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VOLUME 2:
Food Production to Nuts

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Meals on Wheels specializes in providing daily meals for shut-ins, especially the elderly. PHOTO COURTESY OF AP/WIDE WORLD PHOTOS.

communities to provide hot meals in group dining situations for persons over sixty years of age and their spouses, regardless of the spouse's age.

For those senior citizens who were unable to prepare adequate meals for themselves or attend the congregate nutrition centers because of ill health or physical incapacity, the first so-called meals-on-wheels program was established in Pennsylvania. Volunteers dubbed "Platter Angels" prepared, packaged, and delivered meals to homebound elderly in the community.

As the demand for the service continued to grow, additional neighborhood meals-on-wheels programs sprung up across the country. Volunteers organized programs and delivered meals. A fee was charged to cover the cost of food and preparation. Charitable institutions such as churches and civic organizations were called upon to subsidize costs for those unable to pay.

Although limited federal funds were available to the volunteer programs, Congress recognized that a major federal effort was needed. Another change to the OAA in 1978 (Title III-C-2, Home-delivered nutrition services) provided for the home-delivered meals for those assessed as unable to participate in the congregate meal program. Administered by the U.S. Department of Health and Human Services Administration on Aging, the program focuses on those in greatest economic and/or social need.

By requirement, each home-delivered meal must supply at least one-third of the Recommended Dietary Allowances for this age group. It is estimated that 40 to 50 percent of most required nutrients are supplied in practice. Guidelines developed to assist in menu planning indicate both the types and the amounts of food to be included in each meal. Some state programs have chosen

to offer additional services such as offering medical nutrition supplement products. Delivery packaging materials for the meals should be safe and acceptable for both hot and cold foods, they should prevent contamination, and be reasonable in cost. Improper handling by recipients leading to food safety issues has been raised as a concern. Evaluation studies of program effectiveness affirm that the nutrient-dense meals improve the status of the homebound.

Thirty percent of the cost of the home-delivered meals is met through OAA funds. Public and private partnerships leverage additional resources. Every \$1 in federal funds leverages an additional \$3.35 in the home delivered meals program. The demand for homebound meals has dramatically increased in concert with the growing number of frail and homebound elderly who want to remain independent. Based on the most recent figures, about 135 million home-delivered meals are served annually. From the program's inception more applicants were attracted than could be accommodated, and waiting lists in many areas are not uncommon.

A separate but similar national organization that complements the federally supported home-delivered meal service is the Meals-on-Wheels America (MOWA) program. Their additional home-delivered meal service is seamlessly integrated into existing meals on wheels programs. Meals-on-Wheels America helps local communities raise funds and expand their nutrition programs for homebound elderly.

With the elderly population expected to double by 2030, senior feeding programs such as meals on wheels will continue to provide much-needed ongoing services.

See also **Government Agencies; Government Agencies, U.S.; Poverty; WIC (Women, Infants, and Children's) Program.**

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Connie E. Vickery

MEAT. For most human beings, meat is a highly desired food, but it is more of a treat than a staple. Meat, whether obtained from hunted or domesticated animals, is more expensive than staple carbohydrate-rich foods because of the investment in land and labor required to produce it. This reality is often the justification for reserving meat, or the best parts of it, for those with higher status.

In a majority of the world's cultures, this elite is men and, sometimes, the women and children attached to them. Furthermore, when there is enough meat to go around, the preferred parts, usually the muscle, go to these same individuals.

It is this special status of meat that makes it of particular interest in human culture, psychology, and cuisine. Meat is also the only class of food that is frequently formally proscribed by certain religions, cultures, or cultural subgroups.

