Center for Academic Research & Training in Anthropogeny (CARTA)

"The Evolution of Human Nutrition"

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Chairs:

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ABSTRACTS

Background and Overview

Leslie C. Aiello, Wenner-Gren Foundation

The evolution of human nutrition has gained general prominence in recent years through the popularity of the "paleolithic" diet, popularly referred to as the paleodiet, caveman diet, or Stone Age diet. Interest in the paleodiet is largely a response to the epidemic of diseases such as obesity, type-2 diabetes, cardiovascular disease and high blood pressure (among many others) that plague modern civilization. The basic premise is that by returning to the diet of our pre-agriculture, paleolithic ancestors we will achieve better health and well-being. Paleolithic is sometimes taken to include the entire span of the Pleistocene extending back over 2 million years and at other times to include only the Upper Palaeolithic and our pre-agriculture modern human ancestors (e.g. ~40,000 – 50,000 years ago). The common denominator is the exclusion of dietary items such as legumes, grains, and dairy products introduced during the agricultural revolution as well as processed foods of the modern era. However, pre-agriculture human diets were never uniform and dietary shifts have been associated with the major evolutionary events in human prehistory. These include the first appearance of the genus Homo, the subsequent appearance of Homo erectus and the movement out of Africa. Diet has been associated with the evolution of the large human brain as well as the evolution of human cooperation, division of labor, and life-history variation. The point is that the paleodiet is not a uniform diet. The major purpose of this background and overview (as well as of the larger symposium) is to highlight the evolution of human nutrition from our earliest ancestors to the modern day and to draw attention to the diversity in the human diet and its consequences.

Diets and Microbes in Primates

Steven Leigh, University of Colorado, Boulder

Human microbiomes, or communities consisting of the microorganisms that live in, on, and around us, have profound effects on health, disease, and normal host function. The intestinal microbiome is an especially important "partner" in dietary adaptations, functioning to convert foods and food components that are otherwise inaccessible into useful nutrition to the benefit of the host organism. Our project explores the nature of the primate microbiome with the goal of understanding the impacts of microbiomes on human evolution. Taxonomic comparative analyses of intestinal microbiomes (mainly bacterial microbes) using high throughput sequencing of ribosomal DNA (16S rDNA) enable identification of microbial taxa residing in the primate gut, permitting us to explore ties between microbial communities and diet. Moreover, we conduct analyses of functional microbial genes to determine how microbes contribute to dietary adaptations. While the taxonomic composition of the primate intestinal microbiome is similar across primate species, the relative proportions of microbial taxa vary according to the host's diet, phylogenetic history, and environmental quality. Functional data show that nonhuman primate microbial taxa play larger roles in protein metabolism than do microbes residing in the human gut. In general, our results point to important contributions of microbial ecosystems to the evolution of human diet. We also see implications for human brain evolution through energy and micronutrients that are produced by microbial taxa.

Current Hunter-Gatherer Diets

Alyssa Crittenden, University of Nevada, Las Vegas

The diet composition of hunter-gatherer populations continues to be implicated in the reconstruction of dietary models and social behavior of early members of the genus *Homo*. Diet has been linked to the evolution of the enlarging hominin brain, the sexual division of labor, routine food sharing, cooperative breeding, and family formation. Despite this significance, few quantitative studies are available; the cross-cultural data used for many of the reconstructions remains anecdotal and was not collected systematically across populations. Here, I report data on the diet composition and foraging profiles of the Hadza hunter-gatherers of Tanzania. Hadza plant foods were analyzed to determine the energy values (kilocalories), content of fat (lipid), crude protein (CP), free simple sugars (FSS), fiber (neutral-detergent fiber - NDF), total non-structural carbohydrates (TNC), and ash. The significance of meat, tubers, and honey is addressed and the role that these food items play in evolutionary models is explored.

Australopith Diets

Peter Ungar, University of Arkansas

Robert Atkins wrote in *The New Diet Revolution* of our ancestors "eating the fish and animals that scampered and swam around him, and the fruits and vegetables and berries that grew nearby." This makes intuitive sense, but where's the evidence? This presentation considers the fossils themselves and what they can teach us about the diets of our early hominin forebears. It focuses on a key part of human evolution, when our ancestors and near cousins, the australopiths, began to descend from the trees. By about four million years ago, *Australopithecus* had evolved thicker, flatter, relatively larger teeth than their predecessors, suggesting a change in diet from soft foods, like forest fruits, to harder or tougher ones, like nuts or leaves. Then, about 2.5 million years ago, as forest began to give way to savanna, there was a fork in the evolutionary road. One direction led to *Paranthropus*, our near-cousins, with even more specialized teeth and jaws. The other led to the earliest members of our own biological genus, *Homo*, and a reversal of this trend. Evidence from tooth chemistry and microscopic wear suggests that some species had increasingly specialized diets, but others, including those of early *Homo*, ate a broader variety of foods.

