American Harvesting Machinery—The Birth and Growth of a Vast Industry.

If the political economist is asked to designate the ultimate source of the wealth of the United States, he will point without hesitation to our vast agricultural interests. In colonial days and during the first three-quarters of a century of our life as an independent republic, we were essentially an agricultural people. With the introduction of the steam railroad and the development of our merchant marine, came the development of our manufactures; but these, compared with our agricultural interests, were at first insignificant. With the introduction of Bessemer steel, however, we began to make rapid strides in all lines of manufacture, and during the past half century we have moved rapidly forward to the premier position among the great manufacturing countries of the world. Nevertheless, it is a fact that to-day, in spite of our leading the world in manufactures, it is customary for Wall Street to base its forecasts of the immediate prosperity of the country upon the predictions of the State Agricultural Department as to the prospect of the next year's harvest.

This fact of the close relation between the products of our farms and the prosperity of the nation as a whole is pretty well known to every American; but probably few people realize how greatly the development of the farm lands of the United States and the development of their full productive capacity has been due to the invention of special agricultural implements, and particularly of that marvel of ingenuity, the American harvesting machine. Originally designed to aid the farmer in developing sparsely populated districts in his own country, in which the amount of available manual labor was sadly disproportionate to the vast area brought under cultivation, American agricultural machinery has been shipped in enormous quantities to every agricultural country in the world, and has been undoubtedly the most potent factor in developing the vast cultivable areas of every continent of the world.

For the beginnings of the agricultural implement industry as we know it to-day, we must go back to the year 1831 and to the State of Virginia, where Cyrus H. McCormick built the first practical grain-harvesting machine. Compared with the modern harvester, it was but a crude affair. Nevertheless, it contained the essential elements that have been found in every grain harvester that has proved a success from that day to this. The parent machine had a main wheel frame, from which projected to one side a platform containing a cutter bar, having fingers through which reciprocated a knife which was driven by a crank. Upon the outer end of the platform was a divider, which separated the grain to be cut from that to be left standing. Above the platform was placed a reel, which served to hold the grain against the reciprocating knife and throw the cut grain back upon the platform. The machine was drawn by a team which walked by the side of the grain. This machine was successfully operated on the farm of John Steel near Steel's tavern in the summer of 1831. The farmers of those days were proverbially conservative, and it is amazing to learn that it was not until 1840 that Mr. McCormick succeeded in making his first sale. It was not until he had gone personally on horse-back among the farmers of Indiana, Illinois, Ohio, and Kentucky, and obtained from them written orders for

FORTY BINDERS AT WORK IN A WESTERN WHEAT FIELD.

A COMBINED REAPER AND THRESHER DRAWN BY THIRTY HORSES AND MULES AT WORK ON A FIELD OF BARLEY IN OREGON.

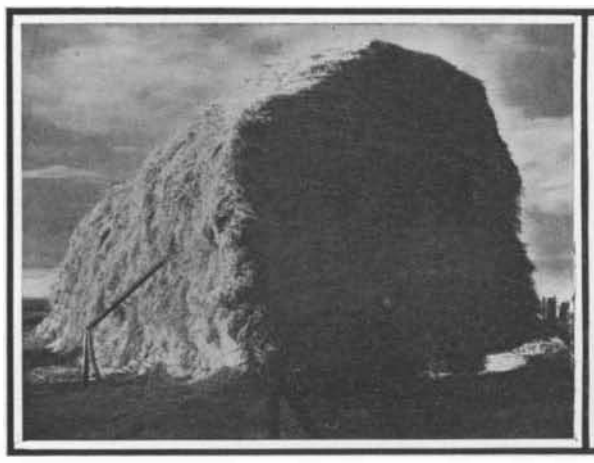
his machines, that he induced a firm in Cincinnati to take up their manufacture.

The next step in the development of the reaper of 1831 was the addition of the raker's seat, a device invented by McCormick in 1845, by which the raker could be carried upon the machine and rake the grain from the platform to the ground. In the spring of 1851 McCormick exhibited his reaper at the World's Fair at London, and was awarded the Grand Council Medal. On this occasion the judges referred to the reaper as being worth to the people of England "the whole cost of the exposition." At a later exposition McCormick received from the French government the decoration of the Legion of Honor for "having done more in the cause of agriculture than any living man."

