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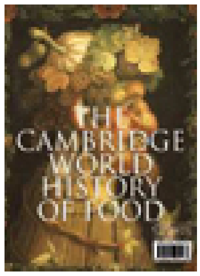

The Cambridge World History of Food

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Chapter

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I.6. History, Diet, and Hunter-Gatherers

In the years since 1960 there has been a dramatic change in our perception of the diet, nutrition, and health of "hunter-gatherers," who constitute the world's smallest, most "primitive," and presumably oldest-style societies. The Hobbesian perspective (Hobbes 1950, original 1651), which assumes that malnutrition, disease, and hardship characterize primitive life – a view that prevailed among scholars for the nineteenth and the first half of the twentieth centuries – has been challenged during recent decades by a large series of new observations and a new theoretical paradigm.

Contemporary Hunter-Gatherers

Studies of African hunter-gatherers by Richard Lee (1968, see also 1969) and James Woodburn (1968), in the influential anthology *Man the Hunter* (Lee and DeVore 1968), suggested that far from living on the

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edge of starvation, primitive hunter-gatherers frequently enjoyed not only adequate and well-balanced nutrition but also a relatively light workload.

In his analysis of the diet and workload of the !Kung San hunter-gatherers of the Kalahari Desert in southern Africa, Lee (1968, 1969) noted that the San diet consisted of an eclectic, yet selective, collection of wild foods – mostly (about 80 percent) vegetable, eaten fresh. He found that the San consumed 23 of 85 plant species that they knew to be edible in their environment and 17 of 55 edible animal species.

He calculated that for a relatively small investment of time, San hunter-gatherers obtained an adequate and well-balanced diet. By obtaining chemical analyses of their native foods and estimating the quantity of each food consumed by every individual, he was able to show that theoretically, each individual in the group received sufficient protein, vitamins, and minerals. In contrast to modern diets, what seemed the "limiting" factor – the element in the San diet most likely to be short or lacking – was the number of calories it delivered. Lee estimated the caloric intake at about 2,140 kilocalories (kcal) per person per day during a season of the year that he considered neither the richest nor the poorest.

Similarly, Woodburn (1968), although less precise, was even more sanguine in his description of the diets of the Hadza of Tanzania, who frequented a far richer environment than that of the !Kung San. He described their quest for food as leisurely and richly rewarding.

Medical observations of the San (Truswell and Hansen 1976) confirmed that they showed no signs of qualitative malnutrition, in that they had no visible deficiencies of vitamins, minerals, or protein, although they may have been showing signs of low caloric intake. (Low calorie intake has been cited by various others as responsible for stunting San growth and reducing their fertility.) Also of note was an absence of high blood pressure and elevated serum cholesterol, as well as the scarcity of heart problems. (See also Bronte-Stewart et al. 1960; Wehmeyer, Lee, and Whiting 1969; Metz, Hart, and Harpending 1971). Particularly striking were the observations on both the San and the Hadza suggesting that children did not suffer from the kinds of childhood malnutrition – kwashiorkor, marasmus, and associated weanling diarrhea – that were otherwise so common in African children (Jelliffe et al. 1962; Truswell and Hansen 1976).

At about the same time that these studies were emerging, agricultural economist Ester Boserup (1965) proposed a new model of economic growth in human history. She argued that population growth rather than technological progress had been the main stimulus for economic change. "Primitive" behavior, although usually considered to be a function of ignorance, might, she suggested, be seen as an efficient adjustment to a small population and a small social scale. So-called progress, she argued, might simply be a necessary adjustment to increasing population size, scale, and density and might be associated with declining rather than improving labor efficiency and declining rather than improving individual welfare.

Based on the work of Boserup, Woodburn, and Lee, a number of archaeologists proposed that the initial adoption of farming by prehistoric hunting and gathering groups, which occurred in various parts of the world beginning about 10,000 years ago (the "Neolithic Revolution"), might also have been a grudging response to ecological stress or population "pressure" on resources. In other words, the Neolithic Revolution might not have been the result of technological progress as had previously been assumed (Binford 1968; Flannery 1969; Cohen 1977).