Ambivalence and the Psychology of Meat

The stakes are high with meat. Meat is both the most tabooed—and the most favored—food across the human race, in both developed and traditional cultures. Meat is a magnet of ambivalence for human beings. It is meaningful, in both the positive and negative sense. Eating meat is both attractive and repulsive. Hunting, too, is problematic. It is a skilled accomplishment at the same time that it is a destructive act. Meat provides a food for humans that is more similar to humans than any other type of food. The similarity means that the biochemical composition of meat is much like that of humans, so that, by eating it, humans get all the nutrients they need. The meat of any mammal is a complete, or almost complete, food, in contrast to vegetable foods. But this similarity means that microorganisms living in the meat are also likely to find a happy home in humans. Meat is thus the most nutritive and most infective food humans eat.

You Are What You Eat

It is quite natural and sensible to believe that a person takes on the properties of the food he or she eats. In general, when A and B are mixed, the resulting product shows properties of both A and B, so why should this not occur when A eats B? The problem, of course, as understood through the lens of biochemistry, is that after digestion the components of various foods, foods as different as beef and bananas, are the same molecules: amino acids, sugars, and so on. From this perspective, the identity of an eaten food is lost by the time it is digested. Nonetheless, the belief remains, and it is present in the thinking of almost every traditional culture. This "principle" is behind such notions as eating owls improves vision, eating swift animals increases running speed, eating rapidly growing plants speeds up growth, and the appearance of foods, including their color, can influence humans' appearance. "You are what you eat" is not just a primitive superstition; it is believed, implicitly, by educated people in technologically advanced cultures.

It follows from "you are what you eat" that the consumption of animals will impart some of their animal properties to the person consuming them. Although many animals have desirable attributes, they all share the property of not being human. And it is a major theme, across cultures, that humans are superior to, and qualitatively different from, animals. Yet, consumption of an-

