CHAPTER ONE.
ANTiquITIES

Out from the albums, the trunks, the shoeboxes, and the closet shelves spill the fine old albumen prints, card-mounted in the style of the late nineteenth and early twentieth centuries. Some of the images are obscure; others release stored recollections. Here stands a favorite team hitched to a binder. Here pose faintly familiar ancestors and neighbors and forgotten hired men with a long-ago-scraped steam engine and a steel separator that now rusts back in the hedgerow. Here loom perfect grain stacks that granddad constructed with care and forbade the children to slide upon.

Historians debate whether there was a golden age of American agriculture, a time before wartime boom and post-war recession disrupted the developing agricultural economy, when farmers prospered and waxed content. The golden hue of the old photographs, however, is not entirely the product of the photographer’s toning, for there is evident in them a golden age of rural culture and agricultural endeavor on the Great Plains of North America. Admittedly, the photographs are questionable evidence. They owe perhaps more to a golden age of itinerant professional photography, before every family snapped its own mediocre photographs with Polaroids, than to the agricultural situation. The people, machinery, and circumstances portrayed also are the product of selection by the subjects and by the photographers. The nostalgic reminiscences they stimulate may also be products of selective memory.

Return, though, to the images. Surely their omnipresence, their vain-glory, their evocation, demand consideration of the possibility that they captured men and women engaged in a proud enterprise and that this enterprise, the harvesting and threshing of small grains, was the focus of a great web of rural culture and institutions. That web, comprising the means and methods by which people on the plains
harvested and threshed prior to the advent of the combined harvester, or combine, is the subject of this book.

The technology and practices of harvesting and threshing that people carried onto the plains were the products of millennia of adaptation and refinement. This evolution was relevant to the history of the plains both because it established the level of technology first available for use there and because it illustrated principles that also governed developments on the plains.

Although after the advent of the combine, terms such as “harvesting” and “threshing” came to be used indiscriminately, descriptions of earlier operations with small grains required more exact usage. Harvesting and threshing were distinct. Harvesting was merely the gathering of unthreshed grain from the field, including both reaping or gleaning (cutting of the heads) and attendant movement of the grain (gathering, making sheaves or bundles, shocking, and so on). Threshing was the breaking loose of the kernels of grain from the straw and chaff. A third operation, winnowing, was the separation of the kernels from the chaff.

The ancient peoples who first employed tools for reaping left scant remnants for archaeologists to examine. More than three thousand years before Christ, inhabitants of the Middle East
reaped grain with straight flint knives, imparting to their tools an unmistakable sheen. Contemporaries in Babylonia and Egypt crafted hard-baked clay into sickles with serrated blades angled forward from the handle for easier wrist action.¹

Egyptians some two thousand years later left a richer record—paintings and artifacts—of harvesting in the Nile Valley. Itinerant harvest laborers enjoying exemption from military service moved down the valley with the progression of the harvest. Methods varied, but usually male laborers grasped the heads of grain in their left hands and clipped them off with angular sickles held in their right hands. Women followed to gather up the gleanings.²

If the Egyptians recognized labor as a crucial element in the harvest, the evolution of reaping tools focused on the sickle as of primary importance. The Egyptians, evidently somewhat later than the Babylonians, had converted from clay to bronze in toolmaking. With the advent of the Iron Age (about 1200 b.c.) the material, although not the basic design, changed again. A needed change in design came early in the Iron Age and was proliferated through Roman conquest and administration: The blade was balanced by curving it back from the line of the handle and around past the handle again. With such a balanced blade, the motion of reaping was no longer a backward pull but rather a circular sweep, easier and longer. With this improvement the sickle reached perfection in basic design, although it was always subject to debate as to optimum angles and curves.³

Roman chroniclers documented both the widespread use of the balanced sickle and its succession by the scythe. Marcus Varro wrote in the first century before Christ of various styles of reaping with a sickle—cutting near the ground, cutting near the heads, or cutting midway up the stalk. Roman art of the preceding Bronze Age, however, had also depicted use of the scythe, a blade similar to a sickle but attached to a handle that extended down from the arm and hand of the harvester. In the Iron Age the scythe blade became shorter and straighter. When after the Middle Ages European agriculture began to emerge from stagnation, both the sickle and the scythe were common implements. During this time the scythe undoubtedly gained on the sickle, given that the scythe was a superior implement for making hay. By the twelfth century the handle of the European scythe was curved and hand posts had been added to facilitate use.⁴

If the scythe was to be superior to any other tool in gleaning grain, and not just in cutting hay, some method had to be developed by which the cut grain could be laid aside in orderly piles to be gathered or tied into sheaves. The answer was to attach wooden fingers behind the blade in an arrangement known as a cradle, depicted in a psalter as early as the thirteenth century. The cradle caught the falling grain, which could then be laid aside on the stubble.⁵
The advent of the cradle made the cradle and scythe the premier implement for reaping in western Europe and established the technologies and customs that would be transplanted to the European colonies of North America. Still, its use was not universal, or even predominant where common, because of human and environmental circumstances. Cradling required a strong body; many women, old men, and children could not do it, but they could wield a sickle. Simple tradition opposed the cradle in some areas, and in parts of Britain, law backed tradition to protect sicklers' jobs. Environment also could be an ally against the innovation, for cradling required ground that was free of stones or other obstructions.

