The Eating Disorders
Edited by BJ Blinder, BF Chaitin, & R Goldstein

Chapter 4

Long-Term History of Human Diet

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INTRODUCTION

A walk down a supermarket aisle these days takes a city-dweller past an amazing array of foods stocking the shelves. Faced with many packages boldly labled "LOW IN SODIUM," "NO CHOLESTEROL," or even "100% NATURAL," a hungry consumer might well pause to reflect. Is there, in fact, a "natural" diet for humans?

Supermarkets and packaged foods, of course, are 20th century additions to the human lifestyle, and the refined, cellophaned diets typical of industrialized societies fall at one atypical edge of the wide dietary range of people today. Most human societies now depend on agricultural products as staple food sources; the particular crops and animals they tend vary with local environmental conditions. Societies in the humid tropics, for instance, often rely on local root crops, while groups in cooler temperate climates generally depend on domestic grains, or more rarely, dairy products.

But these domestic foods that support much of the world's population today have only joined the human dietary repertoire relatively recently; agriculture and animal husbandry were not developed until 10,000 years ago. Today there are still a few groups that prefer a hunting and gathering lifestyle to a farming one, but before 10,000 years ago, and actually during 99% of the human past, people lived solely on wild foods that they gathered or hunted. Whether or not such wild foods can be regarded as the "natural foods" for people, they certainly represent the starting point of human dietary development.

This paper briefly reviews current knowledge of the ancient diets of humans and looks at ways in which modern human diets differ from those of the past. Our perspective of human dietary history is based on information from both the present and the past, and the following sections summarize how different sources of evidence contribute to what is definitely known, what is probable, and what is as yet uncertain about the history of human diet. Even seen from many angles, an overall narrative of human dietary history is incomplete; but what *is* known can nevertheless offer an important perspective on the background to human dietary choices today.

RANGE OF NONINDUSTRIAL HUMAN DIETS COMPARED WITH PRIMATES

A review of the subsistence habits of nonindustrial societies today, such as that done by Gaulin and Konner [1], highlights the incredible variety of human dietary patterns. They range from isolated examples of hunting and gathering populations to a range of food producers dependent solely on domestic stock or agricultural staples to survive. In the face of this dietary diversity, there is little agreement on what an ideal diet for all people should consist of, or even on how to gauge "acceptable" diets [2]. For instance, Young and Scrimshaw [3] and many others [4] discuss the variable nutritional

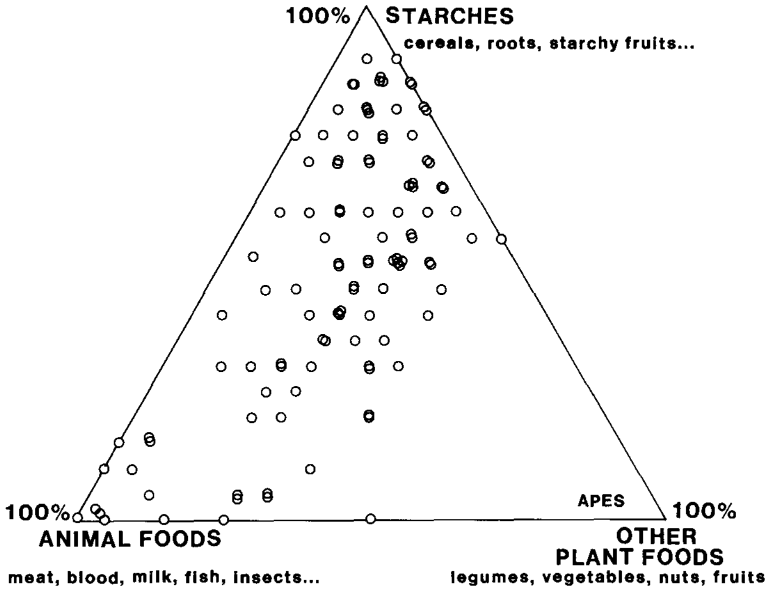

Figure 4.1 Diet composition of 117 non-industrial human societies, in relation to diet composition of apes: proportions of animal foods, starches, and other plant foods. (Data taken from Gaulin and Konner, 1977) [1]

needs of human populations with different geographical, cultural, and genetic backgrounds. However, it is safe to conclude that many very different dietary mixes allow humans to grow, thrive, and multiply.