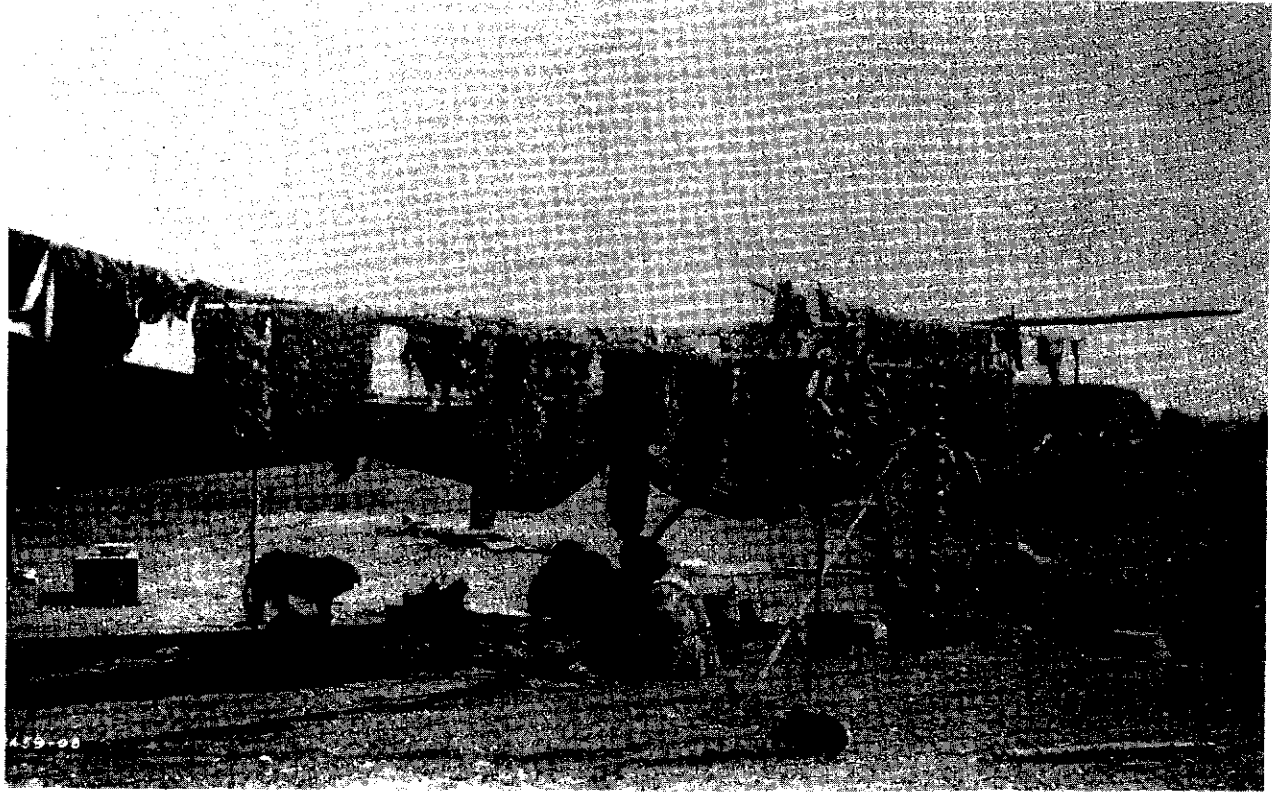


Samaritans sacrificing and roasting lamb at Passover on Mount Gerisim near Nablus, Israel. © DEAN CONGER/CORBIS.

imals, according to the "you are what you eat" principle, would render humans more animal-like, that is, less distinctively human. This belief contributes to human ambivalence about eating meat, and may partially account for the disgust aroused by animal foods in some people.

Meat and the Human Primate

Primates show substantial variation in the types of diets they consume; however, there is a general focus on fruits. Some, particularly large primates, move to a more folivorous (leaf-eating) diet, and some consume a moderate amount of small animals, including insects. The larger stomachs and colons that characterize folivorous animals contrast with the smaller colons and stomachs of the carnivores. Frugivores (fruit eaters) typically have a gut that lies between the carnivore and the folivore extremes, and this is what humans have. This type of gut, and the associated general-purpose set of teeth, are well suited to generalist or omnivorous feeding habits, which characterize humans and chimpanzees. Humans can be distinguished from other primates, including chimpanzees, in their ability to hunt animals larger than themselves. This hunting capacity, related to the movement from the forest to savannah environment, has major implications for human nature and human evolution. First, it introduces the possibility of a substantial amount of meat in the diet.



Native American method of drying meat on racks. PHOTOGRAPH BY EDWARD S. CURTIS, 1908. COURTESY OF THE LIBRARY OF CONGRESS.

In addition, the demands of hunting encourage elaborate communication and cooperative effort as well as the creation of weapons and the technology that goes with them. The yield that results from killing a large animal encourages sharing, communal eating, and preservation technologies. It is fair to say that the shift to a diet with more meat in it, with the inclusion of large animal hunting, was a major force in human evolution. In an important sense, meat as food has shaped human nature.

Meat in Traditional Society

It is presumed that the hunter-gatherer mode of existence, with varying degrees of reliance on vegetable and animal products, was the situation of *Homo sapiens* prior to the appearance of domestication and agriculture. However, this should be recognized as a presumption. Studies of the diverse range of existing cultures that rely to a large degree on hunting and gathering suggest that meat, even at this stage of human cultural and biological evolution, assumed a central role. Meat is generally the favored food, the center of celebrations and social gatherings, and the food selectively available to adult males, the most powerful and high-status members of most hunter-gatherer societies. This situation probably results from a combination of the caloric density of meat and the fact that meat, unlike any particular vegetable, is a

complete food. On the other hand, the relative rarity of meat, which usually constitutes much less than half of the diet, encourages rules for its selective distribution.

Even among hunter-gatherers, however, there are signs of ambivalence to meat. Most food taboos of hunter-gatherers, and they are extensive, are about meat. Taboos are sometimes general, namely that certain types of animals are forbidden as food. On the other hand, most taboos are conditional, restricting the eating of meat, or certain parts (muscle, innards) to particular groups. Generally, the adult males get the greater amount of meat, get to eat the preferred animals, and get the preferred parts (usually muscle). But there are many exceptions to this general rule. Meat or animal taboos, whether in hunter-gatherer or technologically developed cultures, seem to have a few general characteristics. In what has been referred to as "zones of edibility," tabooed creatures tend to be those very close to humans (humans themselves, primates, or companion animals), those very different from humans, and/or those that are rarely encountered.

