Faunivorous and insectivorous mammals eat an extensive array of food items that vary substantially in their physical properties and offer different foraging challenges. Therefore, it is not surprising there are equally diverse adaptations for feeding on them including two morphological extremes. Small-bodied primate, bat, insectivoran, and marsupial insectivores tend to hunt and feed primarily on individual coleopterans, lepidopterans, and orthopterans. Morphologically they have elongate shearing crests and high dental complexity values relative to frugivores. On the other extreme are the myrmecophagous mammals from many mammalian orders that have evolved to prey upon on colonial insects (hymenopterans). These animals have convergently evolved reduced dentitions and dentaries.

Although extant great apes and humans consume insects and related prey, they do not demonstrate either of these typical faunivorous morphotypes. Given this, conventional analyses of dental morphology or jaw mechanics based on the comparative method will not work for dietary reconstruction of fossil hominins. An alternative is explored here. Dental microwear data suggest that small-bodied faunivorous mammals (include primates, insectivorans, and bats) tend to have greater feature densities than either frugivorous or folivorous primates. Dental microwear analyses on the only myrmecophagous mammals that have retained both teeth and enamel, the aardwolf and sloth bear, suggest that these foods are not masticated sufficiently to cause distinctive microwear features. These data on a diversity of modern mammals indicate that it may be possible to detect only certain forms of insectivory in early hominins based on dental microwear.

Correlates of early reproduction in the Dogon of Mali.

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Great progress has been made in applying life history theory to a wide range of problems in human biology, yet fundamental questions remain about the causes of intra- and inter-populational variation in such life history parameters as age at menarche and first birth. To identify the predictors of early maturation and reproduction in the Dogon of Mali, I use data from a prospective cohort study of 1700 children, most of whom were enrolled in infancy and who are now ages 12 to 19 years. My focus will be on the 600 surviving girls in this data set and will include comparisons of girls who migrated to the city versus girls who remained in rural villages, as well as comparisons of the Dogon to other small scale societies. The median age at menarche in the Dogon data set is 16.89 (95% CI: 16.48 to 17.30) years and the median age at first birth is 19 years. I will discuss pathways through which energetic factors are inextricably tied to immune challenges, mortality schedules, and family structure variables, making it difficult to tease apart energetic and non-energetic influences on life history strategies.

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Social states, behavioral flexibility and social evolution.

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A constant theme in the study of social systems is how best to characterize sociality. Traditional paradigms use group size, numbers of adults of each sex, age distributions and kinship. Layered on these key "traits" is the persistence or stability of group membership and the nature of inter-group interactions. We use a dynamic 3-D model to describe dimensions of within-group cohesion over time and space, and apply this model to two contexts. The first examines groups at the extremes of their species' size ranges (e.g., squirrel monkeys, howler monkeys, colobus, mandrills), and the second examines known groups that have undergone marked changes in size and structure over time (e.g., lemurs, muriquis, baboons, macaques, langurs, mountain gorillas, chimpanzees). Using these and other examples, we identify constraints on social evolution due to female reproductive rates and kinship structures, and model outcomes in terms of social flexibility and adaptive potential.

Identification of dietary niche overlap in the primate fossil record using an extant competitive guild.

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Establishing the competitive environments surrounding the evolutionary origins of primate groups is contingent on accurately identifying dietary competition between fossil primates and their mammalian contemporaries. This requires the reconstruction of dietary niche overlap among extinct species using associations between dental morphology and dietary regimes in related extant taxa. These associations must hold across primates and their likely dietary competitors ("primate competitive guild") to directly compare species' niches. Competition is expected to occur within broad dietary categories (e.g., insectivory), but in studies of diet-dentition relationships across primate competitive guilds, more restricted dietary classifications have rarely been employed. This study's objective was to determine whether molar morphological variables are associated with specific dietary niches within an extant primate competitive guild.

