an estimated inbreeding coefficient of .0017. This value, although relatively low, is approximately ten times greater than previous estimates based on migration and pedigree data. Multiple origins of surnames and the use of Scandinavian patronyms account for part of this discrepancy. In spite of some lack of agreement, all inbreeding estimates have been low, supporting the generalization that this population is not highly inbred.

Logistic regression analysis was performed on a subset of 88,202 marriages in which both individuals were born in Utah. The dichotomous dependent variable was "isonymous vs. non-isonymous marriage." Year of marriage was the most significant independent variable, reflecting decreased isonymy in later time periods. Subdivision endogamy had a significant positive association with isonymous marriage, and distance between the birthplaces of the spouses had a significant negative association with isonymous marriage.

Matrices of between-subdivision relationship coefficients were estimated using surname distributions. The correlations between these matrices and kinship matrices based on migration data were not high, ranging from .08 to .42 in different time periods. (This research was supported by NIH grant HD16109.)

Relative growth of the locomotor skeleton in the orangutan and African apes. W. L. JUNGERS, State University of New York at Stony Brook.

Simple visual inspection allows one to discern significant differences in adult bodily proportions among the species of African apes and between them and the orangutan. The goal of this study is to document the ontogenetic pathways taken by elements of the postcranial skeleton that culminate in these marked adult dissimilarities. The data base is drawn from cross-sectional samples of nonadult skeletons of *Pongo pygmaeus pygmaeus* (N=55), *Pan paniscus* (N=30), *Pan troglodytes troglodytes* (N=32) and *Gorilla gorilla gorilla* (N=32). Model II regression (major axis) of log-transformed measurements is employed to estimate ontogenetic shape relationships (as slopes and elevations) between the following variable pairs: humeral diaphyseal length versus radial diaphyseal length, femoral diaphyseal length versus tibial diaphyseal length, humeral diaphyseal length versus femoral diaphyseal

length, scapular width versus clavicular length, and iliac length versus pubic length. Among the findings is the observation that shape relationships seem to be preserved within the forelimb of both species of *Pan*, but growth introduces subtle shape changes in this limb of gorillas and orangutans (in opposite directions, however); these changes are reinforced by transpositional shifts in initial intralimb proportions relative to *Pan*. Only in the orangutan are interlimb proportions maintained ontogenetically; a transpositional shift serves to further distinguish *Pongo* from the African apes. Proportions between scapula and clavicle are also preserved throughout growth in the orangutan, whereas in all African apes the clavicle reduces in length relative to scapula width. All pongid taxa exhibit a tendency for iliac length to grow less rapidly than pubic length, with this trend most pronounced in the pygmy chimpanzee and the orang. Relative growth in a sample of modern humans will also be placed into this comparative pongid context. Supported by NSF grants BNS 8318013 and BNS 8217635.

Biosocial Factors in the Epidemiology of Early Childhood Asthma. BERNICE A. KAPLAN, Wayne State University, Detroit and C.G.N.MASCIE-TAYLOR, University of Cambridge

Data from the first restudy (at age 6-7) of every child born in Britain in the week of March 3-8, 1958 plus all children who were born elsewhere during the same week and whose families emigrated to Great Britain prior to the restudy revealed that among the 18,559 in the sample:

- (1) 3.1% of the cohort report episodes of asthma.
- (2) More boys than girls suffer from asthma.
- (3) There is a positive association between allergy-related diseases (hayfever, sneezing, eczema) and the occurrence of asthma.
- (4) Pneumonia, whooping cough and tonsillitis are also highly correlated with asthma.
- (5) Children from small families, usually first or second children, whose parents are employed in non-manual occupations are more likely to have asthma than are those from larger families, or whose parents are employed in manual occupations. Regional distribution of occupational groups, housing facilities such as crowding and access to household amenity, as well as educational level of parents and family practices: breast feeding, circumcision, maternal smoking and other such findings all relate to the distribution of childhood asthma.

Discriminant analysis is used to determine to what extent asthmatics differ from others in biosocial factors. This analysis successfully classified 89.0% of asthmatics.

Behavioral responses of patas monkeys to group introductions. JR KAPLAN, E NICKS, J RILEY Bowman Gray School of Medicine, Winston-Salem NC.

Based on findings among macaques we hypothesized that group introduction manipulations would be useful in the elucidation of basic social processes among *Erythrocebus patas*, a species which has not been studied intensively. We hypothesized further that the results of group introductions among the more reclusive and dispersal-oriented patas would be different than those observed among macaques. To test our hypotheses an established group of 7 patas (4 adult females, 3 juveniles) was introduced to a group of 11 patas (2 adult females, 4 adolescents, 5 juveniles) in a 1/3 acre corral. The harem males did not participate in the initial introduction. Each group was observed intensively for 4 weeks prior to the introduction and for several months after. The introduction was characterized by a low level of intergroup fighting on the first day and a large physical distance between groups. On the second day the original group (n=11) destroyed the cohesiveness of the new group through attacks by adolescent males and females on the newly introduced adult females. Aggression by the old group on the new group was sporadic but intense; in the first two weeks 25% of all fights involved biting. This percentage then fell to less than 10%. However, for the rest of the study there was persistent harassment and 'herding' of the new group by members of the old group. The addition of an adult male did not change this pattern. During the first week there was almost no intergroup affiliation (grooming, passive body contact). In the following weeks, intergroup affiliation slowly increased but remained lower than would be predicted by chance ($p < 0.01$). We concluded from these and other data that the ability of patas monkey groups to accommodate strangers is more limited than that of macaque groups, with integration occurring at a much slower rate.

Androgens and body fat distribution in adolescence. S.H. KATZ, M.L. HEDIGER, B.S. ZEMEL, S.T. MCGARVEY, J.S. PARKS, Krogman Growth Center, University of Pennsylvania

A number of changes in fat patterning occur in both sexes during adolescence. Prepubertal males accumulate body fat evenly, and then appear to lose fat, especially in the limbs, as they mature. Females tend to continue to accumulate body fat in adolescence, particularly in the limbs and hips. Adult obese females with adult-onset diabetes (Type II) and hypertension have been found to have body fat patterns that emulate the adult male ("android") pattern of relatively more trunk to limb fat.

To determine the hormonal correlates of differences in fat patterning in adolescence, we investigated the associations among levels

of serum dehydroepiandrosterone sulfate (DS) in both sexes, testosterone (T) in males, and patterns of body fat in a sample of 384 black Philadelphia adolescents, aged 12-16 years. Both DS and T were measured on serum samples by radioimmunoassay, and body fat was indexed using the body mass index (Quetelet's) and various skinfold thicknesses, e.g., triceps (Tr) and subscapular (Ss). A ratio of trunk to limb fat was computed as $Ss/(Ss + Tr)$.

One-way analyses of variance comparing among those with low (<15%), moderate (15-85%), and high (>85%) levels of DS for age indicated highly significant ($p < .05$) associations between high levels of DS and increased body fat. In males, there were no significant associations of body fat with levels of T. However, increased ratios of trunk to limb fat were associated with T, as opposed to DS. In females, higher levels of DS were strongly associated ($p < .005$) with this relatively android fat pattern. These data suggest that tendencies toward the android fat pattern are associated primarily with T, not DS, in males. In females, this pattern, characteristic of obese adult females with diabetes and hypertension, may be associated with increased DS and be identifiable in adolescence.

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Cementum annulus counts and chronological age in *Macaca mulatta*. R.F. KAY, Duke University Medical Center, J.G.H. Cant, University of Puerto Rico.

A sample of 110 teeth of 88 rhesus macaques (*Macaca mulatta*) of known age between 4 years and 22 years from Cayo Santiago, Puerto Rico were analyzed to assess the usefulness of cementum annulus counts as a means of estimating chronological age. Most of the teeth were lower first molars, one tooth per individual. Right and left M_1 s were examined for six individuals; I_1 , M_1 and M_2 on one side were examined for 10 individuals. The teeth were decalcified, embedded in paraffin, sectioned approximately parallel to the occlusal plane at approximately 10μ , and stained with H & E. Cementum annuli were counted with a phase contrast microscope at about 100x independently by two observers.

A previous study of a smaller number of animals from the same population had suggested that cementum annulus counts can provide valuable information about the age of these primates living under tropical conditions. The new larger sample confirms this and now allows us to place confidence limits about age estimates derived in this way.

In addition, the difference between the number of counts on M_1 and M_2 provides an objective means of estimating developmental rates in a species: to the extent that annuli form at one year intervals, the difference between the number of annuli on M_1 and M_2 should tell the number of years elapsed between the beginning of cementum deposition on the two teeth. The implications of this for studying changes in maturation rates in human evolution are discussed.

Miocene hominoid cladistics and the demise of the "thick enameled" apes. J. KELLEY and D. PILBEAM, Harvard University, Cambridge.

Over the past several years a consensus has developed that the "thick enameled" hominoids (ramapithecids, sivapithecids, or ramamorphs) constitute a clade which is either the sister group of *Pongo*, of hominids, or of all the great apes and humans. It is now clear that what has been regarded as "thick enamel" cannot be used as a synapomorphy defining this group, and also that there is not a simple dichotomy between "thick" and "thin" enamel. It is also clear that within the ramamorphs there is a substantial amount of variability in craniofacial morphology, some of which is probably due to there being more than one clade represented in this group. One of these, the Asian genus *Sivapithecus*, probably is the sister group of *Pongo*. As this relationship is based primarily upon features of subnasal morphology, anatomical similarity in this region constitutes an important part of the diagnosis of this genus. "Thick enamel" and a robust gnathic complex alone are insufficient to determine inclusion in *Sivapithecus* or the *Sivapithecus-Pongo* clade. *Sivapithecus* is now restricted to hominoids from the Siwaliks of South Asia and Yassioren, Turkey. Other samples may eventually be attributable to *Sivapithecus*. At least some of the ramamorphs that are clearly not in the *Sivapithecus-Pongo* clade may still be in the clade encompassing African apes and humans.

Stress of slavery, Colonial period. J.O. KELLEY and J.L. ANGEL, Smithsonian Institution, Washington, D.C.

Physical evidence exists in 120 Black individuals from 27 sites in Maryland (including Deep River and Catoctin Furnace), Virginia (e.g. Clifts Plantation and College Landing), Mississippi, and North Carolina. Periods for statistical comparison are pre-Revolutionary 1690-1790, Catoctin 1790-1820, and 1800-ca.1860. The Catoctin group is unique since contemporary literature suggests iron-working slaves received better food and management than farm slaves.

Age at death is a major indicator of the total effect of life stresses (32.5 (26), 39.4 (15), 35.5 (52)).

Nutritional stress shows in skull base height (21.3 (21), 16.8 (16), 20.1 (35)); stature (σ 171.8 (12), 170.8 (8), 169.7 (18); ϕ 159.6 (9), 156.4 (8), 155.2 (14)); pelvic inlet index (84.9 (8), 86.1 (9), 89.3 (4)); degree of tibial bowing; porosity of skull; dental health (lesions = 10.3 (23), 12.7 (16), 10.4 (43)); and hypoplastic lines or spots.

Occupational stress occurs in early, and later exaggerated, development of lifting muscles (deltoid and pectoral crests), early vertebral and shoulder breakdown, tibial periostitis, and foot injuries.

Most common pathology is anemia or sickle cell (thickened diaph, healed rays).

Stresses are typical of low economic conditions - poor nutrition; lack of/inert medical care; unsanitary shelter; heavy

workloads, long hours, and inadequate rest. However, what cannot be observed or measured are the psychological effects of oppression. Among the physical effects of oppression are parietal depressions and ulna fractures ("parry").

Dietary change in the 17th century Narragansetts. M.A. Kelley, University of Rhode Island.

Dental caries, antemortem tooth loss, and dental wear were examined for 53 Narragansett Indians (11 males, 18 females, 24 sub-adults) from an early historic cemetery (A.D. 1650-1670) in Rhode Island. This period represents a time of physical and cultural transition due to European contact.

Prior to contact the Narragansett diet is believed to have been based on a mixed economy of wild plant and animal foraging, exploitation of marine resources and agriculture. The present study attempts to 1) clarify to what extent the native diet of these Indians had been modified by the mid-1600's and 2) assess the associated physical stress these Indians experienced.

Caries rate and antemortem tooth loss were extremely high with 22.5% and 32% of teeth affected respectively. Females suffered more dental disease than males and 9.9% of all subadult teeth exhibit caries. Location and severity of these caries suggests a regular diet high in refined carbohydrates. Data from floatation samples, trace element analysis, dental asymmetry, and transverse lines are currently under analysis and should provide additional information regarding diet and stress.

Changing Thoracic Capacity in Prehistoric Peru. DIENJE M.E. KENYON, Pennsylvania State University, University Park, PA.

An enlarged thoracic capacity has been consistently documented among modern native Peruvian highlanders and it has been suggested that this condition is an example of micro-genetic change. Applying a method developed by M. F. Smith (1980) relating the reconstructed morphology of ceramic vessels to their utilitarian function by using simple statistical tendencies concerning shape, we apply a similar method to the reconstruction of the skeletal framework of the thorax of prehistoric and protohistoric populations from measurements made on separate skeletal elements. Methodologically, the vertebral column is visualized as a constant axis about which the ribs and sternum form a set of consistent arcs; these are modeled by taking maximum curvature readings on individual ribs and converting the radii estimates into a series of regression statements which, when plotted, produce single plane and

three-dimensional plots of the thoracic capacity. From this data, volume estimates are generated. Some skeletal components (e.g. the vertebral column) show little correlation with volume; conversely, measurements on the inner surface of ribs show a high correlation with total thoracic volume, especially when a series of measurements on several ribs is used. Sternal length, highly correlated with the enlarged thorax of high altitude populations, also exhibits a positive relationship to volume. The sample analyzed consists of over 450 individuals from highland and lowland Peruvian burial sites and encompasses the time range from 1800 B.C. to A.D. 1400. This range permits a variety of comparisons, diachronic and synchronic, testing the expectations of progressive, positive change toward an enlarged thorax in the highland sample, and increasing differentiation between the highland and lowland sample over time.

Functional Morphology of the Asterionic Region in Extant Hominoids and Fossil Hominids. W.H. KIMBEL, Cleveland Museum of Natural History, Cleveland, and Y. RAK, Tel Aviv University, Tel Aviv, Israel.

Sutural patterns in the asterionic region of Plio-Pleistocene hominid crania have never been examined in detail. We present a comparative and ontogenetic analysis of this anatomical region in apes, Australopithecus, and Homo and relate different sutural patterns to functional changes in the masticatory apparatus.

The great apes and A. afarensis share the common adult catarrhine sutural pattern referred to as the "asterionic notch", which involves strong lateral flare of the parietal's mastoid angle, an invaginated incisura parietalis, and a flattened, horizontal posterior temporal squama. We hypothesize that the asterionic notch develops in response to the hypertrophy of posterior temporalis fibers and the consequent formation of compound temporal/nuchal crests. This sutural pattern also appears to be present on the early Homo cranium KNM-ER 1805.

In contrast, adult male A. boisei crania exhibit a unique pattern in which the temporal squama overlaps the parietal which, in turn, overlaps the pars mastoidea and the upper scale of the occipital bone. We view this arrangement as a reinforcement against the net tensile forces exerted by the masticatory and nuchal musculature on the rear of a thin-walled braincase.

The common juvenile hominoid edge-to-edge asterionic articulation is maintained in adult A. africanus, A. robustus, female A. boisei, and most Homo crania. We discuss this pattern in regard to anterior temporalis hypertrophy in the Australopithecus lineage and to craniofacial pedomorphosis in Homo.

The generalized asterionic notch pattern serves as confirmation of the relatively undifferentiated masticatory apparatus of A. afarensis, while the unique temporoparietal overlap encountered in A. boisei is further testimony to the extreme degree of masticatory specialization achieved by this early hominid.

Age related dimorphism of the masticatory complex in the crab-eating macaque (*Macaca fascicularis*). A.H. KING, State University of New York at Buffalo.

Morphological variation in the muscles of mastication and craniofacial skeletal complex are examined for male and female crab-eating macaques (*Macaca fascicularis*). Young monkeys of both sexes show little evidence of sexual dimorphism in the masticatory complex. Significant dimorphism begins to appear in young adult's masticatory complex. Adult macaques show consistently significant sexual dimorphism for this complex.

The masticatory musculature of 36 crab-eating macaques (19 males, 17 females) was dissected and dry weights of the individual muscles were obtained. Lateral cephalometric radiographs were taken for each monkey to determine the developmental age by degree of completed permanent dentition. Twenty-one skull measurements were taken. Pearson's product moment r was calculated for each individual muscle weight in correlation to osteological and odontological measurements for each sex group and age group.

Male crab-eating macaques show "valid" r values (95%) for most of the correlations, whereas most female r values were not "valid" at the 95% level for most of the correlations. Multiple linear regression analyses for muscle weights with respect to age, mandibular molar dimensions, and condylar surface area, are "valid" for most male and female correlations. T-tests of significance for male and female monkeys are significant at the 0.05 level of confidence for masticatory complex dimorphism.

These results indicate that masticatory morphology is influenced by age and sex in the crab-eating macaque (*Macaca fascicularis*).

Breastfeeding patterns and the resumption of postpartum menstruation in urban Canadian women. M.J. KNAUER, University of Toronto.

In non-contracepting populations, the fertility inhibiting effect of lactation is currently the most important determinant of worldwide fertility. Very few in-depth studies of infant feeding practices and patterns have been conducted cross-culturally. Only now are researchers at the stage of examining the nuances of individual breastfeeding patterns and their relationship to postpartum fertility.

Breastfeeding practices and postpartum fertility were examined in 64 mothers from Toronto, Ontario and the surrounding suburban area. A subset of women ($N=20$) from this sample recorded over 10,000 daily breastfeeding episodes. Frequency and duration of nursing are measured by the length of interbout intervals and the number of minutes per nursing episode respectively. Analysis of these two variables is conducted for each woman as well as for selected postpartum intervals ranging from 100 to 324 days postpartum. Individual women exhibit more

variation in relation to each other than when their patterns are combined into specified intervals.

The model that the length of the intervals between nursing episodes increases and the length of the nursing episodes decreases as infant's age increases is shown to hold in some cases, but overall, the onset of postpartum menstruation cannot be predicted accurately on an individual basis using these two variables only. The predictive value of this model increases during weaning and especially if weaning occurs prior to six months postpartum.

Degenerative joint disease, subsistence, and sex roles at the protohistoric King site in Georgia. B. D. KOERNER and R. L. BLAKELY, Georgia State University, Atlanta.

When controlled for age, trauma, rheumatism, and infection, degenerative joint disease becomes a sensitive indicator of biomechanical stress (Jurmain, 1977). The incidences of degenerative joint disease were compared within and between skeletal samples from the King and Etowah sites ($N = 189$ and 247 , respectively), partially contemporaneous protohistoric towns located 40 miles apart in Georgia. The King site remains exhibit significantly less degenerative joint disease than their counterparts at Etowah. This difference we attribute largely to differences in subsistence practices, with King's residents undertaking more gathering and hunting while Etowah's inhabitants relied more upon agriculture. Support is found in trace element concentrations, anthropometric dimensions, and dental attrition and frequencies of caries. This contradicts Larsen's (1982) contention that gathering and hunting populations experience greater biomechanical stress than do agriculturalists.

The incidences of degenerative joint disease between males and females at the King site were similar, suggesting that sex roles, although undoubtedly different, did not subject the sexes to markedly disparate biomechanical stressors. We argue that, with regard to food procurement, horticultural tasks were divided fairly equitably between men and women. This hypothesis is consistent with Burton and White's (1984) finding that among groups with limited agricultural productivity the sexes participate nearly equally in duties attendant to crop domestication.

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Population affinities on Fogo Island, Newfoundland: A comparison of two approaches.

T. KOERTVELYESSY, M.H. CRAWFORD, and R.G. HUNTSMAN, Ohio University, Athens; The University of Kansas, Lawrence, Canadian Red Cross Blood Transfusion Service, St. John's.

The assessment of population affinities is an important anthropological concern, and di-

rect and indirect approaches have both been utilized for this purpose. One method to assess the relationship between population pairs is provided by the measurement of their dissimilarity (i.e., genetic distance) on the basis of their genetic markers. Another method to estimate interpopulational relationships is to measure the similarity of population pairs on the basis of the frequency of shared surnames (i.e., coefficient of relationship by isonymy). While the coefficient of isonymy (R_1) has been established for a number of communities, the relationship between this measure of interpopulation kinship and that based on genetic markers has not yet been established.

In this paper we compare the measures of genetic distances with those obtained from the coefficient of relationship by isonymy on basis of the Fogo Island, Newfoundland data. The results obtained from three religious communities of Fogo indicate that the population-pairs assessed as most similar by the coefficient of relationship method also have the smallest genetic distance, while those assessed as least similar have the largest genetic distance. At the same time, however, there is a discrepancy between the actual values provided by the two methods.

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Clinical application of anthropometry in the identification of craniofacial anomalies. J.C. KOLAR, L.G. FARKAS and I.R. MUNRO, The Hospital for Sick Children, Toronto.

Since 1973, the Craniofacial Assessment Team at the Hospital for Sick Children, Toronto, has included anthropometric evaluation of patients with craniofacial defects in its program of pre- and post-operative examinations. This evaluation involves a set of 127 surface measurements of the head and face including standard anthropometric measurements and additional methods developed expressly for clinical use. These are supplemented by 52 indices which illustrate a wide range of intra- and interareal proportions of the head and face.

Data collected over the past 11 years has allowed the team to determine objectively the components of a number of rare craniofacial anomalies and to compare these results with the descriptions presented in the clinical literature. The research presently is following a number of these syndromes in post-operative patients to assess the effect of surgery on the growth and development of the head and face.

A pre-operative assessment of patients with Treacher Collins Syndrome, a rare congenital defect of the first and second branchial arches, reveals that a number of the typical signs reported for this syndrome can be confirmed metrically while several others, particularly the prominent nose, are the result of disproportions between normal

and hypoplastic features of the face. This has important consequences for the planning of surgery.

Tarsier beta related hemoglobin genes. B. F. KOOP, J. CZELUSNIAR, and M. GOODMAN, Wayne State University, Detroit, Michigan.

In mouse and rabbit the gamma hemoglobin genes are expressed in embryonic life whereas in Anthropoidea they are expressed in fetal life. Late galago and lemur fetuses only show adult hemoglobin. We are engaged in a study of the beta hemoglobin gene cluster of tarsier, with the object of elucidating the shift in expression of embryonic and fetal genes.

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Dental pathology of the Maroons at Accompong Town, Jamaica - a discrete village study. R. T. Koritzer, Georgetown University School of Dentistry.

Small population paleopathology studies are done frequently. Hypotheses are generated relating culture and disease. This study is a test of such methodology on a living population.

The dental pathology of the Maroons has been recorded and the data analyzed. Sample size is 26, 13 of each sex, age range 9-64. The group is a discrete and cohesive village population.

Subsistence base is primarily non-plow agriculture in a montane setting. Handcrafts are practiced. Dental care is limited to extraction and not locally available.

There is low fluoride in the water and high carbonate in the soil. Caries is high. Periodontal disease is moderate and hygiene fair or better. The society is in transition from chewing sticks and charcoal to toothpaste and brush.

Hygiene variation by sex and age indicated cultural influence. Decayed-missing teeth means varied by sex suggesting different dental service utilization, also a cultural influence. Local limit of food and water use was imposed by economic necessity. Thus, more direct postulation of dental enamel composition is possible.

Genetic correlations among skeletal traits and the impact of selection for one trait on related characteristics. A. A. KRAMER, School of Medicine, State University of New York at Buffalo and L. J. GLEEN, School of Dentistry, State University of New York at Buffalo.

Although the primary effect of selection may be on a single characteristic, there can also be resultant changes in other features. One possible set of related measures on which selection may act simultaneously comprises various skeletal dimensions.

In this paper we investigate the level of genetic variation and covariation existing among several skeletal features through a twin analysis of anthropometric measurements. The observations were gathered as part of a longitudinal study of growth and dental characteristics conducted in Buffalo, New York, from 1966 to 1971. A total of 302 twin pairs were surveyed, of which 50 were monozygous males, 73 were monozygous females, 69 were dizygous males, 59 were dizygous females, and 51 were dizygous twins of different sexes. Anthropometric measurements included stature, biacromial diameter, biiliac diameter, chest circumference, waist circumference, arm length, and trochanteric diameter. An iterative weighted least squares analysis revealed that substantial genetic variance was present, and a multivariate path analysis demonstrated significant levels of genetic correlation among traits included in the study.

There are several implications of these findings: for skeletal dimensions, selection can operate simultaneously on more than one feature; furthermore, intense selection on one skeletal trait can indirectly affect other measures that are not themselves under direct selection.

Affinities of Ouranopithecus macedoniensis to Pongo pygmaeus: New fossil evidence. Margaret C. Tellalian Kyrkostas, Queens College, City University of New York.

Pilbeam (1984) and others have cited evidence that the sivapithecines share certain affinities with Pongo pygmaeus. Kyrkostas (1981) presented palaeoecological evidence to support the affinities between the Neogene hominoid O. macedoniensis and modern P. pygmaeus. This study will focus primarily on the anatomical features of a new specimen from northern Greece.

Recent finds from the Miocene beds at Vathyakos include a right partial mandible with an almost complete ascending ramus of O. macedoniensis (RPL 391). The specimen, the first ramus of the species to be uncovered, appears to have been crushed in several places. The condylar process is complete but is slightly distorted due to two fractures. The coronoid process has collapsed from the body onto the anterior border above the area behind the M_1 . A comparison to Sivapithecus, Proconsul and Australopithecus (A. afarensis) indicates that the hypodigm of O. macedoniensis is intermediate between the early Miocene hominoids and P. pygmaeus.

Scaling accounts for lateral specialization in human brain evolution. C.E. LACINY, The University of Chicago, Chicago.

From an adaptationist perspective, the selective factors responsible for the functional organization of the human brain must have been related to cultural capacities. Since laterally specialized brain functions and, by inference, hemispheric asymmetries comprise neurological substrates of linguistic, technological, and some important aspects of social behavioral capacities, brain lateralization must have played an important role in the evolution of human cultural behavior.

In most respects other than size, the human brain appears to resemble brains of other anthropoids. The scarcity of positive reports of asymmetry and lateral specialization in other anthropoids' brains may be primarily a function of their small size. Nonhuman hominoids, whose brain sizes lie between those of other anthropoids and humans, provide good test cases.

Lateral specialization might represent a scaling phenomenon and the primarily cultural adaptive mode of humans an emergent property of a neotenuously expanded anthropoid brain.

An analysis of basicranial flexion in Australian fossil hominids. J.T. LAITMAN, Mount Sinai School of Medicine, New York and R.C. HEIMBUCH, Ortho Pharmaceutical, Raritan, New Jersey.

Our recent studies have examined the degree of exocranial flexion of the skull base among many extant primates and fossil hominids. This analysis continues our approach by investigating this aspect of the basicranium in Australian fossil hominids. Specimens studied included the originals of 20 late Pleistocene hominids. Methods used were both metric and non-metric assessment of basicranial flexion. On largely intact specimens such as Cohuna, Keilor or individuals from Coobool Crossing, a series of nine linear measurements taken between five craniometric points generated a basicranial line which indicated the degree of flexion. On less intact specimens diagnostic traits, such as the distance between the vomer and sphenoccipital synchondrosis, were used to determine flexion.

Results show that the Australian fossil hominids exhibit highly flexed basicrania similar to those characteristic of modern adult humans. The Australian hominids also show basicranial similarities to other early Homo sapiens such as Petralona, Broken Hill (Kabwe) or Cro-Magnon. Of particular interest is the observation that although a number of the Australian hominids may have undergone considerable artificial deformation of the cranial vault (Brown, 1981), this deformation has had little effect upon the cranial base.

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Sex differences in attachment to home range and natal group in higher primates. JANE B. LANCASTER. University of Oklahoma.

Although most primate social groups are bounded, long-term associations of individuals, attached to a particular geographic locale, their boundaries are not impermeable and are often breached. Socially-induced exclusion of individuals from the resources necessary for successful reproduction is pivotal in the formulation by both sexes of alternative reproductive strategies. Among males this process most often focuses on competition for access to fertile females, but for females it leads to competition for the resources necessary to rear young to adulthood. Often exclusion from the opportunities or resources necessary to reproduce successfully leads to the migration of less successful individuals into social groups which offer greater opportunity. The distribution and predictability of resources may be the key to predicting species' patterns as to which sex is most likely to emigrate from the natal group. There is some evidence that among males differing factors determine migration at puberty compared to migrations as full adults. Immigration by either sex into new social groups is most often assured through two basic forms of alliance: kinship and sexuality.

Biocultural interactions: smallpox and the Mohawk Iroquois. K.M. LANPHEAR, State University of New York at Albany.

It has long been suggested that the decline and fall of American Indian culture was due to the large depopulation of this group that occurred with European colonization of the New World.

The introduction of virgin soil diseases, such as smallpox, had a devastating effect on the Mohawk Iroquois. But this devastation was not caused by depopulation alone. While 50 - 70% of the Indians probably died during the first epidemics, this was just the beginning. Morbidity and mortality was probably the greatest among those 15-40 years of age. It was this cohort that was most responsible for subsistence, reproduction, and the transfer of technological knowledge. Further, all those that were ill were likely to be sick at the same time. The Indians could not provide basic nursing care to one another, mortality was higher than it might have been otherwise, and kinship ties were probably strained.

Indian religion and politics also suffered. Shamans could not prevent or cure the diseases and sachems could not restore order in their wake. These two factors may have led to an abandonment of ideological and political traditions in favor of newer European ones.

All of the aforementioned factors combined to lead to an increasing dependency on Europeans and this, in turn, may have served to intensify intertribal conflicts. The end result was an easy colonization of New York by the Europeans and the deculturation and assimilation of the Mohawk Iroquois.

Electromyography of the scapulohumeral muscles during locomotion in the chimpanzee (Pan troglodytes) S.G.LARSON and J.T.STERN, JR., State University of New York, Stony Brook

Roberts ('74) has claimed that many aspects of scapular shape reflect the relative size and orientation of the scapulohumeral muscles, and he associated variations in scapular morphology among primates with the differing roles of these muscles. Most of our knowledge of the contribution of this muscle group to shoulder movement, however, comes from electromyographic studies on humans performing a restricted set of voluntary exercises. The model of shoulder mechanics which has emerged views the rotator cuff muscles as stabilizers of the glenohumeral joint, acting with the deltoid to form a "force couple" during arm elevation. A first step toward testing this model in nonhuman primates was made by Tuttle and Basmajian ('77, '78a&b) for a limited set of locomotor and postural activities. The present study aims to extend the analysis of scapulohumeral muscle function to a wider range of locomotor behaviors.

Telemetered EMG was employed to study the activity patterns of the scapulohumeral muscles during vertical climbing, arm swinging and knuckle-walking in the chimpanzee. The results showed very similar patterns of muscle recruitment during vertical climbing and arm swinging. The anterior and posterior deltoid and teres major all show significant support phase activities, while the anterior and middle deltoid plus supraspinatus and infraspinatus are active during elevation of the arm in swing phase. Only the subscapularis changes roles, being a support muscle in vertical climbing but a swing phase muscle in arm swinging. In both cases, however, its recruitment is associated with medial rotation of the arm. In knuckle-walking the scapulohumeral muscles all reverse their activity patterns from those seen in climbing or arm swinging reflecting their very different functional roles in pronograde versus anti-pronograde locomotion.

This research was supported by NSF Grant BNS 83-18013.

Surnames and the genetic structure of human populations: another method. G.W. LASKER and B.A. KAPLAN, Wayne State University, Detroit.