The first documentation of the use of animal motive power in reaping occurred in the first century. Roman writer Pliny the Elder described how on great estates in Gaul the Romans employed a stripper for harvesting. Later historians generally termed this invention "Pliny's reaper," although he had mentioned it only in passing. Pliny's reaper was a two-wheeled cart pushed through the field by oxen. On the front of the cart were mounted teeth in a comb arrangement that embraced the stalks and stripped the grain from them. A man walked behind the oxen and pushed up and down on a bar that regulated the height of the comb. Another walked alongside the cart and raked out grain that stuck in the teeth. After Pliny's time the Gallic reaper was depicted in stone and, with better detail, in the writings of Palladius about 400.

Despite these classical precedents, it was apparently mere coincidence that when in 1780 the London Society of Arts discussed offering a premium to the inventor of a reaping machine, a few inventors made proposals or models of strippers. William Pitt of Pendleford, England, constructed a stripper that refined the Gallic principles by replacing the fixed teeth with a revolving tooth-studded cylinder that was powered by a ground wheel. These tinkering s were important mainly as an expression of awakening interest in the mechanization of harvesting.

The musings of inventors mean nothing unless conditions are conducive to their efforts. In the late eighteenth and early nineteenth centuries the Napoleonic wars gave impetus to the mechanization of harvesting by absorbing the supply of harvest labor. English landowners mourned the necessity of hiring Irish laborers who, they said, fought and drank and, according to one source, did such a poor job that "a sheep could be lost in the stubble." Between 1786 and 1831 there were more than fifty instances of invention and use of reapers in England, Scotland, Europe, and the United States. Abandoning the stripper, these new inventions cut grain according to one of two patterns of motion by mechanized blades—circular or rectilinear (back and forth).

To little avail, English inventors near the turn of the nineteenth century at-
tempted to employ mechanized circular motion for reaping by fastening blades to a wheel that turned in a plane parallel to the ground. Some also mounted stationary blades into which the moving blades would sweep, thereby shearing the grain. The first patent of an instrument along these lines was in 1799 to Joseph Boyce of Mary-le-bone. His horizontal blades turned around a vertical shaft powered from a ground wheel. In 1805 a man named Plucknet of Deptford designed a similar machine. It had a turning plate with serrated edges to cut the grain, but, like Boyce’s invention, it lacked any scheme to gather the stalks into the cutting apparatus or to push the cut grain off the machine in an orderly way. Furthermore, both machines were pushed by draft animals, unlike still another rotary model built by a man named Gladstone at about the same time, which was drawn by a horse hitched to a shaft on one side.¹⁰

Such experimentation continued over the next decade. From 1811 to 1814 a man named Smith, in Deanston, devised a rotary reaper in which the horizontally revolving blade was at the bottom of a drum that cast the cut grain to the side to form a windrow. Another man named Kerr devised roughly the same machine at about the same time. Donald Cumming, of Northumberland, also contributed a rotary variation, putting a line of revolving disks onto flat bearers, or arms, that extended at an angle into the grain, cutting the grain between the disks as the bearers advanced through the field. He also worked out a process by which a web on rollers would deliver the cut grain to the side in a windrow.¹¹

Trials of rotary reapers continued into the 1850s, but by the 1820s the state of the art in reaper invention had already passed to rectilinear motion. The model was an ordinary pair of hand shears. In 1807 Robert Salmon patented a machine with pairs of shears connected to a bar along the ends of the top blades; the lower blades stayed stationary. Fingers stretched ahead to guide the grain into the shears, and a rake operated by a hand crank swept grain from the platform into piles convenient for binding. The apparatus was pushed like a wheelbarrow. Not much different at first were the efforts of John Common of Northumberland. In secrecy, with trials at night, he constructed a shear-type machine and, with the encouragement of the Duke of Northumberland and the Society of Arts, built two more models, thereby perfecting an apparatus that delivered grain to a windrow along the side by a web moving over rollers.¹²

Common’s machines inspired later inventors whose names are better known. Common had at least thought in terms of rectilinear motion. Henry Ogle, schoolmaster of Newham, had visited Common in 1803. Ogle had read of trials of reaping machines and was looking for practical mechanics to assist him in making one. He was thinking of a rotary machine and was having trouble devising a model. Com-
mon thereupon discussed the shearing action with him. Common also gave patterns for his machine to Thomas Brown, who ran a foundry in Alnwick.\textsuperscript{13}

These disseminations to Ogle and Brown resulted in an important advance in reaper design—the replacement of the rectilinear shear model by a reciprocating sickle, with teeth mounted below or above that extended to hold the grain to be cut. Parties to this later invention disputed how much credit belonged to Ogle and how much to Brown and his son, Joseph. By 1816 the Browns were testing a reaper reported to work satisfactorily that may or may not have incorporated the new principle. By 1820 the Browns were advertising reapers for sale. Ogle, however, later wrote that the essential principles were contained in a model he had given the Browns in 1822. The Browns had then, according to Ogle, built a machine that had a reciprocating knife working under projecting teeth; a reel to push grain onto the knife; a platform to collect grain that might be raked off ready for tying into a sheaf; and a frame into which a horse might be harnessed to draw the machine. Regardless of who was responsible, the machine worked.\textsuperscript{14}

Unfortunately, public reception of the innovation was cool. According to Ogle, farmers at first were skeptical of the whole proposition, and even when the cutting mechanism was shown to be workable, they pointed out that little labor would be saved unless a platform was added to collect grain to be raked off. Even where farmers accepted the machine, a new source of opposition arose. "Some working people at last threatened to kill Mr. Brown if he persevered any farther in it," recounted Ogle. For whatever reason, the Browns emigrated to the United States before public acceptance of their machine in England.\textsuperscript{15}

