CHAPTER I
GRASSES THE BASIS OF CIVILIZATION

“He causeth the grass to grow for the cattle,” says the Psalmist, and Moses promised the children of Israel, as their reward if they kept the commandments of God, that they should have “grass in their fields for their cattle.” With the Prophets grass is the symbol of blessing and redemption—“in the habitation of dragons shall be grass,” “the Lord shall give to everyone grass in the field.” And the want of grass is the symbol of desolation, “the hay is withered away, the grass faileth.” The theme of grazing runs all through Genesis and Exodus. But long before cattle were domesticated, primitive man, living largely on animals he could kill, was vitally concerned with grazing lands. He must have followed the herds of wild cattle and bison, the flocks of wild sheep and goats, as the North American Indian followed the herds of the American bison, or buffalo. An abundant supply of grass meant plenty of tender, juicy meat.

Grazing lands possess other plants than true grasses, but grasses are their most important constituent, because these plants withstand close and repeated grazing better than do other plants. In the grass leaf, consisting of two parts—sheath and blade—growth takes place at the base of the sheath and at the base of the blade (Fig. 36), instead of being diffused about equally throughout the leaf, as it is in clovers and other forage plants. When a clover leaf is bitten off, that is the end of it, but when a grass blade is bitten off, growth keeps on at the base and the blade is soon as long as ever. It is this growth from the base
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Fig. 36. Leaves of grass and of red clover marked to show areas of growth. A, grass leaf: a, base of blade; b, base of sheath. B, same leaf one week later, showing growth at a and b. C, base of culm in sheath; bud of potential branch shown at c. D, same one week later, showing growth at the base and the potential bud developed into a leafy shoot. E, leaf of red clover. F, same one week later, showing nearly uniform growth throughout, the greatest growth taking place in the petiole, the part of least value.
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(like human hair) that makes necessary repeated mowing of the lawn. Moreover, in a grass not only is the leaf renewed but the stem also. A grass stem is jointed, each joint bearing a leaf. In the axil of each leaf is a potential bud, which lies dormant so long as the main stem is growing. If, however, the main stem is grazed or cut off, the bud in the axil of the uppermost remaining leaf develops and replaces it. Grass is nature's nearest approach to an indestructible forage plant. So dominant are the grasses among grazing plants that the English word 'grass', which originally meant herbage in general, and from which is derived the verb 'to graze', has come to be applied particularly to the graminia, or "true grasses."

These true grasses seem to have appeared on the earth during Upper Cretaceous time, as their earliest fossil representatives have been found in formations laid down in this period. In the Eocene there was a notable expansion of the grass family, and in the Miocene it was well on its way to becoming one of the dominant types of plant life. Little Eohippus, of the Eocene, the great-great-great-grandfather of all the horses, and his descendants in the Oligocene, who have left their fossil remains in our Western States, had teeth for eating twigs and bark. During the Miocene our Great Plains were uplifted and became a vast grassland. The little browsing horse, no larger than a sheep, developed teeth for grazing, and, living on a grass diet through many generations, increased in size and swiftness until, when the Ice Age appeared, there were at least ten species of the genus, some as large as the domesticated horse of today and one even larger. The horse and the other graminivorous (or grazing) animals, the ancestors of our domestic live stock, really owe their development to grasses.

Man's first attempts to control his fate, to provide for future need instead of remaining the victim of droughts or other untoward circumstances, which were the beginnings of civilization, must have been on grasslands where
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the young calves, lambs, and kids he caught and tamed could find forage. It was on grasslands, too, that primitive man, after he had reached the food-producing as distinguished from the food-gathering stage, developed most rapidly. The earliest known records of human culture are found in the Nile Valley and in southwestern Asia, open country of scanty rainfall. It is perhaps significant that the most primitive tribes of living men, the pygmies of Africa, New Guinea, and the Philippines, are found only in forested regions. Sheltered in the depths of the forest they have led their timid lives, so near the verge of starvation that they are relatively few and remain in the Stone Age to this day.

