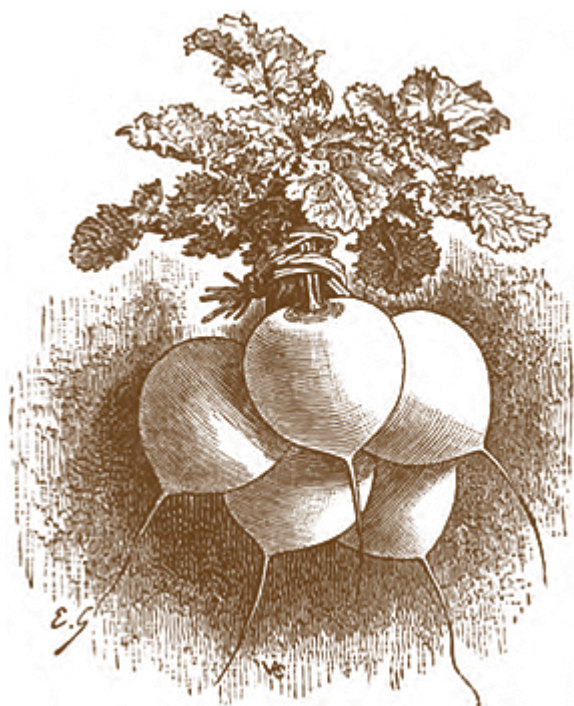


The Roots of Taste



A truth known to every European peasant for a thousand years: the root supplies the food that enables survival through the winter. When reformed agriculture gradually supplanted traditional farming in the late eighteenth and early nineteenth century, a new truth emerged—various roots nourish the soil, livestock, and humanity. Cultivating the most suitable tubers and roots for one’s locale enabled farm self-sufficiency. Here I want to recall the heady heyday of the roots and tubers, when experimentalists made a rich variety of cultivars common on American farms and created a diversity of new varieties to better suit the human palate, the diet of livestock, and the replenishment of the soil.

Replenishment of the soil became the prime directive in revitalizing American agriculture by 1830. Erosion and soil exhaustion had deviled farmers in long-settled areas of the United States by the first decade of the nineteenth century. John Taylor’s *Arator* (1817) prophesied agricultural apocalypse if farmers did not abandon their old ways. By 1820, enterprising cultivators were turning from traditional practices to “book farming” and experimentalism. The agricultural periodical press came into being in 1819 and would begin a growth so virulent that by the Civil War the number of pages and authors published in farming magazines exceeded that of evangelical Christianity and rivaled that of politics. In the farm journals a conviction emerged among the experimentalists: to renovate soil the farmer needed to diversify the farm biologically, by raising livestock as well as growing crops. As John Skinner, the editor of *American Farmer*, asked, “Without live stock how can farmers at a distance from towns raise manure?—how can land be improved without manure?—how can stock

be passed through the winter, in good heart; so as to fatten well early in the next year without the nutriment and medicine of root crops?"

Most experimentalists embraced the ideal of the diversified farm, and so, studied the nourishment of animals—their tastes, nutrition, growth, digestion, and excretion. Their interest in alimentation turned into a complex inquiry into how chemicals and organic matter fed the soil, how soil nourished plants, how plants conveyed nutriment to animals, and how animals (human and non-human) used food to grow and thrive. Exactly how chemicals worked to activate these cycles evaded understanding until Justus Liebig published his analysis of the mineral sustenance of plants in the 1840s. Nevertheless, nearly every experimentalist from 1800 to 1850 grasped the connections between replenishing the soil, growing plants, and feeding animals. Jesse Buel, New York State's most vocal agricultural reformer, devoted chapters six and seven of his classic *Farmer's Companion* (1839) to "Improvement of the Soil" and the "Analogy between Animal and Vegetable Nutrition."

Root vegetables—those compact repositories of plant sugars, fibers, minerals, and fat—became the subject of intensive study, cultivation, and management because they seemed to concentrate the nutritive substances of their surrounding soil. In northern portions of the United States, where climate and rocky terrain made animal husbandry more profitable than cultivating field crops, root vegetables, because of their cold tolerance, availability, and storability in winter months, became crucial for the success of cattle raising, dairying, and herding. Root crops and grass covers became the signature features of "meat farming." In the south where grasslands were often poor, feeding swine, poultry, and cows on roots—particularly sweet potatoes—became the mainstay of feed regimens in animal husbandry.