Following on the heels of the Browns was one last notable British inventor of reapers, Patrick Bell, a Scot. Bell invented his reaper in 1825 while he was a divinity student. He believed that he had made an important innovation, and he carried on his trials in great secrecy and excitement, but in truth his machine was built on faulty principles. His inspiration for the cutting mechanism was a pair of garden shears; he did not use a reciprocating knife. After Bell resumed his ministerial studies, manufacturers produced commercial models of his machine, even exporting a few to Australia, Europe, and the United States. This bit of commercial success did not conceal to later inventors that the true theoretical advance had already occurred with the Brown-Ogle machine.\textsuperscript{16}

The fruition of that development took place across the Atlantic. This was a logical turn of events, not necessarily because of superior American inventive genius but rather because North America, with its abundant acreage and limited labor, provided a favorable environment for technological invention. Remarking later on the rapid advance in reaping technology in the United States contrasted to that in England,
Philip Pusey, gentleman farmer and member of Parliament, pointed out in 1851 that a variety of environmental and social conditions put England at a disadvantage. The climate was wetter, making the grain more likely to lodge; ridges and furrows necessary for drainage hampered efficient operation of machines; fields were small and hemmed by fences and gates that stopped machines; and harvest labor was relatively cheap.

During the early 1800s American inventors paralleled the British in attempts to make rotary cutters, all unsuccessful. During the early 1830s, however, several Americans, apparently independently, hit upon effective principles. Later British claims that American inventors took inspiration from the Bell reaper were groundless. The American machines resembled in principle the Brown-Ogle invention, not that of Bell, and the American inventors evidently lacked knowledge of either precedent. In 1831 William Manning of New Jersey patented a reaping machine with a toothed blade and dividers. Neither his nor other inventors' machines were so important to the history of reaping as were those of Cyrus McCormick and Obed Hussey. The genius and jealousy of these two men combined with historical circumstances to mechanize reaping in North America, whence mechanization and its principles could be repatriated in the Old World.

McCormick was the son of an inventor, Robert McCormick, whose twenty-some years of tinkering with rotary and other designs had produced no workable reaper. Young Cyrus built and tested his first machine in 1831. Like the Ogle-Brown machine, it had a straight, smooth-cutting blade, but unlike the English machine, the blade acquired its reciprocation from a crank and pittman (bar attached to a crank or wheel that converts circular to back-and-forth motion). During the next two years, McCormick traveled constantly between Virginia and Kentucky; however, he did come back to Walnut Grove, Virginia, long enough to improve his design. Most important, he serrated the cutting edge of the sickle.

Unknown to McCormick, Obed Hussey, a sailor from Maine who had retired to Maryland, was working along similar lines. In some respects Hussey's machine, which he first tried and patented in 1833, was superior to McCormick's. It had triangular knives (instead of a straight blade) that were driven by a pittman. After McCormick read of Hussey's patent in 1834, two things happened. First, McCormick rushed to patent his own machine, although he regarded such action as premature; second, he initiated a bitter campaign of publicity and letter writing that he and Hussey would engage in for decades thereafter.

For a few years, while Hussey overhauled his design, McCormick was prevented by personal financial difficulties from pursuing his own development. By 1843, however, McCormick had accepted Hussey's challenge for a public competition between their two designs
near Richmond, where observers and the judges generally favored McCormick's machine. Other contests (as well as acrimonious public correspondence and vengeful lawsuits) between the rivals continued and, with abundant press coverage, spurred sales of both models. In 1851 trials held in England in conjunction with London's Great Exhibition carried the reaping revolution back to the Old World.²¹

West, however, not east, was the important direction of change. Whereas Hussey eventually would give up manufacturing and sell his patent rights, McCormick carried reaper manufacturing westward with the frontier of farming. This, more than his technical genius, marked his place in reaping history. American frontier agriculture in his time was poised on the edge of a domain where a machine such as the reaper was more suitable—environmentally, economically, and socially—than it had been anywhere else: the open prairies of the Midwest, with their black soils and relatively favorable climates for reaping.

By the late 1840s McCormick was building fewer than one hundred reapers in Walnut Grove and had licensed several other manufacturers. In 1847, however, he had begun negotiations that would end McCormick reaper production elsewhere and concentrate it under his own management at a new plant in Chicago, gateway to the West. The advertising campaigns and credit sales he then initiated were well suited to the speculative nature of western frontier enterprise. This move west was particularly important to McCormick because in 1848 his original patent ran out. The relocation made him dominant, nevertheless, while a host of manufacturers—including Manny, Ketchum, and Atkins—entered the field, each introducing its own refinements.²²

During the 1850s reapers led the way toward the mechanization of agriculture on the midwestern prairies. By 1860 more than eighty thousand were operating west of the Appalachians, harvesting almost 70 percent of western wheat. The time was right. The rich soil encouraged production of wheat as a cash crop in conjunction with corn as a feed grain. The Crimean War had pushed grain prices up. The drain of labor into mining rushes in conjunction with increased agricultural settlement of the frontier created a shortage of harvest labor.²³

Even as the reaper eased the harvesting bottleneck, these same conditions turned the attention of inventors toward diminishing the labor requirement yet more. Harvesting with a reaper still required a good-sized crew—a man to drive the reaper, another to rake off the gavel (cut grain), and a half dozen or more to bind and shock the grain. The driver was not expedient, and shocking was a process difficult to mechanize, but the raking and binding of the gavel could be streamlined.