A new method of using the surnames of married couples to study the genetic structure of populations calculates the frequency of pairs of surnames of a husband and his wife

that match the same two surnames of another husband and wife: $\sum S_{ij}(S_{ij}-1)/N(N-1)$, in which S_{ij} is the number of couples with the i^{th} and j^{th} surnames, N is the sum of S_{ij} and summation is over all pairs of surnames. The surnames of the females are then rearranged in random order and paired with those of the males to produce a random model. The frequency of repetitions is dependent on the number of marriages sampled, but the relationship of the observed frequency to the random model is independent of sample size. In a study of data from a census of Paracho, Michoacan, Mexico, collected in 1952, the randomization was repeated 8 times for each of 4 categories: I. 770 instances of husband's father's with wife's father's surnames, II. 695 instances of husband's father's with wife's mother's surnames, III. 723 instances of husband's mother's with wife's father's surnames, and IV. 674 instances of husband's mother's with wife's mother's surnames. The observed values of the new measure exceed the mean of the corresponding random runs by 26%, -1%, 67% and 25% respectively for an average of 29%. This is comparable to the 35% by which marital isonymy exceeds random isonymy. The excess by the new index is statistically significant, whereas the larger difference by isonymy is not. The new method shows the population structure between marriages whereas marital isonymy shows that between husbands and their wives. In the Paracho example the new index yields four times as much information as does marital isonymy. Thus the differences among categories I, II, III and IV are statistically significant by χ^2 for the new index, but the even greater diversity by marital isonymy is not.

Developmental differences between the buccal and gluteal fat depots of the human fetus.

M. LAVELLE, Cornell University, C.M. POISSONNET, Hopital Port-Royal, A. BURDI, S.M. GARN, University of Michigan and P.S. BRIDGES, Hunter Col.

Our knowledge of growth and development of human fetal adipose tissue is severely limited. For example, there are no comparative data on inter-regional differences between fat depots. Of interest is whether fetal fat develops at similar rates between sites and whether differences exist between regions in cell growth due to hyperplasia versus growth due to hypertrophy.

This paper reports results of histological analyses of the buccal and gluteal fat depots obtained from 88 human prenatals in the university of Michigan Patten Embryology Collection. The sample ranged from 14 to 42 gestation weeks of age and was screened for evidence of gross defects or unusual pregnancy history. Serial tissue sections were prepared using standard procedures, and selected sections were photomicrographed at 74.5 magnification. Number of fat lobules, average lobule area, total area of adipose versus connective tissue and estimated number of vacuolated fat cells were digitized within a 10x20cm photo-window for each section.

Data from several sections were averaged per region per subject.

Compared with the buccal region, gluteal fat was delayed in adipose growth and maturation. The gluteal region was characterized by fewer but larger fat lobules and the buccal area by greater numbers of fat cells and percent adipose tissue. These findings were consistent within age groups and were not affected by fetal weight. Sex differences within regions were not demonstrable for adipose growth.

These regional differences in growth of fat indicate that adipose tissue is not homogeneous in the human fetus, and that lobules grow primarily through hyperplasia in the buccal fat pad and primarily through hypertrophy in the gluteal depot during prenatal development.

Research was supported by the Kroc Foundation.

Male-immature social interaction patterns in a captive group of baboons (Papio sp.) W.A. LAWRENCE, New Mexico State University Primate Research Institute, Holloman AFB, NM.

Patterns of male-immature social interactions in a captive group of baboons (Papio sp.), discerned by multi-variant analysis of behavioral data, are presented in this paper. Behavioral data presented were collected during 2400 hours of focal, scan, and ad libitum sampling (Altmann, 1974) in the six acre, natural vegetation breeding corral at the Southwest Foundation for Biomedical Research, San Antonio, Texas. Behavior profiles were developed for 33 sub-adult and adult males with respect to each male's interactions with three immature age-graded cohorts. Cluster analysis was used to distinguish patterns of male interactions and factor analysis served to discriminate behaviors which serve as the principal components of the behavior patterns. Four interaction patterns emerged from the analysis of inter-cluster pattern variation: affiliative, approach-avoid, guardian, and play. Analysis of intra-cluster pattern variation in behavior patterns suggested changes in the male-immature interactions in accordance with the maturation of the immatures. Finally, the possible functions of the male-immature interaction patterns are discussed. This research was funded in part by The Ohio State University Alumni Association, NSF (BNS-8016637), and NIH (5-507-RR05519-13, ARB-RR01104).

Socio-economic change and patterns of growth in a highland Peruvian population. T.L. LEATHERMAN, M. AELIAN, and J.W. CAREY. University of Massachusetts/Amherst.

Over the past ten years a process of relatively rapid social change has occurred in the southern highlands of Peru, due in part to agrarian reform policies and increased market penetration into rural

areas. Such social and economic change might be expected to promote changes in health and nutritional status, which should be reflected in the growth characteristics of these rural populations.

In this paper, we present anthropometric characteristics of growth for 500 males and females between the ages of 5 and 22 years, residing in the town of Nuñoa (4000m) in the southern Peruvian altiplano. The anthropometric measures include: height; weight; sitting-height; bi-acromial, upper chest, and bi-iliocristal diameters; head, chest, upper-arm and calf circumferences; and, triceps, biceps, subscapular, supra-iliac and medial-calf skinfolds.

Selected anthropometric measures are compared to those reported from a study in the same town 15 years ago. The results suggest that in spite of the social change which has occurred, there has been little or no change in growth characteristics of the Nuñoa population. Several explanations are discussed.

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Ontogenetic and static allometry of the Neandertal and modern hominid palate. S.R. LEIGH, University of Tennessee, Knoxville.

The study of allometry has greatly enhanced knowledge of morphology in recent years. However, studies of evolutionary allometry in which fossil hominid material constitutes a data base are rare; even rarer are studies which examine juvenile fossil specimens. This paper presents the results of a study of the ontogenetic allometry of the Neandertal palate and compares these results to the allometric characteristics of the modern hominid (Arikara Amerindian) palate. Although the sample of Neandertal juvenile palates is quite small (n=7), the results of regression analyses suggest that the Neandertal palate is not simply a "larger" version of the modern hominid palate. Tests for homogeneity of least-squares regression slopes between samples show parallel regression lines. These are accompanied by significant differences in intercept values.

In addition to comparing allometric relationships between Neandertals and modern hominids, the relationships between static and ontogenetic allometry in both groups are explored. Generally, a poor correspondence between static and ontogenetic allometry is present in these samples, suggesting the limited utility of using an all-adult sample to estimate ontogenetic trajectories. In summary, these results indicate that allometric studies of fossils should, when possible, incorporate juveniles as well as adults. This procedure should allow a clearer understanding of allometric relationships.

Direct and indirect effects of marriage rules on genetic structure. P.W. LESLIE, State University of New York, Binghamton.

Anthropologists have long been concerned with the wide variety of marriage patterns exhibited by human populations, but our knowledge of the genetic consequences of this aspect of cultural behavior remains shallow. This dearth can be attributed in part to a past lack of adequate data and appropriate models. A full understanding of the relationship between prescriptive rules and genetic structure entails knowledge of 1) the extent to which prescribed rules for behavior are reflected in actual behavior, and 2) the expected changes in genotype frequencies attributable to the actual behavior. The latter include both the direct effect that the rules have on the incidence of consanguineous matings and therefore on inbreeding, and less well recognized indirect effects. Adhering to marriage rules alters the size and distribution of an individual's pool of potential mates, thereby affecting marital movement and celibacy rates, which in turn influence gene flow and genetic drift. The conditions under which the direct and indirect effects are likely to be most important are considered.

Sexual dimorphism in the postcranial skeleton of platyrrhine primates. W. LEUTENEGER, University of Wisconsin-Madison, and S.G. LARSON, SUNY-Stony Brook.

This study examines sexual dimorphism in 24 dimensions of the postcranial skeleton of four platyrrhine species: Callithrix jacchus, Saguinus nigricollis, Saimiri sciureus, and Cebus albifrons.

The two callitrichid species show a relatively small amount of variation in the degree of sexual dimorphism among the different dimensions. Variation is considerably higher in the two cebid species as reflected by a mosaic pattern of sexual dimorphisms with males being significantly larger than females in some dimensions, and females significantly larger than males in others. In dimensions of the pectoral girdle and limb bones, males and females in each of the two cebid species are essentially scaled versions of each other, with males being peramorphic compared to females. This pattern is primarily the result of time hypermorphosis, i.e. an extension of the growth period in time in males. Rate hypermorphosis, i.e. an increase in the rate of growth in males, appears to play an additional role, however, in Saimiri sciureus. By contrast, in dimensions of the true pelvis, sex differences in shape are dissociated from those in size. They are interpreted as the result of acceleration, i.e. increase in rate of shape change in females, as an adaptation to obstetrical functions.

Interspecific analyses indicate positive allometry of mean degree of postcranial dimorphism with respect to body size. This

coincides with previous findings by Leutenegger and Cheverud (1982, 1984) on the scaling of sexual dimorphism in body weight and canine size, and thus supports their model which posits selection on body size as the prime mover for the evolution of sexual dimorphism.

Multivariate comparisons of dental dimensions in some extant and fossil hominoids. S. S. LIEBERMAN, B. R. GELVIN and C. E. OXNARD, University of Southern California, Los Angeles, and California State University Northridge.

Univariate studies of dental dimensions in fossil hominoids show that a series of different sexual dimorphisms exist. This study attempts to discover how the various fossils are placed in relationship to extant species when the same univariate data are entered into multivariate (canonical variates) analyses. Lengths and breadths of teeth for a total of 367 specimens of the genera: Pan, Pongo and Gorilla (sexes known) and Homo (sexes unknown) form the reference population. The data for the fossils are intercalated into these analyses.

Results show that sexual dimorphism in living apes and humans is generally less in molars than in other teeth, and less in the upper jaw than in the lower; these are also features of most of the fossils. The patterns of sexual dimorphisms in the apes, as defined by arrangements along the tooth row are quite different from one ape to another, and more different from modern humans than from each other ape. Sexual dimorphisms in the fossils fall into groups of patterns, all of which differ from those in extant species.

Australopithecus robustus and A. boisei clearly share one fossil pattern, A. afarensis and A. africanus another. Homo habilis is not like any australopithecine but has distinct similarity to Homo erectus. Ramapithecus is not too distant from Homo; Sivapithecus is distinctly ape-like. Because the fossil data have to be interpolated into the analyses of the extant species it is especially important to examine those higher canonical axes which do not provide for statistical separation of the living forms. The information given by the multivariate statistical analyses does not replace, but is in addition to, much of the information divulged in the univariate studies. Together these imply yet further separations between fossil and extant forms.

Dietary changes and disease consequences among Afro-Americans. L.S. LIEBERMAN, University of Florida, Gainesville.

Data from historical documents, zooarcheology and historic archeology of plantations in the lower Southeast are used to reconstruct the dietary and lifestyle patterns of American slaves. Contemporary diets and

epidemiological data are based on the Health and Nutrition Examination Surveys and other National Center for Health Statistics summaries.

Diabetes mellitus (Type II) and hypertension are two diseases that show high prevalences among Black Americans. These diseases are selected to illustrate the hypothesis that under conditions of labor-intensive slavery and dietary limitation both diseases may have represented advantageous phenotypes with physiological thriftiness for carbohydrate and mineral metabolism, respectively. Better understanding of the pathophysiology of Type II diabetes and hypertension have enabled the generation of specific thrifty mechanisms associated with diet and nutritional status. For example, a diabetic phenotype shows reduced gluconeogenesis; and therefore, is nitrogen or muscle-sparing (Cahill 1979). This paper will articulate the biocultural history of American Blacks with the dietary risk factors for diabetes and hypertension. These variables include: (1) dietary changes in the amount and frequency of food intake; (2) dietary change in the types of foods with a shift toward foods with a high glycemic index; (3) changes in sodium, calcium, potassium and phosphorus intake; (4) changes in daily energy expenditure requirements; and (5) the etiology and prevalence of obesity.

This research was supported in part through a contract from the Florida Department of Health and Rehabilitative Services to the University of Florida Diabetes Research, Education and Treatment Center.

Analysis of covariance controlling for the influence of nutritional factors on body form in Aymara and Quechua populations living in comparable high altitude environments. D. S. LINCOLN and R. B. ECKHARDT, The Pennsylvania State University, University Park.

In this paper we present previously unreported data on anthropometric correlates of nutritional status that clarify our understanding of the components of body form. The anthropometric measurements were collected in two populations (the Camacani Aymara speakers and the Huata/Coata Quechua speakers) resident at approximately 4000 meters above sea level on the shores of Lake Titicaca in southern Peru; the total samples exceed 800 and 400 subjects, respectively, with ages ranging from infancy through late adulthood.

We have identified for adult males in these two populations both pervasive commonalities (notably robust thoracic development in combination with short stature) and some complex distinctions (such as the Aymara population members having broader skulls and more robust wrists and ankles). Our principal objective here is to control for nutritional influences on these and other patterns of body form by utilizing an analysis of covariance with upper arm circumference as the covariate. One clear pattern which emerges is that the Camacani Aymara consistently surpass the Huata/Coata Quechua even more in measures of adiposity

than in those of muscle mass or skeletal form, a result which is traceable across the age range available.

This project has been supported by Grant RR 0707082-11 awarded by the Biomedical Research Support Grant Program of the National Institutes of Health; NIH Grant 1 R01 HL 25400-01 awarded by the National Heart, Lung, and Blood Institute; The Harry Frank Guggenheim Foundation; and the Fund for Academic Excellence and Liberal Arts Endowment Fund of The Pennsylvania State University.

Village and household ecology effects on child growth in a rural agrarian community in Southern Mexico. B.B. LITTLE and R.M. MALINA, The University of Texas at Austin, and P.H. BUSCHANG, Centre de Recherche sur la Croissance Humaine, Université de Montreal.

The growth status of 318 (293) Zapotec school children 6 thru 13 years of age was examined with reference to possible environmental effects. The mating decision in this village influences labor allocation and the sociocultural inheritance cycle, which is intimately related to distribution and use of land resources. Interaction of mating decision and sociocultural inheritance cycle in agricultural strategies have a notable affect on child growth and deaths for a variety of parameters. The effects on male child growth are statistically significant. In contrast, female child growth varies slightly across ecological distributions, and the effects are not statistically significant in any parameter. The association of ages at childhood deaths and the relative number of childhood deaths suggests selection may be operating. Thus, interaction of developmental and natural selection factors to produce smaller body-sized, slower maturing children involves ecological and sociocultural influences, indicating a biocultural interaction in the evolutionary ecology of child growth.

This work was supported in part by The Institute of Latin American Studies, The University of Texas at Austin, and National Science Foundation Grant: ENS 78-10642.

Human ecology of pastoral Turkana nomads: problems and progress in a multidisciplinary study. M.A. LITTLE and P. W. LESLIE, State University of New York, Binghamton.

The SOUTH TURKANA ECOSYSTEM PROJECT is a coordinated program of research de-

signed to integrate ecological and anthropological sciences for the achievement of a common goal. Plant, wildlife and livestock ecologists have joined with sociocultural and biological anthropologists to answer three major questions. How do nomadic Turkana pastoralists of northwest Kenya extract resources from an arid and inhospitable savanna environment? How do the pastoralists' practices of resource extraction and utilization influence their health and well-being? How do the pastoralists' methods of resource extraction and utilization modify the ecosystem itself? The principal perspectives of the project are multidisciplinary, collaborative, longitudinal, biocultural and ecological.

Discussion here centers on some of the models developed to analyze relationships among livestock food productivity and human health, nutritional status, activity requirements, fertility and child growth. Evidence to date suggests that food energy is severely limiting and that nutritional status, child growth and seasonal fertility variations reflect these limited food resources. Data are provided to support this assertion.

This research was supported by the National Science Foundation under Grant No. DEB-8206864 (Anthropology and Ecosystems Analysis Programs).

Estimation of the rates of evolution in polygenic systems by simulation. FRANK B. LIVINGSTONE, University of Michigan, Ann Arbor.

Much of the current controversy in human evolution, especially that surrounding punctuated equilibrium versus gradual change, is concerned with rates of evolution. But there are remarkably few studies which attempt to estimate evolutionary rates or to model possible rates of change due to selection or other known forces of evolutionary change. There are also many categorical statements about the possibility of evolutionary change which are not supported by any evidence. Thus, with reference to the Neanderthal-sapiens transition in Europe, Eldredge and Tattersall (1982) state that "The pattern of abrupt displacement is too regular and too short-term to allow in situ evolution by any mechanism whatsoever." On earlier hominid evolution, they also state that "It should have been blindingly obvious that Australopithecus africanus and Homo erectus were two very different hominids and that one could not possibly have suddenly transformed directly into the other." Other comparable statements abound in the literature. However, simulation of the trait changes which occur between these fossil populations indicates that the changes could occur within the estimated time span with less than 1% directional selection. This does not seem improbable, and certainly not impossible.

The analysis of genetic distances in New Guinea using variance components. J.C. Long, P.E. Snouse, and J.W. Wood. Medical College of Virginia, Richmond and University of Michigan, Ann Arbor.

Genetic distances among 18 villages of Gainj and Kalam speaking people in highland New Guinea are investigated in order to determine the relative contributions of geographic, linguistic and demographic factors in the formation of population genetic structure.

Each village is characterized by a vector of allele frequencies. It is shown that Euclidean distances between vectors can be explicitly related to the parameter, $F(ST)$, of Wright's hierarchical population structure model. Capitalizing on this relationship, these distances can be estimated using an extension of the variance-components estimator of $F(ST)$. This new methodology is advantageous because it easily accommodates (i) multiple alleles and loci, (ii) small samples and unbalanced designs, and (iii) genetic hypothesis tests.

A significant level of inter-village heterogeneity is observed, $F(ST)=.0263$. A comparison of the resulting genetic distances with matrices of geographic distances, measures of linguistic divergence, and two demographic factors (village size and endemicity) reveals that the geographic distance separating pairs of villages has the strongest association with the degree of pairwise genetic differentiation, language has a very small effect, and the demographic factors lack demonstrable effects. The low correlation between genetic and linguistic divergence is unique among anthropological groups. This research was supported by NIH-T32-GM07544.

Key Words: Genetic Distance, Population Structure, Methodology.

Preparative fractionation of heterozygous proteins by liquid chromatography. F. W. LOREY, D. G. SMITH, and B. K. ROLFS, University of California, Davis.

The identification of differences in the functional properties of proteins synthesized by allelic genes is often complicated by a high variance in those properties among samples homozygous for alternate alleles. Environmental, metabolic and other influences attributable to individual differences other than those in the structure of the proteins under study contribute to that variance, requiring large sample sizes to confirm the statistical significance of biologically meaningful differences.

Rapid HPLC fractionation and recovery of preparative quantities of proteins synthesized by alternate alleles from heterozygous tissue can overcome these complications by permitting direct comparison of functional properties of allelic fractions recovered from the same sam-

ple. We present here techniques for recovering sufficient protein fractions from heterozygous sera to perform studies of differences in binding properties which have been reported elsewhere.

Sera of rhesus monkeys heterozygous for $A1^{mac}$ and $A1^{Bmac}$ and with the transferrin phenotypes BC, CD, DF, FG, and GH were subjected first to affinity chromatography on Blue Sepharose, followed by chromatofocusing using a Pharmacia P column. The quantitative determination of iron binding properties of the transferrin fractions was made colorimetrically using the ferrozine technique and binding of toxic bilirubin by albumin fractions was measured using the peroxidase assay. The paired-t and Mann-Whitney U tests were used to demonstrate statistical significance of differences in binding properties of alternate allelic proteins, differences which cannot be confirmed using homozygous sera from so few animals. The techniques described above could be applied to the analysis of alternate allelic fractions from sera or hemolysate heterozygous for most polymorphic proteins for which functional or quantitative assays are known and provide valuable insight into the evolutionary interpretations of polymorphic variation.

Determination of sex by osteometric assessment of the sternal rib. S.R. LOTH and M.Y. IŞCAN, Florida Atlantic University, Boca Raton.

While a number of studies have indicated that the sternal rib shows considerable sexual dimorphism, no attempt has been made to establish a method of sex determination based on direct metrical analysis of a single rib. The present study is an attempt to develop a technique to accurately determine sex from the fourth rib. The sample was composed of 200 ribs (144 males, 86 females) taken at autopsy from recent forensic cases of known age, sex and race. Three measurements (height, width and sternal articular pit depth) were taken at the sternal extremity of each specimen. The ribs were considered first as a total group regardless of age and then divided into older and younger groups. The division into older and younger age groups was based on the age determination method developed by Işcan et al. (J. of Forensic Sciences, 1984). Stepwise discriminant function statistics were used to analyze the differentiation of specimens.

Results indicated that the most dimorphic dimensions were the height and width. The accuracy of sex determination ranged from 82% in the younger, to 89% in the older and 83% for the total group. It was concluded that sexual dimorphism expresses itself metrically from the mid-teens to the 70s and increases with age.

A new test of Phenice's method for determining sex from the Os Pubis. NANCY C. LOVELL, Cornell University, Ithaca, NY

Phenice's visual method for determining sex from the Os Pubis (1969 AJPA 30:297-302) is widely used in human osteological analysis

due to its relative ease of application, and apparently high degree of accuracy. However, the only critique of the method is Kelley's test for ambiguity (1978 AJPA 48:121-122) which is based on prehistoric skeletal remains of unknown sex and age. While limits to the accuracy of a technique may be implicit in paleodemographic studies, they must be made explicit in forensic applications. It is necessary to firmly establish the limits to accuracy of Phenice's method.

This test was conducted by twelve researchers on fifty pubic bone specimens from individuals of known sex, ranging in age from 52 to 92 years. Accuracy of circa 83% was recorded, which was compared to >95% accuracy reported by Phenice. This may reflect different age distributions of the two samples. Through replication of test results, the technique was found to be reliable. The extent of the researchers' previous experience in human osteological analysis was shown to have no effect on their accuracy in this test, confirming Phenice's assertion that the technique does not require extensive experience to attain accurate results. Results suggest that there is a moderate negative correlation between accuracy in determining the sex of an individual, and that individual's age.

Porotic hyperostosis: new evidence to support the anaemia theory. P.L. STUART MACADAM, Passmore Edwards Museum, London, England.

The aetiology of skull lesions known as porotic hyperostosis (after Angel, 1966) has long been a matter for speculation. The most widely accepted theory at present suggests that an anaemia, either acquired or genetic, is responsible for lesion development. However, acceptance for this theory is not universal and the nature of the relationship between orbital and vault lesions remains a controversial issue.

The present paper provides a much broader field of supportive evidence on which to base the anaemia theory. This involves a synthesis of information from the clinical and anthropological literature as well as new data from Poundbury Camp, a Romano-British skeletal series. A comparison is made between the clinical and anthropological at the microscopic, macroscopic, radiographic and demographic levels of analysis. This approach reveals the similarities in expression between clinically diagnosed anaemias and porotic hyperostosis.

Sibling similarities in the strength and motor performance of undernourished children of school age. R. M. MALINA and B. B. LITTLE, University of Texas, Austin.

Studies of sibling similarities in strength and motor performance are limited largely to reasonably well-nourished children. This study considers such similarities in a sample of school children living under conditions of chronic mild-to-moderate undernutrition. Sibling similarities for grip strength were only slightly lower than those for better nourished children, and a sex difference apparent in the well-nourished children was not evident in the undernourished children. After controlling for the effects of body size, brother-brother correlations for grip strength were reduced considerably, but sister-sister correlations were essentially unchanged. The reduced correlations between brothers after correcting for size variation may reflect the greater susceptibility of males to environmental stresses. In contrast to strength, sibling correlations in tests of running, jumping and throwing were low and consistently lower than those for well-nourished children. Interestingly, sisters resembled each other more than brothers in the undernourished sample, which is contrary to observations in well-nourished children. Correcting for size variation changed the correlations only slightly.

This research was supported in part by the Institute of Latin American Studies of the University of Texas at Austin.

Holocene environment and megafaunal adaptation in Madagascar. R.D.E. MacPHEE¹, D. BURNEY¹, and N.A. WELLS², ¹Duke & ²Kent State Univs.

It has long been assumed that (1) Madagascar was heavily forested prior to human colonization about 2000 BP, but (2) humans precipitated an ecological disaster that resulted in the replacement of most forest formations by monotonous grassland, thereby causing (3) the extinction of many land vertebrates, most of which are thought to have been forest-adapted. These assumptions have never been critically tested with suitable evidence. We present preliminary evidence that (1) may be incorrect, and that the Malagasy megafaunal extinctions probably involved factors more complex than forest destruction.

Ampasambazimba is currently the oldest radiometrically-dated mammal locality in Madagascar (8245 ±215 BP; wood, 2.8 m below surface; GX-9835). Sample pollen spectra from this site indicate that at ca. 8000-7000 BP central Madagascar may have been covered by a woodland-bushland-savanna mosaic. Although species typical of the dry/mesic forest zone of western Madagascar are common in our spectra, so are significant representations of woody savanna taxa requiring open settings for growth. Our data are not definitive, but they do imply that the depauperate grasslands of modern Madagascar were not exclusively preceded by dense forest formations.

What late Quaternary Malagasy vertebrates would have favored non-forest biotopes? Large elephantbirds (~400 kg) are one possibility. Hadropithecus and Archaeolemur have been specifically proposed as open-country forms, but there are other good candidates among the extinct lemurs. Megaladapis edwardsi and Archeoindris fontoynonti, for example, may have weighed as much as a large chimpanzee or small gorilla, and, like these anthropoids, may have frequently visited the ground. Oddly, subfossil species are extremely rare in archeological contexts. Perhaps their numbers were greatly reduced before human arrival--in which case the subfossil extinctions must have been initiated by a non-anthropogenic cause, as yet unidentified.

Chest size similarity versus height, weight and fatness differences in two samples of high altitude Peruvian children. S.T. McGARVEY, Brown University.

Increased chest dimensions for height have been described in several high altitude Andean populations. This morphological variation has been attributed to adaptation to the hypoxic high altitude environment. Cross-sectional and mixed longitudinal studies of children demonstrate this, as well as natural experimental studies of children of high altitude migrants to low altitude. The present study contrasts anthropometric measures of a sample of 7-9 year old Quechua Indians from Nunao, Peru seen in 1972 with those of the original survey sample of 1963-67 from the same locale. Eighty children, studied as infants, were followed-up 7 years later, and 40 of them were alive and still residing in the region. 22 males and 18 females aged 7-9 years from the later sample are contrasted with 41 males and 40 females of the same ages from a report of the original survey.

Males and females from the later sample are shorter, lighter and leaner than their same aged counterparts in the original population survey. There is no sexual dimorphism in height or weight in the later sample. Chest width and depth are the same for both the original and later samples.

These results suggest a more stable thoracic growth pattern relative to height or weight in these children in response to a presumed caloric deficit. A speculation is that regional socio-economic and agricultural changes between the mid 1960s and 1972 related to agrarian reform may be responsible for a local shortage in food and income. A mild to moderate malnutrition may have resulted in height and weight suppression for age. A small but significant decrease in chest dimensions has been described in other populations suffering mild to moderate malnutrition. However, the absolutely undisturbed thoracic growth shown here may be related to genetic adaptations enhancing cardiorespiratory function in high altitude Andean human populations.

Organization of the Visual System in Tarsiers
EVELYNN MCGUINNESS and JOHN ALLMAN,
Division of Biology, California Institute of Technology, Pasadena, California

In Primates the dorsal lateral geniculate nucleus (DLGN) is the principal relay of visual input from the retina to the cerebral cortex. We have investigated the organization of the DLGN in the brains of a Tarsius bancanus and a Tarsius syrichta, which died from natural causes. The DLGN contains 2 ventral magnocellular layers, a broad interlaminar zone and 2 dorsal parvocellular layers, which is the basic pattern found in all other haplorhine primates; strepsirhines possess these layers plus 2 additional layers containing very small cells intercalated between the 2 dorsal layers (Kaas et al, J. Comp. Neurol. 182:517). The organization of the DLGN in the tarsier is the simplest of any primate and most closely resembles the DLGN of the owl monkey. The DLGN in strepsirhines appears to have been derived from a pattern like that present in the tarsier but contains 2 additional layers not present in haplorhines.

We found in acetylcholinesterase-stained sections a difference in the layers that correlates with the tarsier's nocturnality. In the tarsier the 2 dorsal parvocellular layers are densely stained for acetylcholinesterase, the 2 ventral magnocellular layers are lightly stained. In the nocturnal owl monkey and galago, the parvocellular layers are also densely stained (Fitzpatrick and Diamond, J. Comp. Neurol. 194:703). But in the diurnal macaque monkey (Manocha and Shantha, Enzyme Histochemistry), squirrel monkey (Hess and Rockland, Brain Res. 289:322) and marmoset (personal observations), the ventral magnocellular layers are densely stained and the dorsal parvocellular layers are lightly stained, which is the opposite of the 3 nocturnal species. Supported by NIH EY-03851 and NSF BNS-81-20529 grants.

Comparisons of dental arch shapes.
J.K. McKee, Washington University.

Many attempts at mathematical descriptions of the shape of the dental arch have involved linear distances and ratios. The method described here fits a series of curves to homologous points on the palate. This allows for both visual reconstruction and multivariate description of dental arch shape.

In a test population of Australian aborigines, a discriminant analysis was used to test the multivariate description of dental arch shape. The discriminant functions were highly successful at placing the aboriginal palates into categories of hypsiloid, hyperbolic, and parabolic.

Uses of the mathematical descriptions of palatal shape include comparative studies among living and fossil primates, studies of intrapopulational variation, functional/biomechanical analysis, and clinical applications.

Functional adaptation in delayed development of children and adolescents with cystic fibrosis. MICHAEL C. MAHANEY, The University of Alberta, Edmonton and KAREN S. MCCOY, The University of Florida, Gainesville.

A pattern of development associated with a hereditary disease may be a pathological consequence of, or a functional adaptation to, the disorder. A functionally adaptive pattern of development serves to maintain internal homeostasis in the face of chronic disease stress. Biological development was studied in 50 subjects between the ages of 8 and 17 years with cystic fibrosis (CF), the most frequent lethal chronic hereditary disorder in Caucasian populations. CF, a generalized exocrine disorder which can entail compromised digestion and pulmonary function, has been associated with delayed growth in the clinical literature. A major goal of this research was to determine whether an observed growth deficit in CF is attributable to pathological or functionally adaptive developmental delay.

Data were obtained from radiographic, pulmonary, and physical examinations. Assessments of calcification of the permanent dentition (dental age), ossification of the hand-wrist bones (skeletal age), secondary sex character maturation, and pulmonary disease severity were made. The magnitudes of delays in dental age, sexual maturation, and skeletal age were found to be moderate to severe and significantly intercorrelated. Relationships among these three indicators and pulmonary disease severity, chronological age, and age at diagnosis were analysed by multivariate methods. While significantly correlated with chronological age, delayed maturation exhibited no significant association with disease severity or age at diagnosis. It is suggested that while maturational delay contributes to clinically observed growth deficits in CF, it serves as a functionally adaptive response to the inherited disorder.

Supported in part by the College of Social & Behavioral Sciences, Ohio State University and the Children's Hospital Research Foundation in Columbus, Ohio.

Patterns of disease in a marginal environment: The Black Mesa Anasazi. A.L. MAGENNIS, University of Massachusetts, D.L. MARTIN, Hampshire College, and G.J. ARMELAGOS, University of Massachusetts.