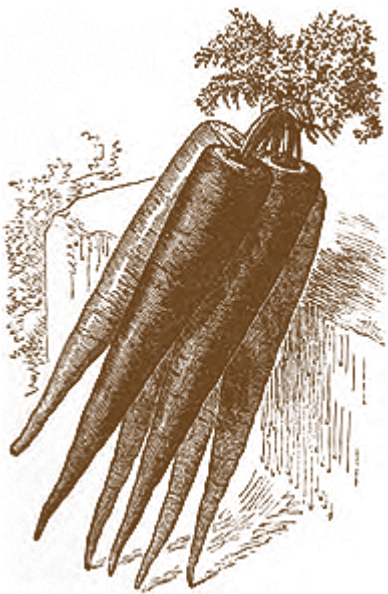
During the experimental age, American farmers embraced all of the European root crops, amalgamating the various national farming traditions: the carrot culture of Flanders, the beet (and particularly the sugar beet) farming of France, the turnip culture of Germany, the rutabaga farming of Sweden, the potato culture of Ireland. Americans took particular interest in the two largest roots in European cultivation—the rutabaga (Swedish turnip) and the mangel wurtzel (cattle beet). Both produced enormous yields per acre. When taking the place of grains cultivated for feed, "it trebles the amount of cattle-feed, and doubles the quantity of manure" (Jesse Buel). The taste and texture of the rutabaga made it palatable for human consumption. The mangel wurtzel, though edible, never earned an open invitation to grace the farmer's dinner plate.

When horticulturists began developing varieties of the European roots, their delectability for animals mattered as much as their taste as human food. Perhaps the readiest way to achieve a sense of the proximity of animal and human nourishment in the agricultural work of the experimental age is to review the early literature about carrots, parsnips, rutabagas, beets, mangel wurtzels, and the other imported roots that proved significant in American farming. We will see the pattern of usage in the array of root vegetables in

planting, feeding, and culinary schemes. One thing becomes clear in this literature: the shared taste for roots by humans and beasts suggested a biological cousinage that began to inflect empirical investigations into the physiology of taste and the mechanics of animal tongues. Seedsmen in their breeding kept a mental picture of the operation of tongues in mind to guide their sense of tastiness of food—for livestock as well as human diners. We'll review their findings about the physiology of taste after surveying the roots being tasted.

The carrot

No widely cultivated vegetable inspired less regard as an ingredient of cuisine in nineteenth-century America than the carrot. *The American Matron* (a "practical and scientific cook") observed in 1851, "carrots are not a very favorite vegetable for the table. They are used in broths and soups, but chiefly sent to table as a garnish, or an accompaniment to salt fish." Even the carrot's defenders were compelled to notice that "[t]his vegetable is but little used, except in soups; yet they are very palatable and healthy, containing a great amount of nutriment." The distaste was for carrots themselves, not their mode of preparation, for the commonest way of cooking them—what some cookbooks designated "American style Carrots"—was to boil them soft and serve them with butter, as simple a rendering as might be conceived, aside from chewing them raw. No cookbook before 1900 recommended consuming uncooked carrots. Recipes for carrot soup, carrot pudding, mashed carrots, fried carrots and carrot fritters appear in antebellum cookery books, but culinary commentators make clear that whatever form the carrot took, it was plebeian fare.



Why, then, did most gardens contain carrots? Because since time immemorial they stood foremost among the vegetables that livestock savored. Both tops and roots

appealed. In New England, in early November, the farmer “cut off the tops, near, but not quite to the crown of the plant, with sharp hoes; they are greedily eaten by oxen, cows, sheep, and swine—then run a plough deep” to unearth the roots for use through the winter. Many concurred with the opinion of John Prince that carrots were the most nutritious field crop for animals. “One bushel of carrots will yield more nourishment than two bushels of oats, or potatoes, and it is a remarkable fact, that horses will frequently leave oats to feed on carrots.” Because of the cost of growing grains, claims such as these found a wide welcome in the second quarter of the century. Experimentalists noted that it thrived when intercropped with flax seed, so that a field could yield two products simultaneously; furthermore, the vegetable did not leech the soil of nutriment as most grains did.

