

*The Role of Horticulture
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CHAPTER 1

Horticulture and Human Culture

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INTRODUCTION

Earth is a plant-oriented planet. The green plant is fundamental to all other life. Were humanity to perish tomorrow, vines would destroy our mighty temples and grass would soon grow in the main streets of the world. In contrast, the disappearance of plants would be accompanied by the disappearance of humankind along with every other animal.

The importance we attribute to any product, however, is related to the probability or actuality of a shortage rather than intrinsic value. Thus, those that are plentiful and readily available are often held in low esteem, even though our very existence may depend upon them. The oxygen we breathe, the nutrients we consume, the fuels we burn, many of the most important materials we use, are all related to plant life.

Plants have a wide spectrum of uses. The most obvious is for human sustenance. Plants supply all of our food, either directly or indirectly as feed for animal intermediaries. They are also utilized as a source of structural support, as a construction material, and as the raw material in the manufacture of fabrics and paper and such synthetics as plastics and rayon. We have come to depend upon many of the complex substances that plants produce—dyes, tannins, waxes, resins, flavorings, medicines, and drugs. Living plants, besides having a direct effect on the ecological position of humans, are used to control erosion by water and wind, to provide a setting for recreation and sport, as landscape materials, and to satisfy our desire for beautiful objects.

The story of humanity is largely a chronicle of our struggle for dominion over the environment. The efficiency of this control is thought of in terms of civilization, or culture. To a great extent, controlling the environment means controlling plant life. The failure to provide a high standard of living for the population as a whole in so-called underdeveloped countries is generally associated with an inefficient system of crop production and distribution. Similarly, the decline of developed societies can in many instances be associated with a disruption in the basic system of resource utilization. Crop production, the management of useful plants, is the very basis of our civilization.

The perceived relationship of plants and people has changed throughout human history and is still changing. Let us trace three cultural waves: pre-agricultural, agricultural, and industrial, and then step into the future.

PRE-AGRICULTURAL

Human beings have been hunter-gatherers for 99% of the 2 million years our race has roamed the earth; only in the last 10,000 years have people been agriculturists. Jack R. Harlan, in his book *Crops and Man*, summarized the life of pre-agricultural peoples based on the experience of hunter-gatherers from Australia. At the time of European contact, the continent was populated by about 300,000 people without a single domesticated plant. Food supply was largely by plant gathering not by the hunting of game. Early humanity, from the beginning, depended upon botanical knowledge for existence. They became familiar with literally hundreds of species. They knew how to clear or alter vegetation with fire, sow seed, plant tubers, and protect plants. They laid claim to individual trees and tracts of land, celebrated first-fruit ceremonies, prayed for rain, and petitioned for increased yield and abundant harvest. They spun fibers, wove cloth, and made string, cord, baskets, canoes, shields, spears, bows and arrows, and a variety of household utensils. They painted pictures, carved masks and ritual objects, recited poetry, played musical instruments, sang, chanted, performed dances, and memorized legends. They harvested grass seeds, threshed, winnowed, and ground them into flour. They dug roots and tubers. They detoxified poisonous plants for food and extracted poisons to stun fish or kill game. They were familiar with a variety of drug and medicinal plants. They understood the life cycles of plants, knew the seasons of the year, and when and where the natural plant food resources could be harvested in greatest abundance with the least effort. As long as populations were below the carrying capacity of the land, famine and starvation were rare. There was a large amount of leisure time. In some ways, it was the golden age!

Man as hunter is another aspect of the human experience that has had a profound impact on human culture. Prehistoric artifacts and Neolithic cave paintings provide a clear insight into the origins of hunting and hunting technology via remains and pictorial representations of weapons (the spear, bow and arrow, the missile), evidence of hunting organization, and depictions suggesting religious and mythic influences. In the once smoky caves, we see dazzling pictures of animals with little if any suggestion of plants. Yet, Paleolithic burials show high pollen counts that suggest evidence of floral offerings to the dead.