Domestication

Meat figures prominently in what might be called the two most important transitions in human evolution: the development of complex cultures and sophisticated tech-

nologies. Just as hunting had a major influence in shaping human nature, the combination of agriculture and domestication laid the foundation for high densities of humans and the subsequent elaboration of culture. By making the human food supply more independent of the seasons and of short-term extremes in weather, agriculture and domestication set the stage for major changes in human life. Domestication made it possible for humans to be the only mammals that could have continued access to the almost perfect mammal food of infancy, milk; it also frequently made meat a less scarce resource. Just as hunting helped encourage the upright posture, the development of hand skills, and major cognitive developments, agriculture and domestication of animals freed humans to develop a wide range of impressive technologies.

Meat in Developed Societies

The tables have begun to turn on meat in today's affluent, developed world. The excitement of meat hunting has given way to factory farming. The butchering of the carcass takes place out of sight of almost everyone, so that the skills involved in butchering as well as hunting are almost gone. The caloric density of meat has lost much of its appeal because the threat to human health is too many calories, rather than too few. Similarly, the nutritional completeness of meat is a less salient virtue, what with the great variety of plant foods available in any neighborhood supermarket. The epidemiological revolution has shifted health risks from minimal diets, unbalanced diets, and infections spread by humans through food and other products, to degenerative diseases like heart disease and cancer. And animal fat has been implicated as a risk factor for heart disease. Finally, the affluence of modern societies permits the development of great sensitivities to nature and the morality of using animals as food; with many options available, it is possible to allow moral concerns to influence diet. Vegetarianism is on the rise, for both moral and health reasons, and many of the nonvegetarians in the urban developed world are queasy about the actual process of killing animals. This attitude appears even in the slaughterhouse itself, where responsibility for killing the animals is diffused across a number of different people and roles. In Britain, the United States, and Canada, the human approach to meat has become increasingly ambivalent. The human primate still loves the taste and smell of meat, while cultural knowledge and sensitivities argue against it.

Disgust

Disgust is a powerful emotion, and animal products often arouse it. Almost all foods that are labeled as disgusting in a number of cultures are of animal origin. It is odd, because "dis-gust" means 'bad taste', and meat is one of the best-tasting foods to humans. It is odd also because, given the superior nutritional properties of meat, it should not be the target of the strongest negative food-related emotion.

Meat preference may be a human predisposition, but it is probably not present in infants. Ironically, there may be some predisposition to find meat disgusting, but this as well is not present in the first few years of life. Human infants eat, or at least try to eat, everything they can get into their mouth. Feces, the universal core of disgust, and itself an animal product, is attractive as a food to human infants, as it is to other young and adult mammals. Presumably the odor of decay, associated as it is with microorganism-infested meat, would be innately repugnant, but there is no evidence for an infant aversion to this odor. Nor is there evidence for such an aversion in other primates or mammals. By age two or three, in Western developed cultures (which have provided all of the data up to this time), children have a clear aversion to feces, and a variety of other animal products, especially those that are decayed. This is probably the result of toilet training, although there is no account available of the actual process through which this aversion to feces and decay is aroused.

The foods that are disgusting to adults, cross-culturally, are almost entirely of animal origin, beginning with feces and, for Americans, extending widely to many of the edible parts of animals. Indeed, considering all of the possible animal foods (insects, mollusks, reptiles, amphibians), it is quite remarkable that Americans consume only four or five species of mammals, a few species of birds, no amphibians and reptiles, a moderate number of the many species of fish, only a few types of shellfish, and no insects. Furthermore, the meats eaten by Americans exclude many parts of edible animals; consumption is almost exclusively limited to muscle, and, in general, not the heart or tongue, although these are muscles. So far as is known, this idiosyncratic selection of animals and animal parts as acceptable food has no nutritional or health basis.