In the colonial period and early republic the long orange carrot, a Dutch invention and England’s standard root in the late eighteenth century, grew universally in American fields. The French white and purple carrots were specimen plants cultivated by experimental gardeners exclusively. In the 1850s the White Belgian and Scarlet varieties enjoyed a vogue among hotel cooks. After the Civil War, the Danvers, the Altringham, and the Early French Forcing Carrot came into wide cultivation. All of these favored varieties eliminated the bane of carrot roots, a woody core. If fed to animals, the root was chopped and served raw.

The parsnip

Sweet, distinctive tasting, and nutritious, the parsnip had been standard garden fare in Europe since antiquity. When cows consumed parsnips, as in the English channel islands, they gave richer milk in greater quantity and butter noted for its piquant sweetness. When farmers fattened pigs or beeves for slaughter, they often fed the creatures on barrows of parsnips. In the United States, apples supplanted parsnips as a “flesh sweetener” for hogs and cattle, but the parsnip served its traditional function in areas where apples did not flourish. For the table, the parsnip evolved a variety of uses over the centuries. It was roasted, fried, stewed, pureed, mashed, and fermented into beer and wine. In the Catholic countries of southern Europe, the vegetable’s original home, it traditionally paired with salt fish. In England it gave rise to a lustrous winter soup. Three botanical varieties were generally known to early Americans: *Pastinaca lucida*, the shiny leafed parsnip; *Pastinaca sativa*, the common parsnip; and the *Pastinaca opoponax*, the rough parsnip. The last had a root widely thought poisonous, but the sap had been rendered into a medicinal gum by medieval apothecaries. The Irish used the seeds of the common parsnip as a curative for stomach disorders. During the colonial period settlers made no differentiation of the root into garden varieties. When experimental agriculture and gastronomy both took off in the 1820s, horticulturists recognized three culinary types: the common, the Guernsey, and the hollow-crowned. These parsnip varieties produced roots of great length—delving into the soil as much as a yard—and boasted greater sweetness than twenty-first century market parsnips, roots that average under a foot in

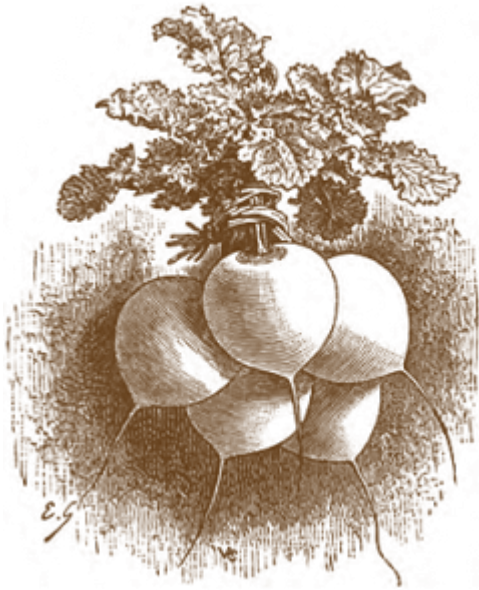
length. The current style of parsnip—modeled on the modestly sweet and compact “Tender and True” variety introduced early in the twentieth century—lacks the robust flavor of the earlier sorts. But it has eliminated the primary fault of the earlier varieties, the hard core that made portions of the root tough chewing for livestock.

Parsnips required rich soil that has been trenched at least 20 inches in depth. Clods had to be up and stones removed, or else the roots grew crooked. This would prove to be a concern in New England. In the south, seed is broadcast or planted in shallow drills on the first warmish day in March. Harvest takes place in October or November, when the leaves yellow on the stalk. Hardier than carrots, parsnips can stand up to extremes of weather. The farmers in the nineteenth century believed the roots tasted better if left in the ground until after the first substantial frost.

From the earliest period of European colonization of North America, the parsnip proved an essential vegetable. Indeed, “New England’s Annoyances” (1643), America’s first folk song, complains that “Instead of pottage and puddings, custards and pies,/ Our pumpkins and parsnips are common supplies.” In the absence of barley and beer, the poet observes “we can make liquor to sweeten our lips/ Of pumpkins and parsnips and walnut tree chips.” This last was no far-fetched claim, for parsnip beer and parsnip wine (including a sparkling version) graced the table of American homesteads well into the nineteenth century.