Earlier inventors in both Britain and the United States had included raking devices in designs for reapers, but until the reaper itself should be perfected, such plans were moot. Moreover, there
were several false starts before inventors hit upon the designs that would make the popular self-rake reaper. During the late 1830s and the 1840s American inventors first tinkered with canvas aprons, such as the one Bell had used on his reaper, then with toothed arrangements that reached from above or below to sweep off the grain, and finally with revolving rakes. The problem was more difficult than it seemed, because not only did the devices have to sweep the grain off the platform, but they also had to deliver it to the left side so that the stubble alongside the standing grain would be free of gavel where the horses would walk on the next round.

During the 1850s a combination of inventors' ideas forged the self-rake reaper. A contraption called the Atkins Automation had brief popularity and advanced the cause. It was created by Jearum Atkins, an invalid and a former millwright, who in 1852 patented a device that merely duplicated the action of a human arm and a rake in sweeping off the gavel. This model did little more than demonstrate the advantage of a self-raker, since its principles were not workable and its manufacture ended after being caught in overproduction by John Stephen Wright, editor of the *Prairie Farmer*.24

Most important to the development of the self-rake reaper was the collection of patents bought or developed by the firm of Seymour and Morgan at Brockport, New York, which enabled the company in 1854 to market the New York Self-Rake Reaping Machine, or New Yorker, as it was commonly called. The New Yorker incorporated the quadrant principle—the idea that the rake should sweep not straight back or across but in a quarter circle back and to the left.25

The New Yorker, however, had only a single rake. The Dorsey, patented in 1856 by Owen Dorsey of Maryland, improved the state of the art by mounting four rake arms on a cam atop a vertical axis. The arms swung low to sweep the platform back and to the left, then swung high around the wheel and gears to the left. This principle, called the pigeon wing or sweep rake, was attributable to a patent in 1852 by a man named Hoffheim. An early problem with the design was that the sweep of the arms did not allow the driver to sit on the machine; he had to walk alongside or ride one of the horses. The company's acquisition of another patent in 1861, however, allowed the arms to avert the sitting driver's head. In addition to raking, the pigeon-wing design had another advantage over earlier models: It eliminated the need for a circular reel to sweep the grain into the sickle. The rake arms swept low enough in front of the sickle to do this. The idea was so successful that McCormick quickly adopted it in 1861. By 1864 two-thirds of the McCormick reapers manufactured were self-rake models.26

A mechanism to deliver grain to the stubble was also designed during this period. The dropper, which Ogle had envisioned years earlier in England, put the platform on hinges so that it
could be dropped to deposit the gavel. American patents for such a design appeared at least as early as 1849, but commercial production was insignificant until 1869, when Amos Rank accumulated a number of patents and licensed various companies to make droppers. These later models held the grain on slats rather than on a solid platform. At any rate, droppers, although popular in the East, were not used that much on the prairies or the plains. For that matter, neither were self-rake reapers, except in the earliest years of settlement. The reason was that the self-rake mechanism, so painfully developed, quickly became obsolete with the advent of a self-binding device. The invention of an automatic binding device would eliminate fully half of the hand labor incidental to the harvesting of small grains. Not only would the raker be unnecessary but also the men on the ground would be relieved of gathering, packing, and tying the gavel into bundles. All they would have to do thereafter was stand the bundles in shocks.

Although the chief, unavoidable obstacle faced by all inventors of binding machines was the conception of a device that could tie a knot to bind the gavel, they first tackled a lesser problem: the movement of the gavel across to the left side of the platform, over the wheel, and onto the far left side where it might be tied up and dropped. The solution was achieved by the Marsh brothers, Charles W. and William W., Canadians who had moved to Illinois. In 1858 they patented a machine that came to be known as the Marsh harvester. Other inventors, such as Bell, had used an endless apron of canvas to carry grain off the platform and to elevate it over the wheel. The Marsh machine, however, intended this motion not just to drop the grain onto the stubble but also to make it available at waist level to men riding on the harvester, who would tie it into bundles as they rode. The grain fell from the canvas into a box, from which the men lifted it and tied bundles with straw bands. The Marsh harvester was itself a notable innovation for the harvest. By 1870 the Marsh firm was building more than one thousand a year. More important, however, were the binding mechanisms that would be attached to their machines, replacing the hand tiers with a practical automatic binder:

The first successful binders that developed from the Marsh model tied bundles with wire because iron wire cost about half as much as twine. C. A. McPhitridge of St. Louis had in 1856 already patented a device that fed wire from a spool, encircled the gavel, twisted the wire around itself, and cut it off. In 1861 W. W. Burson of Yates, Illinois, put such a device on a Marsh-type harvester and on Manny reapers. Other inventors worked along similar lines during the 1860s, and in the early 1870s several companies came out with satisfactory wire binders. James Gordon mounted his packer-binder on Marsh harvesters at the Marsh works in Plano, Illinois; Sylvanus D. Locke put his similar device on a Marsh-type har-
vested by another firm. These two men popularized wire binders early; before long the big companies also stepped in. McCormick, for example, began making wire binders in 1876. 29

Various people, however, objected to the use of wire for binding. Millers feared wire fragments would get into their machinery or pass through into the flour; threshermen complained of wire lodging in their machines; stockmen attributed the mysterious deaths of their cattle to their presumed consumption of pieces of wire and development of hardware disease. Manufacturers of wire binders did their best to stem the swell of popular opinion against wire, but inventors turned it to their advantage.