While humans range from being almost completely carnivorous, as the Eskimo groups in northern temperate and arctic regions, to largely vegetarian, as the San hunter-gatherers in southern Africa [5], the majority of societies effectively balance their diet as an omnivorous mix between meat and vegetables. Most people in most societies depend on plant foods as the main reliable source of calories, and many plant food staples are also good sources of high-quality protein, such as wheat, nuts, and legumes. However others, like manioc and rice, are not and require either supplementary proteins or amino acids to support nutritionally balanced diets [6,7]. Some groups get protein supplements from vegetable greens [8] or by eating suites of plant foods with amino acid complements such as maize and beans [9]. However, such protein balance is easily achieved by eating animal (or insect) foods in a mix with plant foods, and this is the most common dietary pattern, as illustrated in figure 1.

Humans often try to maximize the amount of animal foods that they eat, giving the impression that they would like more meat and fat then they get. Hayden [5] and Speth and Spielman [10] have recently noted this apparent preoccupation with meat and fat among people of many different societies. Lipids, in particular, emerge as a scarce, crucial resource for hunter-gatherers and many food producing groups, probably because humans require essential fatty acids for a number of metabolic functions, and lipids are a concentrated source of energy that can balance some of the high costs of protein metabolism. Yet lipids are rare in most plant foods except seeds, and nondomestic animals tend to be quite lean, with only their bone marrow offering a hunter much in the way of fats [11,12].

In addition to craving meat or fat, most humans seem to have "sweet teeth," and will fill up on naturally occurring sugars —honey and ripe fruits— when they are available. Honey, especially, seems to elicit great enthusiasm and energetic search efforts from a number of foraging groups [5]. However, wild ripe fruits are rarely passed by and are particularly common snack foods among hunter-gatherer groups.

But regardless of fruit's temptations, the largest contributions that plant foods make to modern human diets come in the form of starches. For today's hunter-gatherer populations, tubers are among the most common staple plant foods and are generally quite starchy. And the main staple crops of groups that practice agriculture tend to be much more starchy than their wild counterparts [13], particularly the seed crops such as the wheat and maize that support large populations in western Europe and the Americas, and the rice and millets grown widely in Africa and Asia. Starchy root crops, such as yams, manioc, and potatoes, are also staples over large parts of the tropics [6].

Where there are plant foods, there are also structural carbohydrates, and long hours of preparation are necessary to reduce the bulk of most plant foods. As a re-

Table 4.1 Classes of food eaten by human groups and examples of non-human primates.
Key: Importance in diet. • = very minor; + = minor; × = moderately important (> 15%); X = predominant (>40% or 50%)

	PRIMATES:			HUMANS:				
	Baboon	Gorilla	Chimp	Hunter-Gatherers warm-temperate tropical	Hunter-Gatherers cold-temperate arctic	Agri-Horticulture dry tropics temperate	Agri-Horticulture humid tropics	Pastoralists
Fruits	**X**	+	×	×	∘	+	×	+
Seeds, Nuts	×	∘	+	×	+	+	+	+
Leaves, Shoots, shallow Roots	×	**X**	+	+		+	×	∘
Grains	+			×		**X**	+	+
Tubers	+			**X**	∘	×	**X**	+
Animal meat, fat, insect M fish F dairy D	∘ M		× M	× M F	**X** M F	× M F D	× M F	**X** D

sult, the diets of even the most eclectic of nonindustrial peoples, and particularly those of nomadic hunter-gatherers, have a much higher fiber content than the more refined and meaty diets of western supermarket denizens [14].

At the same time, almost all human groups are subject to periodic food shortages. For hunters and gatherers this occurs to a greater or lesser extent on a regular seasonal basis—often during dry seasons when both plant and animal foods are restricted [15,16]. For food producers such shortages obviously occur less often, especially if foods are stored in any way. But when they do happen, because of drought or crop pests, for instance, food shortages tend to be severe for agriculturalists because of high population densities, and they can produce famine.