The turnip

When North America was first settled by the English at the end of the sixteenth century, the turnip had not become a mainstay of the home table in England. While present throughout the country, particularly in conjunction with hop fields, it was a crop for stock feed rather than human food. A vegetable mentioned by Roman agriculturalists Cato and Columella, it may have been introduced by Roman colonists to England and naturalized into the local herbage after the Roman evacuation. The herbalist Gerard at the end of the sixteenth century noted that its cultivation as a food centered in Hackney outside of London, and appeared in the city only at the Cheapside cross when women of that village carted it in after harvest. Its insinuation into the English diet may be due to the tastes of Dutch expatriates in England. Over the course of the seventeenth and eighteenth century it grew in regard as animal feed and human food. The county of Norfolk made it the basis of its highly reputable dairy and stock system. The poor of Wales made it a staple of home cookery. Arthur Young, the greatest English agronomist of the last half of the eighteenth century, campaigned tirelessly for its incorporation into the diet of sheep. At the time of the potato famine in Ireland, David F. Jones published *Turnip Husbandry* (1847) in Dublin, hoping to move the nation to its adoption as the basis of feed and diet. In the United States it enjoyed popularity in every region among every class of people throughout the nineteenth century.



Growing turnips required some craft then, particularly to avoid devastations of "the fly." The turnip fly (*Haltica nemorum*), a small jumping beetle, devoured the seedling sprouts of the turnip, killing plants before they became established. As a countermeasure to its depredations, experienced planters sped the process of vegetation. For quick germination of seed, the farmer soaked it in rain water for a day. Daring farmers warmed the water and then doused it in lamp oil or lime to impart a flavor offensive to the fly. To quick-dry the seed, the farmer rolled it in ashes or plaster. In the 1830s, traditional farmers sowed the seed broadcast, while experimentalists used a planting device, such as a dibble or a Bennett's drill, to set the seed in regular rows; orderly arrangement made hoeing a much easier task. At the time of the first hoeing, plants were thinned to a spacing ranging from 14 inches to 2 feet depending upon the size of root desired. Crowding stunted growth in the roots. Turnips favored well-plowed soil that had been manured with rotted (old) dung and/or lime. Because turnips were usually intended as a fall-winter vegetable, the crop was sown in July in northern states, August in the middle Atlantic, and September in parts farther south. A maxim directed that "the later turnips are grown the better they are for table." Because of the late date for sowing, turnips usually were a second crop in a field during a season, following a grain or peas. Early on, the power of the turnip to fix nutrients in the soil as well as extract them made them valuable in rotations. Arthur Young advised that turnips be planted before crops of wheat and rye in a season on the field. In the United States, the favorite rotations placed it as a second crop, following field peas or wheat, and preceding buckwheat, rye, or wheat.

During the second quarter of the nineteenth century, the White Norfolk and the Yellow Bullock (or Scotch Yellow) were the favored varieties in cultivation, the former coming to maturity earlier than the latter. The White Norfolk possessed several distinctive virtues: it grew productively; its greens and root appealed greatly to sheep and cattle; and it could over-winter in the

ground, while the common turnip would spoil in frozen fields. Common turnips came in two basic types: the flat turnip and the globe. The flat turnips were further distinguished into green top and red top varieties. The white globe enjoyed increasing popularity during the middle decades of the nineteenth century, as did the Hanover variety. During the latter decades of the nineteenth century, when epicurean interest in the vegetable grew, the varieties began to be distinguished in the market and cookbooks by the color of their flesh rather than their configuration. Among the kitchen varieties of white fleshed turnips to emerge, the most reputable proved to be the White Egg, a quick-growing, smooth ellipsoid root with a sweet mild flavor, the Jersey Turnip, a parsnip-shaped root with a clean nutty taste, and the Pomeranian White Globe, cherished by cooks for the eye appeal of its perfectly round roots. The Norfolk remained in favor because of the succulence of its greens, rivaled only by the Seven Top in the south. Regional preferences found expression in New England's fondness for the Sweet German turnip, a hard-fleshed sweet root known for its tolerance for cold weather. Southerners seeking an early crop turnip planted the Early White Flat Dutch Strap-Leaved variety throughout the Reconstruction period.