Devices for tying knots automatically in twine already existed, and as twine became less expensive and iron more suspect, they were implemented. John P. Appleby in 1858 had invented a knitter with a bird-bill arrangement that gripped the twine, rotated it, and then pulled it through itself to make a knot. An invention patented in 1864 by Jacob Behel refined this design. During the mid-1870s Appleby again turned his attention to knotters and, with the backing of William Deering, finally perfected one. Deering, McCormick, and other major companies knew what was coming. They immediately purchased rights to knotters and began producing twine binders. The 1880s saw the complete abandonment of wire as well as great sales of twine binders. 30

Thereafter, the basic mechanical principles of the automatic binder were in place, although improvements continued to be made. Binders composed predominantly of wood, for instance, were heavy—the McCormick was sometimes singled out as a horse killer. Steel frames introduced in the mid-1880s eliminated this problem. In the 1890s major companies lowered the binder mechanism so that the machines would be less top-heavy. They also put a wheel under the hitch to take weight off the necks of the horses. In all, the companies made the changes that brought binders to near maximum efficiency in the age of horsepower. Further technological gains awaited the introduction of the tractor. 31

Binders cut a considerable amount of straw with the grain, which was an advantage to those who could use the straw for fuel or bedding. This method also allowed the grain to ripen fully and evenly in the shock without heating. However, to the cash-grain operator, the straw was of little value. It made extra bulk for hauling and threshing and required binding for handling.

The solution to this problem lay in the header, a device that cut heads of grain with little straw attached. Since the time of Pliny, developments in harvesting technology had progressed from the handling of loose, headed grain toward the handling of tied bundles. Until the 1840s, no North American inventors or manufacturers produced headers of greater than local use or renown. The machine that forged this new road in technology was invented and patented in 1849 by Jona-
than Haines and then manufactured by Barber, Hawley and Company in Pe­king, Illinois: the Haines's Illinois Har­vester. It tied no bundles, and its cutter bar and reel were longer than those of a binder, thereby enabling it to take a bigger swath. It cut the grain close to the head, leaving most of the straw standing as stubble. An apron of canvas carried the grain to the left side, as on a binder, and elevated it over the wheel; but instead of delivering the grain to a binding mechanism, the header dumped it off the elevator into a wagon pulled alongside by horses. The header, because of its wide swath and unbalanced weight, was pushed, not pulled, by horses. The driver sat behind the machine and steered it by moving the rear wheel with his feet. By 1862 the company had made more than four thousand Haines's Har­vesters. Other companies entered the field during this decade. As various patents ran out during the 1890s, still more companies manufactured headers, which gradually increased in size. This increase was particularly important to drier regions of extensive farming, such as the Great Plains, California, and the Pacific Northwest.32

Although the combined harvester, or
Header on the George Bretz farm, western Kansas, 1915. The header, pushed by horses, elevated the cut grain up a canvas into the header barge alongside. (Courtesy of Guy Bretz)

combine, was implemented on the Great Plains much later than binders and headers, its development predated settlement of the region, and it was used elsewhere early in its history. The invention of the combine in Michigan during the 1830s, its proliferation in the Far West, and its manufacture by Best and Holt became pertinent to the agriculture of the Great Plains only after the turn of the century, when particular circumstances resulted in the combine's introduction there. Until that time, harvesting and threshing on the plains remained sequential, distinct operations. Like harvesting, threshing on the plains inherited a network of previously used systems and technology.

The earliest developments of threshing technology predated historical record. The earliest archaeological sources showed a mixture of methods, including beating and treading, with progressive refinements in each. Classic images of ancient Egyptian methods depicted animals treading on an outdoor threshing floor, men forking out the loose straw, and pairs of workers using winnowing scoops to toss the threshed grain into the air as the wind blew out the chaff. Later depictions, however, showed men clubbing sheaves with sticks, a cruder method. Biblical sources, especially Isaiah, also mentioned both treading and beating.38

Ancient peoples developed a variety of sledges to improve upon simple treading by animals. Archaeologists
pronounced images on an urn in Iraq dating from 3000 B.C. to be a threshing sledge, but written documentation of such devices began with the Romans. Marcus Varro wrote that threshing in his time was done on an open floor with either a *tribulum* or a *plostellum poenicum*. A tribulum was a weighted sledge with pieces of stone or iron embedded in the bottom to rub out the grain. A plostellum poenicum (Punic cart) was an axle, fitted with low wheels, upon which the driver could sit; it was used in eastern Spain and in neighboring regions along the Mediterranean. Sledges and rollers remained in use to modern times in the Middle East.\(^{34}\)

What rollers and sledges were to treading—that is, improvements in device but not in concept—the flail was to beating. The flail consisted of a handle about five feet long and a beater about three feet long joined with leather or metal. Although Pliny mentioned it, and Columella thought it the best method of threshing, the origins of the flail are murky. It was certainly used in England and Europe before the Middle Ages, and its use in China and Japan probably predated that period.\(^{35}\)

What all of these methods had in common was the direct application of human and animal power in linear fashion. The story of modern threshing machines, however, was the development of processes of circular motion in a confined area, processes that could then be converted to other sources of power.