This skeletal series (n=178) is unique in that it sheds light on an alternative mode of adaptation in the American Southwest from A.D. 850-1150. In contrast to the large settled political and economic centers found adjacent to the Mesa, this area represents a marginal environment which was not conducive to intensive agriculture. Instead, small highly mobile groups relied on a mixed strategy including gathering, hunting and periodic non-intensive agriculture. Adaptation is evaluated by a multiple

methodological approach using several stress indicators to measure the fluctuations in subsistence patterns and to document the impact on patterns of morbidity and mortality.

The four stress indicators used are porotic hyperostosis, periostitis, enamel hypoplasias, and cortical bone remodeling rates. These measures are sensitive indicators of metabolic and nutritional stress. While porotic hyperostosis is frequent throughout the entire occupation, it is more prevalent, shows an earlier age of onset, and more severe expression during those periods of greatest environmental perturbations. Enamel hypoplasias show the same general pattern. Periostitis is greatest during peak population density (c. 1100-1150). Variation in the pattern of lesions and skeletal maintenance reflects the impact of the fluctuation in subsistence. Periods of extreme stress correspond to dietary and climatic transitions.

This research was supported by the Peabody Coal Company and the Center for Archaeological Investigation, SIU.

Non-standard mating systems for Saguinus mystax. C.A. MALAGA, Primate Project, Pan American Health Organization, Iquitos, Peru.

The standard system for the captive breeding of Saguinus mystax calls for monogamous pairing of male and female individuals of the species. Recent field studies suggest that the mating structure of this species in the wild is not as rigid as was once thought.

At the Center for the Breeding and Conservation of Non-human Primates in Iquitos, Peru, a breeding colony of Saguinus mystax has existed since 1977. As an effort to improve on the breeding of this species, non-traditional mating systems were used as follows:

Group 1: five breeding groups, each with two females and one male, were formed and their behavior and reproductive performance studied for a period of one year;

Group 2: five breeding groups, each with two males and one female, were formed and evaluated in accordance to the above criteria;

Control Group: fifty pairs of Saguinus mystax, mated using the traditional system (one male to one female), were used as a control for both groups 1 and 2.

Housing, handling and diets for all three groups were the same during the study period of one year.

After completion of the one year study, it was found that Group 2, five breeding groups, each with two males and one female, was the most successful breeding group. This has significant implications for the successful breeding of Saguinus mystax in captivity.

Scanning electron microscopy of Wilson bands and enamel hypoplasias. M.K. MARKS and J.C. ROSE, University of Arkansas, Fayetteville.

The use of enamel hypoplasias and Wilson bands for reconstructing childhood stress in prehistoric skeletal samples has been inhibited by the highly subjective descriptions of these features. During the past decade a number of researchers have defined both Wilson bands and hypoplasias using the light microscope (see Rose et al. 1985 for review). Because these definitions are based on morphological variation of enamel prisms which are difficult to resolve with the light microscope, the superior resolution of the scanning electron microscope was employed to evaluate the validity of these descriptions.

This study employs 20 mandibular canine/premolar pairs derived from the Late Woodland Libben site. Enamel hypoplasias exhibit a continuous variation in morphology with the important variables being abnormal enamel prism morphology, defective calcification, and deficient enamel formation. The canine exhibits a greater variability in hypoplastic expression than its matched premolar defect. This suggests that differential tooth susceptibility has a greater influence on hypoplasia morphology than the magnitude of the etiological agent.

Wilson bands as described with the light microscope also exhibit a gradation in prism morphology, prism bending, and quality of calcification when observed with the SEM. However, Wilson band types are distributed randomly within teeth and between matched canine/premolar pairs. This suggests that Wilson bands are not influenced by differential tooth susceptibility.

This study was supported in part by a grant from Fulbright College, University of Arkansas.

Cortical bone maintenance in an historic Black cemetery sample from Cedar Grove, Arkansas. D.L. MARTIN, Hampshire College, A.L. MAGENNIS, University of Massachusetts, Amherst, J.C. ROSE, University of Arkansas, Fayetteville.

The Cedar Grove cemetery is a large collection of Afro-Americans who lived in the rural South at the turn of the century. A previous study of morbidity and mortality suggested that the subadults experienced a high prevalence of rickets, iron deficiency anemia, and protein-calorie malnutrition. The adults exhibited high frequencies of periostitis, trauma, osteoarthritis, and dental disease. These data suggest that occupationally-related health problems and nutritional inadequacies were chronic stressors affecting health.

The goal of this study is to further clarify the impact of these stressors on skeletal maintenance. Mid-shaft femoral thin-sections were

taken from 32 adults. Measures include thickness, percent cortical area, and frequencies of resorption spaces and forming osteons. Mean percent cortical area is low for adults when compared with published norms. The histological analysis demonstrates that resorption of bone calcium is rapid. While this pattern has been linked to pregnancy and nutritional stress in females, what is important is that males seem also to be experiencing bone mineralization problems. We suggest that a combination of stressors are producing poorly mineralized bone. These include a diet poor in calcium, iron and protein, a chronic exposure to infectious agents, a rigorous life-style, and the potential interaction of sickle-cell anemia.

This research was funded in part by Hampshire College's Dana and IBM Faculty Development Grants.

The development of a lateral ridge on the superior ramus of the pubic bone in three species of Old World monkeys. J.C. MARTIN, University of Wisconsin, Milwaukee.

The degree of development and frequency of a lateral ridge on the superior ramus of the pubic bone among males and females of three African monkey species are both age and sex related. The data source consists of the following material:

<u>Cercocebus albigena</u>		
Adult	18 males	24 females
Juvenile	16 males	20 females
<u>C. ascanius</u>		
Adult	29 males	19 females
Juvenile	11 males	15 females
<u>C. aethiops</u>		
Adult	14 males	5 females
Juvenile	11 males	9 females

No juvenile males in the three African species were observed to possess a lateral ridge. In contrast, 30% of the juvenile females of Cercocebus, 23% of C. ascanius and 33% of C. aethiops showed signs of this ridge. This indicates that a certain percentage of females in the three African species develop this ridge earlier than their male counterparts. Among adult males, 33% of Cercocebus, 40% of C. ascanius and 40% of C. aethiops showed signs of development. Adult females had a larger percentage: 81% for Cercocebus, 60% for C. ascanius and 83% for C. aethiops. There appears to be a trend in both sexes to have a greater percentage of individuals showing signs of a lateral ridge as they mature, although males consistently have a smaller percentage than females. Females tend to also have a more pronounced development of this lateral ridge than their male counterparts. The function

of this morphological feature is puzzling in that it does not appear in all specimens of either sex nor is it exclusive to only one sex.

Developmental inferences from the structure of genetical covariation of finger ridge counts. N.G. MARTIN, Department of Human Genetics, Medical College of Virginia, Richmond.

The genetical and environmental structure of covariation between finger ridge counts in twin and sibling data has been analysed using the method of Martin and Eaves (Heredity:38,77) adapted from Joreskog. Alternative models for the sources and structure of covariation are fitted by maximum likelihood and tested by criteria including goodness of fit and parsimony.

Most environmental variance is specific to each finger, the small environmental covariances being explained by a single common factor. Covariation is largely due to additive genetic effects. As well as a common factor, evidence is obtained for five other independent additive genetic factors, one for each digit. The thumb factor loads only on the two thumbs but the four finger factors load on the finger in question and on the adjacent fingers. A single common factor for non-additive genetic variance produces a considerable improvement in the above model. Loadings on these factors differ between left and right hands. Developmental implications of these factor patterns will be discussed (Ann. Hum. Biol.:9,539).

Non-additive genetic variance for ridge counts might imply a history of directional selection on this trait. Accordingly, correlations between dermatoglyphic variation and tactile sensitivity were sought and found (Ann. Hum. Biol.:11,113).

The usefulness of mathematical models for osteonal remodeling. R.B. MARTIN, West Virginia University.

The remodeling of cortical bone by secondary osteons (SO's) is important for mechanical as well as metabolic reasons. Because the continuous replacement of bone by this process appears to be partly determined by such specific functional requirements as the manner of locomotion, a better understanding of osteonal remodeling may improve our ability to infer function from bone structure. Also, because SO's accumulate with age, the degree of such remodeling has proven useful to physical anthropologists in assessing the age of skeletal remains. For these reasons, it is useful to study mathematical models for osteonal remodeling in order to

develop a better appreciation for the ways in which this process changes the appearance, structure, and function of cortical bone. An SO is formed by a tunneling and refilling process which generally adds a new Haversian canal to the cortex. Thus, osteonal remodeling contributes to increased bone porosity. As SO's accumulate with age, however, they begin to overlap, so that some may replace an old canal instead of adding a new one. The degree to which this happens will depend upon the specific factors which control the placement and direction of new SO's. If SO's are in effect randomly distributed, it is found that porosity will increase at a rate which decreases with age, and approaches a limit. This is confirmed by experimental measurements. Since the material strength of bone has been shown to depend upon the square of porosity, this behavior is of great mechanical significance. The number of new SO's per unit area will also increase at a decreasing rate. This prediction agrees closely with the empirical standards used to estimate age from osteon counts. Furthermore, one finds that repair of fatigue damage is maximized while the reduction of bone strength due to increased porosity is minimized.

Other mathematical models will be reviewed which provide insight regarding such effects as the relative distribution of double and single tetracycline labels among forming osteons, and the temporal aspects of cortical remodeling.

Profiling the demography of Chirikof Island: prelude to additional analysis. CHRISTINE A. MARVIN and KATHERINE RAFFERTY, Indiana University, Bloomington.

The microscopic aging technique developed by Ellis Kerley in 1965 has rarely been applied to determine the age of an entire archaeological population. The Kerley technique has primarily been limited in its usage to the age determination of forensic cases.

An archaeological skeletal series recovered from Chirikof Island, Alaska may prove of pivotal importance in understanding the effects of early Russian contact, as well as biological relationships between the three major Eskimoid groups inhabiting the area. In order to address these major questions, a basic demographic profile of these people must first be constructed.

Due to processes of weathering, much of the skeletal material from Chirikof is disarticulated and eroded. As a result, analysis of the pubic symphysis and cranial sutures, traditionally used in age determination, prove to be inadequate. With the application of the microstructure aging technique, a demographic profile can be constructed in order to evaluate the Chirikof skeletal material and facilitate further research.

Assortative mating for IQ and personality
C.G.N. MASCIE-TAYLOR
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University of Cambridge, UK.

The role of personal preference as an active process in mate selection is contrasted with the more passive results of limitations of available mates due to social, educational and geographical propinquity. Using data collected in Cambridge and Oxford, UK, it was possible to remove statistically the effects of social, educational and geographical propinquity. There was evidence in both regions for a small but significant amount of variance left that could be attributed to personal preference for IQ and introversion/extraversion as measured by the Wechsler Test and the Eysenck Personality Inventory.

The Chirikof Island skeletal populations: outline of research and general health profile. ROSIE M. MEER, Indiana University, Bloomington.

The Chirikof Island skeletal remains were originally described as representing a community of Koniag Eskimos placed on the island by the Russian-American Company as conscripted laborers sometime during the early historic period. Extensive weathering in the burial areas resulted in loss of primary archaeological context and major time constraints during collection limited the extent of in-the-field site analysis. The skeletal material was collected from two separate burial areas without a good understanding of the temporal or biological status of each cemetery. For these reasons, the preliminary interpretation of the skeletal series became suspect.

The Chirikof skeletal material is important due to the relative lack of complete skeletal series from this area for population comparisons and further because of its apparent temporal context.

Preliminary analysis of the skeletal material in 1982 indicated that Chirikof may have housed two distinct breeding populations. Therefore, a program of research which would facilitate analysis of a weathered and disarticulated population was undertaken. This program focuses on three major questions: (1) what is the relationship between the two series from Chirikof? (2) what are the biological effects of Russian contact on the aboriginal population in this area? (3) what is the biological relationship of the Chirikof series to the three major cultural groups in southwestern Alaska?

The general health profile of the Chirikof groups, based upon radiographic and microscopic analysis of growth arrest lines, indicates major differences between the two skeletal series. It further suggests that the group from Chirikof with definite Russian affinities was exposed to more health stresses.

Intergroup dynamics of the Barbary macaque, Macaca sylvanus L., Ghomaran Rif, Morocco. P.T. MEHLMAN, University of Toronto, Canada.

This paper is based on a two year study of the Barbary macaque in fir forest habitat of the Moroccan Rif. 933.2 observation hours were collected on 6 groups (12-61 ind., $\bar{x}=26.7$) with a mean sex ratio of 0.75. Some adult males were consistently peripheral to their groups; these same males were also sighted as solitaries and as peripherals to groups other than their assumed natal group. The cumulative 2 year home range size for the focal group (max.=61 ind.) was 9.1 km²; five other groups overlapped 50 % of the focal group home range. Estimated density for the fir forest habitat of the Ghomaran Rif is 8.9 macaques/km².

This paper focuses on intergroup dynamics of the study area and compares the results with one previous study from the Middle Atlas (Deag 1974) which reported "herding" of groups and groups travelling together (accounting for 33 % of all intergroup encounters). The overall rate of intergroup encounter in the study area was approximately 1/2 that reported for the Middle Atlas populations. 13 complete intergroup interactions were observed during this study; they can be divided into two types of intergroup encounter: (1) neutral encounters with little behavioural interaction (77 % of all encounters, mean contact time between groups = 125 minutes); and (2) agonistic encounters with group displacement (23 %, mean contact time = 47 min.). Some of the neutral encounters also seemed to result in group displacement. The only social interaction between groups other than watching, retreating, vocalizing, and branch-shaking was agonistic behaviour performed by adult and subadult males. An analysis of branch-shaking behaviour indicates it to be a common intragroup display behaviour used by all age-sex classes; its communicative content is not specific to intergroup interactions.

"Herding" (temporary unification) of groups and groups travelling together were not observed in this study. However, it did appear that groups were sometimes attracted to the same "eco-islands" (unevenly distributed, high-quality resource areas), causing temporary aggregations of up to 90 macaques.

The conclusion of this study is that "herding" is not an intergroup behavioural phenomenon in Barbary macaques of the Ghomaran Rif. Current evidence on Macaca sylvanus in its natural habitat indicates: (1) "herding" is not a species-specific characteristic of social organization in Macaca sylvanus; and is, in fact, rare throughout the species' entire range; and (2) intergroup dynamics in this species are quite variable throughout its range (e.g. male migration) with some Barbary macaque populations differing little in intergroup dynamics from other comparable species of the genus Macaca.

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Assortative mating in monozygotic twins. R.J. MEETER and P.L. JAMISON, Indiana University, Bloomington.

It is well established that the human species engages in non-random mate choice involving phenotypic expression at both behavioural and morphological levels. Further, the departure usually follows along positive directions in which there is a tendency for phenotypic likeness to be matched in marital union. This study investigated assortative mating in a series of monozygotic twins (males=16 pairs; females=35 pairs) by means of a battery of anthropometric variables. The adult twin panel is derived from a half-sib study being conducted at the Indiana School of Medicine, Indianapolis.

The results showed that in female twins mutual mate choice based upon morphology was much more likely than in male twins. After correcting for age, numerous anthropometric measures including stature, limb and extremity variables, and facial dimensions were significantly correlated ($p < .05$) between female twins and their spouses. Some of these variables dropped out of significance when partially correlated against stature. Thus it would appear for female twins that there is assortative mating based upon body linearity.

It is suggested that this practice is an extended manifestation of the closely matched lifestyles of the female twins. Their families tended to live in the same neighborhood and to interact more frequently than found in the male twins and their respective families.

Accuracy and direction of error in the sexing of the skeleton: Implications for paleodemography. R. S. MEINDL and C. O. LOVEJOY, Kent State University, Kent, Ohio.

Error in the determination of sex based on skull morphology (cranium plus mandible) was compared to that based on pelvic morphology (innominate plus sacrum) of the same specimens of a skeletal series of known sex. Sex, race, and age of each specimen (as well as overall proportion of sex, race, and age of the sample) were not revealed to the assessors. The crania were also sexed by means of several of the Giles and Elliot linear discriminant functions.

(1) Within-sex correlations of cranial and pelvic morphologies were smaller than expected. (2) Subjective assessments of the skull were superior to the results of the Giles and Elliot procedures, but these functions utilize no mandibular measures. (3) The *direction* of error for all procedures was the same, *i.e.*, a greater number of actual males was incorrectly sexed.

Error in sex estimation is confounded by age at death and completeness of the skeletal remains. The resulting distortion of the sex differentials in adult survivorship is one of the strongest arguments to the paleodemographer that primary reliance should be placed on the pelvis for the determination of sex of the adult skeleton.

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Demographic and genetic impact of war in Åland, Finland. J.H. MIELKE, University of Kansas, Lawrence, and K. PITKANEN, University of Helsinki, Finland.

War is usually discussed in terms of the number of enemy soldiers killed, captured

territory, significant battles, and great leaders. Historically, however, war also had a devastating effect upon the civilian populations in the area. In general accounts of war, large numbers of civilians are usually killed or forced to flee to safer regions. This study examines the demographic impact and possible genetic consequences of the 1808-09 War upon the civilian population of Åland. The study emphasizes the mortality patterns as they relate to the noncombatants caught between two armies: the forces of Russia and Sweden.

The population of Åland was reduced by approximately 23 per cent as a result of deaths alone during 1808-09. The greatest concentration of deaths occurred between birth and one year of age (18%) and after age 50 (42%), with lesser effects being felt among the reproductively active segment of the population (21% of the deaths between ages 20 and 45). The majority of the causes of death were numerous infectious diseases such as typhoid, typhus, and dysentery that moved swiftly through the entire archipelago. It is surprising that the population structure of the islands was not greatly affected as shown by the population pyramids before and after the war. Also, the fertility rates of the Ålanders were not greatly reduced. These are rather unexpected results given the gravity of the situation and the forced movement of much of the population. The Åland population responded extremely fast after the war and their numbers increased rapidly.

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Human-ape phylogeny: The anatomical evidence. D. J. MELDRUM, J. G. FLAGLE, and A. KEITH, State University of New York at Stony Brook.

In 1863, Thomas Henry Huxley marshalled evidence to indicate that our closest primate relatives were the chimpanzee and the gorilla. This view was supported by Darwin and a host of other comparative anatomists and anthropologists from both the last century and the first third of the present century. More recently, this view has received especially strong support from a wide range of biomolecular studies.

In contrast, Schwartz has argued that analysis of anthropoid morphology supports a Homo-Pongo clade, in disagreement with the largely phenetic results from biomolecular data.

In order to explore this apparent disagreement between the results of gross morphological studies and biomolecular studies, we have reviewed the literature on great ape and human anatomy and compiled a list of several hundred features that can be used to assess the phylogenetic affinities among humans and the living apes. Analysis of this data set demonstrates that correct identification of primitive and derived character states and appropriate treatment of unique features found

in single taxa can dramatically affect the phyletic conclusions that are drawn.

This work was supported in part by research grant BNS 8210949 from the National Science Foundation.

The pathogenesis and biodemographic consequences of porotic hyperostosis and periosteal reactions in earlier human groups. R.P. MENSFORTH, Kent State University, Kent.

Age related patterns in the incidence of porotic hyperostosis (PH) and periosteal reactions (PR) are reported for 310 Late Woodland and 119 Archaic subadults ranging in age from birth to 16 years. Epidemiological analyses incorporate an age paradigm sensitive to patterns of disease and nutritional stress, qualitative assessments of lesion remodelling status and degree of osseous tissue response, and differential diagnoses based on the presence/absence of skeletal changes considered pathognomonic for those conditions regarded as major factors in the etiology of the two lesions.

Results show that (1) age-at-onset and periods of peak incidence for PH and PR are similar in the two hunter-gatherer groups, (2) associations between PH and PR are highly age-specific, (3) the overall frequencies of PH and PR are significantly higher for the Late Woodland vs. Archaic subadults and are thus in accord with demographic patterns of childhood mortality observed for each group, and (4) patterns of skeletal involvement and age related distribution for the two lesions supports the inferences that PH is a direct result of iron deficiency anemia and that the majority of PRs are the consequence of relatively common bacterial pathogens (i.e., staph infections).

The role that constitutional factors, diet, and infectious disease play in the etiology of iron deficiency anemia are discussed. The demographic consequences of impaired immune response, gastrointestinal dysfunction, and altered bioavailability of iron are emphasized. It is suggested that age related patterns in the frequency of PH and PR are best understood in terms of the symbiotic relationships between iron deficiency and infectious disease. With regard to the etiology of PH specifically, it is further suggested that earlier studies concerned with the pathogenesis of the lesion in Old World circum-Mediterranean skeletal groups are in serious need of revision (i.e., those attributing PH to thalassemia and/or sickle-cell anemia).

Structural aspects of arboreality in titi monkeys (Callicebus moloch). C.R. MENZEL, University of California, Davis.

In nature titi monkeys spend virtually all of their time in trees. Preferences for certain heights above the ground or for trees per se are probably not, however, the immedi-

ate causes of this behavior, for animals housed in a large field cage containing many trees spend 88% of their time on an artificial runway system that is only .9m (and in places 1.6m) above the ground. Further, the animals are not necessarily reluctant to touch the ground. To investigate the importance of perceived substrate structure as a determinant of arboreality, individuals were given opportunities to descend from their home runway and travel to food placed nearby on the ground. The animals showed a strong preference for travel along a stick rather than across open ground when given a choice of these substrates, but they readily crossed the open ground when it was their only travel option. When the stick route to food increased substantially in length over the open ground route, it was still the preferred substrate. The results suggest that for titis an attraction to appropriate substrates is a major factor underlying their arboreality.

International Correlation of Anthropometric Variables and Adolescent Growth Patterns with Breast Cancer Incidence. M.S. MICOZZI and A. SCHATZKIN, Cancer Prevention Studies Branch, National Cancer Institute, Bethesda, MD

Cross-sectional analysis of international differences in breast cancer incidence and mortality rates indicates the importance of environmental factors in the etiology of breast cancer in women. Epidemiologic studies of Japanese migrants to the United States demonstrate a higher incidence of breast cancer in migrants compared to Japanese women in Japan. As migrants undergo progressive acculturation to western lifestyles and diet, migrant breast cancer rates progress toward those of the host country.

Human epidemiologic evidence on diet and breast cancer support the hypothesis that increased nutrient intake, especially excess fat, protein and total calories, is related to breast cancer incidence and mortality. Case-control studies of diet and breast cancer have focused on current nutritional patterns in breast cancer cases. Since cancer is a multi-stage process with a long latent period, anthropometric variables that are reflective of nutritional patterns in early life may also be relevant. We compared cross-sectional geographic variation in reported patterns of childhood growth, and anthropometric measurements, with variations in breast cancer incidence in various human population groups. Our analyses indicate that patterns of childhood growth, and enduring indicators of childhood growth (such as height, frame size and lean body mass) are highly correlated ($r=0.75-0.80$) to breast cancer incidence on a worldwide basis. Measurements of weight, per cent body fat and total body fat appear to be less correlated to world wide breast cancer incidence.

Breast cancer is a health outcome which shows strong correlations to measurements of growth and body size in populations. Recognition of this relationship raises a new context for consideration of the adaptiveness of body size in human populations.

A biomechanical interpretation of wrist measurements reflects molecular similarity of African apes and humans. RAND A. MIYASHIRO, University of California, Berkeley.

Previous studies show that hominoid genera can be distinguished by linear measurements of their wrist bones. The limitation of this approach has been the lack of a standard to interpret measurements. One solution is calibration of a set of measurements to a molecularly derived phenogram. This metric abstraction reflects not overall morphological change, instead it tracks molecular change. Using specimens from the Smithsonian Institution, and based on previous work by Corruccini (1975), 14 measurements of the lunate, scaphoid, distal radius and ulna of hominoids closely follow a molecularly derived phylogeny.

Measurements grouping humans with African apes relative to Pongo can be interpreted as differing solutions to compressive stress of knucklewalking versus fist walking. Pongo retains a predominate radial lunate articulation and tubelike shaft at the ulnar head. African apes and humans have greater stiffening between the proximal scaphoid and the distal proximal phalanx III, greater scaphoid predominance in the wrist, and oval-like shaft at the ulnar head.

The expanded dorsal surface of African ape and human third metacarpals, a feature outside the wrist measurements, results from hyperextension of the first phalanx on the metacarpal during knucklewalking; a parallel example is seen in digitigrade macaques.

A social selection model of the albinism polymorphism in American Indians. K. MORGAN, University of Alberta, Edmonton, and S. YOKOYAMA, Washington University, St. Louis.

Various selection hypotheses have been proposed to explain the relatively high frequency of albinism in, for example, the Hopi and Zuni. We analyze a social selection model in which a benefit (r) accrues to the albino and his first-degree relatives that balances the loss of fitness (s) intrinsic to the trait. We have investigated two cases of social selection: (1) when there is an albino parent and (2) when there is an albino sibling or parent. At mutation-selection equilibrium, social selection via case 2 leads to a narrower range of allele frequencies. For example, for a recurrent mutation rate of 10^{-5} and s less than about 0.2, r must be less than about $s/2$ to be compatible with observed trait frequencies. This implies that the intrinsic fitness of tyrosinase-positive albinism would be as large as 0.8 in pueblo society.

An assumption of the deterministic model is that the pueblos comprise a large, randomly mating population. On the other hand, aboriginal groups are likely to have been small and more or less isolated. In order to model the stochastic effects of finite population size, we assume small selection coefficients. The results suggest that isolates of effective size 500 with r and s in the range 0.01 - 0.02 would be compatible with the observations. Thus, population structure and the attainment of equilibrium are critical assumptions of the social selection model.

We propose that the mechanism for the social selection resides in the importance of the extended, matrilineal family in controlling resources and ceremonial functions. The duties of the albino who remained at home enhanced the prosperity of the extended family. Should the appropriate genealogies be made available, this hypothesis can be tested by comparing the relative sizes and persistence of matrilineages with and without adult albinos.

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Excessive bone destruction in historic burials. D. MORSE and R.C. DAILEY, Florida State University, Tallahassee.

Archaeological excavation in the vicinity of an historic cemetery on the northwest coast of Florida yielded a number of wooden coffins dating to the early part of this century. The area in which the coffins were found was covered with a heavy growth of the palmetto plant. In every case there was partial to total destruction of the coffin contents as a consequence of root action. This is a phenomenon neither often encountered nor understood. Illustrations of the burials and their destruction are presented and the mechanism of root action discussed.

Preliminary results of the introduction, management and reproductive success of Saguinus mystax on Padre Isla, Loreto, Peru. LUIS MOYA IBANEZ, Ministry of Agriculture, Agricultural Region XXII-L, Iquitos, Peru.

During 1977, 1978 and 1980, 20 groups (87 live animals) of Saguinus mystax "moustached tamarins" were captured in their natural habitat along the bank of the Amazon river, collared for group identification, and liberated on a small island called Padre Isla situated in the Amazon river approximately 8.5 km. to the northeast of the principal port of the city of Iquitos (S $3^{\circ}44'$, W $73^{\circ}14'$). The ecological conditions of the island are similar to those observed where S. mystax ranges freely in their natural habitat. This, plus the fact that there were no primates living on the island made Padre Isla an ideal study location.

The method of capture and the management of the animals is described in detail. The groups of *S. mystax* which were released in 1977, 1978 and 1980 were observed during 1981, 1982, and 1983. The results of these observations have been evaluated and are discussed in detail. The observations include the following: (1) The groups which were originally liberated on the island dispersed to inhabit the entire area of the island; (2) Various groups showed changes in group member associations by migration from one group to another or by the joining of members from more than one group, while other groups maintained their original structure; (3) Reproduction is active. The current population estimate is 124 individuals of *S. mystax* on the island, with percentage increments in population growth being 25.0% in 1981 and 13.7% in 1982.

Anthropometric differences between age-matched diabetic and non-diabetic Mexican American adults. W.H. MUELLER, S.K. JOOS and W.J. SCHULL, University of Texas Health Science Center, Houston.

Android (Central) obesity has been associated with non-insulin dependent diabetes in many studies. Our studies of normal variability in body fat patterning have suggested that Android obesity involves more than relative differences in thickness of subcutaneous fat: The Android obese appear to have less overall subcutaneous fat, more deep body fat, have greater body weights for a given height, and a more mesomorphic and less endomorphic body build than the gynoid (general) obese. If these observations are correct, we should see diabetics having these same characteristics when compared to non-diabetics of the same age and sex. These expectations are confirmed in a sample of 436 subjects from the diabetes alert study. Compared to the non-diabetics, diabetics had greater upper/lower and trunk/extremity fat ratios, a smaller calf fat/muscle ratio, a greater arm/calf fat-muscle ratio, and a higher waist circumference to bitrochanteric diameter ratio. These differences were evident in subjects of both sexes ($p < 0.01$). In addition, diabetic women had a greater androgyny index ($p < 0.05$) and greater arm and calf muscle areas ($p < 0.01$) than the non diabetic women. Diabetic obesity appears to involve increased muscularity and skeletal proportions suggestive of androgyny. Vague's (1956) idea of this type of obesity being a masculine obesity is supported by the data. Supported by NIH AM 27582.

Functional aspects of human auditory ossicles as determined by principal component analysis. ROBERT J. MUTAW, University of Colorado, Boulder.

Principal component analysis has been used as an inductive method of

determining underlying morphological variation in biological systems. Once elucidated these patterns provide the basis for functional analysis of the system under study. This is accomplished through the deductive interpretation of the weightings on the principal axes. A set of measurements describing the human auditory ossicles provides a practical example of principal component and functional analysis.

Measurements of the auditory ossicles have been collected from a collection of adult and subadult skeletons from Kulubnarti, Sudan. First, the hypothesis put forward in previous studies that adult and subadult ossicle morphologies do not differ is tested by comparing measurements from these two groups to each other with multiple analysis of variance. They are not found to be significantly different and the two groups are treated as representatives of the same population. Principal component analysis is then performed on the pooled data.

Functional interpretation of the components indicates that the first component is weighted by the largest measurements of the ossicles. This is usually interpreted as a generalized size vector. Second and subsequent components clearly show functional relations between parts of the same ossicle and between parts of different ossicles. In all the principal component analysis provides a framework for interpreting the basic elements of sound transmission by the ossicular chain.

A quantification and interpretation of the mandibular molar cusp components of Proconsul species. JOY E. MYERS, Kent State University, Kent, Ohio.

New recoveries of Miocene hominoids demand a reassessment of currently existing taxonomic categories. Dentition constitutes a major part in this assessment. Past studies of Miocene dentition have consisted of either subjective, qualitative descriptions or metrical definitions based largely on traditional mesiodistal and buccolingual measurements. Masked by these dental studies, particularly the latter, is the complexity and variation expressed in the molar occlusal surface.

This study acknowledges the problems present in Miocene taxonomy and dentition. It assesses the cusp components of mandibular molars of Proconsul species, as well as for extant Hylobatidae and Pan, based on frameworks provided by Erdbrink (1965) and Wood et al. (1983). This work establishes the percentage that each component contributes to the total area of the occlusal surface and provides a quantitative guideline for

better taxonomic discrimination among the Proconsul species, particularly having importance in terms of isolated molars.

Gumivory in prosimians, with special reference to galagos. L.T. NASH, Arizona State University, Tempe.

Among prosimians, Cheirogaleus medius, Mirza, Microcebus, and Perodicticus eat gums opportunistically. Several species of galago (including Euoticus) include gum as a staple in the diet. Among prosimians, Phaner is the only non-galago gum specialist. Gums are complex polysaccharides most likely requiring fermentation for digestion. Phaner and gum eating galagos have relatively enlarged caeca which suggest gut adaptations for fermentative digestion. Gum, like other plant parts, may contain secondary compounds, e.g. tannins, which are anti-nutritive in action. Galagos which include gum in their diet are predicted to show sensitivity to these compounds. Recent laboratory and fieldwork on East African galagos has examined the role of gum in their diets. Wild Galago senegalensis braccatus, like the South African galagos, utilizes Acacia gum extensively in its diet. Captive G. s. braccatus will reject gum containing tannin. Wild G. garnettii and G. zanzibaricus, from coastal Kenya forests, do not encounter Acacia and do not normally eat gum. Wild individuals of these species will eat offered Acacia gum, but not other plant gums. However, these latter two species do not always reject tannin in Acacia gum. These species differences suggest that the degree to which gum is normally incorporated in the diet influences the tendency or ability of animals to discriminate between gums differing in tannin content.