One of these scholars (Cohen 1977) extended the argument by suggesting that much of what had passed for progress in prehistory might, like the adoption of farming, have been a response to the pressure of growing population, rather than the result of new inventions, since the new "progressive" techniques seemed to represent the input of extra effort for relatively little output. These "improvements" would include the adoption of diets based on small seeds and the development of grindstones to process them; the development of small projectiles for hunting small game; and the increase in shellfish consumption and concomitant development of fishing equipment during the Mesolithic or Archaic stages of prehistoric economic development. It is true that an argument could be mounted that such apparent economic trends may be distorted by problems of archaeological preservation. For example, the scarcity of shellfish remains in earlier prehistory might reflect poor preservation. However, it is difficult to defend a similar argument about the late appearance of grindstones and small projectile points.

Questions and Challenges for the New Perspectives

A number of questions remain about these new perspectives and the data upon which they were originally developed. For example, it is not clear whether the !Kung San are as well nourished and as affluent as Lee presented them (see also Sahlins 1968). Nor is it clear that the !Kung San are typical of modern hunter-gatherers in the quality of their nutrition. And finally, it is not clear that they, or *any* contemporary hunter-gatherers, lead lives that are representative of the historic and prehistoric experience of human hunters.

In the matter of the nutritional state of the !Kung San, G. Silberbauer (1981) has suggested that the groups of San he studied were nutritionally depressed and might have been lacking in B vitamins. Similarly, Edwin Wilmsen (1978) estimated that San caloric intake might fall well below 2,000 kcal per person in the poorest season. Others such as Kristen Hawkes and J. F. O'Connell (1985) and N. Blurton-Jones and P. M. Sibley (1978) have also argued that the San are not as well nourished as they have been described,

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that their caloric intake may be deficient, and that their "leisure" time may actually be an adjustment to the extreme heat and dryness of the Kalahari, which limits activity for significant portions of the year.

Moreover, Carmel Schrire (1980, 1984) and others have questioned the value of the !Kung San and other contemporary hunter-gatherers as models for prehistory, arguing that they are not remnants of an ancient way of life but, rather, modern societies formed by contemporary political and economic conditions in South Africa and elsewhere. As such, according to Schrire, their experience has little meaning for the study of prehistory.

Some New Evidence

Recent work in several fields has suggested that the broad perspectives introduced by Lee, Woodburn, and Boserup are accurate even though some details of their arguments may be open to challenge (Cohen 1989).

Such work rests, at least in part, on the assumption that despite undeniable pressures and inputs from the larger societies that surround them, contemporary hunter–gatherer societies can (with appropriate caution) be viewed as twentieth-century experiments in the hunting and gathering lifestyle. And as such they can tell us important things about patterns in prehistory even if the groups studied are not pristine remnants of that prehistory. For example, they can presumably tell us about a people's ability to extract balanced diets from wild resources with simple technology lacking any source of energy other than human power. They can tell us about the relative efficiency of different foraging techniques and extraction methods connected with hunting big game, hunting smaller animals, fishing, shellfishing, and gathering and processing various vegetable foods. They can also tell us something about the effect of small group size and mobility on the transmission of infectious disease.

A broader collection of comparative data on twentieth-century hunter–gatherer nutrition from around the world (Cohen 1989) suggests that contemporary hunter-gatherers (with the exception of those in the Arctic, where vegetable foods are scarce) seem routinely to enjoy relatively eclectic and thus well-balanced diets of fresh foods. Moreover, their typical practice of exploiting a relatively wide range of soils tends to minimize the impact of specific nutrient deficiencies (such as iodine) that are associated with particular soils. As a result, these groups are, for the most part, well nourished at least by contemporary developing-world standards; and they are conspicuously well nourished in comparison to the modern world's poor.

Where contemporary hunter-gatherers coexist with farming populations, as is now commonly the case, hunter-gatherers typically operate as specialists who trade protein, vitamins, and variety foods to farmers in exchange for calories (Williams 1974; Peterson 1978; Griffin 1984). It would appear, therefore, that hunting and gathering diets are almost always relatively nutritious in terms of variety and quality but potentially lacking in calories.