Until about 1830, there was more progress in the development of threshers in Scotland and England than there was in North America. As with harvesting implements, early attempts were designed to imitate known motions, and it took some time to break away from these principles. Early threshers replicated the motion of a flail. Efforts of inventors in England and Scotland during the early 1700s produced little. Not until late in the 1700s did a Scot named Andrew Meikle finally build several important machines; his first patent was in 1788. Grain was fed into Meikle’s machine headfirst between two rollers so that the heads intruded into the path of four scutchers (bars mounted on an axis to be spun around). Threshing occurred when the scutchers pounded the heads. The process was enclosed within breasting, but this breasting did not operate as a concave, one of the frictional elements in later threshers. Although the scutchers moved in a circle, their threshing was still done in beating, linear fashion. However, Meikle’s work, especially because he applied water power to his machines, was important. He and his son, George, sold machines commercially, and numerous other inventors of the 1790s copied their designs.\(^{36}\)

In fact, the Meikle design set the course for the development of what would come to be known as the “Scottish” design of threshing, characterized by the beating action of the scutchers. This action did not fully exploit the advantages of circular motion, however. John Ball of Norfolk remedied that in 1805 with a design that set the pattern
for the “English” thresher. This model had no rollers; grain could be fed in any fashion. A concave was set close to the moving bars, which were not just beaters such as Meikle’s scutchers but were designed to pass near the concave, separating the grain by rubbing it in a circular motion around the circumference. The English design proved superior and was eventually revived on the western shore of the Atlantic after being improved in 1848 by John Goucher of County York. His threshing bars were rasped rather than flat, with grooves to produce greater action on the grain. 37

Early threshing machines knocked the grain loose from the chaff, but they did not expel the chaff from the grain. This step was done separately with a fanning mill. Since antiquity, when winnowing had been accomplished by natural wind alone, the development of the fanning mill had gone through a strange course. In China, by the time of the Han Dynasty, the Chinese were using a human-powered rotary fan to blow the chaff from grain. Centuries later, European traders in China, especially Dutch traders, observed this process and brought the idea back to western Europe, where the first rotary fanning mills, closely modeled after those of the Chinese, appeared in the 1500s. Subsequently, James Meikle, father of the Andrew Meikle who was to greatly advance the technology of threshing, traveled to Holland in 1710 with the backing of an English patron. He brought back the technology of fanning mills, and these mills were fitted on some of his son’s thresher. Local clergy, who favored the use of natural wind and could even approve of waving barn doors to aid it, condemned the use of Meikle’s “Devil’s wind”; but the fanning mill was a major advance, especially when coupled with a sieve for separation. In 1761 William Evers patented the process whereby the fanning mill forced air through the threshed grain and blew out the chaff and light straw. The grain and heavier straw fell upon a sieve that excluded the straw. 38

In Scotland and England lay the scholarship and the scientific and mechanical abilities to devise basic principles of threshing, and there they developed. In the isles, however, threshing mechanized slowly because there was not the pressing need for such innovation as was present in North America. During the early nineteenth century, as the hierarchical society of British agriculture was transformed by an international cash-grain economy, a labor surplus prevailed. Farm laborers, hired by the day or week, were reduced to reliance on the Poor Laws. When certain farmers, more for efficiency than for economy, proceeded to adopt machine threshing, they encountered considerable social resistance. This opposition came to a head in 1830 with the Thresher Riots. Farm laborers, seizing on the mechanical symbol of their economic troubles, destroyed nearly four hundred threshing machines. Other tactics of the hard-pressed workers included setting fire to ricks and barns and sending
threatening letters, signed by “The Swing” or “Captain Swing,” to landowners. The Swing, which began as a
local protest against threshers, developed into a general movement for regular employment and a living wage.
Magistrates enlisted the aid of troops and large posses of temporary constables to quell The Swing; special com-
misions moved from county to county and tried the rioters. Nineteen were executed, and some five hundred
transported to Australia or Van Diemen’s Land. Nevertheless, public senti-
ment largely favored the cause, if not the incendiary tactics, of The Swing.
The Swing, the sentiment that sup-
ported it, and the labor surplus com-
bined to retard, but not stop, the pro-
liferation of threshing machines.39

In North America there were few
such social constraints. Agriculture was
expanding, labor was relatively scarce,
and technical advances were hailed as
freeing men from hard labor, not dis-
placing them. The colonists brought
with them English and European ways
of threshing, modified somewhat by
environment. Generally, threshing in
New England, following English and
Scottish precedent, was done with a
flail in the barn. Old-World style flail-
ing also prevailed among the culturally
conservative Pennsylvania Dutch, ef-
fecting the distinctive designs of their
barns. In other wheat-growing Middle
colonies and the states that developed
from them, treading was an accommo-
dation to more expansive operations
producing cash crops. In the same area
during the early nineteenth century,
there developed a special roller in-
tended for indoor use called a porcu-
pine (or groundhog, or Tumbling
Tom). It consisted of an oak log
trimmed hexagonally; pegs driven into
it, the pegs longer at one end than at
the other; and a shaft running down
the middle. The end with the shorter
pegs was attached by the shaft to a post
in the center of a barn threshing floor,
and the whole porcupine was pulled in
a circle around the post by horses. Fan-
ing mills were also used in this region
before the Revolution, although most
farmers winnowed with a sheet or a
wicker fan. As threshing methods ex-
tended into the Midwest, farmers con-
tinued to choose between flailing and
treading according to a complex of cir-
umstances—ethnic background, avail-
able markets, grains raised, barn styles,
the need for straw to feed and bed ani-
mals. The material culture of thresh-
ing, especially flail design, displayed
the rich variety typical of dynamic folk
cultures.40

The first mechanical threshing ma-
achines used in the United States were
imports, beginning with a Scottish
model, probably one of Meikle’s, which
arrived in New York in 1788. Thomas
Jefferson of Virginia imported a
threshing machine in 1796. Scottish
and English threshers were imported
in numbers thereafter, at first mainly
into the mid-Atlantic states. The first
American patent for a threshing ma-
chine was in 1791 by Samuel Mullikan
of Philadelphia, and the first thrasher
built in the United States was by a Col-
onel Anderson, also of Philadelphia, in
1792.41

Thereafter more American manu-
Manufacturers produced home products to compete with the imports. This trend was true especially after 1822, when A. Savage patented a distinctively American improvement to thresher design—the peg drum and concave. In this design the threshing was accomplished, not by rubbing the bars against the concave, but by striking the grain between two sets of meshing teeth. These pegs protruded from both the drum and the concave and were set to pass close to one another as the drum turned, thereby striking out the grain. These early peg or toothed machines were called groundhog threshers, some said because they were staked to the ground, and others said because they looked like they were digging into the ground like a groundhog. The machines were built low, perhaps four feet high at the top. They were powered by horsepowers, and early ones threshed perhaps one hundred fifty bushels of grain a day. The grain was often passed through a separate fanning mill as well, especially if it was to be used for seed.