It was while the ice of the fourth Glacial Period covered most of Europe, some hundred thousand to five hundred thousand years ago, according to Breasted, that the earliest Nile dwellers slowly changed from hunters to breeders of flocks and tillers of the soil. Wheat, with ages of selective cultivation behind it, has been found in some of the oldest known graves in the world, in the Nile Valley. The stomachs of bodies from these early cemeteries contain husks of barley and of a kind of millet (*Echinochloa colonum*) no longer cultivated. In the Nile Valley the cultivation of grain seems to have preceded the grazing industry, but breeding of donkeys, sheep, and cattle was well established by 3500 B.C.

In Europe the hunters of the Old Stone Age advanced but slowly until the final retreat of the glaciers some seven to ten thousand years ago. But the domesticated or half domesticated animals of the Nile Valley and the eastern shores of the Mediterranean somehow found their way into Europe, following steppes and valleys until in time they reached the grassy Swiss uplands, where they were again domesticated by the Swiss lake dwellers.

For thousands of years the women of those early ages had gathered the seeds of wild grasses, crushed them between stones, and made cakes of them. At an early
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period barley and wheat somehow reached these lake-dwellers, for these grains have been found in the remains of Swiss lake villages. Men as well as cattle must have wandered from the East, each generation going further west and carrying seed grain with them. With grain and cattle the Europeans of the Late Stone Age were able to advance rapidly from a life of hunting to one of settled communities of cultivators and cattle breeders. As in Egypt the two types of culture, growing of grain and cattle raising, both based on grasses, proceeded together, the prototype of modern farming.

In western Asia the hunter developed primarily into a cattle breeder, depending on the wild grasslands for forage, ever wandering in search of fresh pasture. When Abram and his family set out from Ur, between the Euphrates and the desert of Arabia, “to go into the land of Canaan,” he was a herdsman, doubtless seeking new grazing lands. He followed up the valley of the Euphrates, far to the north, instead of striking across the desert to Canaan, and stopped at Haran (later called Charan) in upper Mesopotamia, a region of good pasture land. Later Abram wandered southward in the country bordering the Mediterranean, stopping where he found water and pasturage, until, when “there was a famine in the land,” he drove his “sheep and oxen and he-asses and she-asses and camels” down into Egypt. In that fertile land Abram became “very rich,” that is, his stock increased, until, on returning to Canaan with his nephew Lot, they had such vast droves of animals “the land was not able to bear them.” And “there was strife between the herdsmen of Abram’s cattle and the herdsmen of Lot’s cattle,” even as there was between the cattlemen of our Western States in the seventies and eighties of the last century. Later there was trouble with Abimelech over a well and more strife between herdsmen, and so the story of the patriarchs unfolds, always against a background of seeking grazing land and trying to hold it. Famine came in Isaac’s
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day and he sowed a field “and received in the same year an hundredfold.” This is the first mention in the Bible of sowing, but what Isaac sowed we do not know. The first mention of grain is in the passage where Isaac, blessing Jacob by mistake for Esau, says, “God give thee ... plenty of corn.” This corn must have been wheat or barley, both of which were cultivated in Egypt and adjoining regions centuries earlier.

The Indo-Europeans, our own ancestors, were already herdsmen when, some forty-five hundred years ago, they began to spread from the great grassy steppes which lie east and northeast of the Caspian Sea. Tribe after tribe of these nomads wandered across Europe seeking pasture, until they reached the westernmost land, the British Isles. Besides cattle and sheep, these people had horses. Among the Hebrews and other Semitic tribes donkeys were used as beasts of burden and camels for riding. The early European tribes were horsemen, the great-great-grandfathers of our cowboys. As these tribes found promising land—the valley of the Danube, the plains of Hungary or Lombardy, the valley of the Rhone—they settled down, cultivating wheat and barley as well as raising livestock, just as American pioneers took up homesteads in the West. Middle and western Europe, being a land of mixed forest and relatively small stretches of open grassland, encouraged this settled life of farming and progressive civilization. The great grasslands to the north of the Black Sea and stretching far into Asia remained the home of nomads, who depended on wild pasture. As the tribes and their flocks increased they became ever more warlike, fighting with one another, and periodically—when there was a drought, probably, or when the grasslands were depleted by long overgrazing—moving out in vast hordes, overwhelming towns and agricultural settlements. The Scythians before the Christian era, and the Huns, Tatars, and Mongols, who later overran Europe, were such swarming nomads. Much of his-
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tory is but the record of invasions of peoples seeking fresh grasslands.