The dermatoglyphics of Cacajao and Pithecia with reference to interspecific differences. L. NEWELL-MORRIS and H. Brehme, University of Washington, Seattle and Universität Freiburg, West Germany.

The dermatoglyphic pattern frequencies of two previously unreported genera of New World monkeys, Cacajao and Pithecia are described.

The two species of Pithecia (P. pithecia, n = 32, P. monachus, n = 55), and Cacajao rubicundus (n = 38) show the typical cebid palmar and plantar total pattern intensities (TPI) of middle to low values when compared to those of Old World monkeys, palmar TPI approximately 4.0 and plantar TPI ranging from 2.0 to 3.0.

In areal pattern intensities there were significant intergeneric and in-

terspecific differences. In the palm a gradient of decreasing pattern intensity existed from interdigitals I to IV (.90 to .70), except in P. pithecia in which the exceptionally low value of .30 was observed for interdigital III. In the sole P. pithecia was again distinguished by its markedly lower PI values in interdigital areas I and II.

These results demonstrate that significant differences in dermatoglyphic patterning can be detected at the specific level, especially when the discrete areas of the palm and sole are considered. The role of dermatoglyphic traits in taxonomic classification is discussed.

Residence and marital migration in emerging Metis populations in western Canada.

T. NICKS, Royal Ontario Museum, Toronto and K. MORGAN, University of Alberta, Edmonton.

The North West Half Breed scrip applications comprise the most extensive historical demographic record of nineteenth century Metis populations in western Canada. This single data source contains over 14,000 life histories from 900 localities. The individuals represented can be distributed into eleven neighbourhoods defined by sociopolitical criteria and resource utilization. Record linkage to church and field data for one neighbourhood resulted in only 13% overlap between data sets indicating that the scrip applications constitute a largely unique record for some Metis populations. Comparison of birth, marriage, and last residence neighbourhoods for 5,439 first marriages reveals a higher frequency of migration for males than for females. Endogamy rates computed by comparing birth and marriage neighbourhoods reveal rates of endogamy of less than 50% for spouses and uniformly higher rates of endogamy for females than for males. The incidence of matrilocality for the neighbourhoods considered ranges from 30% to 70%.

This research was supported in part by SSHRC grant 410-78-0023.

A comparative fitting of two growth functions using serial growth data of the pig-tailed macaque. RICHARD NISHIKAWA, University of Washington.

One method of deriving growth and growth velocity information from a mixed longitudinal study is through the use of fitted individual growth curves. For nonhuman primate growth studies, the choice of an appropriate curve-fitting function remains problematic.

Individual growth curves were fitted to serial measurements of three segments of the lower limb of *Macaca nemestrina*. The sample data consisted of 10 to 17 serial measurements per individual for 28 female and 22 male animals covering an age range of 0.299 to 9.970 years. An exponential function corresponding to equation 9 of Gavan (1971) and the Preece-Baines model 1 function (Preece and Baines, 1978) were used to fit individual growth curves through nonlinear least-squares regression.

For the exponential equation plots of residuals of the fitted curve versus age show systematic age-related errors in the fit of this function to individual growth data. As seen by Watts and Gavan (1982), the fitted curve provides underestimates of size during infancy and adolescence and overestimates of size during childhood. The systematic error in the fit of this exponential function indicates that a growth model of constantly decreasing velocity is inappropriate.

Residual plots of the fitted Preece-Baines model one function versus age exhibit no consistent age-related patterning. A Wilcoxon paired-sample test of the residual variances indicate a significant ($p < 0.005$) improvement for the fit of the Preece-Baines model one function. For some cases, the fitted function parameters provided inappropriate values for derived biological parameters. These errors may be due to model inadequacies for animals with low magnitude adolescent growth spurts.

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Characteristics of mixed-species troops of *Saguinus mystax* and *S. fuscicollis*: Group dynamics. M.A. NORCONK, University of California, Los Angeles.

It is hardly possible to study a *Saguinus mystax* troop in the wild without considering an accompanying troop of *S. fuscicollis*. Close proximity of these two species during daily ranging activities appears to be the norm throughout the geographic range of *S. mystax*. During an eleven month research period at the Blanco Stream site it was found that two factors characterized the mixed-species troop. First, the two species were rarely out of auditory contact throughout the day. The most common form of social interchange between the species appears to be vocal communication. Second, the integrity of the joint territory was actively maintained by individuals of both species, although participants in territorial bouts interact in a species-specific manner. Within a mixed-species troop, agonistic interactions between members of the two species are rare and the reproductive activity or potential of each species is not adversely affected. The benefits of existing in a mixed-species troop appear to decrease as the collective size of a "troop" exceeds 12-15 members.

Tactile discrimination capacity of *Saimiri* relative to organization of somatic sensory cortex. P. NYSTROM, J. CHARLTON and M. CARLSON, Washington University and McDonnell Center for Studies of Higher Brain Function, St. Louis, MO

The adaptive significance of the primate hand can be determined by observations of feral behavior, complemented by laboratory tests of manual dexterity and sensory discrimination in captive animals. The evolution of manual sensorimotor capacity is associated with an elaboration of the motor and sensory regions in the cerebral neocortex.

In the prosimians *Galago* and *Perodicticus*, we have found a single somatotopically-organized projection pattern for the hand in the primary somatic sensory cortex (SI). This contrast with the multiple cutaneous hand areas described in SI of the Old World (*Macaca* and *Cercopithecus*) and New World (*Aotus*, *Saimiri*, and *Cebus*) anthropoids. To determine the possible behavioral significance of single as opposed to multiple SI cutaneous hand areas we tested *Macaca* and *Galago* on tactile tasks determined to be independent of manual dexterity. We found *Macaca* to be superior to *Galago* on texture but not on size tasks. This is consistent with the evidence that the second cutaneous area in anthropoids contributes selectively to texture discrimination capacity.

In our current behavioral studies of *Saimiri* we find them to be similar to *Galago* and *Macaca* on size tasks. They are, however, inferior to *Macaca* on texture discrimination tasks although they each have multiple cutaneous hand areas in SI. These behavioral studies suggest that it may be the overall size of the cutaneous projection to SI that determines the texture capacity of a species rather than the number of topographic areas. An interesting correlate of these behavioral findings is the apparent importance of tactile sensitivity in the delicate manual grooming typical of *Macaca*, but lacking in the behavioral repertoire of *Galago* and *Saimiri*.

Gum exudates as a dietary staple of patas monkeys. D.K. OLSON, University of California, Los Angeles.

Gumivory as a primate feeding specialization has evolved independently among the prosimians, callitrichids and cercopithecids. Primates using gum as a major dietary component are generally referred to as "gum specialists" when gumivory is coupled with intensive exploitation of arthropod food items. Patas monkeys (*Erythrocebus patas*) are true gum specialists consuming throughout the year substantial quantities of gum exudate and arthropods of a variety of species. In this paper the importance of gum exudate in the diet of patas is examined, and the ecological position of patas as gum specialists is compared with that of other gum-feeding cercopithecids.

Data on patas feeding behavior and on the ecology of gum-bearing acacias are derived from three field studies carried out at the same site in Kenya during 1979-1984. Ecological analyses are based on systematic sampling of the distribution and abundance of gum deposits within different vegetation types. Gum feeding behavior per se was recorded in focal animal samples during all studies.

Gum exudate of the patas' major feeding species, Acacia drepanolobium, is comparable in composition to that of other edible acacia gums, and it represents an important dietary staple (sensu Milton) throughout the year. Gum feeding accounts for at least 20 percent of adult feeding activity each month. During a single day, a large patas group may feed on gum deposits in over 1000 acacia trees. Yet despite their reliance on gum feeding, patas are unlike the majority of prosimians and callitrichids in having morphological specializations of either the digits or dentition that facilitate gum extraction or gum feeding. Among the cercopithecoids, baboons and vervets also feed extensively on acacia gums. Neither of these primates, however, feeds on arthropods to the same extent that patas consistently do, and baboons and vervets do not appear, on the basis of overall diet, to be gum specialists.

The importance of female choice in the mating system of wild patas monkeys. D.K. OLSON, University of California, Los Angeles.

One means of studying a species' mating system is to assess the relative contributions made to the system by intrasexual competition and by mate choice. It is generally thought by no means exclusively the case that males will compete actively for mates and that females will choose their mates from within the ranks of competing males. In this paper, the contribution that female choice makes in shaping the mating system of wild patas monkeys (Erythrocebus patas) is examined.

Ecological and behavioral data presented here are derived from studies of a patas population in Kenya that has been observed for more than 4500 hr since 1979. Behavioral data were collected as focal animal samples or as ad libitum records while ecological data were collected as day range maps or as qualitative descriptions of range use patterns.

Patas females conceive annually, and conceptions within a given year are usually confined to a 10-15 week period. Mating activity is predominantly and conspicuously initiated by females. During the annual conception period, males compete vigorously to enter heterosexual groups and to copulate once they are in such groups. Within a conception period, more than 10 different males may be available as breeding partners. Although females' patterns of ranging may determine, in part, how many different males will be encountered, females do not intervene directly in inter-male contests to determine which males will be successful in entering a group, and females have never been observed to oust a resident male. Females do

"choose," however, whether or not to alert the resident male or males to the presence of potential invading males. Females exhibit a variety of behavioral strategies for choosing, which males they will mate with when more than one male is simultaneously present including behavior that might be called "incitement" and the participation in rudimentary forms of consortship.

HLA distribution and biological variation in a U.S. black population. K.E. O'NEIL, University of Illinois, Champaign-Urbana.

The human histocompatibility system (HLA) is a highly polymorphic genetic region. It is thus one of the most useful genetic systems for anthropological research, including the study of population differentiation and health and disease.

In the present study, HLA-A and HLA-B frequency distributions are calculated according to the method of Smouse and Williams (1982) for a sample of 257 individuals from a black population in central Mississippi. HLA frequency distributions for this southern black population are compared with published data (e.g., Reisner et al. 1983, Terasaki 1980) from other North American black populations. Differences in HLA antigen frequency are assessed by Fisher's exact test with correction for the number of comparisons made. Comparisons among population samples indicate important geographical differences in HLA frequency patterns among U.S. blacks. The black population from Mississippi is most similar to other populations from the American South. Thus, black populations from the southeastern U.S. seem to have a rather distinctive HLA frequency distribution compared to black populations from other regions of the U.S.

HLA antigen frequencies are also compared between subgroups within the sample from Mississippi. These groupings are based on relative weight indices and obesity percentiles as defined by the 1971-74 U.S. Health Examination Survey. Significant differences in HLA antigen frequencies are found between weight and obesity groupings. The HLA associations also differ by sex, and could indicate important sex differences in the predisposition to increased relative weight and obesity.

Sexual dimorphisms in fossil higher primate teeth. C. E. OXNARD, University of Southern California, Los Angeles.

Recent studies of overall bodily proportions and of dental dimensions in living primates show that, rather than exhibiting simply greater or lesser degrees, sexual dimorphism actually exists as several qualitatively different complex patterns. In partic-

ular humans and great apes possess, each, separate and unique dimorphisms (Oxnard, Amer. J. Primatol. 4:1-22; Oxnard, Lieberman and Gelvin, Amer. J. Primatol. In press). And studies of dental dimensions of the Chinese ramapithecines show that sexual dimorphisms can be readily discerned in fossils when samples are large (Wu and Oxnard, Amer. J. Primatol. 5:303-344). This present study tests, through examination of the distributions of dental lengths and breadths, the degree to which this also applies to the teeth of other higher primate fossils.

The results confirm that in fossil hominines and hominids, sexual dimorphism is not just a feature that is simply greater in some forms (e.g. australopithecines) and lesser in others (e.g. hominines). Rather it is a condition that shows distinctly different patterns in each of the fossil groups. Different arrangements are found among the various species for (a) canines, (b) individual remaining teeth and (c) overall patterns in the tooth row.

Such findings have implications for the evolution of sexual dimorphisms in these fossils. Thus, results for australopithecine teeth suggest different sexual dimorphisms than are found in either extant apes or humans. Examination of data for fossil Homo demonstrates that human-like sexual dimorphism is rather old. Among the second-order implications is the idea that many complex radiations rather than few simple lineages characterize hominoid evolution.

Developmental masticatory biomechanics: an *in vivo* study using growing vervet monkeys. O.J. OYEN and M.D. RUSSELL, Case Western University Dental School, Cleveland.

This report relates progress made in quantifying a key variable in masticatory biomechanics: *in vivo* bite force potential. To determine how much *in vivo* bite force potential is affected by tooth development and eruption and dietary consistency, 15 growing male vervet monkeys (C. aethiops) were used. Ten were raised on a "hard" diet and five on a nutritionally equivalent "soft" diet. Maximum bite force potentials were bioelectrically elicited and measured at selected points along the occlusal surface with a bite force transducer. Body size, dental condition and relevant cephalometrics were also measured.

Controlling for body size soft diet monkeys had measurably lower bite force potentials (Soft \bar{X} =6.45 Kg, S.D.=2.12; Hard \bar{X} =9.29 Kg, S.D.=1.37, $t=2.17$, $p<.05$). It was also determined that bite force potential is not a simple function of age or size, but fluctuates with stages of tooth development and eruption. Comparisons of maximum incisal bite force with molar bite force within individuals shows that animals with relatively stable incisors had a bite force ratio at least 12% greater than animals with erupting incisors, regardless of dietary consistency (Erupting \bar{X} =39.4%; Stable \bar{X} =52%; $t=4.5$, $p<.0005$). Preliminary analyses of bite force of the posterior denti-

tion indicate that shifts in bite point associated with dental eruption have an effect on molar bite force potential that exceeds other growth changes. These results show that tooth development and eruption significantly affect bite force and masticatory biomechanics. Supported by NSF Grant BNS-82-17034.

Porotic Hyperostosis in Prehistoric Southwestern Pueblo Populations. ANN M. PALKOVICH, George Mason University

Porotic hyperostosis is a commonly observed skeletal pathology in prehistoric Pueblo groups. Underlying etiology of porotic hyperostosis and associated lesions in these populations has been identified as iron deficiency anemia. Beyond this differential diagnosis, it is clear endemic nutritional stress had a significant impact on the health status as well as the porotic lesion pattern in Pueblo populations.

Analysis of several skeletal series demonstrates the unusual populational characteristics of porotic hyperostosis for these prehistoric Pueblo groups. Peak incidence of porotic lesions and associated periostitis occurs in individuals less than 6 months of age at death. Apparently subsistence resources endemically deficient in dietary iron rendered both newborns and women of childbearing age susceptible to iron deficiency anemia. This pattern is distinct from the characteristic pattern of peak involvement in individuals 1-3 years of age at death.

Early onset of porotic lesions is consistent with the picture of endemic malnutrition suggested by climatic, ethnobotanical and archaeological studies conducted in the Southwest. Most importantly, this study shows that a differential diagnosis of iron deficiency anemia is only a start. Subtle differences in age of onset, quality and extent of lesions yielded distinctly different pictures of the morbidity, mortality and health status of prehistoric populations.

Developmental implications of palmar dermatoglyphics among Highland and Lowland Peruvian Quechua. KENNETH R. PARHAM, University of Tennessee, Knoxville, and A. ROBERTO FRISANCHO, University of Michigan, Ann Arbor.

Fetal hypoxic stress has been generally measured indirectly by birth-weight and other variables. An examination of comparative dermatoglyphics between highland and lowland populations of similar genetic background may thus provide more direct clues to fetal hypoxic effects, particularly during the first trimester of fetal development. This study assessed the

variability of palmar ridge-counts (a-b, b-c, and c-d from both hands) between a central Peruvian highland population (n=209) and an eastern Peruvian lowland population (n=181). These groups are linguistically related, the lowland being the only known Quechua-speaking population from the tropics east of the Andes. Gene frequencies of the A-B-O and Rh systems are highly similar between the two groups.

Multivariate analysis of variance showed significant intergroup variability. Principal components analysis was performed on the six variables. PC1, PC2, and PC3 contrasted the c-d, b-c, and a-b counts, respectively, with the others. The remaining three principal components reflected aspects of asymmetry. Principle component scores subjected to analysis of variance showed significant intergroup differences, particularly with respect to PC2, PC3, and PC4.

Given the similarity between these populations in the A-B-O and Rh systems, underlying environmental factors must be sought to explain the dermatoglyphic differences. It is reasonable to suppose that these dermatoglyphic differences may be attributable to hypoxic stress occurring during the early stages of fetal development.

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Osteometric analysis and population affinities in southwestern Alaska. SANDRA K. PARKER, Indiana University, Bloomington.

Anthropometric measurements on the long bones from the Chirikof Island skeletal series, representing two distinct burial areas (A and B), are analyzed. The primary purpose of this analysis is to describe the two groups in terms of morphologic and genetic relationship. Further, comparisons are made with previously published data on a number of Eskimoid groups to clarify population affiliation.

Standard measurements were collected on the femur and humerus and used to calculate statural estimation, platymeric index and robusticity. Student's t-tests and discriminant function analysis are employed in accessing relationship between areas A and B from Chirikof. However, due to the nature of the previously published data, only basic descriptive statistics and a few univariate tests can be utilized in accessing the relationship of the Chirikof material to surrounding groups.

Results show fairly small differences between the two Chirikof series. These differences take on greater significance when compared with data collected by Hrdlička in the 1930's on prehistoric Aleut and Koniag material. Many of the measures indicate that there is as much or more variation between the two Chirikof series as is found between the Aleut and Koniag material. Further it is difficult to differentiate any of the groups consistently at a statistical level.

These results suggest that closer scrutiny of population affinities and admixture in southwestern Alaska is needed.

Nutritional Stress and Health During the First Intermediate Period in Ancient Egypt. J. PECOTTE, University of Utah, SLC.

Biological acute and chronic stress indicators are used to test hypotheses generated by historical references during a stressful period in ancient Egyptian history, the first Intermediate Period (2400-2100 B.C.). A total skeletal sample of 143 individuals was examined for stress indicators from two contemporaneous sites in Upper Egypt: Elephantine and Gebelein.

Several biological variables were examined in all age groups between the skeletal samples of the two sites including transverse and oblique lines of increased density; cortical thickness, midshaft diameter, and maximum length of the femur; dental abscesses; antemortem molar loss; periostitis and cribra orbitalia.

The results indicate that Gebelein has significantly more antemortem molar loss than Elephantine (p=.0004) which indicates that Gebelein has worse dental health than Elephantine. Moreover, the incidence of periostitis is significantly higher (p=.02) in Gebelein adults (65%) versus Elephantine (20%). This incidence of periostitis appears to be a chronic condition of unknown etiology which suggests a higher chronic infection rate for Gebelein. Both populations demonstrate a high prevalence of cribra orbitalia of 78-80%. Nordin's Index, a ratio of cortical thickness to midshaft diameter of the femur as measured on radiographs, is higher (p=.01) in the Elephantine adult sample even when one controls for sex.

The same stress indicators were also examined in the juvenile subgroup between the two sites. Although samples were too small to be meaningful statistically, the trend for increased chronic stress in Gebelein is manifested in the juveniles.

The data support the supposition that Gebelein tends to be more chronically stressed during the First Intermediate Period than Elephantine. Explanations for the disparity of results between the two sites are most likely due to sociocultural factors.

A comparison of stunting and wasting indicators of malnutrition in Philippine school children. D.L. PELLETIER, J.D. HAAS and J.B. MASON, Div. of Nutritional Sciences, Cornell U, Ithaca, NY.

A common use of anthropometric surveys in developing countries is to identify areas with high prevalences of childhood malnutrition in order to target resources for intervention. This study compares height-for-age (HA) and weight-for-height (WH) indices as targeting indicators

among Philippine school children and describes some of their environmental correlates.

The data consist of height and weight measurements on 14,971 first-graders from 99 municipalities in Region VI of the Philippines. HA and WH were calculated from Philippine and NCHS standards. The mean and prevalence were calculated for each municipality. Data on demographic variables, topography, cropping patterns, occupations and housing were obtained from censuses and school teachers. Spearman correlations were used.

There is a negative correlation between mean HA and WH ($r_s = -.27$, $p = .007$), but the prevalences of stunting (HA 90% of standard) and wasting (WH 80% of standard) are not associated ($r_s = .05$). Municipalities with a low mean HA (and high stunting prevalence) have a lower population near the town center and in the lowlands, fewer rice farmers but more corn farmers, and more traditional housing. By contrast, mean WH is lower in municipalities with a higher proportion of population near the town center and fewer corn farmers. Compared to municipalities with low stunting and high wasting prevalences, those with high stunting and low wasting are farther from the provincial capital and the town center, have a higher proportion of population in the uplands and more corn farmers, lower population density and more traditional housing.

It is concluded that HA and WH indices are not correlated (prevalences) or even negatively correlated (means) with each other at a group level and bear different relationships to environmental characteristics. They should therefore be distinguished as indicators of malnutrition when being used for surveillance of school children.

Vocal repertoire breadth in wild Florida monkeys. E.H. PETERS, Florida State University, Tallahassee.

The free-ranging rhesus monkey (*Macaca mulatta*) colony of Silver Springs, Florida is an interesting example of human assisted colonization of a habitat to which these animals would not otherwise have access. Although partially provisioned as a tourist attraction, monkeys numbering in excess of 200 animals (and distributed in four social groups) freely roam the lowland floodplain adjacent to the Silver River. Vocalizations recorded for a troop of individually identifiable animals were spectrographically analyzed. The results show a vocal repertoire that is significantly broader than any indicated in previously published catalogs. They also indicate a broader range of stimuli and responses associated with previously defined calls. The complexity of social and physical challenges presented to members of the Silver Springs rhesus colony are useful for expanding our understanding of the boundaries and complexity of rhesus vocal skill.

The earliest Lapita human remains from the Pacific: a mandible fragment from Natunuku, Fiji. M. PIETRUSEWSKY, University of Hawaii-Manoa, Honolulu.

The fragmentary human remains of a single individual excavated at Natunuku, northwestern Viti Levu, Fiji, which date to approximately 1500 B.C. are described. These remains represent the earliest human remains from the Pacific in direct association with Lapita pottery; a cultural complex now widely accepted as ancestral to the present day Polynesians.

More than half of an endentulous right mandible missing only the superior ramus is one of the best preserved bones in these remains. Multivariate statistical procedures (Generalized Distance, stepwise discriminant function analysis and Mean Measure of Divergence) are applied to metric and non-metric traits recorded on the Natunuku mandible and several other prehistoric and near contemporary mandibular samples from the Pacific.

These multivariate statistical results suggest a close similarity between the Natunuku mandible fragment and other Lapita associated mandibles but similarities of a lesser magnitude with more modern Polynesian and Melanesian samples.

Various hypotheses proposed mainly on linguistic and archaeological evidence for the ultimate origins of the Polynesians are examined in view of this recent evidence from human skeletal biology.

Antibiotic resistance patterns and population structure of *E. coli* in human and nonhuman associated yellow baboons from Mikumi National Park, Tanzania. JANE E. PHILLIPS-CONROY, ERIC J. ROUTMAN and RAYMOND D. MILLER, Washington University Medical School, St. Louis.

Strains of *Escherichia coli* were isolated from feces of yellow baboons in order to compare bacterial population structure and antibiotic resistance with *E. coli* from human strains. Samples were collected in Fisher culturettes and stored under field conditions until returned to the U.S. 3 months later. Antibiotic resistance was determined by ability to grow on 5 commonly used antibiotics. Strains isolated from baboon troops which were associated with humans showed no greater antibiotic resistance than did nonhuman associated baboons (6.9% vs. 10.7% respectively; $p > .05$). This did not differ significantly from *E. coli* collected from humans before antibiotic use became widespread, but was significantly less than found in a reference collection of *E. coli* from modern humans and zoo animals (29.1%). Multiple resistances were found in all the collections. Baboons showed a higher incidence of multiple resistances than predicted.

All strains were tested for ability to grow on each of 7 sugars, the pattern of fermentation ability defining the strain biotype. 46 different biotypes were found in the 3 collections—36 among the baboons. Variation in *E. coli* diversity was partitioned as follows: 39.8% within individuals, 38.7% between individuals within troops and 21.5% between troops. One baboon

sampled 3 times in 6 days exhibited substantial turnover in that time.

The data suggest that the population structure and antibiotic resistance of *E. coli* from baboon hosts is similar to humans. Further, excellent possibilities exist for exploring temporal variation in *E. coli* fauna in the wild, because swabs sampled earlier showed no effect of their long-term field storage.

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The G-banded karyotype of *Tarsius bancanus* and its implications for primate phylogeny. P.A. POORMAN, M. CARTMILL, R.D.E. MACPHEE, and M.J. MOSES, Duke University Medical Center.

Metaphase chromosomes of skin fibroblasts cultured from female *Tarsius bancanus* (Tba) at the Duke University Primate Center have been karyotyped by G-banding. We confirm Klinger's report that $2n = 80$ in Tba, which thus has the highest diploid number in primates and one of the highest in mammals. Of the 80 chromosomes (ranging in size from 5.3 μm to 1.0 μm), 64 are acrocentrics; 10 are relatively large and metacentric or submetacentric; and 6 are diminutive and metacentric. The X chromosome has not yet been identified.

The G-banded chromosomes of Tba display a surprising degree of apparent homology with those of strepsirrhine prosimians. Fully two-thirds of the banded chromosomes of Tba are visually and metrically indistinguishable from chromosomes of *Galago crassicaudatus montei*. Fewer but still numerous identities with Tba can be found in the chromosome complements of *Hapalemur griseus* and *Lemur fulvus*. Far fewer Tba patterns can be recognized in complements of the anthropoids examined (*Aotus*, *Alouatta*, *Pan*), even when we postulate such operations as Robertsonian fusion to maximize correspondences. The homologs of 3 pairs of Tba chromosomes have not been found in the complements of the other primates examined.

If any of the specified karyological similarities between *Tarsius* and strepsirrhines are not merely evolutionary convergences or primitive retentions, then tarsiers are more closely related to galagos and lemurs than to anthropoids. Since no other anatomical evidence supports this conclusion, the entire body of information bearing on tarsier affinities needs to be reassessed.

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Taphonomy, paleoecology, and hominids of Lainyamok, Kenya. R. POTTS, Yale University, New Haven, P. SHIPMAN, Johns Hopkins School of Medicine, Baltimore, and E. INGALL, University of Utah, Salt Lake City.

The hominid locality at Lainyamok was studied to assess activities and paleoenvironments of Middle Pleistocene hominids. Hominid presence at Lainyamok was indicated by *in situ* teeth and surface stone artifacts. Preliminary geology and mapping of surface finds showed a clumped distribution of fauna, including sets of associated bones from the same carcasses, in a lake margin zone. Excavations helped to assess (1) whether hominids deposited the artifacts and animal bones at Lainyamok, and (2) the characteristics of hominid activity in the area.

From geologic evidence, the 2 m thick fossil layer represents a fine-grained sediment flow that had entered the lake margin and introduced bones and artifacts to Lainyamok. The fauna was of a dry savanna-mosaic and included species previously unknown in East Africa. A hominid femoral diaphysis found in excavation does not show characteristics usually attributed to *Homo erectus*. Besides isolated fauna and stone artifacts found scattered through the fossil layer, eight dense patches of bones, each less than 1 m² in area, were also excavated. Taphonomic analysis suggests that these either were accumulated by hyenas in burrows dug into the fossil layer or were accumulated just prior to sediment flow and then incorporated into it. An inordinately high percentage of carnivores in the fauna also suggests that carnivore activity was important at Lainyamok. No *in situ* concentrations of stone artifacts comparable in density to the bone patches were found. Although hominids in the area probably exploited animal tissues, their activity was not intensive and resulted in neither dense patches of debris nor refined artifacts.

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Differential Diagnosis of Treponematosi in the Southeastern Mississippian Population at Moundville, Alabama. M.L. POWELL, National Museum of Natural History, Smithsonian Institution.

Early research into the antiquity and possible Pre-Columbian American origin of 'syphilis' was traditionally focused upon the venereally-transmitted treponemal syndrome (Williams 1932). Hallow and Shands (1938) discussed "Evidences of Syphilis in Mound Builders' Bones", presenting examples of bone lesions in human skeletal material from the prehistoric Mississippian community at Moundville in west central Alabama. A recently completed analysis of skeletal pathology in 564 individuals from that population supports a diagnosis of treponematosi. However, the form and patterning of lesions suggests an endemic, nonvenereal syndrome more similar to

bejel (Hudson 1958) or to yaws (Hackett 1951) than to the venereal form. Dental stigmata associated with congenital syphilis were absent, and high prevalence of subperiosteal apposition on lower limb long bone shafts and moderate prevalence of cranial stellate lesions were observed. The Moundville pattern corresponds well with the model of endemic treponematoses developed by Cook (1976) from research on Illinois Woodland skeletal series. Osteological evidence from other regions (Arkansas, Louisiana, Florida) suggests that such a syndrome has been in existence in the Southeast since the Archaic period.

Is there a universal mammalian brain-body scaling coefficient? T.M. PREUSS, C.M. IWAI and A.F. RICHARD, Yale University.

A brain-body allometric coefficient of approximately $3/4$ has recently gained wide acceptance on the basis of studies using large samples drawn from diverse mammalian groups. Coefficients for lower taxa, however, are generally less than the $3/4$ value for "mouse-to-elephant" plots. For instance, for a sample of 600 mammalian species from 12 orders, the mean scaling coefficient for orders, .612, is significantly smaller than the coefficient for mammals as a whole, .729 ($p < .025$). Such "taxonomic rank inflation" is paradoxical, since the same information is used to calculate the mammalian slope and the mean slope for orders: it is unclear why the two values differ and why one value should be accepted as fact in preference to the other.

We suggest that rank inflation occurs because there is a positive relationship between absolute body size and relative brain size (encephalization). In primates, for instance, the highly encephalized haplorhines are generally large bodied while the less encephalized strepsirhines are small bodied. The slope of the principal axis is .735 for haplorhines and .708 for strepsirhines. If the value for each sub-order estimates the "true" primate coefficient, that coefficient should lie between .708 and .735. Because body size and encephalization are correlated in primates, pooling the sub-orders to obtain a single primate sample yields an inflated estimate of .796.

These results suggest that allometric coefficients obtained with heterogeneous, "mouse-to-elephant" samples are confounded by phyletic differences in encephalization and are not interpretable as measures of brain-body scaling. Coefficients for more homogeneous groups (lower taxa), ought to be more accurate measures of scaling. However, while values for lower taxa average much less than $3/4$, at any given taxonomic level, they are extremely variable. It is likely, therefore, that rather than obeying a universal $3/4$ law, brain-body scaling follows different rules in different mammalian groups.

Exudate feeding in Upper Amazonian *Saguinus* and *Cebuella*. M. Ramirez, Anthropology Program, Graduate Center, CUNY, New York.