Combining a threshing machine with a fanning mill to create the combined thresher and fanner was the achievement of Hiram A. and John Pitts of Maine. The Pitts brothers did custom threshing with a groundhog thresher during the 1820s. In 1830 they patented and began producing their own horsepower thresher, and by 1834 they were selling a combined thresher and fanner. In their machine the grain passed through a peg drum-and-concave threshing chamber and was
carried to the fan by an endless belt of wooden slats fixed on two chains. The grain fell between the slats while the fan blew out the chaff and light straw. The larger pieces of straw were delivered to a raddle, a vibrating table with spikes inclined up from the endless belt, that carried the straw away. An improved patent in 1837 substituted an apron conveyor for the endless chain.43

In 1847 the Pitts brothers—following the wheat frontier west, as had McCormick—moved to Alton, Illinois, and shortly thereafter to Chicago. Hiram Pitts produced the Chicago Pitts thresher there, while his brother, after working temporarily in Ohio, went back east to Buffalo, joined in partnership with Joseph Hall of Rochester, and began producing the Buffalo Pitts thresher.44

Two other men—George Westinghouse and J. I. Case—were also prominently associated with the manufacture of threshers during this period. Beginning in the early 1840s, and continuing past 1900, Westinghouse and his company built threshers at Schenectady, New York, on the patents of Jacob V. A. Wemple. The Westinghouse threshers used canvas aprons in place of wooden slat belts for moving straw, and they improved the design of the raddle. Case, a native of New York, ran a groundhog thresher near his home as a teenager. In 1842 he bought six machines on credit and took them to Racine, Wisconsin. There he sold five and started custom threshing with the sixth while making improvements on the design. In 1843 he began to manufacture and sell threshing machines in Racine.45

One more major improvement came prior to the Civil War. Following a pattern patented as early as 1829 in England but little used there, Cyrus Roberts and John Cox of Belleville, Illinois, in 1852 patented a machine that did away with both raddle chains and canvas aprons. Their machine, which Roberts produced for market, incorporated straw walkers, or, as they were called then, “vibrators.” The Nichols and Shepard Company of Battle Creek, Michigan, soon improved the original design and marketed a machine under the name Vibrator. By 1859 this company had put in double shakers, the reciprocal actions of which balanced one another, thus preventing the machine from crawling along the ground. Case’s company waited until 1880 to adopt the straw walker principle and then called its machine the Agitator.46

Throughout the antebellum years there echoed various objections to the use of groundhog threshers. In addition to harboring general distrust of machines and fear of the capital investment required, many eastern farmers maintained that the grain did not come out as clean as it did when they flailed and fanned it themselves, and that the straw came out broken up and likely to spoil if moist. Developing agricultural conditions and technological improvements swept these objections aside, however. The settling of the prairies and their planting to wheat, coupled with the perennial shortage of labor on
the frontier, required mechanization in threshing just as in harvesting and other agricultural operations. By the 1860s groundhog threshers were regarded as reliable and could thresh up to two hundred bushels a day when powered by two horses. One man was needed to feed in bundles, one to pitch away straw, and a third to bag grain. Few machines were portable (mounted on wheels); so farmers either bought their own machines or, more often, hauled their grain to the threshing site of a custom operator. The Chicago Pitts machine was already on wheels, which facilitated custom work and made the machine even more popular on the prairies. By 1866 the United States commissioner of agriculture was able to report that “threshing machines are as perfect as they can be made” and that custom threshing, with each machine handling up to three hundred bushels a day, was ruling in the West. 47

The development of threshing on the prairies had truly been rapid and amazing. By the time of the commissioner’s report the main difficulty holding back further technological progress was not the mechanism of threshing but the application of power, which was still largely limited to horsepower. There were two common ways of converting the linear motion of animals into the circular motion of threshers. One was a treadmill, composed of an endless belt of chains and slats, which was sometimes made portable by mounting it on wagon wheels. There were several technical problems with treadmills in threshing. For example, the mill tended to run away if the load

_Treadmill threshing near Duck Lake, Sask., 1907. (Saskatchewan Archives Board, Regina)_
was lessened or if a chain broke, forcing the poor horse to either gallop or fall. The addition of governors and flywheels corrected this problem, but the fact remained that the great number of moving parts in a treadmill dissipated much of the power applied to it. Furthermore, that power was limited to the efforts of one horse.48

Consequently, the more popular method of applying horsepower to threshing was with sweeps, sometimes called booms. Sweeps were horizontal beams that stretched out from a vertical axle. At the outside ends were hitched teams of horses. The axle transferred power through a series of gears to a tumbling rod, which ran out from the circle to connect with another gearbox on the thresher; power was sometimes applied directly from the gearbox to the thresher, often by means of an endless belt. During the 1840s inventors put such devices on wheels, constructing the beams so they could fold and thus be portable. A popular sweep horsepower was the Pitts-Carey, developed by Hiram Pitts and marketed in portable form in 1856. This horsepower had a variable number of sweeps to accommodate up to five (later six) teams. Another popu-
lar sweep was the Woodbury and Dinggee, manufactured by Case in Racine. Horsepowers continued in common use throughout the nineteenth century. By 1905 fifty-seven manufacturers offered them for sale. By that time, however, they were already a technical anachronism. The age of steam had begun.49