Comparing the range of nonindustrial human diets with the feeding habits of other primates [1,17] emphasizes that many of these general features of human diets are actually quite distinctive. As summarized in table 1, the bulk of the diets of our closest natural relatives, the apes, is composed of fruits and leaves, with modest intermittent supplements from the flesh of small animals and insects. Humans stand out for several reasons:

1. the much higher proportion of *animal food* they eat;
2. their focus on *starchy* plant foods, particularly grains and tubers (foods rarely, if ever, touched by apes); and
3. their use of cooking and *preparation* techniques that help reduce the fibrous bulk of these foods and make some, such as grains, more palatable.

Figure 1 emphasizes how distinct the range of nonindustrial human dietary patterns is compared with other primates along two dimensions: in terms of plant food starches—rather than sugars—as sources of carbohydrates, and animal foods—rather than leaves—as primary sources of protein. However, these modern differences between the diets of humans and other primates were not nearly as pronounced during the course of prehistory. The next section summarizes what is known about the human dietary past from the fossil and archaeological records.

EVIDENCE OF PREHISTORIC HUMAN DIETS

Before considering what human ancestors ate, it is useful to summarize who they were and where they lived. Figure 2 presents a simplified "time line" chart of some of the key features of dietary evidence relating to the human fossil record. Note that while the modern human species *Homo sapiens* has only been around for the last 40,000 years,the time line presented here begins with fossil samples roughly ten million years old.

1. Abundant fossils of ape-like quadrupedal primates have been found from the early Miocene time period in areas that were once forested and tropical. Paleontologists are reluctant, as yet, to choose between these fossil ape species to pick a particular human ancestor, but several of them could be likely candidates.
2. Between the Miocene period and the subsequent

Plio-Pleistocene there is a four to five million year gap in the record of hominoid fossils, but biochemical evidence suggests that this is the time during which the human lineage separated from the African apes.

3. From the period around four million years ago, paleontologists have found a number of fossils in Africa that can be placed squarely on the human family tree: creatures that walked upright on two legs and had ape-sized brains and distinctive teeth—members of the genus *Australopithecus*.
4. The first fossils that can definitely be placed in the human genus *Homo* have been found in African sediments roughly two million years old; early *Homo* resembled contemporary Australopithecines in many ways but had a distinctly larger brain.
5. By one million years ago Australopithecines are no longer present in the fossil record, and the only surviving human-like creature was *Homo erectus*, a larger-brained descendent of the early *Homo*, fossilized in sediments throughout the Old World tropics and lower temperate latitudes.
6. For the next million years the human lineage spread throughout the Old World and slowly evolved larger brains until, by 150,000-100,000 years ago, human ancestors resembled extremely robust and sturdy versions of modern humans, with brains as large as ours today. They are referred to as "archaic" *Homo sapiens*, or neanderthals.
7. After 125,000 years ago, human populations underwent a fairly swift biological shift that can be called the "loss of robusticity" transition. Human skeletons became much less muscular, with more slender limb bones; subtle changes also occurred in pelvic shape and the boney architecture of the skull. Current genetic and fossil evidence [46,47] suggests that this transition from archaic to modern *Homo sapiens* first took place in Africa, and that fully modern human populations spread from Africa to other parts of the world. After 30,000 years ago, all human populations were fully modern.

For the oldest of these stages the fossil bones themselves provide the only evidence of diet, and this kind of evidence is also available for the entire prehistoric record.* Fossil jaws and teeth, in particular, can be examined from the perspective of comparative studies of the biomechanics of jaw function and the relationships between diet and dental anatomy in primates. In contrast to the Miocene hominoids that had dental patterns basically similar to those of living apes [18,19], the Australopithecines had a distinct "megadont" adaptation of very large, thickly-enameled cheek teeth and massive chewing musculature relative to their body size [20]. Such dental apparatus is apparently suited to heavily masticated diets, including foods that require either strong crushing or long periods of sustained chewing [21,22]. The later Australopithecines that branched off the human lineage, such as *A. robustus*, developed these characters to an extreme, having only tiny front teeth, but sporting huge molars and premolars with thickly enameled crowns, often worn flat. Even young juvenile robust Australopithecines show heavy wear on their huge milk molars [21].

Early specimens of *Homo*, on the other hand, have relatively larger incisors and much smaller cheek teeth than the robust Australopithecines, and the subsequent species *Homo erectus* and *H. sapiens* continue the trend of allometrically reduced post-canine dentition [20]. This suggests that *Homo* had shifted to a diet of foods requiring less oral preparation than the foods of Australopithecines—perhaps foods that were less fibrous, or foods that were prepared, before ingestion, by the use of fire (eg, singed to remove tough coats or cooked) or other technology (eg, shredded or pounded).