Grasses were the innocent cause of trade wars, also, for caravans of camels or horses had to follow grasslands; and these trade routes were fought for, as sea routes and railways have been fought for in modern times.

GRASSES AND OLD WORLD CIVILIZATION

Although grazing was an advance over hunting it did not forward civilization as did the cultivation of grain, which compelled a settled abode. At the dawn of history the beginning of such cultivation was so far in the past that it had become a myth. In Egypt wheat was held to be the gift of Isis, in Greece, of Ceres. Our breakfast “cereals” commemorate the Greek myth to this day.

From Egypt and adjoining Asia, the cradle of a civilization based on the cultivation and grazing of grasses, this culture slowly spread in all directions, reaching from China to the British Isles and down through Abyssinia to the tribes of East Africa, a culture built up on the economic foundation of grain fields and herds.

None of the cultivated races of wheat are known in the wild state. A wild form of emmer (Triticum dicoccum) was discovered in 1906 on Mount Hermon, in Palestine, and later in Moab, by Aaron Aaronsohn, and called Triticum dicocoides by the German botanist, Koernicke. In 1910 it was found again in western Persia, in the Zagros Mountains. It seems fairly certain that this is the ancestor of cultivated wheat. In emmer and in its wild variety, the axis of the head breaks up, the grain remaining enclosed in the chaff. In cultivated wheat (Fig. 37) the axis does not break up and the grain can readily be freed from the chaff. This character must have been developed and fixed by selection, yet so long ago was it accomplished that the wheat found in the earliest known graves is free from chaff. Breasted states that the stomachs of mummies in these graves contain the chaff of barley, which,
Fig. 37. Heads of grasses. 1, four-rowed barley; 2, rice; 3, cultivated wheat; 4, rye; 5, oats
being difficult to separate from the grain, was present in the bread. The chaff of wheat is not found in the stomachs, because it was readily removed from the grain.

Tales have been told of the germination of wheat found in Egyptian graves, and it has been claimed that the peculiar wheat with branched heads called “mummy wheat” was derived from such seed. These statements are not credited by scientists. It must have been an easy matter for a guide or other person to replenish the wheat in graves shown to travelers, and doubtless many a traveler was willing to pay well for a few grains of wheat from an ancient jar found in a grave with a mummy. But the so-called mummy wheat has not been found in Egyptian graves, and authorities agree that it did not exist in antiquity. Pharaoh’s dream of seven ears of corn on one stalk suggests that the branched heads of wheat may have appeared as occasional sports since early times, though it was only in modern times that this form of wheat was fixed by selection and breeding. Certain varieties of Poulard wheats produce branched heads, especially in Alaska, as do some of our native wheat grasses, such as Agropyron smithii.

Barley was also cultivated in the New Stone Age, for it is found in Egyptian pottery jars dating from 4000 B.C. and in the remains of Swiss lake villages. The barley of antiquity was the six-rowed kind (Hordeum hexastichon) less commonly cultivated today than the four-rowed (Hordeum vulgare). The two-rowed (Hordeum distichon), also cultivated today, is the only form known to grow wild. The four-rowed barley appears to have been derived less anciently from Hordeum spontaneum, now growing wild from the Caucasus to Persia and Arabia.

Wheat reached China long before the Christian era, but rice is the more widely cultivated grain in eastern Asia. Rice was developed in the dim past, being cultivated before 3000 B.C. In an ancient Chinese ceremony five kinds of seed were planted, rice by the emperor himself, the other
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four by princes of his family. Of the five, esteemed as the greatest gift to the race, four are grasses, rice, wheat, sorghum, and millet. The fifth is a legume, soya or soy bean. Rice was cultivated in India in very early times; thence it spread to Babylon, and finally, about a thousand years later, it reached Syria and Egypt. It also spread south and east throughout the Malay Archipelago. In the Philippines today as for ages past rice is cultivated on the terraced mountain sides, the terraces holding the rains and preventing erosion. In this conservation of soil Philippine culture is far in advance of our own wasteful methods, which have resulted in denuding vast areas of fertile top soil. There are forms of rice growing wild in southeastern Asia which probably represent the species from which the cultivated rice (Oryza sativa) was developed.