The hunting experience has not disappeared from our present-day culture. It remains in the suburban fox hunt—"the unspeakable chasing the inedible"—the lure of the National Rifle Association, in the participation of weekend warriors in war games, the longing to cover our bodies with fur and leather, and our love of hunting canines now transformed into spaniels and lap dogs. The domestication of animals modified hunting into herding and nomadic life. The symbiotic relation of people and grazing animals (sheep, goats, cattle, camels) with pasture and forage plants created a tripartite bond that is reflected in the metaphors of the good shepherd and the cowboy. Herding took people out of the cave and placed them under the stars during their trek for green pastures and provided time for contemplation, to develop soaring poetry, religious sagas, and the beginnings of astronomy/astrology.

THE AGRICULTURAL REVOLUTION

The most sweeping technological change for humanity occurred in prehistory: the use of tools, the discovery of fire, and the invention of agriculture. Knowledge concerning the origins of agriculture comes to us from the diggings of archaeologists but also from deep,

subconscious memories that surface in the form of legend, myth, and religious teachings. Agriculture appears in the compressed time warp of the archaeologist as a sudden transformation referred to as the Neolithic Revolution. About 10,000–12,000 years ago, in the highlands of the Tigris-Euphrates River complex, there appeared the sure remains of sedentary existence and the beginnings of cultivation. The history of humankind irrevocably changed.

The precise origins of agriculture are unknown. The traditional view has been that agriculture is a divine gift. In Egypt, the source was the goddess Isis, the black soil of the delta, created by the touch of her husband and brother, Osiris, the Nile itself. It was she who discovered wheat and barley and, in thanksgiving, was worshipped in December, when the sun was reborn, as she nursed, in a stable, her miraculously conceived son. In Greece, she was Demeter and, in Rome, she was Ceres and Flora; in the New World, agriculture is a gift of Quetzalcoatl, a god disguised as a plumed serpent.

The biblical account in Genesis is the other side of the coin. Agriculture is not a gift, but a curse. Adam (man) was originally given every herb-bearing seed and was provided abundant provision in the garden of Eden. Eve's quest for knowledge is punished by the pain of childbirth and subjugation to her husband, while Adam must toil by the sweat of his brow. Their children continue to get the same message. The offering of Abel (the nomad) is preferred over Cain's (the cultivator), and the first conflict between rancher and farmer is decided violently. (Clearly, a nomad, with time to contemplate the stars and to chant soaring poetry, was the author of the book of Genesis.)

The universally accepted theory for the origin of agriculture is that it developed from a series of inventions emanating from the discovery, by sedentary people, of seed or vegetative propagation. Cultivated plants and domesticated animals substituted for the bounty of wild species previously harvested by gathering and hunting. This concept was first formulated by Charles Darwin, and the details were modified by various students of agricultural beginnings. Jack Harlan (1975) has made the point that every model for the origin of agriculture has evidence against it and concludes that the best model is no model. His conclusion is that humankind found various reasons and various ways to come up with similar solutions to fundamental problems. Whatever the precise impetus for the origins of agriculture, there is no question that the effect has been cataclysmic.

Survival systems based on gathering and hunting are successful only when the human population is maintained well below the carrying capacity of the land. Harlan has made a good case that present-day hunting societies function with little effort and great leisure and desist from agriculture more out of inclination than lack of knowledge or skill. Despite the leisure and ease of present-day remnants of gathering and hunting societies, these cultures are restricted and cannot expand. In fact, it is clear that all hunting societies developed strategies to restrict population by a combination of tactics such as warfare, sexual codes to delay conception or to restrict fertility, and perhaps murder, be it euthanasia for the old or infanticide for the young. Whatever the precise impetus for the exchange of the vagaries and thrill of the hunt for the security and toil of agriculture, a way was found to maximize productivity by domestication of wild plants and animals. Agriculture ensures increasing food production, but it also makes high population an economic asset for the producer. Thus, modern mores that extol the sanctity of life, high fertility, and the work ethic are a direct result of the agricultural revolution.

The discovery of agriculture is remarkable for two reasons. One is its universality. Although it is tempting to ascribe a single locus and a diffusion pattern, the evidence suggests that agriculture was an independent discovery throughout many parts of the world. For example, each great ancient civilization was based on grain—a nutritious, compact, and versatile source of food: wheat in Europe and the near East, rice in Asia, maize in the Americas, and sorghum in Africa—thus demonstrating the technological brotherhood of humankind. The second remarkable aspect of agriculture is the perspicacity of each population in ferreting out the desirable species—plant and animal—and transforming them into

new entities—crops and livestock, a process known as domestication.