Three-dimensional measurements of molar form were obtained from 73 species (Primates, Chiroptera, Marsupialia, Rodentia) from a s ingle locality (Balta, Peru). Dietary categories were subdivided to create "operational dietary units" (ODUs), and species were assigned to ODUs based on a series of parameters, arranged hierarchically: primary dietary component, relative proportions of food resources, specific dietary items, and canopy foraging level. Principal components analysis was used to demonstrate separation of ODUs, and canonical discriminant analysis was performed to identify the measures that maximized variation among ODUs. Results indicated that ODUs were differentiable within dietary categories by cusp sharpness, crest length, basin depth, and cusp height (first two principal components explained ~85% of the variation in the sample). These results provide an initial step towards refining reconstructions of dietary competition in the primate fossil record.

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The primary orientation of trabecular bone in the hominoid tibiotalar joint.

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The primary orientation of trabecular bone (Tb) has been demonstrated empirically *in vivo* to develop in alignment with the direction of applied habitual load. This study tested the hypothesis that Tb morphology and orientation in skeletal ankle bones differs among hominoids in ways consistent with presumed differences in the habitual loads across the joint during life. The shape and primary orientation of Tb underlying the joint surfaces was digitally quantified in 9 s ubregions from micro-CT images of the distal tibia and talus (astragalus) of *Homo, Pan, Gorilla, Pongo,* and *Papio*. In both the distal tibia and talus, humans were found to have relatively greater Tb anisotropy and displayed overall more elongated Tb than the non-human hominoids, consistent with stereotypically predictable, sagittal-plane locomotion. In contrast, orangutans had overall more isotropic, less elongated Tb in the talus than the other species, and there were no significant differences found in Tb shape among regions, both results consistent with habitual loads that are more evenly distributed throughout the bone. The primary orientation of Tb was significantly different between humans and the non-human hominoids in the posterolateral and anteromedial regions of the talus, although not in the distal tibia. This study furthers understanding of the functional morphology of trabecular bone and its potential in inferring locomotor mode in isolated skeletal specimens.

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3D biomechanical simulation of a fossilization process of a bony structure: new perspectives for the retrodeformation of paleo-anthropological fossils.

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One of the main difficulties in studying unearthed human fossils is that they have often undergone plastic deformation due to the slow movement of the surrounding geological layers, the increasing compression of the sediments that piled-up onto them, and more generally the diagenetic phenomena.

To investigate this issue, we designed a test-bed to simulate a fossilization process leading to a plastic deformation. We took a bony structure, plunged it into an acid liquid and applied a controlled mechanical load by using a calibrated weight. The bony structure then deformed plastically and 3D data are acquired regularly by using a surface laser-scanner or a volume CT scanner. This results in a time-series of 3D data representing the shape of the bony structure at different states of deformation.

3D image processing algorithms were applied to segment the external surface of the "fossil" in each 3D data of the time-series and to find automatically the point correspondences between the successive 3D surfaces. The resulting 3D displacement fields characterize the plastic deformation due to the "fossilization" process.

We used the SOFA software to build a mechanical model of the bony structure. This software proposes also several algorithms for describing various sets of constraints (pressure constraints, unilateral constraints, etc.) and it is particularly adapted for rapidly testing combinations of methods. By fitting the models of the structure and of the constraints to the observed 3D displacement field, we inferred some biomechanical laws which characterize a plastic fossilization process

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Trabecular bone structure in the forelimb and hindlimb of quadrupedal primates and carnivores.