These facts lead to the conclusion that disgust at animal products, and the avoidance of most animal products, has an ideational base; it is based neither on taste (most of the "disgusting" types of meat have never been tried) or actual health risks. It is the *idea* of eating lizards, cow eyes or intestines, or insects that is upsetting and expressed as disgust, somewhat parallel to the formal taboos in other cultures against the consumption of many types of animals or animal parts.

Humans are clearly adapted to a partial meat diet and to liking the taste of meat, especially when it is cooked. But there are some negative sides to meat eating. Perhaps most important is the threat of microbial contamination; because animals are more like humans than plants are, animals are more likely to harbor microorganisms that can afflict humans. This microbial load also makes animal flesh vulnerable to decay after death. Many have argued that the use of many spices originated as a culinary means of discouraging spoilage of meat. During the twentieth century most of the microbial risks were overcome with controlled raising, preparation, and storage of meats. However, as feeding a population of



SAFE MEAT PRODUCTION

With the appearance in the 1990s of bovine spongiform encephalopathy (BSE; more familiar to the public as "mad cow disease") in England and France, and the deaths caused by its spread to humans who ate meat from diseased cows, vigilance with respect to safe meat production became even more critical. In spite of research demonstrating that the disease had been spread in herds that had eaten feed that contained meat products, some feed suppliers in the United States were found continuing the practice in 2001, and, without enough USDA inspectors to monitor meat production from start to finish, the public cannot be sure that the meat they eat does not come from cows infected with BSE.

Robin Kline

billions a diet with substantial amounts of meat became the goal, a new problem arose: it takes much more out of the environment to make a pound of meat than a pound of vegetable starch or fruits and vegetables. This was not much of a problem when there were fewer humans, and when animals were hunted rather than herded. For some it has become a serious issue that threatens the welfare of our planet.

Plants, of course, as the alternative food source, have their own problems. They are more likely to contain toxins, and they are less calorie dense and less complete nutritionally. As with the minimization of the microbial risks of meat consumption by technological rearing and preparation techniques, the risk of plant toxins can be reduced both by a culture-based selection of appropriate plant products to eat and by the development, through agriculture, of staple plant-based starches that are essentially toxin-free.

Meat and Vegetarianism

Most people in the Third World eat relatively little meat, mostly because of its cost and rarity. They would eat more if they could. On the other hand, in some religious groups, such as orthodox Hindus, all meat is prohibited. And within some meat-eating cultures, individuals or groups of individuals reject meat as food. This type of vegetarianism has a history that goes back at least to ancient Greece. Historically, this type of elective vegetarianism has been motivated primarily by moral or religious concerns, often having to do with negative reactions to the killing of animals or the psychological effects of consuming animals. Within many developed cultures, vege-

tarians invoke, in addition to moral, religious, or aesthetic concerns, worries about the long-term health effects of eating meat. Some vegetarians can be classified as either health or moral vegetarians, though most long-time vegetarians express a little of both motivations. Interestingly, moral vegetarians are more likely to find meat disgusting than are health vegetarians. When meat becomes disgusting, it is much easier to avoid it.

Vegetarianism seems to be growing in the Western world, impelled by health and moral motivations. For most people who choose this path, it is usually a long development over time, frequently a movement from rejection of a small category of animal products (for example, baby mammals or red meat) through larger and larger spheres of rejection (adding poultry, fish and shellfish, eggs and dairy products, and nonfood animal products). For many, the sequence stops at some point along this trajectory. People also often slide backwards, either abandoning a particular level of rejection for a less stringent set of prohibitions or completely abandoning the vegetarian style.