Domestication involves two distinct events. One is to identify potentially useful species and the other is actually to transform them into dependable servants. The latter is accomplished by no less than a genetic transformation achieved through selection of genetic variants that intensify desirable traits and eliminate undesirable characteristics.

The choice of appropriate species seems obvious when it is completed, but so are all acts of genius. The virtue of the original, unimproved, selected species may not have been so obvious. Cassava, for example, is poisonous, and many crops are unpalatable or inedible without the cooking process.

Selection (differential reproduction) led inexorably to evolutionary changes, as the process converted weedy plants to new species dependent upon people to complete their life cycles. The traits desirable from a human perspective are often ones that prevent survival of the plant. Cultivated plants, unlike weeds, are usually unadapted to exist without the benefit of human interference. The development of crops resulted in a loss of independence of both people and plants. As in the case of the dairy farmer and his herd, it is not clear who serves whom the most. Many crops, maize, for example, have been so altered that they no longer exist outside cultivation, and a direct connection to their ancestors has been obliterated.

The success of domestication assured the expansion of agriculture. Examples of fundamental alterations in crops are changes that ensure dependable cultivation and increase harvestability (e.g. loss of seed dormancy and seed shattering) and alterations that increase productivity, usually by altering the proportion of the plant that is economically useful (harvest index) rather than an increase in true biological efficiency.

The end result of the agricultural revolution has been a fundamental change in the human condition. The interaction of people, crops, and domestic animals has resulted in fused genetic destinies. An abundance of food causes changes in selection pressure and alterations of human evolution equivalent to those wrought by the domestication of plant and animal species.

Agriculture, by creating not only a dependable food supply but a surplus to be stored, permitted civilization to develop. In the process this new system pushed out the hunter and the nomad and rapidly expanded to all usable land, filling it with people even beyond its capacity! As agriculture produced more food, it instilled the quest for fertility—of corn, of cattle, of soil. The present population explosion has its roots in that phenomenon.

The social ramifications of the Neolithic Revolution remain. They include the implications of territoriality, our feelings regarding fertility and population, and our attitude regarding community. Important technological questions remain unresolved. Have our forebears made, in fact, the best choices of servant species? Are we hostage to the solutions of our forebears, or can we begin anew? One is awed by the conservatism of the human species seemingly held captive by the resource base of the past.

THE RISE OF HORTICULTURE

The intensive use of plants for people is the meaning of horticulture. Its origins are inseparable from the beginnings of agriculture. Horticultural art and technology survived the dark ages in monastic gardens and gardening became an integral part of monastic life, providing food, ornament, and medicines. The gardener (*hortulanus* or *gardinarius*) became a regular office of the monastery. As feudalism gave way to trade, garden culture was taken over by secular rulers and the rising monied middle class. The rise of horticulture during the Renaissance is to be found in the formal gardens and magnificent landscapes of European royalty, and reached a peak in the Palace of Versailles, constructed over a 25-year period by Louis XIV and designed by his architect, Andre Le Nôtre (1613–1700).

The resurgence of horticulture comes to us in the illustrated and printed herbals, in the

threads of medieval tapestry, and romantic poetry. Shakespeare, the greatest writer in English—if not the greatest in any tongue—is a rich source of horticultural information. The Renaissance came late to England but flowered with a brilliance that still interests humanists and scientists alike.

The great bulk of Shakespeare's imagery is drawn from everyday things, seen and unseen. Of all the images of nature, the greatest number is devoted to horticulture. Who can forget that "rough winds do shake the darling buds of May." Shakespeare displays an intimate knowledge of plant growth, propagation, grafting, pruning, manuring, weeding, ripening, and decay. Over 200 plants are mentioned. The horticultural imagery and allusions have become part of our culture and fuse plant lore and literature. The gardener to the King in Richard II is so instructed:

Go bind thou up young dangling apricocks,
Which like unruly children make their sire
Stoop with oppression of their prodigal weight;
Give some supportance to the bending twigs.
Go thou, and like an executioner
Cut off the heads of too fast growing sprays.
That look too lofty in our commonwealth;
All must be even in our government.