Fire, Starch, Meat, and Honey

Richard Wrangham, Harvard University

Unlike all other free-living animals, human populations need to eat much of their food cooked. When and why this evolutionary commitment to the control of fire began is a fascinating evolutionary puzzle. We now know that cooking causes starch and meat to provide much extra energy; that cooked food saves so much eating time that it makes dedicated hunting possible; and that honey-eating by African hunter-gatherers offers a remarkable clue that the control of fire is an ancient habit. From an evolutionary perspective, the special feature of the human diet is not so much its ingredients, as how we prepare them.

Neanderthal Diets

Alison S. Brooks, George Washington University, Smithsonian Institution
Margaret J. Schoeninger, University of California, San Diego

Neanderthals present an enigma for which there is no consensus about their cognitive and behavioral capacities compared to those of anatomically modern humans. With regards to nutrition, Neanderthals are commonly presented as top carnivores based largely on analyses of the organic fraction of their bones. Here we consider their wide geographical and temporal range, which stretched from the Levant to northern Europe, and eastward to Iraq in both glacial and interglacial periods. The resultant variation in climate and ecology produced significant variation in their plant and animal dietary options. Concomitantly, their energy requirements would also have varied in association. Recognizing these constraints, we consider the physical evidence for diet including associated floral and faunal assemblages, starch grains and plant phytoliths (plant silica bodies) recovered from Neanderthal dental plaque, tooth enamel microwear, and other archaeological data. We also re-evaluate the bone composition data using comparative data from modern human sites. We conclude that Neanderthal subsistence strategies varied with their local environments and included various combinations of plant and animal foods throughout their range. Like modern humans, Neanderthals selected foods that are relatively high in protein from both plant and animal sources.

Archaic Human Diets
Mary C. Stiner, University of Arizona

What is the legacy of the human ecological footprint in deep time, and how might this legacy relate to the evolution of human social and energy networks? At least three major transitions can be seen from the archaeological record of meat-eating. The first of these transitions of interest was the development of hominins as big game hunters by roughly 500,000 years ago, followed by diversification of the meat diet and new patterns of labor collaboration sometime between 100-50,000 years ago. At the end of the Pleistocene, between 11-10,000 years ago, we see a rather sudden substitution of a broad spectrum diet for intensive, managed use of just a few prey species. Each of these transitions came with new labor and social arrangements that extended well beyond the mechanics of hunting. The transitions also relate to major changes in environmental carrying capacity and human population densities. These changes are predicated on new ways of capturing energy and insulating the group (especially children) from variation in the supplies of high quality food.

Agriculture's Impact on Human Evolution
Clark Spencer Larsen, Ohio State University

Beginning some ten to twelve thousand years ago, fully modern *Homo sapiens* began to alter their diets in ways that would profoundly impact their lives and livelihoods on a global scale. Starting from at least ten independent centers of plant and animal domestication in Asia, South and North America, and Africa, the shift from foraging to farming laid the foundation for remarkable increase in population size and fundamental changes in health, quality of life, and workload. This presentation explores what anthropologists have learned about the alterations of the lives, lifestyles, and wellbeing from the study of bones and teeth of our recent ancestors during the one of the most dynamic periods of human evolution. Just as the process of domestication was complex and involved regional economic, social, and environmental circumstances, the impact of the foraging-to-farming transition on human biology and evolution was varied. In general, however, the outcome of this fundamental behavioral shift in how humans acquire food was decline in health owing to population crowding, reduced nutritional quality, and related factors. Collectively, this outcome was central to creating the circumstances that transformed the human biological landscape into what it is today.

Impact of Globalization on Children's Nutrition
Barry Bogin, Loughborough University

Globalization is, in part, an economic force to bring about a closer integration of national economies. Food globalization brings about nutritional transitions. The most common transition today is the shift from a diet based on locally-grown, minimally refined vegetable foods supplemented with small amounts of animal food to the 'modern diet' of globally sourced highly processed foods, rich in saturated fat, animal products, and sugar, but poor in some nutrients and low in fiber. The Maya people of Mexico and Central America are a poignant case of globalized diets. The Maya are the largest population of Native Americans, 7-8 million people, and one of the shortest in average height. Our research finds that the children of Maya migrants to the city of Merida, Mexico and to the United States also tend to be overweight. The combination of shortness and overweight comes with many risks for poor health. The case of the Maya is not isolated and many other children suffer the effects of food globalization. We must come to terms with the impact of globalization if we are to improve child health and the well-being.