While turnip roots could be consumed raw by livestock, progressive farmers chopped and steamed them when using them as feed to aid digestion. Among traditional and experimental farmers a consensus reigned that turnips were fine food for horses, hogs, and sheep. Debate raged, however, over whether turnips imparted an odd taste to butter and milk when fed to dairy cows.

The rutabaga

The rutabaga, or Swedish turnip, became an object of intense experimentation because of the favorable report of William Cobbett, the English-born agriculturalist and political writer, in one of the first issues of the *American Farmer*. Throughout the early 1820s, the magazine distributed rutabaga seeds to interested farmers in every region of the United States.



The root had two advantages over common turnips: the rutabaga was more productive, capable of yielding as many as 600 bushels per acre, and more nourishing. In the 1820s, husbandmen adopted the root widely, and by the 1830s its virtues were generally recognized. A Genesee farmer enthused, "This turnip is far more nutritious than the common turnep, keeps much longer, and is greedily devoured, cooked or raw, by horses, cows, sheep and hogs; and is withal a very excellent vegetable for the table ... Of all root crops, if we except the common turnep, this is the least exhausting, occupies the ground the shortest time, is cultivated with the least expense, is saved with the least care, and we think makes the greatest return in food for animals." The yield of the rutabaga won general appreciation, but the root had its liabilities in certain eyes. Among dairy farmers, particularly in New England, it fell out of favor because it "communicates an unpleasant flavour in milk when fed to cows." It was also said to taint the flavor of meat if cattle were fattened on the root in the weeks before slaughter. Yet if sheep and swine populated your farm, rutabaga proved beneficial. Levi Lincoln, the head of the Massachusetts Agricultural Society, reported that swine "became fond of the Roots, and will continue to eat them greedily through the winter."

Because the vegetable is a cross between a wild cabbage and a wild turnip, the leaf and stalk are also edible to humans and livestock. In the south there existed a sect of farmers who granted that swine loved the root, but would not grow them because they made horses "windy." One experimentalist, "Darien," argued in the pages of the *Southern Agriculturist* that any problem that horses had digesting rutabaga could be countered by salting and steaming the root. He closed his argument by noting it was as good a horse food as corn, that an acre of rutabaga produced much more food than an acre of corn, and for half of the labor and expense. "Darien" conservatively calculated that an acre of rutabaga yielded 300 bushels of roots; that same acre in corn generated 20 bushels. When faced with these sorts of yield numbers, the calculating farmer had to decide whether sweet potato or rutabaga was more productive; in the north, whether rutabaga or mangel wurtzel was the more economical pick. Because yields of

these rival crops were roughly comparable, the decision turned on other matters: human taste preferences, and marketability in the neighborhood.

Mangel wurtzel

The mangel wurtzel is unusual among root vegetables in that much of the bulb grows above ground, exposed to the elements. Consequently it had to be harvested before frosts could damage the plant, weeks before rutabagas or carrots. It possessed a number of solid virtues: it did not taint milk with any pronounced flavor; it lacked insect predators; it tolerated drought; it fattened cattle more efficiently than grains; and it kept well, provided the stalk was trimmed an inch off the root rather than flush. Indeed, its durability became legendary among farmers on both sides of the Atlantic. Of winter feed roots, "the white turnip is in March entirely divested of its fattening power; the Swede [rutabaga] in May becomes shriveled, and is almost refused by cattle; the potatoe after this time entirely sprouts away all its vigour, diminished in bulk and dries up; but not so the mangel wurtzel." Its powers remained undiminished the year round.

Because the cultivar was a novelty, it became the subject of a multitude of comparative experiments. The Albemarle Agricultural Society in Virginia tried it against rutabaga and found the advantage all to the mangel wurtzel. Col. John Hare Powel, corresponding secretary of the Pennsylvania Agricultural Society, undertook in the early 1820s a widely publicized trial of the root as feed, comparing it with corn: "my neat cattle prefer mangel wurtzel to any root which I have offered them. I have found its effects in producing large secretions of good milk very great. I selected in November, two heifers of the same breed, and very nearly of the same age, and in similar condition; they were tied in adjoining stalls, and have been fed regularly three times a day by the same. One of these had four and a half pecks of mangel wurtzel and four quarts of corn meal daily. The first, which has had mangel wurtzel alone, is in the condition of good beef; the other is not more than what graziers call half fat."