Nonetheless, caloric intake by hunter-gatherers appears sufficient when compared to modern developing-world populations. For example, San caloric intake, although considered marginal, is estimated at 2,000 to 2,100 kcal per person per day, although it falls somewhat below 2,000 kcal per person per day in poor seasons (Lee 1969; Wilmsen 1978; Tanaka 1980). Yet this compares favorably with estimated caloric intake in developing-world countries such as India and China, which *averages* only 1,800 to 2,200 kcal (Bunting 1970; Clark and Haswell 1970; Pellet 1983). Moreover, it compares very favorably with estimates for modern urban poor, who may take in as few as 1,100 to 1,500 kcal per person per day (Basta 1977).

Contemporary hunter-gatherers also receive a relatively large part of their diet from animal products. This is in the range of 20 to 40 percent of the diet, which is about the same as that estimated for affluent modern Western people but well above the modern world average. Daily animal protein intake among the San, for example, is estimated by various sources at approximately 30 to 50 grams per person per day (Lee 1968; Wilmsen 1978; Tanaka 1980; Silberbauer 1981), which far exceeds an estimated average of 7 to 10 grams of animal protein per person in modern developing-world countries and among the world's poor (Basta 1977; Peterson 1978).

It should also be noted, in response to the observation that contemporary hunter-gatherers may have low caloric intake, that they live in some of the world's poorest environments and consequently those most difficult to exploit for food. In fact, judging from the nutritional experience of other contemporary hunter-gatherers, it would appear that the !Kung San, although typical in the variety of their diets, are actually somewhat below hunter–gatherer average in their calorie and protein intake (Hawkes and O'Connell 1985; O'Connell, Hawkes, and Blurton-Jones 1988; Cohen 1989). Populations such as the Hadza of Tanzania, who live in a richer foraging area, are estimated to get 3,000 kcal and 50 to 250 grams of meat protein per person per day (O'Connell et al. 1988). Indeed, groups like the Hadza appear to be a better model for prehistory than the San because they live in the same kinds of environments as early human beings. Yet even the Hadza frequent an area now partly depleted of big game (Hawkes, O'Connell, and Blurton-Jones 1992).

Infection and Nutrition

Another important but not always apparent factor that must be considered in assessing the diets of hunter-gatherers is their comparative freedom from parasites, which affect the nutritional value of diets in a variety of ways (Scrimshaw, Taylor, and Gordon

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1968; Beisel 1982). Parasites can cause diarrhea, speeding up the flow of nutrients through the intestine, and therefore interfere with nutrient absorption from the intestine into the bloodstream. In some diseases, such as malaria or hookworm, the parasites destroy or consume human tissues (in these cases, red blood cells), which must be replaced. Other parasites, such as tapeworms, simply compete with humans for the vitamins and minerals in our digestive tract. And infection may actually cause the body to deny itself nutrients as a means of destroying the invader, as can be the case with the body withholding iron (Weinberg 1974, 1992).

Parasite load is, to a large degree, a function of habitat. Warmth and moisture generally encourage the survival and transmission of parasites, so that tropical forest hunter-gatherers such as the Pygmies of Zaire have higher parasite loads than those in drier or colder climates (Price et al. 1963; cf. Heinz 1961).

But the parasite load also tends to increase with the size and density of the human population and with permanence of human settlement, regardless of climate, since larger accumulations of filth, of people, and of stored food all facilitate parasite transmission. Diarrhea-causing organisms, for example, are typically transmitted by fecal–oral infection, in which feces contaminate food and water supplies, a problem that is relatively rare among small and mobile groups. Hookworm infection also thrives on human crowding. The worms grow from eggs deposited on the ground in human feces. They then penetrate human skin (usually the soles of feet) and find their way "back" to the intestine, where they live by consuming red blood cells while shedding a new generation of eggs. Obviously, people on the move are less likely to contaminate the soil around them.