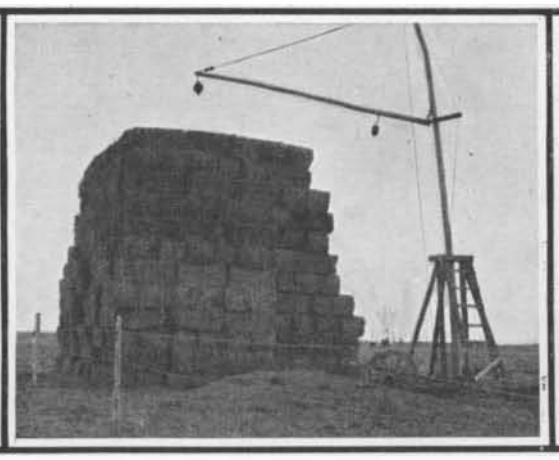
The next step was taken in 1849, when the Mann brothers of Indiana added a series of endless bands for carrying the grain, after it had been cut and reeled upon these bands, to the side of the machine, from which it was dumped upon the ground. In the same year Jonathan Haines brought out the first "header," which was pushed ahead of the horses, clipping the heads of the wheat, which were carried on endless aprons to the side of the machine and deposited in wagons.

In 1850 Adams and Gifford built the first hand-binding harvesting machine, which contained a platform upon which the grain fell from the endless apron, where it was bound by men carried upon the reaper.

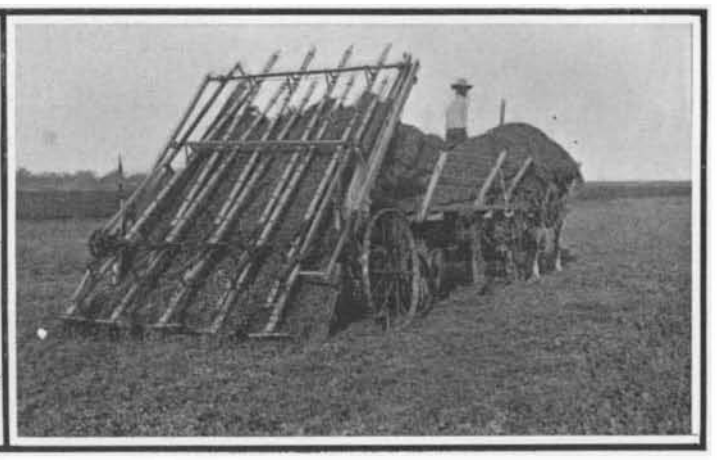
The next stage of development toward the modern self-binding harvester was the attachment of a binding device to take the grain that had been cut and raked into gavels, and bind the same automatically into bundles; the patent for this device being taken out by Heath of Ohio in 1850. Then came Jacob Bethel in 1864, who patented the knotting bill which loops and forms the knot, and the turning cord holder for retaining the end of the cord; and later in 1873, after associating himself with A. Wood, he built and sold what was probably the first automatic self-binding harvester that was ever put upon the market. After various attempts had been made to use wire for binding, Gorham in 1874 put in the field the first successful automatic self-sizing binder. This remarkable machine contained the essential elements of the McCormick reaper with the ingenious grain binder added. The grain is delivered upon a platform, where it is seized by packers, carried forward into a secondary chamber, where it is compacted by the packer against a yielding trip so arranged that when sufficient grain is accumulated the trip yields and starts the binding mechanism into operation. The cord is carried on the machine in a ball. The grain is forced against this cord by the packer, and when the binder starts, the needle encircles the gavel, carrying the cord to a knotting-bill of the Bethel type. Here the end is again seized by the



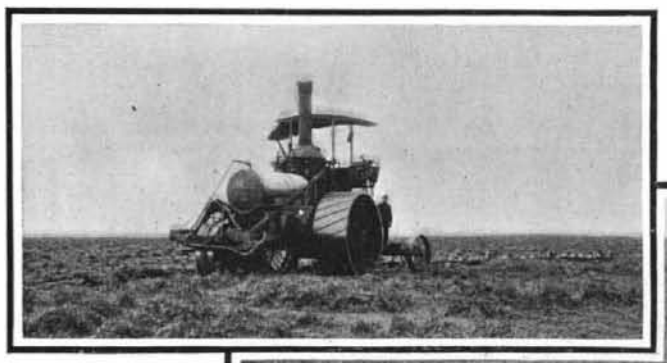
A 100-TON STACK OF ALFALFA RAISED ON IRRIGATED LAND.



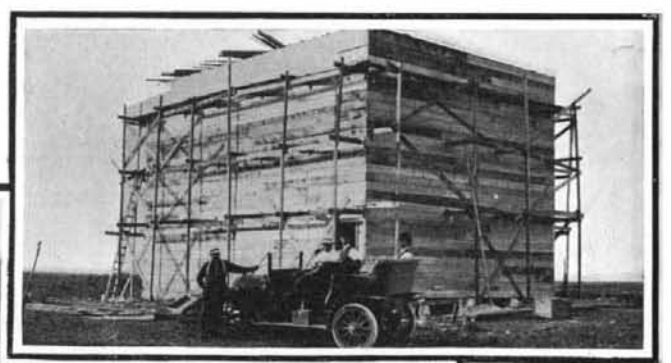
BALED HAY RAISED ON IRRIGATED LAND, TRUCKEE, NEVADA.