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Primate quadrupeds differ from most other mammals in having higher peak reaction forces on the hindlimb compared to the forelimb. Recent analyses indicate that primates in general have more robust trabecular architecture in the femur than in the humerus, independent of locomotor behavioral differences. These results support locomotor analyses indicating hindlimb dominance in primates, perhaps to allow the development of greater forelimb manipulatory abilities. Differential limb usage in non-primate quadrupedal species often reflects the opposite pattern of forelimb and hindlimb loading. The goal of this study is to explore the adaptive response of trabecular architecture in two contrasting loading environments, represented by primates and carnivorans. High-resolution computed tomography scan data were collected for the proximal femur and humerus of 20 individuals from three carnivoran species, and 30 individuals from four primate species. Bone volume fraction, anisotropy, trabecular thickness, spacing and number were quantified in multiple volumes of interest within the articular region of each specimen. Despite significant differences in the kinematics of locomotion among the taxa analyzed, all species exhibit the same pattern of forelimb to hindlimb trabecular bone structural organization. Bone volume fraction is significantly higher in the femoral head than in the humeral head in all taxa, independent of locomotor behavior or taxonomic group. Humeral head trabecular bone is significantly more isotropic. These results suggest that individual measures of trabecular bone do not appear to reflect locomotor behavioral differences, and potentially indicate a canalization of femoral and humeral trabecular bone architecture across quadrupedal mammals.

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Bone microstructural features combined with synchrotron radiation x-ray fluorescence spatial maps of lead and strontium in historical bone samples from Antigua suggests biogenic uptake.

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A promising method to discern the diagenetic from biogenic origin of trace elements in archaeological bone is to identify the spatial distribution of the elements with synchrotron radiation x-ray fluorescence (SR-XRF) and match the spatial maps with histological features of the bone. We have successfully used this approach on cortical fragments associated with a nonsegregated Royal British Naval cemetery population (1793-1822) located in Antigua, West Indies. It has been suggested that during the early 19th century, members of the Royal British Navy were impacted by lead poisoning. We therefore hypothesized that evidence of biogenic lead uptake would be present in skeletons from this historical context but would be absent from precontact samples from the island. Secondarily, we explored the distribution of strontium within these groups hypothesizing that the more mobile historical population would exhibit a more heterogeneous distribution of this element. This preliminary study (n=4 historical, n=1 precontact) revealed evidence of the biogenic uptake of lead in the historical Antiguan samples, whereas the precontact sample was negative for lead. Both the historical and precontact samples exhibited heterogeneous distributions of strontium. This pattern suggests that pre-contact and post-contact diets consisted of food and water containing strontium and that these levels varied. While the use of SR-XRF is not novel, the successful application of this technique where trace element spatial distributions are mapped to discreet bone features holds new promise for the area of trace element research.

Comparison between Von Luschan tiles and spectrophotometry in human skin color variation.

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Prior to the introduction of skin reflectometry in the 1950's, human skin color was classified by a matching method using Von Luschan tiles. Unexposed skin was compared against 36 standardized, opaque glass tiles arranged in a chromatic scale. Our goal was to establish quantitative correlations between tile-based color-matching and reflectometry methods in order to make historical data accessible. Skin pigmentation measurements were taken at three locations (forehead, upper inner arms, and backs of the hands) using the tiles and narrow- and broad-band spectrophotometers in volunteers of a range of skin pigmentations in State College, Pennsylvania and Atlanta, Georgia. Only 50% of the tiles were used by the observers because some were of shades deemed unrealistic and others were difficult to distinguish from one another. Regression analysis indicated a moderate correlation between the tiles and melanin index (M) measured by spectrophotometry (R^2= 0.66, p = 0.004). Volunteers self-identified their racial designation and ethnicity. The M values for each affiliation had distinct ranges, but also showed significant overlap. These data provided a range of M values for the tiles utilized and, more specifically, for the most commonly used and less problematic tile colors, and can later be used to approximate the M in historical studies.

The results of this study make possible comparison of historical, tile-based data with those collected using reflectometry. This is particularly important for populations now extinct, extirpated, or increasingly admixed for which tile-based data on skin pigmentation are the only type available.

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GRF moment arms about the knee in A.L. 288-1.

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Although it is generally agreed that australopiths were bipeds, some researchers project bipedal modernity into the early hominin fossil record, while others argue that australopiths utilized a 'bent-hip, bent-knee' form of bipedalism. Here we model potential midstance positions using human and chimpanzee kinematics as boundary conditions and combine those with human and chimpanzee body segment parameters to calculate the ground reaction force (GRF) moment arms about the