SHAKESPEARE, RICHARD II (III, iv, 29–36)

PLANTS AS SYMBOLS

Symbols invoke images deeply embedded in the human experience. In many cases, the original meanings have become changed and subverted as layers of new meanings are superimposed over the old. The significance of plants to human history—for sustenance as well as healing—has created a rich treasure of plant symbolism that we cherish without a clear understanding of its origins, yet its power is such that we pass it on to our children generation after generation. This has intensified with the rise of agriculture and it is no accident that the symbolism of sexuality and fertility is especially powerful in plants—scarcely repressed in present-day romantic uses of flowers.

Thus, the poisonous white fruit of the parasitic European mistletoe, *Viscum album*, was once considered to be the generative power of the oak god. In the Renaissance, remembering its phallic significance, mistletoe became a love charm, and this memory is retained in our modern custom of kissing under the mistletoe at the Christmas season.

Flowers still retain extensive ceremonial use in the expression of joy, affection, welcome, gratitude, sympathy, celebration, grief, friendship, marital union, or spiritual contemplation. Flowers have become the "language of love," and we still "say it with flowers."

Plants with strong aromas and flavors very early attracted human attention, probably, at first, for magical rites, spells, purification ceremonies, and embalming, as well as for fragrances, perfumes, and cosmetics. We prefer their odor to our own as we sweeten our breath with their essences and perfume our bodies with their scents. Fragrances and perfumes have always played enticing roles in love making. The Song of Solomon combines eroticism with metaphors of spices and vegetative fertility. It is indeed a miracle that, through convoluted exegeses, the Song of Solomon has survived as a portion of Holy Scriptures.

The ancient traffic in spices is celebrated in the story of Joseph and his brother, who "saw a caravan of Ishmaelites coming from Gilead with their camels bearing gums, balm, and myrrh on their way to carry it down into Egypt." The voyage of Columbus, whose 500-year anniversary we soon celebrate, was lured by a shortcut passage to the spice-rich Indies. The new crops discovered in the New World were to prove more valuable than all the gold and silver stolen from the treasuries of the New World empires.

Towering over mortals, trees have always been powerful symbols endowed with spiritual meaning. They have long been worshipped, some times as oracular gods or goddesses. Many myths refer to the Tree of Life, and the sacredness of trees is retained as we knock on wood for luck. The story of Eve and the forbidden fruit (sometimes considered a fig, but transformed to an apple in our time) and the Christmas tree, which dates to pagan ceremonies in Southern Europe, retain the emotional impact of tree symbols.

The importance of plants to human history has made them powerful national symbols. The fleur-de-lis symbolizes France, the shamrock Ireland, the leek Wales. The red and white Tudor rose is the royal emblem of England, symbolizing the politic marriage of Henry Tudor to the Plantagenet Elizabeth of York, which cemented the peace after the Wars of the Roses, 1455 to 1485, between the House of Lancaster, which chose the red rose as its symbol, and the House of York, which carried the white rose.

Life cycle events are still memorialized by plants. Cigars are given out at our birth, and our first date and sexual awakening is ritualized in the exchange of floral sex organs—the corsage. Our fiancées are swept off their feet with roses, and the marriage couple is showered with rice to bestow fertility. We celebrate motherhood with flower arrangements, and, when gravely ill or near death, some are anointed with blessed olive oil; our deaths are memorialized with floral wreaths.

Our holidays—both secular and religious—are rich in plant symbolism. We toast the New Year with champagne, associate the father of our country with a cherry tree and the great Emancipator with a log cabin or split rails. On Valentine's Day, the florists get well. The ashes of burned palm fronds are daubed on Catholic foreheads on Ash Wednesday, and their lapels are graced by crosses of fronds on Palm Sunday.

The Jewish festival of Passover is celebrated with unleavened bread, bitter herbs, and a mixture of apples and wine. The wine and bread received during the celebration of mass by Christians transubstantiate to the blood and flesh of the Son of God. We remember our veterans with poppies, and our children celebrate Halloween with jack-o'-lanterns made from pumpkins. Thanksgiving is unthinkable without cranberries, and Christmas is synonymous with evergreen trees and wreaths.