Mad Cow Disease

Although in general Americans seemed to be the most concerned group about the diet-health link as the twentieth century ended, the advent of mad cow disease engaged Europeans more than Americans. Mad cow disease (bovine spongiform encephalopathy [BSE]) is quintessentially about meat. Mad cow is doubly animal: it involves not only animal meat—beef—but also feed consumed by cows, animals that are normally vegetarian, that contains animal parts. Studies of risk perception by psychologists indicate that people tend to exaggerate risks when they are catastrophic, hidden, delayed, and not understood. Mad cow disease meets all of these conditions and adds the predisposition to be emotionally involved with foods of an animal nature. It is hard to believe that as much fuss would be made if this were mad broccoli disease. It is also just as likely that "mad broccoli disease," because it would not originate with diseased animals, would not lead to a delayed, unexpected, hideous, and certain, death.

See also Aversion to Food; Cannibalism; Cattle; Disgust; Game; Goat; Hinduism; Horse; Hunting and Gathering; Mammals; Pig; Sheep.

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Paul Rozin

MEAT, SALTED. The food industry incorporates sodium chloride (NaCl) in preservation, processing, and manufacturing operations for vegetables, poultry, fish, seafood, and meat. Although a number of food preservation techniques have been used for many years, including drying, freezing, heating, canning, filtration, enzyme treatment, high-energy irradiation, and chemicals such as organic acids, nitrate, and liquid smoke, salt remains one of the common methods of meat preservation with a long history. Salt is used to preserve meat in its dry form, as a brine, or in solution pumped into tissues (Doyle and Roman, 1982). Researchers still are examining the beneficial functional properties of NaCl in meats and other food commodities (Hajmeer, Marsden, Crozier-Dodson, Basheer, and Higgins, 1999; Pszczola, 1997).

Use of Salt in Meat and Meat Products

Sodium contents of unprocessed meat are about 55 mg/100 g of beef fiber, and 65 mg/100 g of pork fiber (Institute of Food Technologists, 1980). The level is increased when NaCl is added to the meat during processing. Salt has been used by the meat industry as a dry application and in the formulation of fermented, processed (cured or uncured), and restructured meats. Salt added to a meat system serves three main functions: extracting salt-soluble proteins, enhancing flavor, and extending the shelf life (Claus, Jhung-Won, and Flick, 1994).

Originally, in the absence of refrigeration, meat was dry-salted for extended periods of time to preserve it from microbial deterioration. Excessive salting and extended storage increased water loss, and dehydration removed water from the tissues by osmosis, lowering the water activity in the system to conditions unsuitable for microbial growth and leading to cellular plasmolysis, shrinking of cytoplasm away from the cell wall. In addition to dry-salting, NaCl is incorporated in fermented meats such as semi-dry sausage during preparation. Adding NaCl prevents growth of undesirable spoilage or pathogenic microorganisms by favoring the growth of acid-producing, salt-tolerant bacteria, such as lactobacilli and micrococci. Production of acid by these microorganisms gives the meat a desirable tangy flavor and lowers the pH of the system, which adds another safeguard against the growth of undesirable microorganisms.

In processed comminuted meats, for example, bologna, frankfurters, and summer sausage, and non-comminuted meats, for example, ham, bacon, and pastrami, NaCl is one of the basic ingredients, after the meat itself. Other ingredients include water, spices, nonfat dry milk, sweeteners, phosphates, and nitrite. Salt and nitrite are the main ingredients used to cure meats and are applied dry, by immersion, or by injection methods. Salt added to processed meats helps to extract NaCl-soluble proteins, increases the gel strength of the emulsion or batter, enhances the flavor, inhibits or minimizes microbial growth, and enhances antimicrobial activity of other compounds in the system. Salt-soluble proteins coat the fat molecules in the system and provide a stable emulsion, which is important in improving moisture retention and texture of the final product (Claus et al., 1994). Salting prerigor hot-boned meat to be further processed, for example, when making sausage, helps maintain its water-holding capacity (WHC) and fat-emulsifying properties (Hamm, 1981).

Salt, in conjunction with sodium tripolyphosphate, is used for protein extraction in the preparation of restructured meats, which are sectioned and formed non-cured products. Restructuring meats makes it feasible to use lower-grade, less expensive cuts and, similar to the concept of processing meats, restructuring them provides more diversified products that are flavorful, nutritious, affordable, and convenient.