The diet of most Callitrichini studied to date include predominantly insects (up to 70% of feeding time) and fruits (>40%); exudates (about 5%), nectar, seeds, flowers and leaf buds constitute a minor percentage of the yearly diet. Upper Amazonian *Saguinus* typically feed on exudates during the dry season (up to 40% of plant feeding) although the smallest species (e.g. *S. fuscicollis illigeri*) tend to use exudates throughout the year. Tamarins for the most part make opportunistic use of exudate holes gouged by rodents and insects. As an example of tamarins *S. mystax*, a large tamarin by Callitrichin standards (>500 g, 25-35 Ha territory) is compared to the diminutive *Cebuella* (100 g, 0.1-0.4 Ha range) in their use of the exudate resource. *Cebuella* in northeast Peru seems to depend on exudates -gums and sap- for most of its food, insects account for 33% of feeding time. Exudates make up 67% of the feeding time during the dry to mid wet season and 99% of the plant food consumed during this period. More than half that time is spent gouging holes on exudate trees. On the other hand, *S. mystax* studied in northeast Peru showed low yearly intake of exudates -gums in most cases-, while insects and fruits made the bulk of its diet. However, from mid dry to early wet season exudates averaged 17% of plant feeding. Curiously, exudate feeding was more intense (37% of plant feeding) at the onset of the wet season, but decreased rapidly as preferred fruit trees fructified. Almost all (90%) the exudate feeding time took place on exudate trees currently being used by *Cebuella* groups. *S. mystax* did not gouge holes but occasionally bit and/or scratched the bark surrounding the hole.

In summary, while *Cebuella* spends a good deal of time and energy year around gouging holes on trees in procurement of exudates to feed on, *S. mystax* parasitizes the exudate of holes gouged by *Cebuella*. Exudativaly in *S. mystax* is seasonal and coincidental with a decrease in fruit abundance.

Feeding ecology of the Moustached Tamarin *Saguinus mystax*. M. Ramirez, Anthropology Program, Graduate Center, CUNY, New York.

The behavior of two marked groups of *S. mystax* was studied at the Blanco Stream (Tahuayo river, Peru). Feeding behavior was studied over 70 full days of observation, from Oct. 1981 to Nov. 1982. Tamarins ranged over 25-35 Ha territories, and fed on a variety of fruits (about 90 spp.), exudates (about 10 spp.) and invertebrates (Insecta, Arachnida). Foraging for the latter accounted for about 50% of feeding time. Orthoptera and Lepidoptera were common prey items. Insect foraging occurred throughout the year, but was predominant in the mid-late dry season, when foraging bouts became longer, success rate increased, and search tactics changed from scan and pounce to intensive substrate manipulation and flushing. Fruit was the most important food in all samples, and the only vegetable matter ingested in at least four samples. Commonly, tamarins ate the sweet mesocarp or aril from drupes and berries, while the seeds of some species were ingested whole. Main fruit resources included relatively abundant tree/liana species with long (*Maripa* sp., *Parkia* sp.) and/or synchronous (*Pouroma* spp.) fruiting periods which made for 33% of all the time spent feeding on plants. A few tree species producing large fruit crops (*Byrsonema* sp, *Ficus* sp.)

accounted for 13% of plant feeding time. Time spent feeding on fruits remained mostly unchanged from mid-wet to early-dry season. By late dry season - the time of lowest fruit availability - plant feeding time decreased by about 20% as well as the number of fruit trees visited, from 8 to about 2 per day. Although in some cases visits were prolonged, ingestion rates were low, presumably because of high handling costs (e.g. opening of *Parkia* pods). Exudate feeding became apparent at this time, initially accounting for only 5% of plant feeding. By early wet season, with fruit still scarce, exudate feeding increased to 37%, then rapidly declined as preferred fruits (e.g. *Pouroma*) became available. In late dry and early wet season, tamarins entered the sleeping tree up to 90 minutes earlier, and the distances traveled were shorter than at other times of the year.

The dietary patterns described here indicate that *S. mystax* feeds on fruits and insects throughout the year. In periods of fruit scarcity, tamarins combine a strategy of early retirement to sleeping tree, reduced travel distances, intensive use of the few fruit resources available, change in insect foraging strategy and exploitation of the exudate resource.

Health and disease at a South Carolina plantation: 1840-1870. T.A. RATHBUN, University of South Carolina, Columbia.

Although historical sources provide partial physical, nutritional, and disease information for participants in the plantation system, only rarely have human remains been available for direct examination. This osteological analysis of 30 adults and 7 subadults recovered during a cemetery relocation project at a coastal plantation near Mt. Pleasant, S.C. provides data for both regional and temporal comparisons of a biohistorical nature.

The sample was dated to 1840-1870 by mortuary customs, coffin hardware, and in one instance, a death plate. No grave markers or tomb stones were found. Temporal variation within the cemetery is suggested by a range of mortuary practices from shroud burials to elaborate coffin hardware of white metal and textiles.

Morphological and metric attributes of the skeletons indicate African ancestry for the sample and the demographic structure suggests that the cemetery was not used by the entire plantation population.

The skeletal analysis includes morphological, metric, radiological, and microscopic techniques as well as examination of attributes with relevance to health and disease. Documentation of stature and frequencies of Harris lines, degenerative joint disease, and evidence of nutritional anemia suggest an intermediate pattern between earlier slave groups in the area and a contemporary urban white elite sample. Trauma was relatively frequent in the sample and dental pathologies such as carious lesions, alveolar abscesses, linear enamel hypoplasias, and posterior tooth loss are common. Extensive sickle anemia is suggested by thickened diploe and, in one instance, post-cranial changes. Preliminary trace element analysis reveals elevated skeletal lead burdens and moderate amounts of strontium and zinc.

Comparisons to other samples suggests that the plantation system was not monolithic, but that considerable temporal and regional variation can be documented by physical evidence.

Secular trend toward increasing body size in rhesus monkeys. K.J. REICHS, The University of North Carolina at Charlotte, C.J. DeROUSSEAU, New York University.

Secular trends toward earlier maturity and larger size have occurred in many human populations over the past several centuries. Although diet is strongly implicated as a source of this variability, the evolutionary significance of these phenomena remains largely speculative. Little information is available on the incidence of secular trends in other primate species.

In order to examine differences in body size and proportions over time in a nonhuman primate population, cranial and post-cranial osteometric data were collected on the Cayo Santiago skeletal collection. Since the collection is comprised of individuals who have lived at various intervals over the last 30 years, both cross-sectional and longitudinal analyses were conducted.

The data suggest that a secular trend toward increasing body size has occurred over the history of the colony. Environmental factors, including protein content of the diet and availability of dietary components, are considered as contributory factors, and the implications of primate secular trends for our understanding of evolutionary change are explored.

Parasitism of Colonial Newport, Rhode Island. K. J. REINHARD, Texas A&M University, College Station, K. A. ORLOSKI, Northern Arizona University, and STEPHEN A. MROZOWSKI, Brown University.

Parasitological study of extinct peoples can provide precise ecological and behavioral data. With this in mind, an examination of helminth eggs from privy soils was undertaken. Two privies were examined in Newport, Rhode Island. Both privies dated to the years immediately preceding the American Revolutionary War and were used contemporaneously. One privy was used by a wealthy merchant's household and the other by a poorer artisan's household. The households were separated by a two block distance. Differences in economics resulted in differences in the helminth community infecting the households. The merchant household was surrounded by ornamental gardens which provided the conditions necessary for the survival of *Trichuris trichiura* which heavily infected members of the household. Also, hookworm was present in the privy, possibly the result of slave trade.

The poorer household had yard gardens in which vegetables were grown. The use of garden plots, combined with the primitive fecal disposal techniques resulted in high parasitism with *Ascaris lumbricoides*. Lack of dense shade around the house and yard reduced *Trichuris* survival.

The final study clearly demonstrates the utility of parasite analysis in study of paleoecology and paleopathology.

Effects of Population Size on Rates of Gene Flow in North-Central Massachusetts, 1740-1850. J.H. RELETHFORD, State University of New York College at Oneonta.

Studies of the genetic and demographic structure of human populations have focused on genetic effects of population size and migration rates. Little attention has been given to the way in which these factors interrelate in human groups. The purpose of this paper is to assess the effects of population size on rates of gene flow in a set of populations undergoing rapid growth.

Data consist of 4,860 marriage records from four towns in north-central Massachusetts from 1741 to 1850. All four populations show rapid growth, but at any given time period each population is a different size. Twenty nine samples based on population and time cohort were used for analysis. Four measures of gene flow were computed for each sample: exogamy rate, local migration, long range migration, and effective migration rate.

Three samples showed very low exogamy rates, all of which were samples from the first generation of settlement. A "settlement effect" is hypothesized whereby populations recently settled show high endogamy rates due to intermarriage among the children of first settlers. This effect disappears a generation after initial settlement. Summary statistics from the remaining 26 samples show a nonlinear relationship between population size and gene flow. Various nonlinear regressions were tested, giving R-square values ranging from 0.47 to 0.84. Migration is greatest in small (<1000) and large (>2000) populations, and lowest in intermediate sized populations (1000-2000). High migration rates in small populations are due to a lack of potential mates. High migration rates in large populations reflects the loss of isolation following population growth. These relationships could have an effect on slowing down the loss of genetic diversity as populations grow.

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HUMAN BODY MODELLING FROM A HUMAN BIOMETRICS DATABASE

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A graphic data processing system has been developed in order to apply the different aspects of anthropometry and biomechanics to ergonomics of man-machine systems.

A human body model has been elaborated from the representation and 3-D data processing software (EUCLID). It consists of a skeleton compound with 19 segments and 20 joints which totalize 36 degrees of freedom. The segmentary volumes are defined by facets representing the human body surface.

All the parameters (heights, lengths, widths, circumferences) come from the International Human Biometrics and Ergonomics Database ERGODATA. So, the model can account immediately for the variability of the dimensions and the movement features of representative samples of various populations.

Among the different possibilities of applications, it allows a new approach :

- in anthropometry, the problems of segmentary proportions, volumes, growth, morphotypes,
- in biomechanics, movements, equilibrium, effects of impacts and vibration,
- in ergonomics, the space requirements, postures, reach area and more generally workplaces design and layout.

Activity and Dietary Differences Among Intensely Infected Egyptian Agriculturalists. K.RICE, University of Utah, Salt Lake City.

Egyptian agriculturalists live in a communicable disease stressed environment, especially for schistosomiasis. This situation is expected to lead to decreased working time, lowered productivity, and decreased caloric intake. Examination of the relationship between intensity of schistosomiasis infection as determined by egg counts and productive time use as determined by random time sampling indicates that heavily infected agriculturalists spend significantly more time working than not infected or lightly infected individuals. Although agricultural work time is an important risk factor for infection and intensity of schistosomiasis since exposure time is increased, this relationship is not significantly correlated in this sample. Furthermore, mean productive output was not found to be significantly associated with differences in overall productive time use and disease intensity categories.

As expected, caloric intake does significantly associate with the amount of work time and leisure time. Given that productive time use increases with disease intensity, it is expected that infected individuals would consume more calories. Dietary intake data as determined by four seasonal 24-hour recalls support this expectation. The results of this study indicate that commonly accepted explanations for the relationship between poor health and productivity are not valid.

The Variable maxillary lateral incisor: Is the variability genetically or environmentally determined. E.R. RICHARDSON, S.K. MALHOTRA, K. SEMENYA, and R.C. ELSTON. Meharry Medical College, Nashville, Tennessee and Louisiana State University, New Orleans.

The maxillary lateral incisor has been referred to as a very instable tooth. There is great variability in its morphology and size. The purpose of this study was to look at the available data on human tooth formation and develop a plausible theory for this great variance observed in the morphology and size of the maxillary lateral incisor.

Materials and Methods: Data on tooth formation were available in the works of Logan and Kronfeld, Massler and Schour, Kraus and Jordan, Kraus, Kitamura, and Latham, and unpublished data by E. P. Crump. The mean times of tooth formation were available from some of these groups of studies and the times of beginning calcification were available in all of the data. Observations were made on environmental factors affecting tooth formation such as intra-uterine factors and postnatal factors such as changes in nutrition, illness, and physical comfort. Analyses were made to determine the relation between time of tooth formation and the variance in tooth size and shape.

Findings: The maxillary lateral incisors form during the first year of postnatal life. Most of the other early forming teeth considered to be stable form prenatally and calcify postnatally. The later forming teeth that are considered more stable than the lateral but less stable than the early forming group form after one year of age. Environmental stresses on the child is greater during the neonatal period and later during the first year. These factors are discussed in relation to the association between time of tooth formation and variance of tooth size and shape.

Conclusion: The variability observed in the morphology of the maxillary lateral incisor is genetic in the sense that it forms at a certain time but the environmental stresses produce the great variance expressed.

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A two-dimensional application of the finite-element scaling method to growth of human crania. J.T. RICHTSMEIER, Center for Craniofacial Anomalies, University of Illinois College of Medicine, Chicago, and Northwestern University, Evanston, IL.

Limitations of the methodology used in comparing serial cephalometric radiographs have marred their use in cranial growth analysis. The foremost flaw is the lack of a biological basis for orientation of superimposed films when analyzing growth. Finite-element scaling, a new method based on the principles of finite element analysis and continuum mechanics provides quantification of form (deformation) without special orientation or registration. When the forms

depict an ontological series, deformation studies quantify growth. The derivation of mean forms from algorithms allows statistical analysis of the changes in form defined by finite-element scaling.

Serial cephalometric radiographs (lateral view) of 20 individuals from the Bolton Series, Case Western Reserve University, were traced. Two-dimensional coordinates of 15 homologous points located on the cranium were entered into a computer. Mean forms were derived for 01, 10, and 17 years. Deformation analyses were conducted using the younger cranium as the reference, and the older as the deformed mean cranium. A measure of size change showed the "young" deformation (01 to 10 years) to be greater in size than the "older" (10 to 17 years) deformation, as expected. The deformation analyses exhibited similar directional expansion of the face and select points on the basicranium, but growth of the area surrounding the hypophyseal fossa and foramen magnum showed contrasting direction in the two deformations. The direction of facial growth determined by finite-element scaling varies from that described in traditional cephalometric analyses.

A Comparison of Pronation-Supination Mobility in Proconsul africanus and Pliopithecus vindobonensis, M. Robertson, University of Michigan, Ann Arbor.

Laboratory studies of humans (Youm et al. 1979) show that the more radial the fixed axis of the hand during grasping, the greater the movement of the distal ulna, suggesting one possible mechanism of increasing pronation-supination mobility. They also suggests a functional relationship between the grasp used and the anatomical correlates associated with increased pronation-supination mobility.

Compared to New World Monkeys, most Old World primates use a grasp with a relatively radial axis of support. Although most Old World primates use such a grasp, variation exists in pronation-supination mobility at the distal radioulnar joint. These differences are associated with differences in the use of the hand during locomotion. That is, among more closely related animals that use similar grasping postures, one finds differences in the morphological correlates of pronation-supination mobility associated with differences in the forces exerted by the hand.

Among Miocene hominoids, evidence suggests that the axis of the grasp is more radial and that pronation-supination mobility is greater in Proconsul africanus than in Pliopithecus vindobonensis. Although evidence from the hindlimb indicates that Pliopithecus may have been capable of hindlimb antipronograde behavior, evidence from the forelimb suggests that grasping with the hand was relatively more important in Proconsul than in Pliopithecus.

U.S. Air Force Physical Anthropology. K.M. ROBINETTE, Air Force Aerospace Medical Research Laboratory, Wright-Patterson AFB.

For more than 40 years the U.S. Air Force has sponsored work in applied research in engineering anthropology. This is the study of body size and physical capabilities and their application to engineering design. While some of the work in this area is done "in-house" by anthropologists employed by the Air Force, much of the work is done through contracts, grants, and special programs. One such program is the visiting professor program, which provides funds to enable a university professor to use the laboratory facilities to conduct research in an area of interest to the Air Force. Such appointments are usually for a period of one year. The goal of this paper is to provide information regarding particular studies the Air Force is pursuing, and various ways for profit and non-profit groups or individuals to participate.

Growth in weight and recumbent length during infancy. A.F. ROCHE, D. MUKHERJEE, and M. KOUCHI, Wright State University, Yellow Springs, Ohio; Department of Experimental Statistics, Lorex Pharmaceuticals, Skokie, Illinois, and Department of Anthropology, University of Tokyo.

Most analyses of growth during infancy provide data for status at selected ages or for increments. Few have fitted mathematical functions to serial data for individuals and, when this has been done, the analyses of the parameters have generally been incomplete. In present study, serial data for weight (W) from birth through 2 years (N=344) and for recumbent length (RL) from 1 month through 2 years (N=441) have been analyzed. There was considerable overlap between these groups of infants. For each variable, the parameters of the model were θ_1 (estimated value at birth for W and at 1 month for RL), θ_2 (intrinsic growth rate) and θ_3 (pattern of growth). In this model:

$$Y_{ij} = \theta_{1i} + \theta_{2i} t_{ij} + \theta_{3i} t_{ij}^2 + \epsilon_{ij}, i=1(1)n, j=1(1)p,$$

where Y_{ij} is W or RL, θ_{1i} , θ_{2i} and θ_{3i} are the parameters of initial size, intrinsic growth rate and growth pattern respectively of the i th individual, t_{ij} is the age (years) at the j th data point, $t_{i1}=0$, ϵ_{ij} is the random error, n is the number of individuals and p is the maximum number of data points for an individual. After adjustment for the average error variances and covariances, the parameters were almost independent of each other and the fit was good. Growth appeared to be a linear function of the square root of age. Only small proportions of the adult variance in W , $W/\text{stature}^2$ and subcutaneous fat thickness were accounted for by the estimated parameters. Corresponding parameters for W and for RL were correlated about +0.6. The sib-sib, but not the parent-offspring, correlations for the estimated parameters were significant indicating the importance of environmental effects.

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Vocalizations of rhesus monkeys: Effects of heritage on variance in acoustic features of "coo" calls. P. S. RODMAN, University of California, Davis.

Familial interaction in complex social groups of cercopithecine primates could be enhanced by family resemblance in acoustic features of vocalizations. Such resemblance could result from common heritage or from learning or both. Alternatively, there may be no intrafamilial similarity, though family members recognize each other's calls by their individual characteristics.

To initiate study of this aspect of communication in complex social groups, I have recorded "coo" calls of six to eight year old adult females in a group of rhesus monkeys (Macaca mulatta) at the California Primate Research Center. The primary subjects are three pairs of full sisters who share a single father. Thus each subject has four paternal half sisters and one full sister in the set. Each pair has at least one maternal half sister in the group, and I recorded calls of these as well as of numerous unrelated peers. Adult females and young normally give a chorus of coo's at the approach and departure of the technicians who census the group daily. By recording these coo's I controlled for gross contextual variation of the calls.

The calls are digitized for graphic and statistical comparison of fundamental frequencies, development of harmonics, formants, and temporal changes in each of these during the call. Variance among females in each measure is partitioned according to relatedness of the females to estimate the heritability of acoustic features of the calls.

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An assessment of proposed dietary changes over time in a northeastern Georgia skeletal sample. C. ROETZEL, Wake Forest University.

Seeking a refined knowledge of lifestyle among a southeastern late Mississippian group, an examination of indicators of dietary and disease changes over two time periods, the Beaverdam phase (1200-1350 AD) and the later Rembert phase (1350-1450 AD), was made using 24 individuals from the Rucker's Bottom site (9EB91), Georgia. Preliminary pathological and archaeological descriptions suggested an improvement in skeletal health in the later Rembert phase. The preliminary evaluation was followed by gross pathologic, radiologic, and microscopic examinations, as well as an examination for dental enamel hypoplasia. Concentrations of four trace elements (Zn, Mg, Ca, Sr) were determined, resulting in a Sr/Ca ratio illustrating possible food choices.

Analyses indicate minimal difference in diet and skeletal health between the Beaverdam and Rembert phases. In light of current views regarding Mississippian subsistence patterns, these data suggest that subsistence modifications had minimal effects on skeletal health. The data also provide information on disease conditions and diet/disease interactions in terminal Mississippian skeletal sample.

Life history strategy, social interaction, and population dynamics. A. R. Rogers, State University of New York at Albany.

The dynamics of population growth depend on how soon and how often individuals choose to reproduce, and these choices are affected in turn by access to resources (food, space, wealth, etc.). To build a theory of population dynamics, then, we need to know (a) how access to resources conditions reproduction, and (b) how resources are distributed within the population. The first of these topics is an aspect of the human life history strategy, and the second will depend in large part on the structure of social interactions.

I begin by showing how (a) and (b) above affect the stability of equilibria in a simple model. If the curve relating individual reproduction to resources is steep, or if variation in access to resources is low, the population will tend to oscillate. I then explore the evolution of life history strategies when resources can be inherited, and an interesting result emerges: in species like our own, decreasing the resources available to a population may increase its rate of growth.

Perspectives on phylogeny: a Mennonite example
L.A. ROGERS, University of Kansas, Lawrence.

Perceptions of phylogenetic relationship among populations affect the way biological data on human variation are interpreted. Phylogenetic models can be developed from varied sources of information. The accuracy of oral or historical accounts in developing such models is rarely questioned although such information may not focus on "biological relationship." This study examined phylogenetic relationships among several Kansas and Nebraska Mennonite congregations. The accuracy of local historical accounts was compared to demographic data in church records and ships passenger lists.

Eight Mennonite congregations in Kansas and Nebraska were said to be derived from

three settlements established in 1874. According to local people and historical accounts, the founders of the three settlements were members of one Mennonite congregation in Russia prior to 1874. The analyses of fissioning using demographic data revealed the congregations were not unilinearly related as historical accounts would indicate. Founders of the settlements were not members of one congregation in Russia.

Although historical accounts were accurate in indicating a fundamental biological relationship among the three settlements, the time span in which the populations had been separated as biological units was shortened at least two generations. The results indicate that when populations can be viewed as "related" from a number of perspectives, some information on the nature of biological relationship may be lost. The historical model of population fissioning was compared to measures of genetic distance obtained by M.H. Crawford of the University of Kansas from 15 blood group loci. The two generation error in pinpointing the time of fissioning did not affect the relationship between the biological data and the phylogenetic models.

Functional anatomy of orang-utan hands and feet. M.D. Rose, New Jersey Medical School, Newark.

During arboreal positional behavior orang-utans use the fore- and hindlimbs to equal extents for climbing and suspensory activities. Trunk orientation is varied, tensile and compressive forces act on the limbs, and the cheiridea grasp branches of various sizes and orientations. The cheiridea function as grasping hooks (quadruhamulitism?). Grasping is predominantly a function of the lateral four digits and their musculature. The pollex and hallux are reduced and play a minor role. Lateral digits are long, metapodials are robust dorsoventrally, and all ray elements are curved longitudinally. Flexor musculature is well developed. The long flexor tendons are channelled through tarsal and carpal arches and confined within strong flexor sheaths on the digits. The tarsal and carpal joints act as the equivalent of universal joints, allowing the digital hooks to be oriented in a variety of positions. Eversion-inversion of the foot and pronation-supination of both the hand and foot are important and extensive movements. There is an inversion and supination set to the foot and these movements are extensive at the subtalar and calcaneocuboid joints, allowing the digits to grasp vertical supports effectively. The tarsal joints are maximally stable when the foot is dorsiflexed in this position. Within the carpus pronation-supination, involving rotation of the

scaphoid and lunate in the proximal row around the capitate in the distal row, allows the hand, like the foot, to grasp branches of various orientations. More importantly, combined forearm and wrist pronation-supination allows the suspended body to be oriented in any position below the fixed point of a grasping hand.

Neandertal Birth Canals. K. R. ROSENBERG, University of Michigan, Ann Arbor.

The pelvic morphology of Neandertals is one of a suite of characteristics which have been proposed to distinguish them from anatomically modern humans. Neandertals have superior pubic rami which are long medio-laterally, compared to modern humans, giving them significantly larger birth canals. In addition, the superior pubic ramus in Neandertals is thinner (superior-inferiorly) than in modern humans.

Trinkaus (1984) has recently argued that the change in pelvic morphology seen in the transition from Neandertals to anatomically modern humans is evidence for a significant shift in reproductive pattern, stating "It is therefore likely that Neandertals with their large pelvic apertures had gestations approaching 12 months".

An alternative hypothesis is that the elongated superior pubic ramus in Neandertals functioned to maintain a large birth canal in short, heavy people with large heads. This hypothesis predicts that in human populations in which head size is large relative to stature, birth canal size will be relatively large.

In order to test this hypothesized relationship, birth canal size was examined in a number of modern human populations, chosen to represent the extremes of modern variation in stature, weight and head size relationships. Whether absolutely large or small, populations with heads which are large relative to their stature (Eskimos and Mayans) have large birth canals, resulting from long superior pubic rami, as predicted, while those with heads which are small relative to their stature (Sudanese) have small birth canals. Other populations, whose head size:stature ratios are intermediate, have birth canals which are intermediate in size.

Gumivory and insectivory and the adaptive radiation of marmosets. A. L. ROSENBERG, University of Illinois at Chicago, Chicago and A. MUSKIN, Graduate Center, CUNY, New York.

Field studies have shown the importance of exudates as a dietary staple in a number of species of the ceboid subfamily Callitrichinae (marmosets). Comparative anatomical studies

have interpreted various dental features as adaptations to enhance the efficiency of harvesting gums. The *Callithrix/Cebuella* group presents a rake-like configuration of the anterior teeth, reinforced tooth crowns and symphyseal architecture which enables them to scrape bark without dangerously stressing the mandible. This mechanical complex allows marmosets to independently stimulate gum production as well as expose hidden insects and larvae. No such derived gnathic features occur in *Callimico* or *Saguinus*, although some similar traits are seen in *Leontopithecus chrysomelas*. Therefore, *Saguinus* opportunistically feeds on gum licks. It appears that the specialization on exudates is related to body size, additional dental modifications and habitat in the *Callithrix/Cebuella* group. *C. pygmaea*, *C. jacchus* and *C. penicillata* are the most strongly gumivorous species and perhaps the most cryptically colored, while the Amazonian *C. humeralifer* and some eastern Brazilian species, e.g. *C. aurita*, may depend on exudates to a much lesser degree. Other characteristics of the Marmoset Anatomical Complex, such as small body size, digital claws and clinging rather than grasping hands and feet, are more likely to reflect the primitive marmoset strategem--insectivory in a vertical niche space--rather than a phylogenetic commitment to gums. The feeding catholicity of *Callithrix* species, along with their anatomical specializations, questions the generalization that gums, and not insects, were the primary dietary adaptation pertaining to the origins of the *Callithrix/Cebuella* group.

The dentition of *Oreopithecus bambolii*: systematic and paleobiological implications. A. L. ROSENBERG, University of Illinois at Chicago and E. DELSON, Lehman College, CUNY.

The dental morphology of *Oreopithecus* has always been the best known but perhaps least understood aspect of its anatomy. The first descriptions noted a mixture of superficial similarities to both apes and Old World monkeys, combined with a variety of unique "specializations" (autapomorphies). Restudy of portions of thirteen dentitions (plus some isolated teeth), including the associated 1958 specimen, allows us to make several new observations and support our earlier argument for synapomorphy with a cercopithecoid morphotype. The dentition shows clear adaptation to folivory, as has generally been agreed. The unique upper central incisor occludes with both lowers, aligned by its large lingual pillar. Variation in lower P3 molarization is extreme, comparable to the Hadar sample of *A. afarensis*, although almost all specimens derive from the age-equivalent site units of V1 (Baccinello) and Casteani. Sexual dimorphism is also high, with molar differences between 5 and 13% (in samples averaging only two of each sex).

Given the rather hominoid nature of most aspects of postcranial morphology, as well as enamel ultrastructure, the systematic position of *Oreopithecus* cannot be determined solely from its dentition. Moreover, the question has

been raised whether the similarities with cercopithecoid bilophodonty are true homologies or merely functional convergences. We continue to suggest that they are homologous synapomorphies, while we cannot find any such features clearly shared with hominoids. The polarity of lower P3 mesial flange reduction proposed by Harrison, with a long cercopithecoid-like flange present in early eucataarrhines and later reduced in modern hominoids, appears incorrect. The rather short flange in *O. bambolii* is thus expected in a conservative eucataarrhine, hominoid or cercopithecoid. Synapomorphies with cercopithecoids include great elongation of molars, reduction of M1-2 hypoconulids, exaggeration of overall relief (depth of ectoflexid, ectoflexus, median notches, distobuccal lower molar fossette) and some mirror symmetry of occluding cheek teeth.

Salivary defense systems in adult Liberians differing in dietary cyanide intake. J.D. RUDNEY, Cariology Program, School of Dent., U. of Minn., Mpls., L.C. JACKSON, U. of California, Berkeley, and Q.T. SMITH, School of Dent., U. of MN, Mpls.

Cyanide in tobacco and dietary plants is converted *in vivo* to thiocyanate (SCN⁻), which is then excreted in secretions. In saliva, SCN⁻ functions within an antibacterial defense system. The enzyme salivary peroxidase (Spx) uses hydrogen peroxide (H₂O₂) generated by oral bacteria to oxidize SCN⁻ to hypothiocyanite (OSCN⁻), an inhibitor of bacterial metabolism. Hypothiocyanite production is primarily governed by H₂O₂, but differences in SCN⁻ concentration may also be important. The present study compares Spx system components in Liberian adults consuming low cyanide rice (*Oryza sativa*) or high cyanide cassava (*Manihot esculenta*) as staples. Diet and smoking information were obtained by interview and by observation. Saliva samples were collected and frozen, and 38 were later assayed for OSCN⁻, Spx and SCN⁻. The number of persons retaining OSCN⁻ activity is significantly larger in the high dietary cyanide intake group (p=0.013). Dietary cyanide intake is in turn significantly correlated with cassava consumed (r=0.79, p<0.01). There is no significant difference between dietary groups for Spx activity. Salivary SCN⁻ is significantly correlated with smoking (r=0.80, p=0.001), but shows no significant difference between dietary groups even when smoking is controlled for. Results are thus somewhat contradictory. They suggest a relationship between OSCN⁻ and dietary cyanide which could have important implications for oral health. However, OSCN⁻ is generated from SCN⁻, which seems more strongly related to cyanide from tobacco. A possible explanation may be that other cultural practices of cassava-eating groups predispose towards elevation of H₂O₂ production in oral bacteria. Further research is needed to clarify this point. Such information should enhance understanding of the role of biocultural factors in salivary defense systems.

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Use of CT scanning in skeletal structural analysis. C.B. RUFF and F.P. LEO, Johns Hopkins University School of Medicine, Baltimore.

CT (computerized tomographic) scanning has great potential for nondestructive analysis of internal skeletal structure. Several potentially significant sources of error, however, should be considered by those using this method. We carried out an empirical investigation of some of these factors using an AS&E Model 500 CT Scanner in the Russell Morgan Department of Radiology, Johns Hopkins Hospital.

1) Window level and window width. CT cross-sectional images are reconstructed from serial x-ray profiles which depend on the mass absorption coefficients of the particular tissues scanned. The visual display of these images can be changed by altering the center (window level) or range (window width) of x-ray absorption coefficients (CT numbers) shown for that image. Optimum parameters must be determined empirically for each machine. We accomplished this by scanning a) tissue-equivalent phantoms with known physical dimensions, and b) a series of long bones which were then sectioned and compared with scan images. Optimum settings for compact bone on the AS&E Scanner, which has a total range in CT numbers of -1200H to 2800H (water=0) are 800 (level) and 600 (width).

2) Distortions in hard copy output. Hard copy output (e.g., transparencies) are derived from CRT displays which may not correspond exactly to images on the scanner viewing screen. We found it necessary to adjust the CRT display using phantoms of known size prior to each scanning session.

3) Relating CT numbers to mass densities. CT numbers depend on several factors other than mass density. To investigate this relationship we scanned samples of compact and trabecular bone, as well as other materials, and compared average CT numbers with measured densities. A linear relationship between CT number and density was found, with correlations of .997 (bone) and .984 (all materials).