Tapeworms, whose life cycles commonly include both people and domestic animals, are also rare in societies that keep no animals but obtain their meat by hunting wild game. Tapeworms typically are passed to domestic animals such as cows and pigs by human feces. The proximity of domestic animals as well as the density of both human and animal populations facilitates transmission.

The !Kung San avoid most such parasites (Heinz 1961). They do suffer from hookworm because even their desert habitat, mobile habits, and small groups do not entirely prohibit transmission; but they suffer only a fairly mild infestation that is not generally sufficient to promote anemia, the main danger of hookworm (see Truswell and Hansen 1976).

In short, increased parasite load diminishes the quality of nutrition, but hunter-gatherers suffer less of a nutritional loss to parasites than other societies in the same environments. The consequence is that hunter-gatherers require smaller dietary intakes than people in those other societies.

Hunting and Gathering Populations of Prehistory

Reason to believe that the hunting and gathering populations of prehistory were at least as well nourished as their contemporary counterparts can be gleaned from comparing the environments in which prehistoric hunter-gatherers chose to live and those to which their modern counterparts are confined by the pressures of competition with more powerful neighbors. Prehistoric, but biologically modern, human hunter-gatherers seem to have expanded first through relatively game-rich environments, savannas, steppes, and open forests. Occupation of the deserts and jungles in which most hunting and gathering groups now find themselves is a relatively recent phenomenon.

Hunters also seem initially to have focused on medium- to large-sized animal prey plus a relatively narrow spectrum of plant foods. Small game, seeds to grind, fish and shellfish (at least consistently and in quantity) all appear to be relatively recent additions to the human larder. The additions were made in the Mesolithic period of prehistory (Cohen 1977) and were associated with what K. V. Flannery (1973) has called the "broad spectrum revolution," which took place within, approximately, the last 15,000 years. The use of secondary habitats and the adoption of demonstrably inefficient foraging techniques suggest strongly that the diets of hunter-gatherers began to decline under the pressure of their own populations almost from the time that the efficient hunter, *Homo sapiens,* first emerged to spread out around the world.

Actual tests of the relative efficiency of various foraging techniques indicate that prehistoric hunter-gatherers in environments richer in large game than that occupied by contemporary counterparts would have fared well in comparison to contemporary groups. Indeed, numerous investigations point out that when available, large game animals can be taken and converted to food far more efficiently than most other wild resources. Data provided by Stuart Marks (1976) and recalculated by the author (Cohen 1989) suggest, for example, that big game hunters without modern rifles or shotguns in game-rich environments may obtain an *average* of as much as 7,500 to 15,000 kcal for every hour of hunting. Many other studies also suggest that large game, although relatively scarce in the modern world, can be taken with great efficiency once encountered, even if hunters do not use modern firearms (Jones 1980; Blackburn 1982; Rowly Conway 1984; Hawkes and O'Connell 1985).

By contrast, most of the resources taken by contemporary hunters, including small game, fish, shellfish, and small-seeded vegetables, are far less efficient to gather and convert to food. Estimates of shellfish-gathering efficiency, for example, suggest that it produces about 1,000 kcal per hour of work; hunting small game may average no more than 500 to 800

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kcal per hour; small seed processing also produces only about 500 to 1,000 kcal per hour (Jones 1980; Winterhalder and Smith 1981; Rowly Conway 1984; Cohen 1989). Collection of nuts may, however, constitute a partial exception. Brazil nuts, for example, can be harvested at rates that provide kcals comparable to hunting. But the nuts must still be cracked and processed into food, both relatively time-consuming activities. Similarly, anadramous (migratory) fish can be harvested very efficiently but only after large weirs have been constructed (Werner 1983; Rowly Conway 1984).