New studies of the microscopic wear patterns on the teeth of these fossils are beginning to provide additional evidence of dietary habits. Walker [20] and others have found that the teeth of Australopithecines and early *Homo* show no signs of the bone-chewing or grass-eating that produce distinctive wear patterns on the teeth of other animals; instead these fossils show wear patterns that most resemble wear on the teeth of largely frugivorous primates, like the chimpanzee. The one specimen of *Homo erectus* so far examined has unusual (for a primate) microscopic scratches on its molars that may have been caused by eating roots or other foods covered with sand grains from the soil.

Archaeologists seek telltale bits of ancient equipment used in the food quest and have collected a record of

* In addition to clues from the morphology and biomechanical properties of fossil bones, under favorable circumstances the composition of ancient bones can give some indication of what the animal ate. For instance, the ratio of plant food to meat in the diet can be reflected in the relative proportion of strontium in that individual's bones. Similarly, eating certain foods like maize or legumes gives a distinctive isotopic composition to the bones of the consumer (eg, stable carbon and nitrogen isotopes). Techniques to determine the trace element and isotopic composition of ancient bones as an indicator of ancient diets have been most successfully applied to bones from recent time periods, to trace the development of agriculture, for instance [43,44]. However, researchers are now also planning to analyze the composition of fossil bones from our earliest ancestors as well [45].

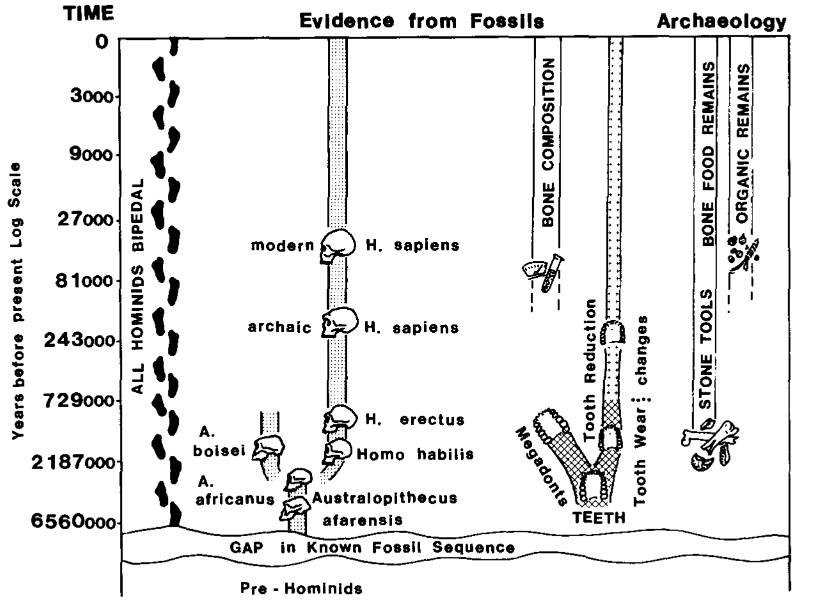

Figure 4.2 Time-line of the available evidence used to infer prehistoric diet: the fossil record and the archaeological record.

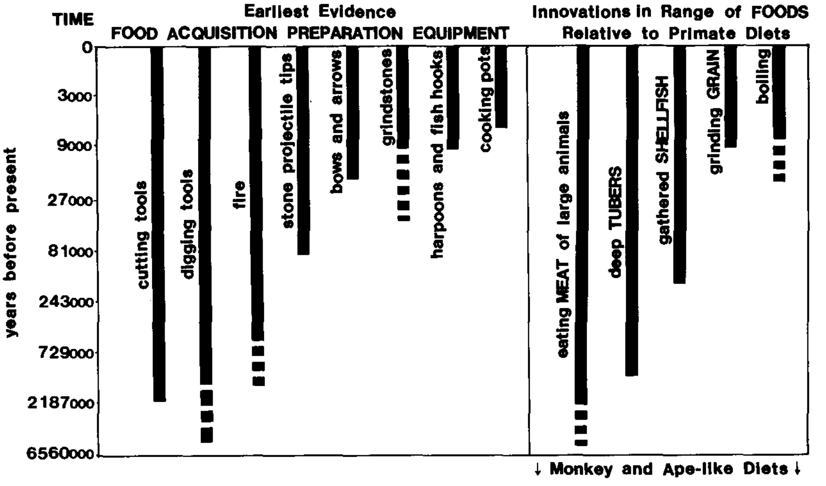

Figure 4.3 Stages in the history of human diet: innovations in food acquisition and preparation equipment, and innovations in dietary range.