Abbe Rosier, the French agricultural encyclopedist, observed that the French used the leaves of the plant as well as the roots for feed, stripping stalks of the largest leaves as many as six times in a growing season. The roots, when prepared as feed, were chopped to the size of nut meats, mixed with a measure of cut hay or clover, or sometimes, for hogs, served in a trough of milk. Animals devoured them raw, so the time and expense of cooking the roots, as in the case of potatoes, was avoided. The Abbe anticipated a twenty-first century practice in which pellets processed from root vegetables are mingled with silage to aide in their consumption by livestock.

Because a mangel wurtzel could grow to ten pounds, it required chopping. It also required space in the garden or the field, so it tended to be intercropped with vegetables that grew vertically, particularly English peas, or compactly, such as cabbages.

Though both stalks and root can be eaten by humans, the former boiled like chard, the latter boiled and mashed, it never found a place on the American table. Some made beer of the root. Some added the leaves to pot liquor. But every other root vegetable here discussed has a more pronounced flavor. If one's horse relishes what one considers mediocre fare, then give the root to the horse.

The beet

William Cobbett noted in 1820 that the beet, a root that had never enjoyed great popularity in England, had been embraced by American farmers. Eighteenth-century farmers tended to categorize beets by color—yellow, white, and red (blood), with the last receiving most favor. Nineteenth-century farmers made further discriminations on the basis of root shape, with tap-rooted beets vying with round-rooted (or turnip-rooted) beets for attention. Both sorts required a deeply dug, loose soil to prevent clods from causing roots to fork or deform. By the 1830s, a number of named varieties appeared regularly in nursery seed stocks: Early White Scarcity, Early Dwarf Blood, Early Blood Turnip-Rooted, Yellow Turnip-Rooted, Long Blood Red, Green, and the French Sugar. The early beets were sown in spring, preferably during a rainy spell since dry seed had a penchant for not sprouting. Soaking seeds several days before planting was a general practice in drier regions of the country. Once sprouted, the leaves were stripped for cattle feed every fifteen days. "Oxen, cows and sheep devour them greedily, and fatten readily upon them. All domestic poultry eat them readily, when chopped fine and mixed with grain."



Of all the beet varieties, the French sugar beet most fascinated the experimenters. Jesse Buel observed in the 1830s that "The beet culture in France now furnishes annually a hundred millions of pounds of sugar, for human consumption; while the refuse of the crop enables the French to enjoy the luxury of good beef and good mutton, which were scarce commodities with them before the beet culture was introduced." The French sugar beet had an amber-red skin, with white body. It was not a good table beet. While Germans had derived sugar from beets as early as 1447, France became the center of sugar

experimentation during the Napoleonic era when the Milan Decree of 1809 forbade the importation of British West Indian sugar.

Throughout the 1830s, when southern planters attempted sugar cane culture as part of agricultural diversification, they discovered that the plant's sensitivity to cold made it nearly impossible to thrive to the north and west of the Carolina Lowcountry. The sugar beet and sorghum, however, were substantially more cold tolerant. New Yorkers experimented with beet sugar with success, enabling the manufacture of sweeteners locally. The grip of the West Indian cane planters on the sugar bowl was broken by the French beet.

While humans preferred to consume the granulated expression of the beet's natural sugar and not the root itself, cattle enjoyed and greatly benefited from both the greens and the pressed pulp of the beet. By the 1830s it had established itself as a primary form of winter feed for herds. For the remainder of the century, a debate raged among the partisans of sugar beets and those of mangel wurtzel over which better served herds as feed. By the 1870s the economics of the sugar beet—the ability to secure two products, cattle feed and granulated sugar—made northern farmers begin to regard mangel wurtzels as “great pulpy sacks of water.” The advantages of the beet remain unchanged in the twenty-first century, when Canadian herdsmen and beef producers in the Upper Midwest have embraced the root for feed and for sugar production. The cattle can eat the beets unprocessed, mixed with straw. The beets overwinter well in cold regions, though the return of spring and heat can cause insect problems. Pulp left over from beets that have gone through the sugar extraction procedures, converted to pellet form, make up an important component of animal diet in those northern zones where corn does not grow well.