Interestingly, the relative efficiency of hunting large game (when available) appears to hold whether foragers use iron or stone tools. In fact, metal tools apparently add relatively little to hunting efficiency, although they add significantly to the efficiency of gathering vegetable foods, not to mention growing them. In a Stone Age world, therefore, the advantage of being a big game hunter would have been substantially greater than even these modern comparative tests of various economic activities undertaken with metal tools suggest (Colchester 1984; Harris 1988). Hunting large game with spears is also clearly more efficient than hunting smaller game with bows and arrows and small projectile points or nets or probably even primitive muskets – the point being that "improvements" in hunting technology did not offset the loss of efficiency that occurred as prey size became smaller. In addition, hunting large game would have clearly been more efficient than harvesting wild wheat or farming wheat with stone tools such as the sickles and grindstones that appear in human tool kits relatively late in prehistory (Russell 1988). In short, a decline in available big game was apparently more important than any technological innovation in affecting foraging choices and determining the overall efficiency of the economy. The ultimate adoption of farming seems to have been only one in a long series of strategies adopted to offset diminishing returns.

One further point is worth making. Modern hunter-gatherers, such as the !Kung or even the Hadza, who contend with game-depleted environments or those with legal hunting restrictions must clearly be less efficient in putting food on the table than their (and our) prehistoric forebears.

The data also indicate that prehistoric hunters in game-rich environments would have consumed diets containing a larger proportion of meat than most of their contemporary counterparts. Yet as John Speth (1988) has argued, there are limits to the proportion of meat in the diet that a human being can tolerate since meat, without commensurate carbohydrates or fats, is calorically expensive to process. Moreover, meat is a diuretic, so that people like the San, who live in hot deserts where water and calories are both scarcer than protein, may limit meat consumption to conserve water.

The Evidence of Prehistoric Skeletons

There is also a good deal of direct evidence (most of it gathered since 1960) to support the hypothesis that prehistoric hunter-gatherers were relatively well nourished. Their skeletons, often in large numbers, have been analyzed from various regions of the world. In more than 20 areas of the globe (but mostly in North America) it is possible to use these remains to make comparative analyses of the nutrition and health of two or more prehistoric populations representing different stages in the evolution of food technology (Cohen and Armelagos 1984). For example, in specific cases we can compare hunter-gatherers to the farmers who succeeded them in the same region; or compare early hunters to later foragers; or incipient farmers to intensive farmers, and so forth.

Such analyses generally confirm that infection and associated malnutrition become more common as small groups become larger and more sedentary. The skeleton displays nonspecific infections called periostitis when only the outer surface of the bone is affected and osteomyelitis when the infection penetrates deep into the medullary cavity of the bone. Osteomyelitis is rarely found in prehistoric skeletons, but periostitis is routinely found to have been more common in larger and more sedentary groups and can probably be taken as an index of the prevalence of other infectious diseases. In addition, other types of infection can occasionally be glimpsed. For example, a comparison of mummified populations from Peru (Allison 1984) demonstrates an increase in intestinal parasites with sedentism. A comparison of preserved fecal material from different archaeological layers in the American Southwest also demonstrates an increase in parasites with the adoption of sedentism (Reinhard 1988).

Other such evidence can be found in the characteristic lesions on the skeleton left by diseases such as yaws, syphilis, leprosy, and tuberculosis, all of which increase with density or appear only in relatively civilized populations. Tuberculosis appears to be almost entirely a disease of relatively recent, civilized populations in both the Old World and the New (Buikstra 1981; Cohen and Armelagos 1984). Yaws (a nonvenereal disease caused by a spirochete identical to the one that causes syphilis) has been shown to increase with population density among New World Indians (Cohen and Armelagos 1984).

Skeletons also provide fairly specific signs of anemia, or lack of sufficient red blood cell function. The condition is called porotic hyperostosis and cribra orbitalia and appears as a thickening and porosity of the bones of the cranium and eye orbits in response to the enlargement of marrow cavities where red blood cells are formed.

Anemia can result from inadequate dietary intake of iron associated with diets high in maize and other cereals, since the cereals are poor sources of iron and

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may actually interfere with iron absorption. However, increasingly, anemia is thought to reflect the secondary loss of iron to parasites such as hookworm, and losses in fighting diseases such as tuberculosis, and even the body's own sequestering of iron to fight infection (Weinberg 1974, 1992; Stuart-Macadam 1992). In one particular archaeological sequence from the American Southwest, in which preserved human feces have been examined, anemia was shown to relate to the frequency of parasitic worms in stools rather than to diet (Reinhard 1988, 1992). But whatever the cause, anemia seems to have been primarily a disease of more civilized or sedentary farmers rather than hunter-gatherers everywhere they have been studied, and it *increases* through time in association with group size and sedentism in almost all reported archaeological sequences (Cohen and Armelagos 1984).