The adoption of steam power for threshing was slowed by a number of fears. Explosions were common because the pressure in boilers could reach one hundred pounds per square inch. The fire maintained under the boiler was dangerous around straw and farm buildings, so much so that insurance companies at first refused to insure buildings on farms where steam was used. Still, horsepower was not without its disadvantages, either. First, horses were needed for other farm work, and threshing not only occupied them for the duration of that job but also generally wore them down, because threshing sweeps were hard on their necks and shoulders. Second, the power delivered by teams was often uneven, for horses were likely to stumble or fall down. And, last, after the Civil War, there was a temporary shortage of animals as agricultural expansion resumed.50

As early as 1784 James Watt, in England, had acquired a patent on a portable steam engine applicable to threshing, and many people had used steam for threshing through the next several decades. In 1814 William Lester patented a portable steam engine designed specifically for threshing. By the 1830s portable threshers and engines operated by custom outfits were fairly common on large estates in the eastern counties of England. In North America, however, although Horace Greeley of the New York Tribune had reported use of steam for threshing in 1850, its employment was insignificant until after the Civil War. The large-scale implementation of steam threshing awaited further technological advance and the development of a greater need for it. The impetus was to come with the agricultural settlement of the Great Plains.51

Through centuries of trial and experimentation, farmers and inventors had struggled to reduce the labor involved in harvesting and threshing. Labor was the central question, and it was seasonality that made the question sticky. Harvesting and threshing required intensive labor for short segments of the year; harvesting and threshing were by nature the bottlenecks in the production of small grains. The employment of itinerant labor for the harvest was an expedient dating from the ancient Egyptians, but it was an expedient nevertheless. The hope for eventual resolution of the seasonal problem lay in technology. Hence the continual efforts of inventors.

Progress, however, was halting. Sometimes this was due to negative constraints on innovation (for example, popular discontent, unfavorable environments, or economic problems) and sometimes to the absence of positive in-
centives (for example, the opening of new agricultural lands). Given the right conditions, however, innovation flourished and often in such flurries that it was impossible to trace individual achievements. Progress sprang from many heads and hands at the same time. Implementation of the resulting improvements was then rapid, moving small-grain farming in the direction of capital intensiveness, that is, into the Machine Age. Custom operators eased the demands of capital intensiveness on farmers by making machines available for seasonal work.

The technological progress of harvesting and threshing prior to the settlement of the plains had prepared North American farmers to enter the region. They carried a substantial yet dynamic technology as well as a body of customs that had filled the prairies and were ready for the plains. The technology was to enter a new phase of development as it responded to the still more expansive and distinctive agriculture and environment of the plains, just as it had with the earlier advances of geographic frontiers.

The new agriculture of the plains was to be not only expansive but also expanding. In westward migration from the Atlantic coast, wheat followed the frontier, but there was never a wheat frontier like the plains. This frontier was on the move continually (not continuously, for economic conditions interrupted it several times) from the late 1860s through the mid-1920s. The Golden Belt of central Kansas, the heart of the winter wheat area, was settled during the 1870s, but beyond it lay the increasingly marginal lands of western Kansas, western Nebraska, western Oklahoma, west Texas, and eastern Colorado. Thus the plow-up continued. The Dakota boom dated from 1878, but after the level Red River Valley and other parts of eastern Dakota were filled with settlers, beyond stretched the West River country, and beyond that the tarpaper-shack frontier of Montana. To the north was the Last Best West of Canada, where converged streams of settlements from the American midwestern states, the Canadian middle provinces, and, as was always the case on the plains frontier, the European nations. The accessibility of railroads, the voracity of European markets, and the environment of the plains compelled farmers to emphasize small grains and encouraged, in vast areas, virtual wheat monoculture—a cash-grain farming that was strikingly different from the more diversified, self-sufficient agriculture of earlier frontiers.

The expansion of grain farming onto the plains was concurrent with a flowering of farmers' receptivity toward technological innovation. Notwithstanding popular and historical images of farmers as "reluctant" or "troubled," the agriculturalists of the late nineteenth and early twentieth centuries were innovators—not just adopters of innovations but adapters and even originators as well. Farmers as a whole did not lunge after every new contraption that came along, but among the people on the land, certain
individuals—often custom machine operators—acted as the leaven in the meal. A historian of power farming in the United States has concluded that “to the American farmer, change was traditional”; a historian of western Canada has termed his region a “mechanical agricultural frontier.” It is the idea of a tradition of change that makes the wheat culture of the plains, especially its harvesting and threshing, comprehensible. Such a regional culture might evolve continually, adjusting to complex forces, and still retain enough overall regional integrity to constitute a recognizable culture.

New technologies, whether from private invention or from public research, would take shape according to the needs of the region. Into the Great Plains, agriculturalists carried their technologies and customs, some of which worked well, at least initially, while others seemed inadequate. Rapidly, those ways not suited to the environment of the region would be replaced by ways more appropriate. This process was to require ongoing technological innovation. The accommodation of technology and custom to environment, however, was not to take place in static, insulated circumstances. Mighty forces from outside the region, such as international economic trends and national governmental policies, would have their effects as well. Technological heritage, environmental adaptation, technological innovation, and the effects of outside forces would combine on the plains to create a vital culture devoted to the harvesting and threshing of small grains.