Plants are also symbols of evil. Some plants have been, and will continue to be, associated with the dark side of nature. Shakespeare is obsessed with weeds as metaphors for decay and death. Hamlet declaims:

How weary, stale, flat, and unprofitable
Seems to me all the uses of this world!
Fye on it, ah fye! 'tis an unweeded garden
That grows to seed. Things rank and gross in nature
Possess it merely.

HAMLET (I, ii, 133–137)

The Queen in 2 Henry VI observes:

Now 'tis the spring, and weeds are shallow-rooted;
Suffer them now and they'll o'ergrow the garden,
And choke the herbs for want of husbandry.

2 HENRY VI (III, i, 31–33)

In our time, we have killer tomatoes, kudzu, and coca, which produces cocaine and crack, not to mention the tobacco in Kools, Carletons, and Camels. We also have stinging nettles, thorny brambles, poison ivy, poison oak, poisonous mushrooms, hay fever plants, crabgrass, and, my movie favorite, the odoriferous murky bogs where the villain quickly sinks up to his neck and slowly, horribly, subsides screaming, as he disappears below the ooze. Finally, George Bush has tried, with some success, to add broccoli to the list of evil plants.

PLANTS AS CURES

Herb lore was a complex discipline in primitive society, and the accumulated wisdom was dispensed by practitioners who became sacred healers with great power and prestige, despite their inability to cure in most cases—a tradition carried over to our modern physicians. Knowledge of the curative power of plants is the beginning of medical wisdom. The accumulation of knowledge, as well as misinformation, is stored in ancient and modern herbals that, to this day, have not lost their appeal. Probably, as a result of disaffection with the complexity of late 20th century life, herbal lore has undergone a resurgence as we sip herbal teas, gorge on oat bran cereals, and eagerly take up skin rejuvenators and elixirs. Yet, many of our most important medicines originate from plants: aspirin from willow bark, reserpine from Indian snakeroot (*Rauwolfia serpentina*), colchicine from autumn crocus, quinine from cinchona. The history of drugs is largely the early history of botanical science. The famed herbal of Dioscorides in the 1st century became the sourcebook for physicians for 1500 years!

Over 10% of dry mass of some plants is made up of chemicals designed for defense against predators. What is one creature's poison is another creature's medicine. The screening of plants for new efficacious pharmaceuticals is still in its infancy. It has been estimated that only 5,000 of 300,000 species have been intensively investigated. Plants are some of the most complicated chemical factories known, and we risk our future health if we ignore them or, worse, let them disappear through extinction.

THE INDUSTRIAL REVOLUTION

The rise of the industrial revolution in the 19th century led to the industrialization of agriculture—first by mechanization and then by the application of chemistry in the form of fertilizers, herbicides, and pesticides and biology via genetics, plant breeding, and biotechnology. This has produced a population explosion in the developing world and a surplus of food in the developed world at the same time it has resulted in a dearth of farmers. In the United States, there are more unemployed workers than agricultural producers. In the rich countries of North America, Europe, and the Pacific Rim, the typical person is on the verge of being cut off from direct contact with plant life. Our athletic fields have been stripped of grass and replaced with Astroturf; our cotton jackets are made of nylon; our bouquets are silk flowers; our once wooden school desk is now plastic. Even our great parks are being strangled, with the light cut off by skyscrapers and open spaces eaten up by buildings and roads. Worse, the crime rate of our cities has become such that our parks become repositories of fear as soon as the sun goes down.

The changes in agriculture brought about by the industrial revolution brought into sharp focus many problems with which traditional practices could not cope. Progress in agriculture had been, up to the early 19th century, largely derived from empirical studies. The accumulated successes and improvements had become embedded in human consciousness via legend, craft secrets, and folk wisdom, and had become part of our modern culture. This information was stored in tales, almanacs, herbals, and histories. More than practice and skills were involved as improved germplasm was selected and preserved via seed and graft from harvest to harvest and generation to generation. The sum total of these technologies made up the traditional agricultural lore.