changing subsistence technology that spans about two million years. In many cases they have also found the refuse from ancient meals associated with tools. Figure 3 summarizes features of this long record.

The earliest technology we have evidence for is associated with *Homo habilis*. Simple, but effective, sharp-edged stone flakes were used as cutting tools for meat and plant foods. This is evident from diagnostic micro-wear "polish" preserved on the tool edges [23]. Stones were also used as hammers, or pounders. Broken animal limb bones that were used as digging implements have been found at archaeological sites at Olduvai Gorge, Tanzania, and at Swartkrans, in southern Africa [24,25], suggesting that hominids were already digging up underground bulbs or tubers. Wooden digging implements were probably in more general use than bone ones, but because wood does not survive as well as bone, we lack direct evidence of this.

By modern standards, the pace of technological development during most of the Pleistocene was very slow [26,27], and many of the tools and devices used to acquire or process foods first appear in the archaeological record only very recently, after the emergence of modern *Homo sapiens*. Examples of very recent technological inventions include bows and arrows, and spear throwers (atlatl); stone sickles used to harvest cereals; grindstones, commonly used to grind seeds; and storage and cooking devices such as pottery or ovens.

Faunal and floral remains found in association with tools at archaeological sites can also be an important source of information about prehistoric human diets. For instance, many of the bones of large ungulates found at the early archaeological sites in east Africa have cut marks on them inflicted by stone tools, which were used to slice off meat [28,29]. Cut marks provide additional evidence that by two million years ago eating meat from large animals was a part of ancestral human subsistence to a degree unknown in any living ape or monkey, although it is still unclear whether animals were actually hunted during this early time period or whether meat was obtained by scavenging [30,31,32,48].

The use of fire is not firmly documented in the archaeological record until 500,000 years ago, although it may go back some 1,400,000 years. Because cooking can significantly alter the palatability and toxicity of foods, especially plant foods, prehistoric human diets before the use of fire could well have been more restricted than modern hunter-gatherer diets [33]. For example, many legumes could not be used as a major food source until detoxified by cooking.

The earliest archaeological remains of intensive shellfish and fish consumption are found in two 100,000-year-old sites, one in the north and one in the south of Africa [34]. Aquatic foods were most probably not eaten much before this period, but shellfish and fish have since become dietary staples in many parts of the world. Stretches of coast in many areas of North America, Australia, and Africa, for instance, are still mounded with the shellfish middens left at recent archaeological sites. While the shells are conspicuous, fish were often the main food eaten at these sites. Catching fish in quantity requires sophisticated tools, such as nets, hooks and lines, or harpoons, that were only invented during the last 20,000 years.

It is difficult to document the prehistoric consumption of plant foods. Human ancestors undoubtedly ate ripe fruits and some greens, just as most humans and nonhuman primates do today, but it is important to determine at what point starches came to be such a distinctive staple in human diets. At any time human ancestors could have easily gathered shallow bulbs and corms low in starches, as baboons do with paws alone in many parts of Africa [35,36]. Digging tools found at early sites [25] suggest that by two million years ago deeper underground foods had become accessible to prehistoric human populations as well, but it is still uncertain at what point in prehistory human populations began to systematically harvest the vast, and probably starchy, stores of deeply buried tubers common in dry habitats that sustain many hunter-gatherer populations today.

Documenting the consumption of seeds is slightly easier. While Jolly [37] suggested that seed-eating may have been a very early adaptation in the course of human dietary history, no evidence of eating hard seeds is present on any of the early fossil teeth so far examined [22]. It is also not known whether prehistoric populations could have gotten much nutritional benefit from eating any amount of raw cereal grains. The first archaeological indications of seedy prehistoric diets come with the appearance of equipment roughly 20,000 years ago—grindstones to process seeds, and stone "sickle blades" used to harvest grasses—followed by wild cereal grains themselves preserved at archaeological sites, all very late in prehistory relative to long-term dietary adaptations.