Rye came into cultivation far later than wheat, barley, and rice, probably about the beginning of the Christian era. It seems to have originated in a region farther north, somewhere in the Russian steppes of Europe or Asia. Unlike the earlier-known grains, rye will run wild and maintain itself under favorable conditions for a time. For this reason it is difficult to determine whether plants that have been found growing wild were really wild forms or descendants of cultivated rye.

The common oat (Avena sativa) is generally believed to have been derived from the wild oat (Avena fatua); the Algerian oat from Avena sterilis, and a few other varieties from Avena barbata, all three species native to the Mediterranean region. Oats were known to the ancient Greeks as weeds in grain fields, but appear to have been cultivated in middle Europe during the Bronze Age.

Sorghum (Sorghum vulgare) in various forms has been widely cultivated for ages; but, though long grown by Egyptians, it has not been found in the early tombs. A number of closely related species are native to east-central Africa. Sorghum was probably derived from one of
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them, and introduced in prehistoric time into Egypt, whence it spread to India and China. In warm countries sorghum seeds so heavily that it is the staple food of millions of people, especially in Africa. Sweet sorghum (Sorghum saccharatum) also was probably derived from a central African species. It appears to have reached Egypt after the time of the Pharaohs and to have spread to Arabia, India, and China, where it is the kao-liang, or “great millet” of the Chinese. In the United States kafr, milo, and durra, forms of sorghum, are grown for seed and for forage. Broom-corn sorghum is grown for its great branching heads from which our brooms are made. Sweet or saccharine sorghum or sorgo is cultivated for the sweet juice extracted from the stem, which, boiled down, was the delicious sorghum molasses so commonly made by farmers of the Middle West a generation ago.

Several other species of grasses have been cultivated by primitive peoples for the seed, but are now largely replaced by wheat and other grains. Common millet (Panicum miliaceum), a native of Asia, probably reached Europe nearly as early as wheat and barley, for it is found in remains of Swiss lake dwellings. It has become naturalized in many temperate regions, including the United States. Italian or foxtail millet, with a multitude of derived forms, such as Hungarian millet and German millet, was also commonly cultivated in prehistoric times, apparently spreading westward from China, and reaching Switzerland in the Stone Age. Pearl millet (Pennisetum glaucum), another African grass, is grown in Africa and in tropical Asia for food. At maturity the smooth and shining grain bursts through its chaff, the long cylindrical spike being thick set with these “pearls.” Coracan (Eleusine coracana), a native of India, teff (Eragrostis abyssinica), and fundi (Digitaria exile), natives of Africa, are also cultivated in tropical Asia and Africa but are unimportant compared to the grains.

Besides the grains, whose seeds furnish the breadstuffs
of the world, there is another grass which is the source of an important food, sugar. Sugar cane (*Saccharum officinarum*) is now cultivated in all tropical and subtropical regions of sufficient rainfall (Fig. 38). Compared with the grains its cultivation is relatively recent. Sugar cane seems to have originated in southeastern Asia (New Guinea, according to Brandes) and was grown in China a century or so before the Christian era, but was not known to Europe until the Middle Ages, when it was introduced by the Arabs into Sicily and the south of Spain. The ancients had to depend on honey for their sweetening; hence the ideal land, flowing with milk (having plenty of grass, that is) and honey. Sugar cane in cultivation rarely flowers and very rarely sets seed. Since the rich store of sugar in the stem would be used by the plant in the production of seed, the species has been artificially selected for sterility. Plant breeders occasionally succeed in securing seedlings, but sugar cane is propagated by planting joints of the cane, which root at the nodes and send up new stalks.
Field of sugar cane in the Hawaiian Islands. Photograph by Hitchcock
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GRASSES AND AMERINDIAN CULTURE