The delectation of beasts

Farmers distinguished livestock into creatures that devoured plants exclusively, the herbivores, and those like human beings that ate anything, the omnivores. Some herbivores—cattle, sheep, goats—had stomach adaptations (a bacteria-filled compartment) that assisted them digesting plant matters; others—horses and rabbits—had an enlarged large intestine and caecum filled with microorganisms that dissolved cellulose. Omnivores—pigs and fowl—consumed a vast range of flesh, fruit, milk, and plants. Because mammalian omnivores, from human perspectives, bore a great resemblance to *Homo sapiens* in their structures of digestion, livestock farmers presumed that cooking animal food would be the best way to secure its nutritive benefits. Whether this also proved true for herbivores was hotly debated, with proponents of raw feed predominating.

Observers of animals' feeding habits had discovered certain limits and proclivities of taste. Foremost, they saw that omnivores' taste was more sensitive than herbivores', or even the carnivorous pets kept in the buildings and yards. Cats lacked sensitivity to sweetness. Dogs showed indifference to salt. Pigs, however, smelled and sampled much, loving sweet and bitter things

particularly.

At first, questions of taste were governed by a notion of communicability. Things that tasted sweet to humans when fed to livestock would be imparted to the flesh of the creature, so that when slaughtered and consumed by humans it would taste sweet. This theory depended upon a rather unreflective belief that what tasted sweet to humans would taste sweet to creatures, and furthermore that one became what one ate. Eat sweet, become sweet. While there was some empirical grounds for this theory when omnivores such as hogs or goats were involved (sweet sapped apples fed to fatten hogs in the weeks before slaughter did improve the taste of flesh measurably, except on dung hill hogs), the farmer was nonplussed when discovering some animals indifferent to foods that he or she savored. Cattle, for instance, preferred sweet potato greens chopped as silage to the chopped roots. The farmers loved the roots but tended not to include potato vines in the family's pot liquor. So the question arose, what do cows really like, and why?

Animal physiologists in the later half of the century found a register of mammalian savor for different foods in the amount of saliva generated by the submaxillary glands (in cattle a range of 110 grams in 15 minutes for hay to 20 grams in 15 minutes for juniper berries). Early in the century, when comparative anatomy was relatively undeveloped, attention centered upon the mechanics of the tongue. Two beliefs undergirded the interpretation of experimental findings about the mechanics of taste: that analogous structures in the mouth (a glossopharyngeal nerve, papillae on the tongue) produced similar effects in humans and "higher animals"; and that the sensate experiences of humans could model that of most animals. Regarding the former belief, the similarity of papillae between species seemed more significant than structural differences, such as the sheathing of the conical papilla in ruminants in a long, slender, flexible, horny filament that curved backward, or the spiny sheathing of the papilla in cats that gave the tongue a rasplike texture. Regarding the latter belief, the human educability of taste—the capacity to savor items such as putrid eggs—suggested disgusting tastes or smells could be overridden, particularly if hunger, habit, or reflection guided consumption (consider the durian fruit.) This last conviction led farmers to believe that livestock could be taught to consume things for which they had a natural distaste, so economical foods might be substituted for naturally sought after food. Yet when livestock were being fattened for market, reversion to savored foods, particularly those with high sugar or fat content, promised best results in terms of speed and effectiveness of weight-gain.

For cattle the substitution of roots for grasses and grains as feed reflected current understanding of the educative character of taste. Attention to the predilections of cattle when consuming roots instructed farmers to develop qualities in root vegetables that caused them to be eaten in greater quantity and with greater avidity. Two brute observations made during the experimental age guided both the breeding and processing of root vegetables: the first, that cattle had a liking for sweet things, and the second, that the odor of sweet

roots did not immediately set cattle feeding, even in the stall. The consequence was a mixed feeding regimen, at first with roots being boiled with grain, and later with the roughage that cattle naturally consumed intermingled with shredded, cured roots. Swine were found to prefer cooked roots. Certain vegetables—the turnip and sweet potato particularly—had greens that livestock savored as much as hay and more than the roots. These were harvested, made into silage, and served mingled with the root. This is not greatly different from twenty-first-century feeding schemes, mixing roughage with pellet-formed feed derived from root vegetables or grains.