In many parts of the world the archaeological record documents significant changes in prehistoric human diets that occurred at about the same time that seeds became staples. These changes to so-called "broad-spectrum" subsistence systems 20,000 years ago were marked by expanding breadth of hunter-gatherer diets as different groups used new types of technology to procure and process food. It was in such settings that farming and animal husbandry developed in a number of different parts of the world shortly after 10,000 years ago [6].

The advent and spread of food production, especially farming economies, brought with it rapid changes for human diet. Most plants were domesticated for their seeds or roots, and so with widespread farming came the strong human dependence on dependable starch staples such as cereals and tubers, as well as legumes. Food production also allowed people to focus more intensively on the production and consumption of a few staples, for better or for worse, losing much of the diet breadth that is characteristic of most hunter-gatherers that anthropologists have observed. The shift to farming had a variety of profound interlinking effects. Some of the changes are ones that we still feel positive about: the adoption of more settled ways of life; living in sturdy houses; having more possessions and wealth; forming the large-scale cooperative societies that we associate with civilization. But not all changes were for the better. In some instances, overcrowding and unbalanced, monotonous diets produce disease and malnutrition levels among food producers that are unknown among hunter-gatherer populations [38,39].

Table 4.2 Tracing feeding patterns back from the present

Stage	Years ago	Food Acquisition Technology and Its Implications	Notes
IV	0	Development of bulk food transport, global trade networks. Use of fossil fuels. Processed, packaged foods.	Great diversity in feeding patterns, both within and between societies. Diverse diet for both rich and poor.
III	2000	Beginning of farming and its spread. Cereal, root and legume crops become staple foods for many societies	Starch staples become common – for many individuals, most nourishment is derived from just a few kinds of crops.
II	10,000	Development of cooking pots. Development of seed- and grain-grinding equipment. Development of equipment for getting more animal foods (nets, traps, bows, arrows, etc.).	Most populations were sustained by a wide variety of plant and animal foods.
I	30,000	Control and use of fire. Gathering and hunting in cooperating groups. Development of carrying devices (bags, baskets, trays). Development of digging tools, spears, knives.	Dietary patterns in this period are poorly understood. They probably include more meat than any primate eats today, yet were dominated mainly by plant foods. Powerful chewing was important.
0	2,000,000	Primate-like condition, probably with fruit and leaves as the predominate foods.	Individuals move to where food is, then feed and move on.

HUMAN DIET, PAST AND PRESENT

Table 2 summarizes the main stages in food acquisition and diet that probably characterized the human past, beginning with a period over two million years ago during which our ancestors had feeding patterns probably similar to those of several primates today. While the increasing use of technology in food acquisition through time paces dietary changes, the manner in which dietary patterns were causally linked to technological developments is still imperfectly understood. Still, clear changes in human diets can be traced over the last two million years, with the rate of change strongly accelerating in the very recent past with the development of food production.

Ultimately, the starting point for the trajectory of change must have been a fiber-rich fruit and leaf diet, as is commonly eaten by monkey and apes. The first steps away from this, taken by our ancestors two or three million years ago, added meat, and probably (starchy?) tubers, to the diet. Then for a very long time human ancestors undoubtedly ate varied, fiber-rich diets that combined proportions of starches, meats, nuts, fruits, and some leaves. Some of the genetically controlled physiological differences between modern humans and apes [40,41,4] are, in fact, probably linked to the long-term history of such distinct, human dietary patterns.

Such varied, diverse diets remain characteristic of most human groups today [49]. However, since the invention of agriculture, and since the soaring rise of technology, some humans have begun to eat different, less-balanced diets. Many of the world's poor are obliged by circumstance to eat mainly starch, while in cities the affluent populations can choose novel gastronomic patterns impossible for our ancestors, such as fiber-free diets or fat-rich diets coupled with inactive lifestyles. With these extremes, in spite of human physiological flexibility, health problems may arise that are linked to eating patterns unique in the long-term history of human diets [42]. Given this situation, archaeologists, anthropologists, and zoologists cannot say "this is what one should eat," but they can show which modern diets are most different from the range of patterns that were normal in the long-term past.

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