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Cutmarks: Immediate vs. delayed carcass processing. M.D. RUSSELL, Case Western Reserve University Dental School, Cleveland, P. SHIPMAN, Johns Hopkins University, Baltimore, P. VILLA, University of Colorado, Boulder.

The ability to distinguish taphonomically between immediate and delayed processing of carcasses and corpses would help resolve several problems in the interpretation of hominid behavior. For example, the presence of cutmarks on hominid remains (e.g. Krapina) has traditionally been interpreted as evidence of cannibalism. Alternatively, such marks may represent processing of partially decomposed corpses preparatory to secondary burial. In another case, it has been suggested that the Klassies River Mouth hominids actively hunted

small bovids, but may have been "late scavengers" of large bovids. To help resolve these and similar taphonomic problems, a series of experiments was initiated to determine what if any characteristics distinguish cutmarks made during immediate versus delayed carcass processing.

Method. Cutmarks were made with both steel and stone blades through fresh soft tissue, through dried, partially decomposed soft tissue and on dry clean bone surfaces. Replicas of these marks were made by M. Russell, labeled in code and sent to P. Shipman for SEM analysis.

Preliminary Results suggest that a combination of mark morphology and bone weathering stages will distinguish immediate from delayed carcass processing. If additional experiments yield similar results, a number of interpretations of hominid behavior can be transformed from suggestions and assertions into testable hypotheses.

Nutrient intakes of infants in the United States: Results from two national nutrition surveys. A.S. RYAN and G.A. MARTINEZ, Ross Laboratories, Columbus, Ohio.

An analysis of nutrient intakes of infants provides base-line information for the assessment of potential food-related health problems. With the use of data from two national surveys, the Nationwide Food Consumption Survey (NFCS) 1977-78 and the Second National Health and Nutrition Examination Survey (NHANES II) 1976-1980, nutrient intakes of 694 infants ranging in age from 1 week to 12 months were analyzed according to different foods (milk and milk products, infant formula, infant cereal, commercial baby foods, and table foods) and to demographic characteristics. Results indicated that American infants generally consumed nutrient intakes above recommended dietary allowances (RDA). However, across all demographic characteristics, infants fed a diet that included cow's milk had a median intake of iron below the RDA. Additionally, a large proportion of infants (69%) aged 7-12 months fed a diet that contained cow's milk received a median sodium intake above the estimated safe and adequate range. The health-related implications of low iron intake and high sodium intake during infancy are considered in relation to infant growth and development.

Of molecules, comparative anatomy, and the fossil record--the evolutionary messages cannot conflict. V. M. SARICH, The University of California, Berkeley.

The goal of integrating comparative information from diverse sources into a single evolutionary narrative or scenario has proven elusive. Nonetheless we know there is only one sequence of events to approximate. Thus, the

path to that actuality must involve playing off one line of evidence against another, saving that which fits and temporarily laying aside that which does not for future investigators. One can illustrate such an approach starting with the now clear molecular message concerning hominoid phylogeny, which appears to afford a stable framework within which the implications of other lines of evidence can be tested--as well, of course, as the stability of the molecular message itself. Next, it can be shown that measures of morphological distance exist which also have the useful property of apportioning additively along unique phylogenies--phylogenies which turn out to be highly congruent with the molecular message. It then follows that fossil specimens cannot be placed into their appropriate phylogenetic positions unless the identical features of extant forms would in fact give you the phylogeny of those forms. Lucy's elbow can be used to illustrate the morphometric positioning of a small piece of her anatomy into the phylogenetic framework provided by the same features of the elbows of extant species and their molecules. Another conundrum is the matter of a knuckle-walking phase in our past. The molecular data practically require it; comparative anatomists have been unable to see it. Corruccini's 1978 data can provide a solution by developing a phylogeny from them; this phylogeny turns out to be perfectly congruent with the latest molecular one, even to the extent of indicating a common Homo-Pan lineage after the separation of the Gorilla line. More importantly, the analysis also shows that about half the Homo-Pongo wrist morphological distance accumulated along the common Homo-Pan-Gorilla lineage after the separation of that leading to Pongo.

The evidence for terrestrial quadrupedalism in the hominid lineage Esteban E. Sarmiento, Department of Anthropology, New York University.

The similarities in the anatomy and proportions of the hands and feet in humans, cercopithecoids and gorillas, suggest a human heritage of terrestrial quadrupedalism. Because it can be shown that similarities in the hands and feet of humans and cercopithecoids are parallelisms and not primitive retentions, humans most likely developed these adaptations after the divergence of the common pongid-hominid stock. Initial adaptations to terrestriality may have been developed in common with the African apes, but the decidedly more terrestrial specializations in humans suggest that they further emphasized a terrestrial trend independently. Comparisons of the locomotor behavior and postures of hominoids suggests that terrestrial quadrupedalism preadapts an arboreal cautious climber to bipedalism. While arboreal climbing behaviors emphasize limb movements in both sagittal and frontal plane, terrestrial behaviors emphasize movement only in the sagittal plane.

Length proportion indeces and the supposedly bipedal traits in the hip of australopithecine, suggest that a terrestrial

quadrupedal stage did occur in the hominid lineage. Comparisons of the circumferences of the femur and humerus and the cross-sectional area of the body of the first sacral vertebrae indicate that australopithecines were weighing the hindlimbs as much as the forelimbs. A number of traits in the hand show unequivocal adaptations to terrestrial quadrupedalism. The available skeletal evidence when considered in its entirety suggests that australopithecines practised a varied locomotor behavior which included terrestrial bipedalism and quadrupedalism. Although arboreal behaviors in australopithecines were possible, the proportions and skeletal anatomy of the hands and feet indicate that these were restricted mostly to relatively large diameter supports.

The use of simulation in studying natural processes. L. SATTENSPIEL, University of Michigan, Ann Arbor.

Advances in computer technology over the past quarter-century have made simulation of natural processes a practical and useful method of study. The utility of this technique is examined with respect to the spread of disease in human populations.

Disease, like most natural processes, has significant random components, such as whether contact occurs between an infected individual and a susceptible individual, and whether such contact actually results in transmission of the disease. Human populations usually have a complex structure, including spatial subdivision of the population and movement of individuals into and out of the population. Simulation allows for the incorporation of these random effects and other realistic features, which, when included in mathematical models, rapidly make the models too complex for anything but simple qualitative analysis.

The utility of simulation for studying the spread of disease in human populations is explored. A simulation model is used which considers the spread of hepatitis A in a population of pre-school children, some of whom attend day care centers. Results from the simulation are compared to data from Albuquerque, New Mexico on the spread of hepatitis A within and between day care centers. These results are then used to point out advantages and limitations of simulation for studying complex phenomena.

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Effects of sex and reproductive state on food intake in *Galago senegalensis braccatus*. M.L. SAUTHER and L.T.NASH, Arizona State University, Tempe.

Few researchers have focused directly on intraspecific sex differences in feeding behavior of primates. Yet many primate field

studies indicate that such sex differences occur. One causal factor for such differences may be the female's reproductive role. This was tested in a study of food intake in captive galagos (5 females, 2 males). Subjects' daily food consisted of pre-measured amounts of bananas, apples, and two types of grain-based commercial primate food (one normal and one with extra protein added from freeze-dried egg albumin). Female's food intake was sampled during three reproductive states: pregnancy, lactation, and cycling (i.e. neither pregnant or lactating). Subjects' food intake was measured as the weight of each food consumed daily. Kruskal-Wallis analysis of variance indicated that females altered their food intake depending on their reproductive state. Lactating females ate more than when they were pregnant or cycling. Lactating females also selected a higher protein diet than at other times. Analysis of intake during early and late lactation showed an increase in total food consumption and in protein intake during later lactation. Lactating females also ate more and chose more protein than did males. There were few differences between the food intake of males and cycling females.

Reproductive state thus influences dietary needs and foraging behavior of female primates. As such, it may be one important cause for sex differences in feeding observed in field studies.

Quantitative preservation of human skeletal remains by computerized methods. B.S. SAVARA, J.C. STEEN and G. GROSS, Oregon Health Sciences University, Portland, Oregon; M. VANNIER, Mallinckrodt Institute, St. Louis, Missouri.

"Descendants" of the aboriginal populations, particularly of Australia, Japan and the Americas, are petitioning various governmental and judicial bodies for the return of the physical remains of their ancestors from museums and universities, so that they may be properly interred or otherwise "fittingly" disposed of.

Unfortunately, these demands may result in a devastating loss to the scientific community, particularly scholars of human evolution, population genetics and paleoanthropology.

A method is needed which easily and accurately preserves the entire morphology of a skull, so that future scholars may rely on the data for comparative studies.

Stereophotogrammetry, coupled with computer tomography, offers such a method. As each CT scan represents averaged information reduced from the thickness of the slice, the thinner the slice, the more accurate is the data reproduction and, therefore, the three dimensional recreation.

A North American aboriginal skull from an archeological site was scanned by computer tomographic procedures, obtaining 1.5 mm slices, and used to recreate the bones of the face and head.

Frontal and lateral stereophotographs of the skull were taken. Using photogrammetric techniques, XYZ coordinate data for the bones of the face and head were obtained to an accuracy of 0.1 mm.

While the details of the surface are more accurately reproduced with the stereophotogrammetric techniques, the inner bones can be viewed with the CT scan recreation.

Dermatoglyphics in developmental medical disorders. B. SCHAUMANN and S. B. JOHNSON, Veterans Administration Medical Center, Minneapolis, R. L. JANTZ, University of Tennessee, Knoxville, A. J. KRUSH, Johns Hopkins Hospital, Baltimore.

Although dermatoglyphics develop under strong genetic control, their expression may be modified by early intrauterine environmental factors. Both of these influences and their possible interaction make dermatoglyphics of special interest in clinical studies of developmental disorders.

Apart from dermatoglyphic aberrations as a consequence of gross developmental malformations of the hands and feet, variations in ridge configurations may be associated with certain developmental syndromes involving only minor, if any, limb aberrations, or with various diseases in which no morphologic anomalies are evident. Although the mechanisms by which the genetic and environmental factors exert their effect on the epidermal ridge formation are not well understood, dermatoglyphics offer several diagnostic applications, such as in screening for chromosomal aberrations and determination of timing of a deleterious action of an environmental agent during embryogenesis. As sensitive indicators of altered intrauterine development, dermatoglyphics have been associated with such varied phenomena as the prenatal selection against certain fetuses without obvious morphological anomalies and prenatal developmental factors involved in determining handedness.

Some developmental associations between dermatoglyphics and the hand shape and size are discussed on the background of diverse growth disorders. As illustrative examples, results of our studies in achondroplasia (dwarfism with characteristically short limbs and fingers) and in Marfan syndrome (associated with an elongation of the limbs and arachnodactyly) are presented.

Cigarette smoking during pregnancy and variation in size at birth. LAWRENCE M. SCHELL and DENISE C. HODGES, State University of New York at Albany, Albany, N. Y.

The influence of cigarette smoking during pregnancy and other familial factors

on size at birth and gestation length is investigated among 458 births to 227 mothers who were living in suburban Philadelphia, Pennsylvania. In this sample, 56% of the births are to mothers who did not smoke during the pregnancy while 35% are to mothers who smoked 20 cigarettes or less. Multiple regression analysis is employed to examine the influence of cigarette smoking after statistical adjustment for such social and biological characteristics of the family as parents' sizes, education, income and aspects of mother's reproductive history. Cigarette smoking is entered into the regression model after all of the other variables. Significant explanatory factors in birth weight variation are gestation length, parity, and the number of cigarettes smoked. Cigarette smoking has the largest partial correlation coefficient ($r=-0.23$) second to gestation length. Birth length is also negatively associated with cigarette smoking (partial $r=-0.15$). Gestation length is not associated with cigarette smoking in this sample. Among births to women who did not smoke during the pregnancy, predictors of birth weight included measures of mother's size, age, parity and family income.

Age Estimation in the Rhesus Monkey. E.D. SCHNEIDERMAN, University of Michigan, Ann Arbor.

The rhesus monkey is widely used as an experimental animal in the study of craniofacial growth and development. As the date of birth of monkeys used in such research is frequently unknown, it has been the convention to assign animals to gross developmental categories on the basis of dental eruption (i.e. infant, juvenile, adolescent and adult). While adequate for many investigations, a means of distinguishing among animals within these categories is required to examine subtle developmental changes.

Lateral cephalograms of 40 female rhesus monkeys (Wisconsin Regional Primate Center) less than 10 years old, having known birthdates, were traced and digitized. A set of 36 measurements representing dimensions of the cranial vault and face, and dentitional position were taken. Simple linear, multiple linear, and polynomial regressions of chronological age on these variables were run. Equations were generated for all of the animals together, as well as for various gross developmental categories. A number of jaw measurements (ramus height, mandibular, maxillary and palatal length) were the best predictors of chronological age when used in polynomial regressions. For example, in the subadult animals, the 4th degree polynomial regression of chronological age upon ramus height has an R -squared of .93 ($SE=4.8$ months). These findings suggest that jaw dimensions are the most predictive, and both these and dental variables are considerably more useful than neurocranial variables in the estimation of age. Also, univariate polynomial regressions are better predictors than either multiple regressions or simple linear regressions. Supported in part by NIH Grant DE03610.

The Antiquity of African Regional Morphology
L.A. SCHEPARTZ, University of Michigan, Ann Arbor

Recent work on the Later Pleistocene and Holocene hominids from sub-Saharan Africa has focused on the relations of the fossils to living populations. The antiquity of Negro features has been of special interest and it has been suggested that modern Negro (and possibly Khoisan) morphology has a far greater antiquity than previously assumed (Rightmire 1979, 1984; de Villiers and Fatti 1982).

This research extends these lines of inquiry with an analysis of East African remains from Omo and Ngaloba (LH 18), testing the hypothesis that morphological features common in recent and subfossil East African populations are characterized by a pattern recognizable at least throughout the Upper Pleistocene.

After a study of approximately 400 anatomically modern East Africans, 15 metric and morphological cranial features were selected for comparison. To ensure that regional African, rather than grade similarities were identified, out-group comparisons involved European Neandertals, Upper Paleolithic Europeans, Middle Eastern hominids and the Ngandong remains.

Some features, such as supraorbital form, midfacial reduction and subnasal prognathism are already seen in the African Later Pleistocene and serve to distinguish both early African sapiens and their modern descendants from their European and Middle Eastern contemporaries.

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Surface enamel composition and dental caries in six prehistoric populations of Ohio Amerindians. K.N. SCHNEIDER, Wichita State University, Wichita, Kansas.

The effects of subsistence strategy change from hunting-gathering-fishing to horticulture on the composition of dental enamel is examined in six populations of prehistoric Amerindians from Ohio. The relationship between subsistence base and inferred diet to dental caries formation is achieved by analyzing the surface enamel of mandibular succedaneous canines using energy dispersive X-ray analysis.

Thirteen elements are quantified. A simultaneous display of all elements and all populations is achieved using correspondence analysis. Evaluations of cariogenic and cariostatic effects of each element are made on the basis of caries frequency comparisons among the groups.

Results indicate that zinc, copper, iron, nickel and the calcium-phosphorus ratio distinguish populations demonstrating relatively high, moderate, and low caries frequency. These elements also discriminate the hunting-gathering-fishing and horticultural populations included.

Sexing Indian skeletons with the acetabulum/pubis index. F.P. SCHULTER-ELLIS, University of Maryland Medical School, Baltimore, and L.C. HAYEK, Smithsonian Institution, Washington, D.C.

Recent studies using a discriminant function analysis of an acetabulum/pubis index, a measurement of ischial height and femur head diameter correctly sexed 96% and 97% of our samples of Terry Collection black and white skeletons, respectively. The index was constructed with a measurement of: (1) pubic length from the symphysis to the nearest rim of the acetabulum, and (2) a diameter of the acetabulum which represented a parallel extension of measurement (1). For this study, in order to eliminate the redundancy in the above listed variables, measurements for the index and greatest femur length were made on a sample of 36 Arikara skeletons (15 females, 21 males) from the North Dakota, Mobridge site collection at the Smithsonian Institution. These represented all specimens on which the necessary reference points were intact. The ratio alone assigned 75% of the sample, and the ratio with ischial height and greatest femoral length sexed 91%, correctly.

Morphological, Chromosomal, and Macromolecular Considerations for the Interpretation of Orangutan Phylogeny. J.H. SCHWARTZ, University of Pittsburgh.

Recently, I (1984) found that few apparently synapomorphic features supported a human-African ape or Homo-Pan clade, whereas a large array of systemically varied features supported the grouping of Homo and Pongo. Review of the latter leads to the rejection of one: M_2 smaller than M_2 - which does not characterize all hominids. However, additional features emerge. Humans and Pongo have the greatest frontal lobe and Sylvian sulcus asymmetry (Galaburda et al, 1978), the highest levels of estriol secretion during pregnancy (Czekala et al, 1983), and spontaneous handedness (Bresard and Bresson, 1983). On the other hand, a Homo-Gorilla grouping is further suggested by the frequent development of m. peroneus tertius (Jungers, pers. comm.). And Shea (1985) has correlated similarity in craniofacial growth with frontal sinus development, one of the few features to unite humans and African apes.

Scrutiny of non-morphological studies continues to reveal less than unanimous support for a human-African ape grouping. For example, and although they concluded otherwise, Bruce and Ayala's (1979) electrophoretic analysis of proteins gives the distances from Homo as P. paniscus, Pongo, Gorilla, and then P. troglodytes; in another table, Pan and Pongo are equidistant from Homo and Gorilla is the outlier. Sibley and Ahlquist's (1984) DNA hybridization data yield more than just their published human-Pan grouping and do not contradict a human-Pongo clade. Yunis and Prakash's (1982) study of chromosomes assumed first that Pongo was primitive and then tried to explain changes within the hominoids. Reanalysis of their data yields human-Pongo and Pan-Gorilla groupings as

sharing the greatest number of homologous chromosomes.

Regardless of the final outcome, it appears that we are far from the consensus on hominoid phylogeny that has come to be taken as fact.

Phylogenetic implications of skull form in Asian and African apes. B.T. SHEA, Northwestern University.

The question of phylogenetic relationships among hominoid primates has received much attention of late due to the discovery of new fossil material and reanalyses of extant ape morphology. Particularly central to these debates are the differences in skull form between the orangutan and the African ape/early hominid group. In previous work I have shown that one of the most significant differences between the Asian and African great apes involves the orientation of splanchnocranium on the neurocranium. In the research reported here I have extended these analyses to a broader consideration of other extant and fossil hominoids, with particular attention focused on identifying primitive and derived conditions and analyzing possible morphological correlates of changes in facial orientation. Results indicate that hylobatids in fact resemble orangutans in their possession (if not degree) of airorynchy, or a dorsal deflection of the face relative to the skullbase. This is also true of known fossil hominoid crania. This finding suggests that an important derived feature of the skull linking the African apes and early hominids is a deflection of the face downward, or ventrally on the skullbase. Functional considerations indicate that the appearance of a marked supraorbital torus and a frontal sinus may be correlated derived developments. Circumorbital morphology in fossil hominoids corroborates this hypothesis. These morphological features of the skull support the traditional grouping of African apes and humans, since they appear to be synapomorphic for this group and not merely primitive traits shared with the hylobatids.

New evidence about early hominid lifestyle.
Pat Shipman, The Johns Hopkins University School of Medicine, Baltimore.

Sites from Bed I, Olduvai, have been interpreted as home bases of hominids engaged in hunting and gathering. Recent studies of cutmarks on Bed I bovids challenge this interpretation. Cutmark location and distribution fail to meet predictions based on behaviors of more recent hunter-gatherers. Studies of overlapping cutmarks and carnivore toothmarks show that hominids more commonly processed carcasses after carnivores and suggests that scavenging may have been a major mode of food acquisition.

A paleoecological reconstruction of the Bed I herbivore community and a metabolic reconstruction of a "typical" Bed I hominid were made to determine if scavenging were feasible for early hominids in that ecosystem. These reconstructions yield estimates of carcass biomass and daily foraging area of the hominid. A "worst case" scenario is modelled, in which a lone female hominid carries a suckling infant as she forages for food. Even in this case, scavenging was a feasible food-procurement strategy in Bed I times. Further, adding even a small quantity of high-quality food to the diet of early hominid mothers might have had significant consequences for increases in brain and body size.

This work was funded by the National Science Foundation (BNS 80-1397 and BNS 80-2-1397) and the Boise Fund. It was carried out by kind permission of the President's Office of Kenya and the Tanzania National Scientific Research Council.

Ontogenetic changes in the chimpanzee dentition. J.R. SIEBERT and D.R. SWINDLER, University of Washington, Seattle.

Although a knowledge of variation in dental ontogeny has important applications in primate biology, including phylogeny, the development of the dentition has not been investigated in most species.

We therefore studied the dentition of six chimpanzees (*Pan troglodytes*), aged 6½ prenatal to 4 postnatal months, using *in situ* alizarin red S. The prenatal incisors had prominent mammelons and crowns which covered gelatinous interiors. At birth, the incisors were completely formed and calcified; at 4 postnatal months, they were partially erupted. Other teeth did not erupt during this period. Compared to the incisors, the deciduous canines lagged in degree of calcification and eruption. Deciduous molars were well formed and had a conspicuous tuberculum sextum. The gelatinous, noncalcified tooth germs of the permanent incisors were present in specimens at full term. The order and manner of calcification for M1 cusps were the same in *Pan* as *Homo*; ridge formation, however, varied somewhat.

After obtaining several measures, we calculated rates of growth within and between the major groups of teeth (Butler, 1967). The permanent first molar, for example, grew faster in length than width; distal width increased faster than mesial width.

These findings have several phylogenetic implications. Odontogenetic similarities in *Pan*, *Homo*, and other mammals suggest, as others have concluded, that the ordering of maturation events is a primitive trait. By contrast, variation in the coalescence of cusps and growth rates of mesial and distal moieties of the permanent molars implies different and more recent phylogenies.

Specimens were provided by the Yerkes Regional Primate Research Center, Emory University, Atlanta, Georgia.

ADAPTATIONS to gumivory in marsupial possums and gliders.

A.P. SMITH, Dept. Ecos. Mgt. University of New England, Armidale, Australia, 2351.

The 46 species of Australian phalangeroids (possums and gliders) occupy niches similar to those filled by primates on other continents. What is known about the life history of these species indicates a proportionally higher degree of utilization of plant exudates than occurs in other arboreal mammal faunas. The unique Eucalyptus and Acacia dominated forests and woodlands of Australia have provided opportunity for radiation of sap and/or gum feeding specialists in the genera Petaurus and Gymnobelideus, whilst the rainforests of Australasia support a further seven, little known species in the genera Cercartetus, Distoechurus and Dactylopsila, that have adaptations suggesting some degree of exudate dependence.

Evolutionary opportunities for exploitation of saps and gums are reviewed and are considered to have been determined by: 1) seasonal and other temporal patterns of exudate production; 2) the nutritional value of exudates; and 3) mammalian morphological, physiological and behavioural adaptations for harvesting and digestion of exudates. It is suggested that: a) enlargement and procumbency of the incisors and medium body size (50-300 g) are adaptations for scarring wood to enhance exudate production; b) that saps and gums are exploited as a source of energy and minerals, but are generally deficient in protein so that adaptations to gumivory are confounded by adaptation to insect and/or pollen harvesting; c) that gumivory can lead to water imbalance, which necessitates nocturnality and gastrointestinal specialization in dry forest species; d) that microbial fermentation may be necessary for digestion of some Acacia gums; and e) that high energy to protein ratios in the diet of gumivores reduces reproductive rates.

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Deleterious effects of close inbreeding in three captive groups of rhesus macaques. D. G. SMITH, M. F. SMALL and B. K. ROLFS. University of California, Davis.

Inbreeding depression is known to reduce both fitness and production values of numerous species of domestic livestock and has been frequently cited as a selection pressure favoring both single-sex migration patterns and inbreeding avoidance in multimale groups of primates. We have shown that rhesus monkeys do not avoid inbreeding with close paternal relatives when housed in closed captive groups. Since artificially induced "emigration" of rhesus males of various ages among captive groups has met with limited success, it is of both practical and theoretical interest to assess empirically the influence of close inbreeding upon fitness and vitality of rhesus macaques.

We used 30 polymorphic genetic markers to identify the paternity of approximately 300 offspring born in three captive groups of rhesus monkeys since 1980 when the first inbred offspring was born. After characterizing each offspring as "inbred", "non-inbred" or "indeterminate", a non-inbred control was chosen, matched for age, sex, cage location and cage experience with each inbred offspring. Approximately 10% of these animals, but a much greater proportion of all potentially inbred animals, were found to be inbred.

Parameters describing the mortality, morbidity, birth weight and infant growth rate of the inbred group were compared with those of the outbred group. While

no differences in birth weight, infant growth rate and morbidity were found, the inbred group experienced a statistically significantly higher number of infant deaths than did the non-inbred group.

Additional Upper Pleistocene hominid remains from Vindija Cave, Croatia, Yugoslavia. F.H. Smith, D. C. Boyd, University of Tennessee, Knoxville, and M. Malesz, Institute for Paleontology and Quaternary Geology, Yugoslav Academy of Sciences and Arts, Zagreb.

Ten new fragmentary specimens were recovered from Vindija Cave, Croatia, Yugoslavia in 1980 and 1981. Of these, eight were associated with a Late Mousterian stratum, one probably with an Aurignacian stratum, and another had an uncertain provenience. The Mousterian-associated sample is comparable to the previously excavated Vindija sample as well as to other European Neandertals; however, as in the other Vindija specimens, evidence of an evolutionary trend toward modern Homo sapiens exists. The Aurignacian-associated specimen is similar in overall morphology to the Mousterian ones. It is believed that this evidence helps bridge the gap between Early Neandertals in Central Europe such as Krapina and the more progressive looking morphology seen in many of the previously described Vindija specimens. The new specimens can be interpreted as supporting the hypothesis of "local continuity" in morphology in archaic and early modern Homo sapiens in Central Europe.

Are childhood patterns of change in body fatness inherited?

R.M. SIERVOGEL, D. MUKHERJEE, A.F. ROCHE and W.C. CHUMLEA, Department of Pediatrics, Fels Research Institute, Wright State University School of Medicine, Yellow Springs, Ohio 45387

Data from 434 participants in the Fels Longitudinal Growth Study were used in this study. The data set consisted of 60 parents with 123 children and 206 sibships with 2 or more sibs. Weight (W) and stature (S) were measured approximately semiannually from age 2 years to 18 years for all individuals. A function of the form

$y = \exp [B_0 + B_1 * t + B_2 * t^2 + B_3 * t^3]$, where y = weight divided by stature squared (W/S^2) and t = age, was fitted for W/S^2 for each individual who had at least 16 of the 38 possible data points (semiannual visits from 2 to 18 years). The 4 parameters B_0 , B_1 , B_2 , and B_3 represent intercept, multiplicative rate of change, multiplicative acceleration, and multiplicative rate of acceleration, respectively. Estimates of W/S^2 at birth (Q_B), the age at minimum velocity (t_1), age at maximum velocity (t_2), and the corresponding maximum velocity (V_{max}) were derived as

functions of these 4 parameters. Familial correlations including sex-specific subtypes were calculated for the curve parameters and for Q_B , t_1 , t_2 , and V_{max} . The Z-transforms of main-type correlations are given below.

param.	P-O	Sib	param.	P-O	Sib
n	123	206			
B_0	0.05	0.22	Q_B	0.04	0.22
B_1	-0.04	0.09	T_1	0.05	0.31
B_2	0.04	0.11	T_2	-0.06	0.04
B_3	0.03	0.13	V_{max}	-0.12	0.17

These data suggest that much of familial resemblance in patterns of change in W/S from 2 to 18 years of age may be due to shared sibling environment since sibling correlations (Sib) tend to be considerably larger than parent-offspring (P-O) correlations for each trait.

Supported by NIH Grant HDAM-12252 and the Samuel S. Fels Fund of Philadelphia

Identification and analysis of biogenic Sr/Ca in fossil fauna of the Omo Shungura Formation. ANDREW SILLEN, Dept. of Biochemistry, School of Dental Medicine, University of Pennsylvania.

Sr/Ca analyses have been efficacious in determining the importance of meat in relatively recent prehistoric diets (up to 10,000 years BP). However, it has not been possible to study earlier periods due to diagenetic obscurement of the original (biogenic) Sr/Ca relationships of fauna and humans.

This problem has been addressed by exploiting potential solubility differences between biogenic and diagenetic mineral. In the solubility profile procedure, 50 mg faunal cortical bone specimens were prepared as an ultra-fine powder, and washed repeatedly in 0.1 M acetate buffer at pH 4.5. Under these conditions, this reagent dissolves only the most soluble apatite present. Whole powders, washates (elutions), and residues were analyzed for Sr and Ca using atomic absorption spectrophotometry.

When Plio-pleistocene fauna of the Omo Shungura formation are prepared in this manner, Sr/Ca in the first 10 elutions are extremely high and variable, indicating the presence of a highly soluble diagenetic phase. However, in elutions 10-25 the variability and Sr/Ca values decrease, and the faunal specimens resolve themselves into categories conforming to their trophic level. In particular, there is no overlap between herbivores (N = 4) and carnivores (N = 8) of comparable solubility. Moreover, suid (N = 13) Sr/Ca values in elutions 10-25 fell midway between those of the herbivores and carnivores. These data strongly suggest the presence of a biogenic mineral of intermediate solubility.

The results suggest that it is now appropriate to consider analyses of East African early hominidae for Sr/Ca, in conjunction with further basic characterizations of fossil powders in the solubility-profile system.

This research was supported by NSF grant BNS-8208953 and the L.S.B. Leakey Foundation.

Options for bone aging with the microscope. D.J. Simmons, Washington University, St. Louis, MO.

The skeletons of all large living vertebrates undergo bone-specific ontogenetic changes in the numbers and distributions of cells which secrete new calcifiable collagen matrices (=osteoblasts) and which resorb preexisting bone matrix (=osteoclasts). The numbers & activities of these cells which function via tissue remodeling to maintain the external and internal morphology of bones are also constrained by nutritional and endocrinological influences. Investigators concerned with the practical problem of aging intact and fragmentary archaeological bone specimens, and possibly identifying frank evidence of metabolic bone disease, are denied direct access to information about cell populations kinetics. The cells are not preserved. Nonetheless, the age-wise changes in the microscopic structure and organization of bone in contemporary aging populations present some useful endpoints which can be applied to this problem. We will review the types of microscopic techniques which have been applied to this problem, and examine the range and utility of structures in bone which form as a consequence of bone remodeling activity--Light Microscope Level-- the osteon + osteon fragment census, osteon size, osteonal lamellar bone fiber architecture-orientation, and porosity; Microradiography--microscopic mineralization, zonal osteon census, percent surfaces of bone formation and resorption. The major problems in microscopic bone aging studies relate to sampling site specificity since we do not have normative values for each parameter in every human and primate skeletal element throughout the life-span. Secular changes also need to be considered.

Simulated increases in body weight in newborn and weanling rats on the growth of the tibia and the histomorphology of the proximal tibial epiphyseal growth plates. M. R. SIMON, University of Illinois, Urbana.

Groups of weanling and newborn Sprague-Dawley rats were each subjected to a specific 10% simulated increase in body weight, using constant centrifugation, to study the effects of quantified, increased, intermittent, compressive forces on tibial bone length and on the histomorphology of the proximal tibial epiphyseal growth plate. The data suggest an inverse relationship between increased g and bone growth at 60 days of centrifugation; however, if the rats are subjected to low levels of simulated increases in body weight from birth, or as weanlings for only 30 days of centrifugation an enhancement of bone growth was noted. In fact, the data suggest that very low levels of

simulated increases in body weight from birth produced enhanced body and limb bone growth. The results from histomorphology suggested no prominent changes, when compared to the controls, in the weanling rats sacrificed at 30 days of centrifugation, or in newborn rats subjected to 90 days of centrifugation; however, a prominent thinning of the growth plate was observed in the weanling rats sacrificed at 60 days of centrifugation. The studies by other authors in the literature on the effects of hypergravity on bone growth are consistent both in using accelerations greater than 2 g and in reporting a repression of bone growth. Our studies show, however, that the value of g, the duration of centrifugation, and the age at which the rats are subjected to centrifugation are each factors in the effects of simulated increases in body weight on limb bone growth.