One other dietary deficiency disease, rickets in children and osteomalacia in adults, can be diagnosed in the skeleton. Soft or malformed bones resulting from improper calcification can result from lack of calcium or lack of vitamin D in the diet. Most commonly, however, it occurs from lack of exposure to sunlight, because most vitamin D is produced in the skin as the result of exposure to ultraviolet radiation. The archaeological record suggests that rickets is very rare among prehistoric hunter-gatherers but common, as one might predict, among the inhabitants of smog-bound urban ghettos in the last few centuries (Steinbock 1976; Cohen and Armelagos 1984).

Changes in human growth and stature may also reflect a decline in the quality of human nutrition through time. Many authorities consider average stature to be a fairly reliable indicator of nutritional status (see Fogel et al. 1983), and certainly the increase in European and American stature in the last century has been viewed as evidence of improving nutrition. But for centuries prior to the nineteenth century, decline was the predominant trend in human stature.

The first biologically modern human populations of hunter-gatherers throughout Europe and areas of Asia including India seem to have been relatively tall. Unquestionably these Paleolithic hunters were taller than the Mesolithic foragers and Neolithic farmers that came after them (Angel 1984; Kennedy 1984; Meiklejohn et al. 1984; Smith, Bar-Yosef, and Sillen 1984), and the populations of eighteenth-century Europe to which we compare ourselves with considerable pride were among the shortest human groups that ever lived (Fogel 1984).

Retarded growth may also be identified in the skeletons of children whose bones suggest that they were smaller for their age (as determined by the state of tooth formation and eruption at death) than children living at some other time or place. For example, skeletons of children from the Dickson Mounds archaeological site in Illinois suggest that childhood growth was retarded in a farming population when compared to that of their foraging forebears (Goodman et al. 1984). In addition, malnutrition may show up as premature osteoporosis, the thinning of the outer, solid, cortical portions of bones. This condition seems to be more important in farmers or later populations than in prehistoric hunter-gatherers (e.g., Stout 1978; Smith et al. 1984).

Finally, the adult human skeleton displays scars of biological or nutritional stresses felt in childhood, particularly those associated with weanling malnutrition and weanling diarrhea. Illness while teeth are growing can result in irregularities in tooth enamel that leave a permanent record of stress in the form of visible lines called enamel hypoplasia or microscopic defects called Wilson bands (see Rose, Condon, and Goodman 1985). Prehistoric hunter-gatherers fairly typically show lower rates of these defects than do the farming and civilized populations that followed them, confirming the observation that hunter-gatherer children endured significantly less weanling stress than did farmers or other more "civilized" neighboring populations (Cohen and Armelagos 1984; Cohen 1989).

It is true that some critics object to such conclusions by observing that the use of skeletal indicators of stress in prehistoric populations may be misleading – that, for various reasons and in various ways, skeletons may provide an unrepresentative or biased sample of a once-living population. (For details of the argument see Wood et al. 1992, and Cohen forthcoming). Yet skeletal evidence accords well with ethnographic observations and with predictions of epidemiology. In other words, infection not only increases with sedentism in skeletal populations but also increases in many ethnographic or historically described skeleton groups. Moreover, as already discussed, contemporary hunter-gatherers (and not just prehistoric hunter-gatherers) seem to be well protected against anemia. Put plainly, skeletal data when checked against other results appear to be giving us an accurate and coherent picture of past health and nutrition (Cohen 1989, 1992).