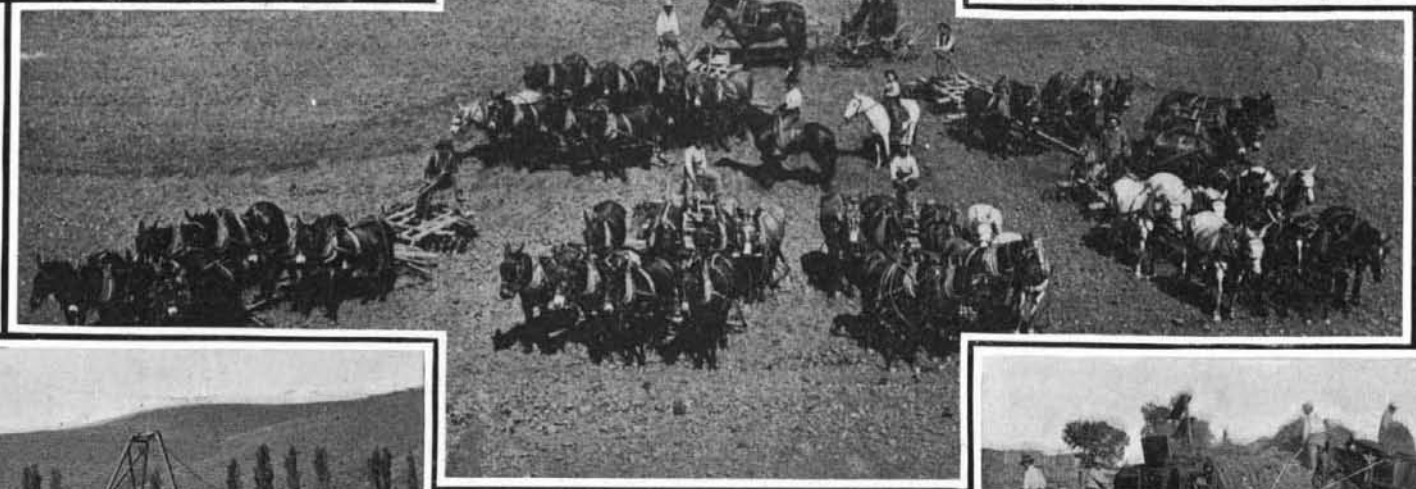
MACHINE LOADING ALFALFA AT LODI, CALIFORNIA.



GANG OF PLOWS DRAWN BY A POWERFUL STEAM TRACTION ENGINE. ON THE LARGER FARMS STEAM IS RAPIDLY REPLACING HORSE POWER.



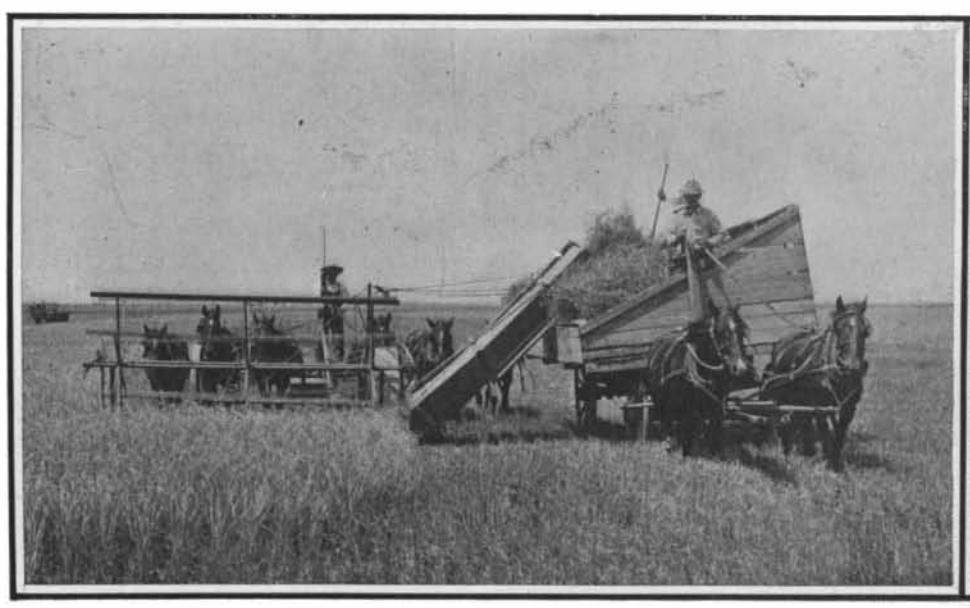
TYPE OF ELEVATOR ERECTED ON IDAHO RANCH FOR INDIVIDUAL USE. FROM THESE ELEVATORS THE GRAIN IS SHIPPED BY RAIL.