The scientific tradition is not as old as the empirical but it is ancient nevertheless. Its beginnings derived from attempts at systematic discovery of rational explanations for nature. Science, from the Latin "to know," is a method of accumulating new information about our universe. The driving imperative is the desire to understand. If necessity is the mother of invention, curiosity is the mother of science. The scientific method involves experimentation, systematic rationality, inductive reasoning, and constant reformulation of

hypotheses to incorporate new facts. When new explanations of natural phenomenon are accepted, they must nevertheless be considered not as dogma but as tentative approaches to the truth and, as such, subject to change. The process is cumulative, and science is only alive when it grows. When any society claims to know the complete truth and that further questioning is heresy, science dies.

The rise of modern science in botany and agriculture has led to a scientific establishment in public and private universities and state and federal experiment stations. These institutions have developed a vast pool of agricultural information on soils, diseases, and insects and have developed improved cultivars of plants that provide the basis for increased agricultural productivity. The enormous advances made in the agriculture of the developed world is a testimony to the correctness of this approach. Our present world food problem is a problem of poverty and politics—not a lack of information or know-how regarding agriculture.

THE FUTURE

We are now entering the future—the post-industrial era. It is a world of instant communication, supersonic travel; it is also the world of the global village, ever-expanding population, and pollution. The post-industrial era traces its beginnings to the 1960s with three crises impinging on world consciousness. The first was apprehension of an emerging world food shortage caused by unchecked population increase in the tropical world. The second crisis, first brought into prominence by Rachel Carson's *Silent Spring* (1962), was the pollution resulting from technology itself. The third was the energy crisis of the 1970s, when the 1973 Arab oil embargo caused a quadrupling of crude oil prices and initiated a general economic disorientation. These three problems were soon shown to be part of a single issue—the distribution of the earth's renewable and nonrenewable resources. Ironically, as we raced to the moon, we rediscovered the earth. Whereas our plant-dominated planet had traditionally been thought of as "Mother Earth," the source of bounty and plenty, the new symbol of a "Spaceship Earth" stressed the finiteness of earth's resources. The new earth was seen as if from the vantage of an observer on the moon: small and isolated yet beautiful and precious as never before.

The food crisis was put in abeyance with the Green Revolution and a slow-down of population increase and the oil crisis self-destructed by the greed of the oil producers—postponed for another day. But the ecology movement has grown and become a political force in the United States and Europe. The "greens" are a power in Europe and are becoming an independent political force in the United States. We have previously identified green with the color of money but now the color green is taking on an entirely new meaning, derived from the color of chlorophyll. Conceived in anxiety and born in fear, the ecology movement inspired religious fervor and struck a responsive chord in the United States in the late 1960s and early 1970s. Although its message was strident and its thrust sometimes veered uncomfortably in an anti-intellectual, antiscience direction, the ecology movement has proved to be a force to be reckoned with. The banning of DDT, its cause célèbre, was the most notable of its victories. The ecology movement turned attention to social problems and displayed concern for the displaced agricultural worker, the human jetsam of agricultural progress. Many of the causes of the 1990s—to save the rain forest, to reduce acid rain, to slow the increase of atmospheric CO₂ and global warming, to prevent a widening in the ozone hole—are largely concerned with plant–people interactions. We have begun to think of the green plant as the canary in the mine—an early warning against deadly peril.

As our space program is renewed and girds again for the challenge of the heavens, the notion of establishing space colonies has become less a dream than a planned goal. It has become obvious that there is not room enough in our space craft for our sustained requirements for oxygen and food. The thought of jettisoning our wastes to float forever in space is

intolerable—all too reminiscent of the Muppets' "Pigs in Space." Rather, we must recycle our wastes, purify our air, and provide sustenance by using sunlight as an outside energy resource. The machine that our engineers have devised that will marvelously recycle our wastes, release oxygen, consume carbon dioxide, and provide our sustenance in the form of carbohydrates, proteins, and lipids is already found in a handful of magical bean seeds. In short, space engineers have rediscovered plants. The green plant, so plentiful and readily available on earth, will prove to be our savior in space. Horticulture again—now in the guise of space biology—has reestablished the essential connection between plants and people. Horticulture must increase in importance, in schools, in homes, in communities, to underscore the interconnectedness of the living world and to improve the beauty and the quality of life here on earth.

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