The culture-nucleus, based on cultivation of grain and grazing, spread from Egypt and adjacent Asia throughout the Eastern Hemisphere, except Australia, which developed no civilization of its own. In America a second center of civilization arose, based on the cultivation of maize, which like that of wheat began so far back in antiquity that its origin is veiled in myth. To the American Indian maize was a gift of the gods. One of the legends is familiar to us—the one which relates how Hiawatha prayed that the lives of his people might not depend on hunting and fishing. In answer to his prayer came Mondamin, with whom Hiawatha wrestled mightily, whom he buried, and from whose grave, carefully tended according to Mondamin's instructions, sprang maize, a never failing food for the people. While Eurasia had wheat, barley, rice, and the other grains America had but one. When the white man arrived maize was cultivated from Central America south to Peru and north to Quebec. The Inca, Maya, Aztec, and Pueblo civilizations were based upon it, and it was cultivated by the North American Indians over much of what is now the United States. The hungry Pilgrim Fathers, we are told, found a buried hoard of Indian corn during their first terrible winter in the New World and thankfully stole it. But for this lucky find there would probably be fewer Mayflower descendants than there are today. The Indians taught the Pilgrims how to plant maize, or corn as it was called by the English settlers, fertilizing it by burying two fish in each hill.

Maize (Fig. 39) has never been found growing wild, and it is singularly unadapted to maintaining itself without cultivation. No species growing wild is at all similar to maize. There are wild species related to each of the Old World grains, from which the cultivated form has probably arisen; but maize (Zea mays) is the only known species in its genus. The genus most nearly related to it is
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_Euchlaena_, to which belongs teosinte, a native of Mexico, occasionally cultivated for forage.

Collins, who has made careful studies of maize and its crosses and also of teosinte, is of the opinion that maize originated as a hybrid between teosinte and an unknown and extinct species resembling pod corn.

Maize is the most highly specialized grass in the world; and it was the American Indian who, by artificial selection through thousands of years before the coming of the white man, produced this marvel of plant-breeding.

In the Old World the primitive agriculturist had domestic animals. The American Indian cultivated grain but had no cattle. The American bison, or so-called buffalo, is distantly related to the ancestors of domestic cattle, and in the mountains were wild sheep and goats; but these American animals for some reason were never domesticated. In South America the llama and alpaca were domesticated as beasts of burden, greatly inferior to the horse or donkey, and as sources of wool, but nowhere did the Indians have milk cattle. Though the horse originated in America, it became extinct on this continent before or during the Glacial Epoch and was unknown to the Indians until introduced by the Spaniards.

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Herd of pack llamas traveling in the Andes, Peru (elevation 14,000 feet). Photograph by Hitchcock
Chinese Indian rice (*Zizania latifolia*) bordering a stream just outside the walls of Nanking. The lower part of the stem is used as a vegetable. The placards on the wall are advertisements. Photograph by Hitchcock.
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The Indians of the Great Lakes had besides maize another grain in the aquatic grass called wild rice, or Indian rice (Zizania aquatica). Down to our own day the Indians have gathered the wild rice, the women going about in canoes and tying together the heads of as many of the plants as could be gathered in the arms. These tied heads were left to ripen, when the women returned and, holding the tied heads over their canoes, beat out the grain. From two to three thousand bushels a year have been gathered in this way. Today Indian rice is an expensive dainty, served with game on the table of the epicure. In China the young shoots of a perennial species of Zizania are used as a potherb.

All the grains, to which man owes his civilization, are annual grasses, that is, the plant bears one crop of seed and dies. Perennial plants live over the winter or the dry season by means of underground parts that remain alive but dormant. Such plants usually bear fewer seed of less viability than do annuals, which must depend upon their seed for survival. An annual that failed to bear good seed would become extinct. Primitive man, or woman, rather, gathering seeds of grasses to add to the food supply, naturally took those of annuals, which were larger and more abundant. Annuals, being short-lived, produce seed within a few months after planting, while perennials seldom bear seed the first year. Naturally, then, it was annuals that were chosen for cultivation.