The Texture of the Diet

Although controversies remain about the quality and quantity of food available to both modern and ancient hunter-gatherers, there is little dispute that there have been significant changes in dietary texture throughout history. Contemporary hunter-gatherers as a group (and, presumably, their prehistoric counterparts) eat foods that differ in texture from modern diets in three important ways: Wild foods are comparatively tough to chew; they are high in bulk or fiber; and, with the occasional exception of honey, they lack the high concentrations of calories found in many modern processed foods. These textural differences have several effects on human development and health. First, individuals raised on hunter–gatherer diets develop different occlusion of their teeth in which the upper

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and lower incisors meet edge to edge. The modern "normal" pattern of slight overbite is actually a consequence of modern soft diets (Brace 1986). Hunter–gatherer diets also generate significantly more tooth wear than do modern diets, so that in contrast to civilized populations, hunter-gatherers are at risk of literally wearing out their teeth.

However, modern diets rich in sweet and sticky substances are far more cariogenic. Significant tooth decay is, for the most part, a relatively recent phenomenon. Historically, rates of caries increased dramatically with the adoption of pottery, grindstones, and farming (which made softer diets possible) and again with the production of refined foods in the last few centuries (Powell 1985). In fact, the difference in caries rates between ancient hunter-gatherers and farmers is so pronounced that many archaeologists use the rate of caries in archaeological skeletons to help distinguish between prehistoric hunters and farmers (see Turner 1979; Rose et al. 1984).

Coarse textured foods have a particularly important effect on two segments of the population, the very old with badly worn teeth and the very young. The problem of feeding the very young may require a mother to delay weaning, and this may help to explain the relatively low fertility of the !Kung – a phenomenon that some, but not all, modern hunter–gatherer populations seem to experience one yet that may have been the experience of hunter-gatherers in prehistory (Cohen 1989; cf. Wood 1990). Without soft foods to wean their children and with "baby food" very difficult to prepare, hunter-gatherers may be forced to nurse both intensively and for a relatively long period. Lactation, especially in combination with low caloric intake and high energy output, is known to exert contraceptive effects (Konner and Worthman 1980; Habicht et al. 1985; Ellison 1990).

But the adoption of cereals and grindstones to prepare gruel by Mesolithic and Neolithic populations would have simplified the problem of feeding the very young whether or not it improved nutrition. And early weaning in turn would help to explain an apparent increase in the growth rate of the human population after the adoption of farming in the Neolithic period, even though no corresponding improvement in health or longevity can be documented (Cohen and Armelagos 1984; Cohen 1989).

The lack of refined foods available to them may also explain the relative immunity of hunting and gathering populations (and many other populations) to diet-related diseases that plague twentieth-century Western populations. For example, the relatively low calorie-for-volume content of hunter–gatherer diets helps to explain the relative scarcity of obesity and obesity-related conditions among such groups. (Even wild animals that must work for a living are relatively lean in comparison to their modern domestic counterparts.) Adult-onset diabetes is very rare in "primitive" societies, although studies in various parts of the world suggest that the same individuals may be diabetes-prone when switched to Western diets (Neel 1962; Cohen 1989). Similarly, high blood pressure is essentially unknown among hunter–gatherer groups who enjoy low sodium (and perhaps also high potassium or calcium) diets, although the same groups develop high blood pressure when "civilized" (Cohen 1989).

High-fiber diets among hunter-gatherers and other "primitive" groups also affect bowel transit time. Members of such groups typically defecate significantly more often than "civilized" people. In consequence, diseases associated with constipation such as appendicitis, diverticulosis, varicose veins, and bowel cancer are all relatively rare among hunter-gatherers (and non-Western populations in general) and are thought to result at least in part from modern, Western low-bulk diets (Burkitt 1982).

In summary, a number of lines of evidence from archaeology, from prehistoric skeletons, and from the study of contemporary populations indicate that small, mobile human groups living on wild foods enjoy relatively well-balanced diets and relatively good health. Indeed, the available evidence suggests that hunter–gatherer diets remain well balanced even when they are low in calories. The data also show that per capita intake of calories and of protein has declined rather than increased in human history for all but the privileged classes. The predominant direction of prehistoric and historic change in human stature has been a decline in size despite the "secular trend" among some Western populations of the last century. Prehistoric remains of more sedentary and larger groups commonly display an increase in general infection and in specific diseases (such as yaws and tuberculosis), combined with an increase in porotic hyperostosis (anemia) and other signs of malnutrition.

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