Did tarsiers arise in Africa? E. L. SIMONS, Duke University Primate Center, Durham, NC.

Afrotarsius chatrathi, Simons and Bown 1985, a species from early Oligocene rocks of the Fayum Province of Egypt is the first tarsier-like primate from Africa. It is also the first prosimian found in the African Oligocene where it occurs contemporaneously with the earliest Anthropoidea. In molar tooth structure it resembles Pseudoloris from the European Eocene but even more so it is like modern southeast Asian Tarsius. Some authorities doubt that Pseudoloris and the European Eocene microchoerines with which it is usually classified are related to present-day tarsiers. All three genera show very primitive, perhaps "shared-primitive," molar structures. The Egyptian Oligocene fauna and flora have ties with both Europe and southeast Asia.

This research was funded by NSF BNS 83-10913.

Prenatal development of sexual dimorphism. J.E. SIRIANNI, State University of New York at Buffalo.

The purpose of this paper is twofold: One, to investigate whether there are significant sexual differences in the growth and development of the dentofacial complex of fetal macaques. Two, to determine if manipulation of the hormonal environment during the prenatal period effects an animal's postnatal growth and development.

Dental maturation scores and linear craniofacial dimensions were determined for 67 female and 81 male pigtailed macaque fetuses (Macaca nemestrina) of known gestational age. The sexes were compared using both univariate and multivariate analyses.

To study the long term effects of altering the prenatal, hormonal environment, the size and shape of the dentofacial complex

of 8 female rhesus monkeys (Macaca mulatta) which had been prenatally exposed to testosterone propionate were compared to 13 control females and 11 control males.

The results show that there are no significant sexual differences in either the development of the deciduous dentition or in the size of the fetal macaque face based on univariate analysis. Multivariate discriminant analysis of these facial dimensions correctly classifies the sex of 71.9% of the fetuses in the age category of 135 to 145 gestational days and 100% of the fetuses in the category of 165 to 175 days. Therefore, there appear to be low level sexual differences in the size of the face.

Although the reproductive organs and the social behavior of the prenatally treated females are more masculine, the size of their teeth, particularly their canines, and the size or shape of their faces are not significantly different from control females. It appears that prenatally administered testosterone propionate does not effect the adult size of the dentofacial complex.

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Multivariate analysis of anthropometric measurements in the Mennonites. SUEB-SAK SIRIJARAYA and M.H. CRAWFORD, University of Kansas, Lawrence.

Human morphology has been effected by the ever-changing environment throughout human evolution. The change or changes of the surroundings may influence the form and function of morphological traits. However, a single alteration of the environment may not result in a single change in structure and function but may possibly effect the interaction of numerous variables. This complex interaction of variables can best be investigated by the use of multivariate analysis.

This study examines the relationship of 38 anthropometric measurements obtained from 1,115 Mennonites from Goessel, Kansas and Henderson, Nebraska. Descriptive statistics on these 38 anthropometric traits are computed through the BMDP2D (1981) program. The factor analysis, based upon the BMDP4M (1981), is utilized.

The anthropometric variation has been reduced into three factors with regards to the rotated factor loadings. These first three factors explain 60% of the observed variance. Factor 1 is a length factor and consists of the following traits, for example, stature, ilio-spinal height, biacromial width and suprasternal height. Factor 2 represents the general cranial size which is made up by head width, minimum frontal width and bizygomatic width. Factor 3 is dominated by the bulk measurements and includes mainly body weight, chest dimensions and skinfold measurements.

The physical components of the Mennonites, delineated by the three factors, are common to all populations. However, in most populations factors 2 and 3 are reversed, in contrast to

the pattern observed in the Mennonites. This pattern may be due to the plasticity of body length and bulk while the facial and head morphology are mainly genetically determined. These findings confirm the study of Devcr(1984) showing that the transmissibilities of body length measurements are the highest when compared to the transmissibilities of body bulk. This research was supported, in part, by the National Institute of Aging grant no. AG01646.

Birth timing, infant growth, and infant survivorship in captive rhesus macaques. M.F. SMALL and D.G. SMITH, Department of Anthropology and California Primate Research Center, University of California, Davis, CA 95616.

Rhesus macaque infants born early in the birth season tend to have either high ranking fathers or high ranking mothers. The relationship between birth timing and parental rank has evolutionary significance only if those infants survive more often. We investigated the possibility that birth timing influences infant birth weight, infant growth rate, and survivorship in a large sample of captive rhesus macaques (Macaca mulatta).

816 rhesus infants were born between 1977-1982 in large (0.2 ha) field cages at the California Primate Research Center. From 1977 through 1982 there was a systematic shift toward earlier births. Infant birth weights and infant growth rates were obtained on 580 infants who survived at least their first year. Stillbirths and infant deaths within 30 days occurred more frequently during the early months of the birth season relative to the number of pregnancy terminations during those months. Male infants weighed slightly more and tended to grow faster than female infants, and differences relative to infant's month of birth were also found. There was a tendency for early births to be male biased.

Although seasonal breeding has been associated with particular ecological conditions, timing an infant's birth relative to other births in the group may also influence the infant's growth and survivorship.

Functional Models of Migration and their Genetic Implications: An Analysis of the Gainj of Papua New Guinea. PETER E. SMOUSE and JAMES W. WOOD, University of Michigan, Ann Arbor.

There are two classes of model that have been employed to study the relationship between gene flow and genetic structure of human populations: the migration matrix model (MM), and the isolation by distance model (ID). The MM approach permits the prediction of the individual entries of the genetic distance matrix, but suffers from the ephemeral nature of the observed migration rates. The ID approach concentrates on broad

geographic pattern, but is restricted to a consideration of distance effects, and does not permit the modeling of much detail. We present here an intermediate strategy that captures the best aspects of both the MM and ID models.

We use the new technique to assess the importance of endemicity, geographic distance, linguistic divergence, and population density for the migration rates and for the genetic distance matrix. Relative to migration rates, we discover that the migration pattern departs substantially from random dispersal in both sexes. Males show strong endemicity but not much else. Females show only modest endemicity, but both geographic distance and linguistic separation reduce gene flow. There is also a small density effect, with females moving from large groups to small ones. Relative to genetic distance, we discover that the genetic distance matrix generated by any migration model improves as a predictor of the observed genetic distance matrix as the migration model itself improves as a predictor of the observed migration matrix.

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Bioanthropology in Transportation Safety Research. RICHARD G. SNYDER. University of Michigan, Ann Arbor

Current technology has rapidly evolved a variety of modes of civil transportation ranging from light-weight moped and ultra-light aircraft to 150-ton mining trucks providing a wide range of environmental safety for the human occupant. Man now travels in air, water, space, and all terrains, each presenting specialized bioanthropologic problems. The physical anthropologist may play an important role in advanced design, occupant protection, trauma analysis, biomechanics, kinematics, or human surrogate development. Recent work conducted by physical anthropologists at the University of Michigan's Transportation Research Institute includes a wide range of biological problems associated with all types of vehicles. Examples include design of specifications and fabrication of the 1990's family of anthropomorphic crash dummies; design and testing of experimental restraints for use in very heavy vehicles, automobiles, aircraft, and flying platforms; head and brain trauma; facial anthropometry for masks; head anthropometry for children to age 4; cervical spine motion and tolerances; mechanisms of spinal injury; regional and whole-body impact tolerances; anthropometry of numerous specialized populations; and two national anthropometric surveys of 8,154 infants, children, and youth to age 19. Equipment includes a new generation of state-of-the-art innovative measurement tools, notably whole-body C.G. devices, 7- and 10-

camera photogrammetry, and computer-controlled specialized anthropometric instruments equipped with electrical and pressure transducers. Typical case examples of forensic anthropological aspects of automotive and aircraft accidents are also discussed.

Body size and proportions of the locomotor skeleton in Oreopithecus bambolii. J. T. STERN, JR. and W. L. JUNGERS, State University of New York at Stony Brook.

The partial skeleton of a male Oreopithecus bambolii has provided a rare opportunity to examine body size and overall bodily proportions in a fossil catarrhine primate of disputed systematic affinities (Schultz, '60; Straus, '63; Biegert and Maurer, '72). Schultz believed the body mass of this specimen was at least 40 kg, but recent estimates derived from regressions of tooth size on body size in living primates suggest an animal less than half the weight proposed by Schultz (Gingerich et al., '82). According to Straus, the high intermembral index (~ 120) of Oreopithecus was due primarily to short hindlimbs rather than to long forelimbs. Biegert and Maurer concluded, however, that the proportions of the limbs and bony pelvis are most similar to Pongo (i.e., very long forelimbs relative to size).

In this study we place the limb and iliac dimensions of the Oreopithecus skeleton into a size-related context based on empirical allometric relationships (regressions) observed in extant catarrhine primates. New estimates of body size for this specimen are derived from regressions of body mass on linear dimensions of articular surfaces in primates of known body mass. Best estimates are approximately 32 kg (femoral head diameter) and almost 33 kg (multiple regression). Compared to both cercopithecoid and African ape base lines, a 32-33 kg estimate implies moderate forelimb elongation (approximately 12% longer than predicted). Relative hindlimb length would be slightly shorter than expected for African apes but would appear substantially less than that expected for cercopithecoids (almost 15% shorter). Ilium length of Oreopithecus can be characterized as relatively short in comparison to African apes (and probably Pongo as well), but is relatively close to the value predicted for large-bodied cercopithecoids. The overall combination of bodily proportions seen in this skeleton is unique among known catarrhines, living or fossil. Supported by NSF grants BNS 8318013 and 8217635.

Mid-18th century American military stature: archival and skeletal comparisons. A.T. STEEGMANN, JR., and P. Haseley, State University of New York at Buffalo.

18th century American military records contain data on stature, age, birth place, and other variables. French and Indian War

militia companies (1755-1760) from New York, Pennsylvania, and Virginia show mean heights between 67 and 68 inches for mature, American-born soldiers. Foreign-born men in the same units average one to two inches less. These samples probably reflect American population statures at that time because militia services was mandatory. The militiamen are close in stature to samples of British regular soldiers from equivalent time periods (1762-1782).

A comparison is also made to statures, estimated from skeletons, of 14 soldiers apparently killed in the fighting around Ft. William Henry (Lake George, N.Y.), between 1755 and 1757. Trotter and Gleser's 1952 formulae produced a mean stature estimate of 69.8 inches for this population.

Explanations for the difference between skeletal and archival data are considered as are environmental sources of stature variation.

Anthropological evaluation of genetic services: preliminary findings. J.S. STELTZ-LENARSKY, G.N. MAHNKE, R.J. MEIER. Indiana University, Bloomington.

The general goal of the study is to provide a methodology for monitoring Indiana's statewide network of regional genetic service centers in order to improve the delivery of genetic evaluation and counseling services. Two specific goals are to determine how much information clients retain from a counseling session and how satisfied they are with the services received. Two approaches are used-structured questionnaires and personal interviews. To date, over 300 families have been surveyed through preclinic, postclinic and staff questionnaires. Over 50 clients have agreed to personal interviews with 13 completed thusfar. Several major issues have emerged from the data, including the following:

- 1) The ability of the genetics staff to provide resource information such as local support groups is a major determinant of client satisfaction.
- 2) Involvement in a support group increases the quantity and quality of information a client possesses about a particular condition.
- 3) Counseling sessions were not scheduled soon enough for some parents who were anxious for information on etiology or progression of their child's particular condition.
- 4) Cost or distance from the clinic did not present problems for most clients.
- 5) Statistical information may be retained but may seem irrelevant or too impersonal to clients.
- 6) The staff person's personality or "bedside manner" is significant in determining overall client satisfaction with the counseling session.

Clients and staff do not always agree on the level of satisfaction reached in the session. It is suggested that the term "counseling" itself may account for some of the client's unmet expectations.

Glycosylated hemoglobin and long-term blood glucose control: applications in the field. B.P. STONER, Indiana University, Bloomington.

The analysis of glycosylated hemoglobin (GHb) in field situations has been facilitated by the recent development of micro-column ion exchange and affinity chromatography techniques. A product of the non-enzymatic attachment of glucose to hemoglobin within the erythrocyte, GHb is widely accepted as a measure of long-term glycemic condition. The application of micro-column assay methods to anthropological problems is a potentially fruitful, if unexplored area of research.

Preliminary testing of several commercially available procedures suggests that GHb assays may be useful for the initial identification of chronically hyperglycemic and hypoglycemic individuals alike. While clinical investigators have focused primarily the elevation of GHb in uncontrolled diabetes mellitus (12-20% of total Hb), the assay may be theoretically applied to the study of depressed levels of GHb (<4%) in nutritionally stressed populations. The GHb assay may therefore be appropriate for the continued investigation of hypoglycemia and its relationship to aggression among the highland Andean Aymara.

To anthropologists working in field settings, the micro-column technique may prove superior to standard oral glucose tolerance tests for its: 1) lack of any pre-test fasting requirement; 2) determination of long-term glycemic condition; 3) minimal time required to perform the assay; and 4) minimal blood sample needed from the subject. The utility of this new technique, however, remains to be fully realized by investigators of glucose metabolism and homeostasis.

Pre-Columbian child and infant mortality at Teotihuacan and Copan. REBECCA STOREY, University of Houston.

The skeletons from a low-status apartment compound, Tlajinga 33, at the site of Teotihuacan, Mexico, yielded a representative population for the first paleodemographic study of a New World pre-Columbian urban population. Life table analysis revealed a population with high juvenile mortality and that the most perilous time of the lifespan was around birth, mainly because 31% of the sample was perinatal in age. The presence of growth arrest episodes prenatally and in early childhood were evidence of health stress undoubtedly contributing to the high mortality. The Teotihuacan study indicates that this New World urban population faced similar health and mortality stresses as Old World preindustrial cities.

The skeletal population from the Late Classic Maya center of Copan is mostly from a residential subdivision with less population density than Teotihuacan. Thus, it provides an important comparative sample for the effects of density on health and infant-child mortality in Mesoamerica. While analysis is ongoing, the data at present suggests that prenatal stress is less but infant and child mortality comparable to Teotihuacan, a situation probably due to the differences in economic systems for the two populations.

New early Eocene primate remains from the Wind River Basin, Wyoming. R.K. STUCKY, L. KRISH-TALKA, J.D. SWARTS, S. ROSE. Carnegie Museum of Natural History, Pittsburgh.

Field work during 1984 in the Lostcabinian (latest Wasatchian) part of the Wind River Formation, Wind River Basin, Wyoming, resulted in the discovery of six extremely fossiliferous quarries that preserve cranial and skeletal remains of a diversity of primates, other small mammals, reptiles and amphibians. The fossils occur in localized concentrations within a 2m thick horizon (B-2, CM Loc. 1040) of thinly laminated limestones, bioturbated limestones and mudstones, intraformational conglomerates and undisturbed mudstones. Taphonomic and geologic analyses suggest a multiple origin for these concentrations, including carnivore and/or coprolite accumulations, natural death and some fluvial transport. The quarries appear to represent remnants of well-drained swamps/overbank deposits developed near a permanent stream.

Remains of six species of primates in five genera were recovered: Cantius or Notharctus; Microsyops; Shoshonius; Uintasorex; Phenacolemur. Among the mammals, this diversity (13%) is second only to that of the Insectivora, and is less than that of anquid lizards. 20% of all identifiable mammalian remains represent primates, ranking behind those of insectivores (30%). Four of the five primate genera (Cantius or Notharctus, Shoshonius, Uintasorex, Microsyops) are represented by complete or partial skulls and three (Uintasorex, Microsyops, Cantius or Notharctus) have associated post-cranial remains. Preliminary research indicates that: 1) Shoshonius has a short snout, a parabolic dental arcade, large frontally positioned orbits and a short zygomatic arch; 2) The snout and lower jaw of Cantius or Notharctus are somewhat shorter than in N. tenebrosus; the lower jaw also differs in having a straight ventral margin, a deeper, more vertical and unfused mandibular symphysis, and more vertically oriented incisors.

The field work was supported by NSF grant BSR-8402051 and a grant from the M. Graham Netting Research Fund, Carnegie Museum of Natural History.

Functional morphology of the Oreopithecus hand. R. L. SUSMAN, SUNY, Stony Brook.

The 1958 skeleton of Oreopithecus retains a fairly complete, but damaged, left hand.

Since the the specimen is distorted, I confine my comments to aspects of the hand that are relatively unaffected by post-depositional factors. The hand is (in addition to being very flat) relatively long with the highest hand length index (32) among the extant apes. The length ratio of the third proximal phalanx to metacarpal III is similar to Pongo and exceeds that in common chimpanzees and gorillas. The scaphoid also bears a close resemblance to Pongo while phalangeal curvature and morphology of the distal phalanges is in the African ape range. The morphology of the hand together with that of the ulna, radius, interlimb proportions and body size, suggest that Oreopithecus was suspensory adapted. With due caution, given the condition of the specimen, and acknowledging that Oreopithecus was a very unique hominoid, it is inferred that Oreopithecus was as well suited for arboreality as chimpanzees, but was less suspensory adapted than modern orangutans.

Geological, geomorphological and paleobotanical evidence from the Oreopithecus bearing horizon (V_j) at Baccinello (Teichmueller, '62; Lorenz, '68) is consistent with the view that Oreopithecus was arboreal. The flora from the Oreopithecus lignite contains swamp species including fern spores, reeds, and large concentrations of algae deposited in a subaquatic environment. Molluscs species attest to the presence of standing fresh water. Arboreal pollen of Quercus, Populus, and others indicate that drier forests were also present in the vicinity. Given its completeness, it is likely that the 1958 specimen died and was preserved in the standing water of a coastal swamp. Supported by NSF Research Grants BNS 8311206 and BNS 8318013.

Computed Tomography and Automated Image Analysis of Prehistoric Femora. D.R. Sumner, Rush-Presbyterian-St. Luke's Medical Center, Chicago, B. Mockbee, K. Morse, T. Cram and M. Pitt, University of Arizona, Tucson.

Computed tomography (CT) is potentially the method of choice for non-invasive characterization of limb bone cross-sectional geometry. CT has the advantage of providing true two-dimensional images which are particularly well-suited for automated analysis.

Archeologically-derived whole femora and diaphyseal segments were scanned with a G.E. CT/T 8800 scanner. The CT monitor was used to measure subperiosteal and endosteal diameters, whereas a Vicom digital image processor was used for measuring cross-sectional geometric properties. An outlining algorithm was written for automated tracing of the subperiosteal and endosteal borders using the Vicom system. The x,y coordinates of these borders were supplied to the SLICE program for analysis of complex shapes.

Use of a water bath reduced the magnitude of the error for subperiosteal diameters from 1.9 to 1.0%, and eliminated directionality in the error. Endosteal diameters were

consistently overestimated by 5%, regardless of the use of a water bath. Cross-sectional geometric properties were underestimated by 4 to 13.4% if the medullary cavity was not filled with water when the specimens were placed in a water bath. Precision error averaged about 1% for the Vicom system and about 3% for the entire protocol.

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Key Words: 1) biomechanics 2) computed tomography
3) femur 4) morphology

Communal breeding among the Callitrichidae and its adaptive significance. R.W. SUSSMAN, Washington University, St. Louis, and P.A. GARBER, University of Illinois, Urbana.

It is generally assumed that tamarins and marmosets are monogamous or live in extended family groups. However, it is obvious from field research on these species that this is not the case. Immigration and emigration by adults is common and groups are composed largely of unrelated adults of both sexes. There is commonly more than one adult of each sex per group. In each group only a single female is usually reproductively active. This female may mate with more than one male, who subsequently provide care for the young. This social system is not uncommon among birds and mammals and has been referred to as a "communal breeding system." More precisely, callitrichids live in small multimale groups, communally rear their young, and show a tendency toward polyandrous mating. We will provide data to illustrate that this is so and that there is a significant correlation between the number of males in a group and the total number of surviving young. The possible adaptive advantages of this social organization are discussed.

The Orangutan deciduous dentition, implications for hominoid systematics. J. D. SWARTS, University of Pittsburgh, Pittsburgh.

Recent discoveries of *Sivapithecus* material from Pakistan has invigorated the study of hominoid systematics, and resulted in alternative hypotheses of orangutan affinities. One way of testing these hypotheses is to examine previously unused anatomical systems. This study is an examination of the deciduous dentition of hominoids in the context of a reconstructed catarrhine ancestral condition. Juvenile anthropoid specimens from the Carnegie Museum of Natural History, the American Museum of Natural History, and the National Museum of Natural History were examined and photographed. The primitive catarrhine deciduous dentition was developed from this data.

Relevant features of this ancestral morphotype, include a lower dm1 which had a poorly developed talonid basin and a long, straight paracristid. The lower dm2 trigonid was approximately equal in length to the talonid. The apices of the metaconid and protoconid were divergent. The talonid opened lingually through a notch between the entoconid and the metaconid. The upper dm1 was triangular in outline with a small protocone and moderately developed cingula. The upper dm2 was squared by the development of a hypocone and moderately expressed mesial and distal cingula.

Utilizing this ancestral reconstruction, unique features of the orangutan deciduous dentition can be identified. The common possession of the following deciduous dental features support a sister relationship for the orangutan and *Homo* among extant taxa. The lower dm1 has an enclosed talonid basin, and a short, acutely angled paracristid. The trigonid of the lower dm2 is one-half the length of the talonid. The upper dm1 is square due to the expansion of the postcingular area, a mesial shift of the protocone and strongly developed preprotocrista-precingulum. The upper dm2 is unique due to the strongly developed hypocone, precingulum and postcingulum.

Molar variation and evolution in the orang-utan (*Pongo pygmaeus*). D. R. Swindler, University of Washington, Seattle.

The earliest hominoid lower molars (Miocene) possessed five cusps with contact between the metaconid and hypoconid resulting in the well-known *Dryopithecus* (Y5) pattern. An additional cusp, the tuberculum sextum, may also be present on the lower molars of these Miocene hominoids. It is generally accepted however, that the Y5 pattern is the plesiomorphic condition. The present paper presents information on the incidence of these and other molar variations in the orang-utan in an attempt to better understand the phylogenetic position of the taxon.

The sample consisted of approximately 250 orang-utan skulls. Observations were made bilaterally on M₁₋₃ of each specimen. The Y5 pattern had the highest incidence, M₁ 98%, M₂ 91.5% and M₃ 86.5% whereas, Y6 was present on M₁ 2%, M₂ 7% and M₃ 9% of the time. Other patterns, such as the Y4, +6, +5 and +4 occurred less frequently except for the +5 pattern on M₃ (4%). There were no significant differences in these patterns between antimeres and only two differences, both in the +5 relation, between sexes.

Several sequences have been proposed through the years to account for the evolutionary shift from five to four cusps and from the Y to the + pattern in certain groups of living hominoids, e.g., *Pan* and *Homo*. Johanson (1979) suggested the sequence Y-5 to +5 to +4 to Y4 as the most reasonable one for hominids. These evolutionary alterations have not occurred at the same rate in pongids, indeed according to the present data, it seems questionable that they ever occurred in *Pongo*

and Corilla. These two taxa have maintained an extremely stable groove pattern (Y) and only a slightly less stable cusp number (5) since the Miocene.

Research supported by an Alexander von Humboldt Award to the author.

Evolutionary morphology of the foot in Oreopithecus. F. S. Szalay, Hunter College, CUNY, and J. Langdon, Indiana Central University.

A comparative, functional, and biorole assessment of a complete tarsus and metatarsals of Oreopithecus, along with other known aspects of the skeleton, indicates that this Turolian Tuscan catarrhine, in the 35-40 kg. weight range, was habitually practicing positional behaviors most comparable to living Pan troglodytes. The specializations of Pongo, unique among hominoids, which allow habitual rotation in the lower ankle joint while the animal is hanging by its feet (and hands) are absent in Oreopithecus.

The foreshortened, mobile, and robust tarsus and metatarsus is not "monkey"-like but, probably independently from an ancient catarrhine source, is most similar to morphology and mechanics shown by Pan.

Inferences concerning bone resorption at the pubis and preauricular area. R.G. TAGUE, Kent State University, Kent.

Osseous resorption (pitting) adjacent to the interpubic and sacroiliac joints is a sexually dimorphic trait. Pitting at the dorsal pubic corpus and preauricular area of the female innominate has been interpreted as evidence of past reproductive events. To test hypotheses concerning formation of the pitting morphologies, data were collected from three Amerindian skeletal populations: Indian Knoll (IK), Libben (LB) and Pecos Pueblo (PP).

In testing the proposition that pitting at the pubis and preauricular area is related to fertility, the hypothesis is accepted unequivocally for the pubis. The rank-order correlations between degree of pubic pitting and age-at-death are highly significant for each of the female samples: $r_s = .32$ (IK), $.53$ (LB) and $.33$ (PP). The inference is supported that pubic pitting is related to fertility rather than simply to advancing age, as the correlations between pitting and age are nonsignificant: (a) among the corresponding male samples and (b) in a sample of black, nulliparous females from the Hamann-Todd collection. The results between pitting and age are inconclusive for the preauricular area as only the females of IK and LB show statistical significance.

Although pubic bone resorption may be related to fertility, a minority of females show a pitting morphology distinct from males: 41% (IK), 37% (LB) and 35% (PP). Dimorphism at the preauricular area is more variable: 38% (IK), 56% (LB) and 47% (PP). Intraindividually,

the severity of bone resorption at the pubis and preauricular area is independent, as the correlation between the rank-order of pitting at these two sites is low and nonsignificant for IK and PP.

An argument is advanced that high estrogen levels during pregnancy increase osteoclastic activity at the pubis and, probably, preauricular area, with the degree of resorption at the latter being influenced by factors associated with the weight-bearing function of the sacroiliac joints.

The dentition of the "old man" of La Chapelle-aux-Saints and inferences concerning Neanderthal behavior. Neil C. TAPPEN, University of Wisconsin, Milwaukee.

It has been suggested that the fossil Neanderthal from La Chapelle-aux-Saints was so toothless that he would have had to have his food pre-chewed or otherwise prepared for him. This has also led to the inference that a high level of altruistic social behavior was characteristic of Neanderthals. This appears to be in keeping with a current trend among anthropologists to upgrade the cultural and evolutionary status of Neanderthals. Close examination of the recovered teeth and the condition of the alveoli indicates that the "old man" of La Chapelle-aux-Saints had upper and lower incisor, canine and premolar teeth on the left side intact and probably in occlusion, and that the same was true of these teeth in the right maxilla. Mandibular incisors, canine and first premolar had probably been lost to a tumor or abscessing on the right side, but this pathology may have developed near the time of death. The right mandibular second premolar was probably functional, although tilted similarly to the intact premolar on the left. It is very unlikely that the individual was unable to chew food. The dentition thus gives no reliable evidence of altruistic behavior by his cohorts. This study may also relate to hypotheses concerning the ancestry of anatomically modern humans.

Consequences of illness on Andean peasants: a research update. R.B. THOMAS, L.A. LALIBERTE and T.L. LEATHERMAN, University of Massachusetts/Amherst.

This paper provides an overview of research conducted on the highland Peruvian population of Nuñoa over the past year and a half, and serves to introduce four individual papers on specific phases of the research. Major changes which have occurred since the population was last intensely studied 15-20 years ago are reviewed. These changes have necessitated analyzing results not only from an adaptive orientation, but also one which acknowledges important political economic processes and unequal access to resources.

Preliminary results pertaining to the consequences of illness on productive activities are reviewed. These include the reporting of major illness events in the course of a lifetime, and the results of the first of four seasonal symptomatology surveys. Symptoms and attitudes toward illness are discussed with regard to socio-economic and residential variation.

This research is supported by NSF Research Grant BNS-8306-186.

Nausea and vomiting of pregnancy and pregnancy outcome. F.D. TIERSON, University of Colorado at Colorado Springs, C.L. OLSEN, Albany Medical College of Union University, and E.B. HOOK, New York State Department of Health.

Nausea and vomiting of pregnancy (NVP) is a ubiquitous system complex, yet relatively little is known of its etiology or epidemiology. Few attempts have been made to correlate NVP with pregnancy outcome or to investigate interactions between NVP and maternal nutrition.

This research is based on a sample of 414 women in Albany, NY, whose pregnancies were ascertained by the 13th week, and who completed interviews at several specific periods during pregnancy. Seven-day diet histories and 24-hour dietary recalls were obtained for the 12th, 16th, 20th, 30th and 38th weeks of pregnancy, and for the month before the last menstrual period (LMP). Data on NVP were recorded by week (since LMP) of onset and termination of symptoms.

The incidence of women reporting symptoms of NVP was relatively higher in this prospective study than has been reported by others. A total of 370 women, or 89.4% of the 414 who completed the study protocol, reported having nausea and/or vomiting of pregnancy. Forty-four women (10.6%) had no symptoms. There were 358 women (86.5%) who had nausea, 136 of whom had no vomiting. The remaining 222 experienced both nausea and vomiting. The total number of women experiencing vomiting regardless of nausea was 234 (56.5%).

Thirty-one of the 414 pregnancies resulted in fetal death, with the incidence of fetal death being significantly higher in the group of women who experienced no symptoms of NVP. The total number of days of nausea experienced during pregnancy was positively associated with intake of sodium during the 12th week, and was negatively associated with intake of niacin during the same period. Increased intake of niacin was associated with decreased infant birthweight, due mainly to shortened gestation length.

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Systemic mycotic infection among prehistoric Pueblo Indians of Arizona. E.J. Tudor, Rice University.

The mycotic infection, coccidioidomycosis, is hyperendemic in the Salt River Valley of

Arizona. Disseminated coccidioidomycosis causes distinctive lytic bone lesions but has rarely been given attention in the paleopathological literature. The pattern of infection described for coccidioidomycosis in the current medical literature indicates distinctive types and distributions of lesions. Lesions are lytic and well demarcated. They occur in the middle of flat bones, on the metaphyses of long bones or on the diaphyses of the bones of the hands and feet. Rib lesions are marginal and vertebral lesions most commonly occur on the dorsal and lumbar spines. The most frequent sites include the vertebrae, tibia, skull, metatarsals and metacarpals. The pattern of involvement stands in contrast to those common for tuberculosis or osteomyelitis due to bacterial infection. This suggests that coccidioidomycosis can be differentially identified. This project examines a series of prehistoric Arizona Indians from the Salt River Valley. All infectious pathology is reviewed with possible cases of mycotic infection individually described. A model for differential diagnosis is presented and applied to these cases.

The existence of coccidioidomycosis in a prehistoric population will have two important implications: first, that mycotic infections can be identified with an appropriate protocol; second, that coccidioidomycosis is an endemic infection of long-standing.

Comparative distance measures in two species of Cercopithecus monkeys; C. aethiops and C. mitis. T.R. TURNER, J.E. MALERS, and C.S. MOTT, University of Wisconsin-Milwaukee

Genetic and morphological data were collected on several local populations of two species of Cercopithecus monkeys. Three subspecies of *C. mitis* and two subspecies of *C. aethiops*, one of which contained four geographically separated populations were sampled. The genetic data was analyzed for F_{ST} values and genetic distances. We have also devised a new measure of morphological distance utilizing sexual dimorphism, metrics and general body size. The genetic distances between local vervet populations ranged from 0.004 to 0.0162 and between 0.0147 and 0.0372 for *mitis* subspecies. Corresponding morphological distances ranged from 0.016 and 0.06 in the *vervets* and 0.025 and 0.058 in the *mitis*. Our data allows us to make comparisons at several levels; local populations of a subspecies, subspecies, and species for both genetic and morphological parameters. The implications of the results of this analysis are discussed with particular reference to the use of allelic frequency data for assessing the process of speciation.