Potatoes, because of their high starch content, became a favored fattening root in the north. A writer in the 1835 *Genesee Farmer* reported, "Potatoes are principally used for the fattening of swine and stall feeding of beef. In the former case they are always cooked, in the latter they are given in the raw state ... Cattle fed in this way will not require a great amount of hay ... Beef made from potatoes has a peculiar sweetness and ... juiciness, but it is thought the animals fall away more in driving to market than those which are fattened on Indian meal [i.e. corn meal]. Of their relative value compared with ruta bega, mangel wurtzel, carrots, parsnips and beets, I shall reserve an opinion until some future occasion." Henry William Ellsworth summarized a decade of experiments about feeding pigs—a daunting task given the omnivorous tastes of swine. He noted the western predilection for feeding pigs corn, and organized his observations in terms of other food's greater or lesser economy and efficiency in fattening animals, registered in dollars and cents and pounds and ounces. Popular feeds such as Arthur Young's oats and pea soup for young hogs are assayed, as well as novelties such as corn cob mash. Among the telling experimental results: it took 140 pounds of turnips to fatten swine to the level achieved by 84 pounds of potatoes; that hogs have a decided preference for sugar beets over rutabagas and carrots; that cooking and mashing beets and letting them sit for two days makes the avidity of hogs for beets strikingly more pronounced; and that Jerusalem artichokes vie with other roots, including potatoes, in terms of their efficacy as a fattening agent. Ellsworth's account is particularly noteworthy because it captures the contest between theoreticians' assessments of the chemistry of nutrition and the practical experimentalists. Chemical theories of nutrition and growth—such as those propounded by Sinclair in the mid-1830s—predicted weight gains that did not pan out when field tested. Even Justus Liebig's elemental scheme—popularized in the 1850s, finding nutritive potentials in potassium, magnesium, nitrogen, and iron—only suggested general tendencies in nourishment and growth because it did not take into account the complications of compound whole foods.

Experimentalists, while paying lip service to new scientific accounts of nutrition, bred vegetable varieties with an eye firmly fixed on the most measurable pragmatic ends: the visible savor of animals, the vendibility of cultivars at market, and the capacity of foods to improve health and girth in creatures great and small. The breeding of mangel wurtzel, rutabaga, and turnips in particular, and sweet potatoes to a lesser extent, were driven by these concerns in the 1830s to 1860s. While the savor of new varieties of roots

to humans suggested possible directions, particularly in turnip culture, the hybridizing of mangel wurtzel was conducted primarily with experimentation in feed trials with animals exclusively. These experiments, and the investigations of the edibility of the greens of these vegetables as silage, gradually generated a literature, and, one might say, an elaborated empirical understanding of certain differences of taste between humankind and ruminants. In the twentieth century this knowledge would drive the creation of flavoring agents that would make cheap feed palatable.

Further reading

For the place of root vegetables in a farm's production system, see Jesse Buel, *The Farmer's Companion* (Boston, 1839); also, Timothy Pickering, "On Root Crops," *Address to the Essex Agricultural Society* (Salem, 1818).

Instructions on growing root vegetables can be found in any of the following volumes, which constitute the American canon of vegetable gardening during the experimental age: Thomas Green Fessenden's *The New American Gardener* (Boston, 1828), Thomas Bridgeman's *The Young Gardeners Assistant* (New York, 1837), Francis S. Holmes's *The Southern Farmer and Market Gardener* (Charleston, 1842), Loring D. Chapin's *Handbook of Plants & Fruits or The Vegetable Kingdom* (New York, 1843), Robert Buist's *The Family Kitchen Gardener* (New York, 1847), William N. White's *Gardening for the South* (New York, 1857), Alexander Watson's *The American Home Garden* (New York, 1859), Fearing Burr, Jr., *Field and Garden Vegetables of America* (Boston, 1863).

For empirical experiments treating livestock taste see T. G. Fessenden, "On Making Cattle Very Fat," *New England Farmer* 1, 40 (May 3, 1823), and Henry William Ellsworth, *The American Swine Breeder* (Boston, 1840). For a summation of nineteenth-century discussions of the physiology of taste in farm animals, see Robert Meade Smith, *The Physiology of Domestic Animals* (Philadelphia, 1890).

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