The Stanford-Meyer Osteopathology Collection. R.A. TYSON, San Diego Museum of Man, San Diego.

The San Diego Museum of Man is the recipient of a collection of human bone pathologies from Stanford University School of Medicine. The collection of approximately 2,500 specimens was systematically developed by the late Arthur W. Meyer, M.D. of Stanford University, Department of Anatomy. Dr. Meyer collected examples of disease, trauma, and morphological variations from over 1,500 dissecting room cadavers, mainly 50-80 year old males.

Stanford documentation, consisting of vital statistics forms and descriptive labels, is available for approximately 400 individuals, mainly from the 1930s and 1940s. Further documentation by 500 radiographs with diagnoses has been made by Donald Resnick, M.D. of the Veterans Administration Medical Center, San Diego.

Some conditions and diseases suggested by radiographic diagnosis include: adamantinoma, ankylosing spondylitis, diabetic neuroarthropathy, diffuse idiopathic skeletal hyperostosis, fluorosis, giant cell tumor, kyphoscoliosis, metastatic carcinoma, multiple myeloma, osteomyelitis, Paget's disease, parosteal sarcoma, Pellegrini-Stieda disease, and rickets. There are numerous examples of fractures, dislocations, and degenerative joint disease in all stages.

The San Diego Museum of Man plans to make this collection available for research.

Gait utilization and gait transitions in squirrel monkeys. J.A. VILENSKY, M.C. PATRICK and C.M. HOCKENSMITH, Indiana University School of Medicine, Fort Wayne.

In order to characterize the locomotor behavior of Saimiri, two adults (one male and one female) were trained to locomote on a treadmill at seven speeds within .89 - 2.58 m/s. The animals were subsequently filmed at 100 and 200 frames/sec.

In contrast to other higher primates, the two squirrel monkeys did not use diagonal sequence symmetrical gaits under steady-state conditions. Rather, they used the more common (for quadrupeds in general) lateral sequence gaits. During asymmetrical gaits both transverse and rotatory gallops were used.

Although the squirrel monkeys used lateral sequence gaits, they did not adjust their footfall patterns to speed in the same manner as typical quadrupeds. Specifically, a comparison of gait utilization by a cat and the male monkey indicated that while the cat switched to a running trot at faster speeds, the squirrel monkey continued to use a lateral sequence-single foot gait.

In addition to steady-state locomotion, the female monkey was filmed during two run-gallop gait transitions. Interestingly, prior to both transitions she used diagonal sequence gaits. Furthermore, these transitions were accomplished by changes in both the swing and stance durations of certain limbs and, in some respects, were gradual.

The utilization of lateral sequence gaits by squirrel monkeys is unusual among primates

and may relate to their small body size and relatively large heads. However, the absence of trotting is consistent with other primates and may indicate basic differences in the neural control of locomotion between primates and other quadrupeds. Finally, the switch to diagonal sequence gaits during run-gallop transitions is unique and can perhaps be used to better understand both the mechanics and neurological control regulating such transitions.

We gratefully acknowledge the Fort Wayne Children's Zoo for providing the animals.

Ecological correlates of intraspecific size variation in Cercopithecidae. V.J. VITZTHUM University of Michigan, Ann Arbor.

Despite the frequent observation that humans and other animals display a great deal of interpopulational variation in body size and morphology, little is known about the ecological conditions responsible for generating substantial morphological diversity within a species. One factor cited as potentially responsible for promoting a relatively high level of intraspecific and intrapopulational variation in primates is a terrestrial savannah adaptation. The savannah is characterized by resource variability, seasonality, and geographic and historical continuity. It has been suggested that these features may favor populational diversity rather than allopatric speciation by selecting against niche specialization in savannah adapted primates.

This investigation tests the hypothesis that a savannah adaptation is correlated with a greater degree of morphological variation than is a forest adaptation by examining tooth size variation in two species of savannah adapted primates (*Papio anubis* and *Cercopithecus aethiops*) and two forest adapted primate species (*Mandrillus leucophaeus* and *Cercopithecus mitis*).

Molar size is chosen for analysis because of its high correlation with body size, considered by many ecologists to be a fundamental component of an animal's adaptation. In addition, studies of tooth size variation in extant primates have important phylogenetic applications to the primate fossil record.

It appears that there are several factors, other than the type of ecozone, responsible for generating a relatively high degree of intraspecific morphological variation. Of particular importance are the nature and diversity of the dietary regime, the social structure and mating system, and the climatic and geographical conditions.

New Proconsul fossils from the Early Miocene of Kenya. A.C. WALKER and M.F. TEAFORD, The Johns Hopkins University School of Medicine, Baltimore and R.E. LEAKEY, National Museums of Kenya, Nairobi.

Excavations at the R114 site on Rusinga Island, Kenya in 1984 showed that the

agglomerate pipe in which the Proconsul africanus skeleton KNM-RU 2036 was found was not exhausted by earlier workers. It is almost vertical, is about 1m in diameter and is at least 3m in depth. It lies in barren country rock of the Hiwegi Formation. It was probably formed by the infilling of a vertical hole left after a large tree trunk rotted away. Some missing parts of the Proconsul skeleton were recovered, including the left maxilla, a cuboid and some bones of the right hand.

Prospecting at site R5 at Kaswanga, Rusinga Island led to the recovery of parts of 5 P.africanus individuals. There are 2 adults, a subadult, an infant and a very small infant. Most of the bones were eroding out on the surface, but the bones of 2 adult feet, part of one adult hand and an infant lower leg and foot were still articulated in situ. Nearly all parts of the skeleton are represented in one or another of the individuals, but skull, vertebral and rib parts are few as yet. All wrist and ankle elements are now known, most several times over. Even if further parts of these individuals are not found when excavations resume, the new fossils add substantially to our knowledge of these Early Miocene hominoids. Since the individual age span is from early infancy to adulthood, they also will allow us to look in some detail at growth and development in P.africanus.

This expedition was supported by NSF grant BNS 8317849 and the National Museums of Kenya.

The causes of porotic hyperostosis in the American southwest and southern California. P.L. WALKER, University of California, Santa Barbara.

Iron-deficiency anemia caused by over-reliance on maize is often suggested as the main factor responsible for the prevalence of porotic hyperostosis in southwestern Indians. Analysis of the distribution of porotic hyperostosis in southwestern sites as well as recent work on human skeletal remains from non-agricultural areas of California indicate that culinary practices and local environmental variables leading to high incidence of diarrheal disease in children are probably just as significant as dietary deficiencies in the etiology of this pathology.

Among corn dependent southwestern Indians, porotic hyperostosis appears to be most common in sedentary, densely aggregated local populations. Under such conditions, contamination of food and water and frequent person-to-person contacts are likely to have led to a high incidence of weanling diarrhea and anemia. In the Santa Barbara Channel area of southern California, porotic hyperostosis is just as common among the Indians of the northern Channel Islands whose diet was composed mainly of fish and other iron-rich marine resources as it is among maize dependent puebloan groups. Among the Indians of the California mainland, whose diet contained a larger proportion of iron-deficient plant foods, porotic hyperostosis is comparatively rare. This lack of correlation between porotic hyperostosis and iron intake in the Santa Barbara Channel area appears to

be explained by island-mainland contrasts in exposure to infectious disease, as well as differences in the overall nutritional quality of the diet.

Developmental dimorphisms and primate evolution: Ontogeny of sex differences and sex differences in ontogeny. E.S. Watts, Tulane University.

Adult sexual dimorphism in skeletal size has been attributed to sex differences in both the rate and the duration of growth. Studies of human growth show that both factors play a role in adult stature dimorphism. However, reports on nonhuman primate growth disagree on the relative importance of rate versus time dimorphism in the ontogeny of adult size differences between the sexes. Longitudinal data on growth and epiphyseal union in chimpanzees (Pan troglodytes) and rhesus monkeys (Macaca mulatta) were analyzed and compared to published work on human children in order to investigate the nature and magnitude of sex differences in skeletal growth and development and their relationship to adult dimorphism.

The sex difference in timing of maturation and length of the growth period is similar in all three species considered, despite widely differing amounts of dimorphism in adult size. The degree of linear size dimorphism appears to be unrelated to timing of the adolescent growth spurt or epiphyseal union. Natural selection for larger males seems to have operated primarily through modification of sex-specific growth rates. At the same time sexual dimorphism in the tempo of maturation appears to have been conserved, indicating that it may be the target of a different set of selective factors from those operating on size dimorphism.

The first three years of growth of African green monkeys fed different dietary fats. D. S. Weaver, Wake Forest University

As part of a project to evaluate the effects on serum lipid levels, endocrine condition, and physical growth and development of different polyunsaturated fat ratios in their diet, 99 African green monkeys fed the experimental diets were followed for 12 growth measures, 3 fatfold measures, and wrist maturation. The diets were fed to the mothers before conception, throughout gestation, and to the infants through lactation and development. The polyunsaturated to saturated fat ratios of the two diets were 2.2:1 and .34:1, respectively.

Sex differences were observed for the growth measures at birth and throughout the first three years. Within each sex, males fed the unsaturated fat diet were larger at a given age, while females fed the saturated fat diet were larger.

Males were larger than females at all ages, and showed higher growth rates.

This research supported by a grant from R. J. Reynolds Industries.

How old are the 'major races'? K.M. WEISS, University of Texas, Houston.

There have been many attempts to use gene frequencies to reconstruct the ancestry of the 'major races'. Phylogenetic trees have been built to show evolutionary relationships among Negroids, Caucasoids, and Mongoloids and to estimate their time since separation; it has been concluded that these groups arose from a common central stock about 100,000 yrs ago. The model on which this is based, however, depends on assumptions concerning migration, and implies the expansion of the source population throughout the Old World at the expense of local inhabitants. Here, the case for a greater ancestry for human macrodifferentiation is presented, including paleontological, cultural, and behavioral arguments against mass migration and favoring more stable change, based on substantial interdemographic gene flow by mate exchange. Problems with genetic distance treatments of human races are identified, in particular the nature of the samples used, the assumptions needed to estimate separation times, and the discrete subdivision of a more continuous reality. The effects of post-agricultural mass migration pose serious problems for reconstructing prior population patterns and limit the use of gene frequency data to discriminate among competing hypotheses; it is not clear whether other kinds of data, such as multilocus linkage groups, mitochondrial DNA, or comparison with known expansions into new territory as in the Pacific, Australia, or the Americas can help. The question itself, however, probably needs reformulation.

The nucleic acid sequence of a dwarf lemur fetal globin gene. MARK L. WEISS, MARY ELIAS, Wayne State University, Detroit; ALEC JEFFERYS, Leicester University, England.

Recent developments in biotechnology have opened further lines for investigation of evolutionary dynamics, primate relationships and biology. Nucleic acid sequences provide exceptionally precise information for interspecific comparisons.

DNA was prepared from Cheirogaleus sp. tissue and Sau 3a partial digests prepared prior to cloning into the Bam HI site of λ L47.1. The genomic library was screened with a rabbit β -globin probe and positives were plaque purified. Using Southern blots and restriction mapping, a putative γ gene was isolated. The sequence was obtained using the M13 system.

Fetal gene status was confirmed by dot-matrix comparisons with human globin sequences. The gene contains three exons, two introns, standard exon-intron boundaries and

promoter sequences. The 5' flanking region exhibits a 16 base repeat, including the CCAAT box, found in other γ genes. This is particularly interesting as electrophoretic analysis has been unable to identify in fetal prosimians a hemoglobin differing in mobility from the adult form.

Translation into an amino acid sequence does not reveal any indications of pseudogene status. However restriction mapping indicates the presence of a putative pseudogene 3' to the fetal gene. The β -globin clusters of prosimians thus far analysed appear to be significantly shorter than those of higher primates. Prosimians appear to have diverged prior to the γ gene duplication. Their β -gene cluster is reminiscent of the rabbit in size and structure.

We wish to thank M. Goodman and E. Simons for tissue samples. This work was supported by NSF Grant No. BNS82-03777 and Wenner-Gren Foundation Grant No. 4328.

Biomechanics of the Leap of Lemur fulvus. J. P. WELLS, West Virginia School of Osteopathic Medicine, Lewisburg.

Body segment data for this study was collected from cadaver material supplied by the Duke Primate Center. Segment parameters include mass, length, location of center of mass, and moment of inertia. The moment of inertia was calculated by using a special device which allowed the segment to rotate on a platform balanced by long delicate wires. This technique provided a critical improvement in accuracy over the standard pendular approach. Films taken at 200 frames per second, were then digitized with the aid of a SAC digitizer. Segment lengths were standardized in this process by the use of radiographic films. A series of computer programs were employed to ascertain the linear velocity and acceleration, angular displacement, angular velocity and acceleration, as well as the kinetic properties of each segment for each position of film. The resulting analysis shows some most interesting findings regarding the use of the lower limb and massive trunk in producing the leap. The leap begins with accelerating and then decelerating ankle flexion with dominance of the ankle flexors. As the course of the total body center of mass changes from downward to upward the extensors become dominant and the joint opens, first decelerating and then accelerating. At the knee the relationship between observed flexion and extension and the accompanying muscle action demonstrates an almost constant role of stability for what is going on proximal and distal to the joint. The role of the massive trunk in initiating the leap is dramatic. As the leap progresses, the role of the trunk seems to be that of a segment which makes finite corrections to the total body trajectory.

Research supported by: grant from the American Osteopathic Association, Duke Primate Center, grant from West Virginia School of Osteopathic Medicine.

The development of feeding selectivity in mantled howling monkeys. J.M. WHITEHEAD, University of North Carolina, Chapel Hill.

Recent studies on the feeding ecology of primates have revealed selective feeding, often influenced by plant secondary compounds. The proximate causes of feeding selectivity in mantled howling monkeys (*Alouatta palliata*) were examined in a three-month pilot study of two mother-infant pairs in a free-ranging group in western Costa Rica. Focused on the social context in which infant monkeys ate specific plant parts for the first time, the observations provide support for two learning mechanisms as determinants of feeding patterns. First, a form of socially dependent learning, like observational learning, governs the ingestion of new and mature leaves; in contrast, feeding on fruits is governed by a learning process, like trial-and-error learning, which can function when the animal is solitary. These learning mechanisms supplement the effects of olfactory and gustatory cues to form a hierarchically organized ontogenetic process of diet selection. These feeding adaptations are responses to specific selective pressures from plants to minimize herbivory and to ensure dispersal of their seeds.

This research was supported by grants from the Organization for Tropical Studies, the National Science Foundation and the Department of Biology of the University of North Carolina.

Orange intake associated with menstrual cycle irregularities in stump-tail macaques (*Macaca arctoides*). P.L. WHITTEN, Yale University, E.O. SMITH, Emory University and R.D. MURRAY, Ohio State University.

Rank-related differences in the intake of orange halves were associated with differences in menstrual cycle irregularities in a captive group of stump-tail macaques housed at the Yerkes Regional Primate Research Center Field Station near Lawrenceville, Georgia. Citrus fruits contain high concentrations of flavones and other flavonoids which have been shown to inhibit estrogen aromatase *in vitro*. If similar processes operate *in vivo*, then an elevated intake of citrus fruits might reduce plasma estrogen levels and, thereby, affect menstrual cyclicity. Accordingly, the relation between menstrual cyclicity and daily orange intake was examined retrospectively in nine non-lactating, non-pregnant females. Estimates of daily orange intake were based on observations of the acquisition of orange halves during daily provisioning. Menstrual cycle durations were estimated from vaginal swabs collected every other day. Menstrual cycles having durations of one week, more or less, than the captive mean cycle length of 30.7 days were considered irregular. Females that consumed an average of 1-2 orange halves per day over a seven-month period had a sig-

nificantly higher percentage of irregular menstrual cycles than females that averaged less than one orange half per day. Moreover, females that had irregular cycles consumed more orange halves during the irregular periods than during periods when cycles were of more normal duration. These data suggest that priority of access to food resources can have costs as well as benefits for reproductive success, and that *ad libitum* feeding of a monotypic diet can have adverse consequences for captive primates. This research was supported by U. S. Public Health Service grants DA-02128, MH-16543 and RR-00165 (Division of Research Resources, National Institutes of Health).

Cultural and historical aspects of admixture in Black-American populations, with special reference to a biologically African Black American caste. C.W. WIENKER, University of South Florida.

Admixture estimates vary considerably for the several Black American groups which have been studied. Much of this variation is due to historical and sociocultural factors. However, many variables confound the analysis of Black American admixture.

Admixture estimates for an unique Black American population, the remnants of a pre-Civil War caste of sawmill workers, are derived from serological and reflectometry data. For this group, N_e is 52.11; the Coefficient of Breeding Isolation is below 50.

The admixture estimates are complicated by such problems as possible distortion due to genetic drift and to the operation of selection. Nevertheless, the estimates do demonstrate that this group has very little European ancestry. The anthropometric pattern of this group, when compared to data from a "typical" Black American sample, also demonstrates a relatively greater African biological heritage.

Evidence of pre-contact tuberculosis in two Woodland skeletal populations from the Northern Plains. J.A. WILLIAMS, University of North Dakota, Grand Forks.

The question of pre-contact tuberculosis in North America still remains unanswered. Evidence strongly supports the presence of tuberculosis in prehistoric agricultural societies. Buikstra (1981) advocates the position that tuberculosis could not have been maintained in nomadic hunter/gatherer societies where conditions would not be conducive to the spread and maintenance of the disease. Evidences for tuberculosis that predate sedentary horticulture are generally dismissed as the result of other infections such as blastomycosis.

Two individuals from two different Woodland populations in North Dakota provide evidence for skeletal tuberculosis well before a settled

horticulture existence. The first was recovered from the Jamestown Mound Site (32SN22), Jamestown, North Dakota. This adult female of 35-45 years displays a massive necrotic lesion of the left innominate and left femoral head. The morphology of this lesion is consistent with skeletal tuberculosis, probably of a traumatic origin. The second individual was recovered from the Arvilla site (32GF1), Arvilla, North Dakota. This individual, a 12 year old child, displays a classic case of Pott's disease, spinal tuberculosis. The vertebral bodies of T4 through T11 display necrotic destruction, as well as ankylosis and kyphosis.

A radiocarbon date obtained from the Jamestown Mound site has yielded a corrected age of A.D. 920. The Arvilla site has no radiocarbon age but is conservatively placed in the time frame of A.D. 600-900. Because both sites are Woodland and antedate settled horticulture in this region by some centuries a bison focus is proposed as an explanation for the presence of these two tubercular lesions.

Variation in the suboccipital anatomy of the orang-utan. L.A. WINKLER, University of Pittsburgh, Titusville.

The suboccipital anatomy of the orang-utan exhibits greater variation than has been recognized. Previous descriptions (Sakka, 1973; Sonntag, 1924) differ in regard to the size and morphology of the musculature. Since each description derives from a single dissection, the difference in the accounts could be a consequence of normal variation in musculature patterns.

This research is based on the dissection of the suboccipital region of several orang-utan specimens of both sexes in a variety of age categories, fetal through adult. Innervation and arterial patterns appear to be fairly constant. However, there is considerable variability in the size, morphology, and relationships among the suboccipital musculature. The degree of obliteration of the suboccipital triangle varies with the size and subsequent overlap of rectus capitis posterior major, obliquus capitis superior, and obliquus capitis inferior. The triangle appears better demarcated in younger specimens where the musculature is less well developed. In addition, in the immature specimens, rectus capitis posterior major possesses two distinct components. However, adult specimens possess a single head which appears to result from the fusion of the two separate components during functionally related muscle growth. It appears that variation in the suboccipital musculature can be tentatively correlated with age and the degree of craniofacial development and prognathism.

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Proximal femoral cortical bone involution in two populations from Chirikof Island. J.D. WISSINX, Indiana University, Bloomington.

In this study, we have used changes in cortical bone thickness with age as a means of comparing two Chirikof Island populations. The technique employed utilized anterior-posterior and medial-lateral radiographs of the proximal half of the femur. From these, bone thickness measurements were made below the greater trochanter for both orientations. Additional measurements were made at the midshaft for comparison with direct measurements taken on samples for histological study. A total of 48 adult males and 40 adult females were examined, representing both populations over a broad range of ages (20 - 55+).

Our results lend support to the hypothesis that the skeletal material corresponds to that of two distinct breeding populations. The difference between the two series was especially pronounced for the male samples, not only in the average cortical bone thicknesses measured, but in the variability of the data. A comparison of involution patterns by age also suggests that significant differences exist between the two groups.

Molting in the freeranging rhesus macaques of Silver Springs, Florida. L.D. WOLFE, University of Florida, Gainesville.

Beginning at the age of 1 year, rhesus macaques experience a yearly molt. For the freeranging rhesus monkeys of Silver Springs, Florida, the monkeys involved in this set of observations, molt occurs in the spring and summer months. Adult males and nonpregnant adult females are first to molt and they are followed by the juveniles. Last to molt are the females with newborn infants. Molting begins on the top of the head, spreads down the back in a straight line and finally moves to the sides of the back and the limbs. Both photoperiods and hormones have been suggested as the causal agents of molting in mammals. In that molting begins at the end of the breeding season for adult males and is delayed in pregnant females, it would seem to be under hormonal control. Moreover, older, less sexually active males molt before younger, more sexually active males. However, molting also occurs during the spring and summer months which suggests some photoperiod involvement. This poster will show monkeys in various stages of molting and discuss the hormonal implication.

Variability: the paradox of paleoanthropology. M.H. WOLPOFF, University of Michigan.

Paleoanthropology is often the study of boundaries or divisions. The critical questions of how many species are present, whether some line or other has been crossed or a grade achieved, or whether some feature is

apomorphic enough to show that this couldn't have evolved into that, have done more to raise blood pressures than a typical Sydney traffic jam. These are all questions about morphological variation, and addressing them in any manner rests on the assumption that features vary enough, or vary consistently enough, to allow the divisions in question to be made in the first place.

Two large samples of fossil hominids from opposite ends of the earth, limited in space and time, will provide the basis for examining the normal variation in several features that have been used to delineate boundaries or divisions widely regarded as important in the interpretation of human evolution. These are the Krapina Neandertals and the terminal Pleistocene Australian Aborigines from Coobool Crossing. Variation in seemingly important characteristics is found to be ubiquitous within these samples. The ominous implications of widespread variation should be obvious to all, but, of course, they are not or there would be no need to present this paper.

Demographic inferences from retrospective data on completed fertility. J.W. Wood, University of Michigan, Ann Arbor.

The prospective data needed to estimate standard age-specific fertility rates are rarely available to the anthropologist. It is possible, however, to make limited but still useful inferences about the reproductive process from retrospective data on the number of offspring ever born to women currently of post-reproductive age. In particular, total fertility rates, parity progression ratios and secondary sex ratios can all be estimated from such data, given certain assumptions about the stationarity of the study population. In this paper, probability densities for these indices are derived under several versions of a model of parity-specific fertility, each version associated with a different birth process (Poisson, negative binomial or geometric). Application to data from Melanesia, Africa and Latin America illustrates the usefulness of this approach for investigating (among other things) the extent of intra-population variation in female fertility, the prevalence of pathological sterility, and the differences between natural and controlled fertility.

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What do monogamous primates have in common? P. C. WRIGHT, Duke University Primate Center, Durham, N. C.

Comparison is made between the 20 species of primates generally considered to be monogamous in order to determine the ecological correlates of this social organization. Monogamous primates range in body size from 100 g to 14 kg. They vary in diet from insectivorous to folivorous to frugivorous. Monogamous primates have a group size that always is small, consist-

ing of an adult pair and offspring. All are territorial and defend territories by loud duets and border skirmishes in which males fight males and females fight females.

Monogamous primates show yet another similarity in the size and distribution of resources in space and throughout the annual cycle. Resources that provide the bulk of the diet are small and occur in uniformly dispersed small patches which cannot accommodate large groups. Females cannot afford to tolerate other reproducing females because there will not be enough food for her and her offspring. Exclusion of other small groups from these limited resources leads to selection for pronounced territoriality. Similarly, the absence of the advantages of sociality, such as predator detection and defense, and aunting behavior, leads to the necessity for male aid. Clearly, monogamy does not just involve a mating system, but numerous aspects of social organization and behavior as well. This system, with all of its inter-related components, has convergently evolved as a unit in prosimians, platyrrhines, and apes. Models of early hominid social organization that invoke monogamy as a mating system do not distinguish the obvious differences between early hominids and monogamous nonhuman primates in other features of the system such as the size of the group and the resource base.

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The concept of social selection and its application to a subdivided population. SHOZO YOKOYAMA, Washington University, St. Louis.

Social selection consists of two fitness components: an intrinsic deleterious effect of a disease that is applicable only to an affected individual and a fitness modification of both affected and normal individuals due to social and cultural reactions to an affected relative. Using models of social selection, the primary interest is in the effect of social behaviors on the incidence of a genetic trait. Social selection theory assumes that these social behaviors exist in human populations but does not address whether or not they are themselves social or genetic.

A social selection model is constructed by assuming that the fitness of an individual is determined by his own as well as his parent's phenotypes and that there is migration such that the number of migrants (M) from the i -th subpopulation is equally divided among all subpopulations including i itself. Under these assumptions, the gene frequency change depends on the loss of fitness due to the trait (γ), to an affected parent in the i -th subpopulation (β_i), to the probability that the heterozygote develops the trait (h), and to the migration rates $m_i = M/N_i$, where N_i is the size of the i -th subpopulation. For $0 < h \leq 1$, a sufficient condition for the protection of the deleterious allele from extinction also depends upon all of these parameters. However, when $m_i \ll 1$ for all i , the condition is given

by $\beta_i < -\gamma/(1-\gamma)$ for some i , whereas when $m_i \gg h\{\gamma + \beta_i(1-\gamma)\}$ for all i it is given by $\Sigma c_i \beta_i < -\gamma/(1-\gamma)$, where $c_i = N_i/EN_i$. Finally, when $h = 0$, the sufficient condition is also given by $\Sigma c_i \beta_i < -\gamma/(1-\gamma)$.

Deterministic and stochastic analyses of this model will be presented with specific reference to known human genetic disorders such as albinism among American Indians in the southwestern United States.

Three Dimensional Anthropometry for Design and Anatomical Reconstruction. J.W. YOUNG, Civil Aeromedical Institute, Oklahoma City.

Three-dimensional anthropometry provides the research physical anthropologist with unique and realistic anatomical descriptions for design and model reconstruction in biomechanical and forensic applications. Techniques that generate these data include stereophotogrammetry, manual three-dimensional anthropometry and geometric analysis of multiple-view X-rays and CAT scans. Current applications of these data include (1) size-range modeling of anatomical segments in the development of human surrogate test devices for safety research and (2) reconstruction of skeletal structures for modeling standards, forensic study and medico-legal evidence. This paper reviews the specific techniques and applications of three-dimensional data used to develop a pelvic model sizing system and for the reconstruction of infant and adult skulls.

An anthropometric evaluation of commercially available crash test dummies. G.F. ZEHNER, Anthropology Research Project, Yellow Springs, Ohio.

The need for accurately testing the effects of impact on the human body has led to the development of sophisticated human analogues. These devices represent an engineering approach to the human skeleton and do not replicate human structure. In addition, the dummies are marketed as representing a specific position (i.e., 5th, 50th, or 95th percentile) in the human body size distribution. Measurements describing the body size, joint ranges, segmental centers of gravity, principal moments and axes of inertia of the dummies are presented in this paper. These values are compared with existing data on humans in order to examine their validity as human surrogates. The results show that, for many variables, the current dummies are not realistic representations of the human form.

The Role of Adrenal Androgens in the Growth of Adolescent Males. B.S. Zemel and S.H. Katz, Department of Anthropology, University of Pennsylvania

It is well known that androgens promote the growth of soft and hard tissues, and

this accounts for most of the changes that occur during adolescence, particularly in males. Androgens are produced by both the adrenal gland and the gonads, but the maturation of these organs is apparently independent. Adrenarche, the maturation of the adrenal gland, occurs in mid-childhood, long before gonadal maturation and the production of gonadal androgens. However, the contribution of adrenal androgens to adolescent growth has not been investigated previously. This paper provides evidence supporting the hypothesis that adrenal androgen production, as indicated by the hormone, dehydroepiandrosterone sulphate (DS), significantly explains variation in height velocities of adolescent males, in addition to and in combination with the effects of testosterone (T). A stepwise multiple regression model was used to determine prospectively the effects of DS and T concentrations on height velocities measured over the following year, in a sample of 188 urban black adolescent males, ages 12-16 years. The results indicate that in younger adolescents, ages 12-13, DS significantly contributes to variation in height velocity ($p < .05$) after T entered the model, and together these variables explained 27-40% of the variation in height velocity at these ages. An interaction term, computed as the cross-product of DS and T, was permitted to enter the model, and at ages 12-14, & 16, this term significantly accounted for 15-40% of the variation in height velocity. These results suggest that differences in the expression of these two maturational processes may be a fundamental source of variation in adolescent growth.

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Body Composition, Menstrual History, and Intensity of Training in Female Runners. D.C. ZIAC, E.C. FISHER, and M. NELSON, State University of New York-Albany, Human Nutrition Research Center at Tufts University, Boston.

Athletic training may affect the menstrual cycle. Female athletes may become oligomenorrheic or amenorrheic. Due to lowered estrogen, they may experience premature onset of osteoporosis. Since fat deposits are extra-gonadal sources of estrogen, one would expect amenorrheic athletes to be leaner and have less bone density than menstruating athletes.

Seventeen white female runners aged 19 to 35 years were studied. They ran at least 20 miles per week and were not pregnant or lactating. Height ranged from 156 to 181 cm and weight from 49.1 to 64.0 kg. Body composition was estimated by hydrostatic weighing and skinfold (triceps, thigh, suprailiac) measurements. Personal, menstrual, and activity histories were obtained through a questionnaire included

as part of a larger study which tested hormone levels, bone mineral content, VO_2 max, and calcium.

When amenorrheic runners were compared to menstruating runners, there were no statistical differences in percent body fat, age, height, menarche, mileage, or pace. There were statistical differences in weight and occupation (60% of amenorrheic runners were students). These results were contrary to those expected. In this population of female runners, amenorrhea was associated with low weight and a particular occupation. Perhaps the sample is too small for the difference in percent body fat to be significant. The observation concerning occupation is curious. The conditions of student life may contribute to stress resulting in amenorrhea.

Sex and the Single Species. A. L. ZIHLMAN, University of California, Santa Cruz.

The Hadar and Laetoli hominid fossils dated between 2.8 and 3.5 mya

have been proposed as belonging to one species, Australopithecus afarensis, supposedly more primitive and sufficiently distinct from other hominid fossils to warrant a new and distinct species ancestral to all subsequent hominids.

Sexual dimorphism has been used to account for the extreme variation in size of the joint surfaces and robusticity of the limb bones in these fossils. The existence of one highly dimorphic species at 3 my is challenged on the basis of: a) recent evidence from molecular data which show a closer relationship between chimpanzees and humans, with gorillas as the outgroup; and b) information on the extent and patterns of sexual dimorphism in living apes.

The possible existence of two species, rather than one, means that the whole issue of sexual dimorphism among early hominids must be re-examined. Furthermore, the scenario of early hominid behavior which argues for male provisioning, reduced mobility of females, and monogamy must be replaced with models which fit more parsimoniously with the two species hypothesis and other available evidence.