TYPICAL OUTFIT ON A LARGE OREGON FARM.

THRESHING GRAIN AT CARSON, NEVADA.

BALING HAY AT FALLON, NEVADA.



HEADER AT WORK IN A KANSAS WHEAT FIELD.

CORN BINDER AT WORK IN THE FIELD.

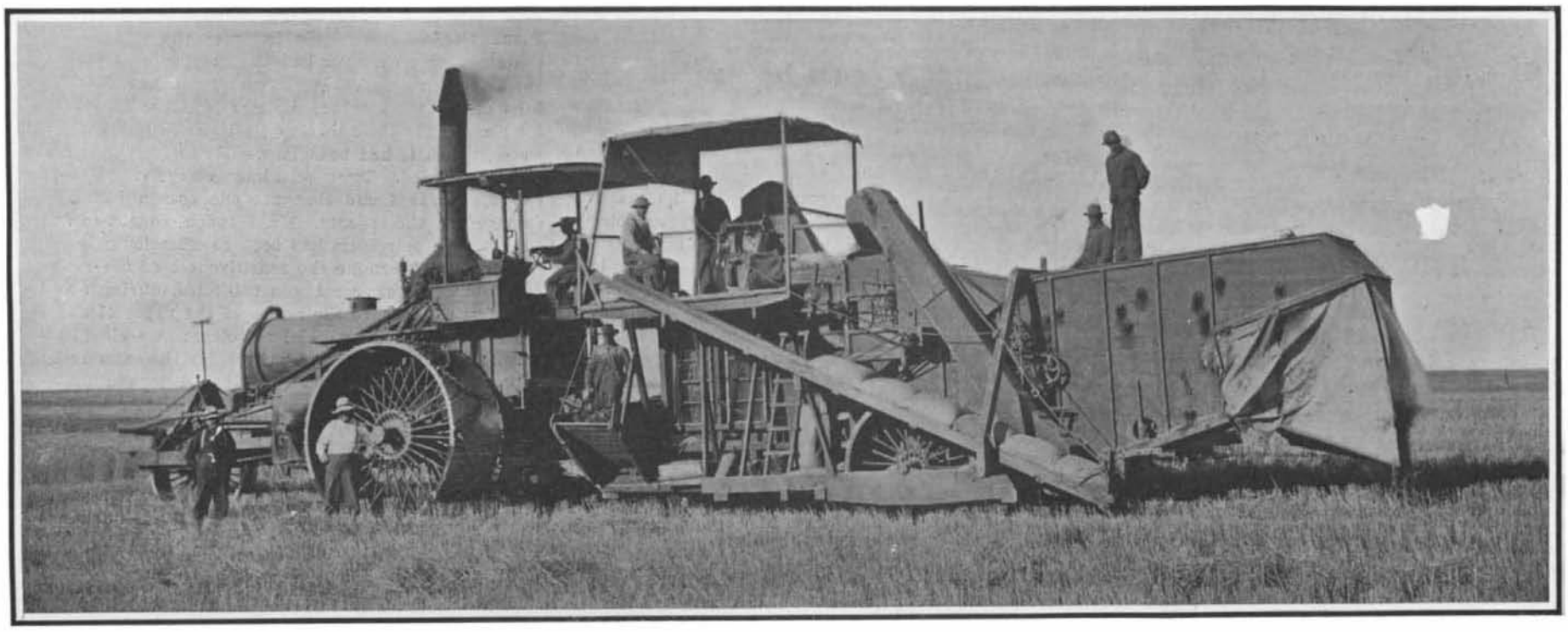
rotating holder, the loop formed, the ends of the bands severed, and the bundle is discharged, bound, from the machine. At the same moment a gate, which, during the binding operation, has shut off the flow of grain, retracts, and the operation is again repeated.

In the thirty-five years since the production of the first successful self-binder, the progress in the development of the harvester has been in the direction of improving its mechanical details and increasing its size and capacity. Originally, the threshing of the grain was done by separate threshing outfits which traveled from farm to farm for this purpose; but with the opening up of the huge wheat ranches of the West, there has been developed and brought to great perfection a combined harvester and threshing machine, several illustrations of which are herewith reproduced. These wonderful machines cut, thresh, and sack the grain at one operation. As they travel through the field, one sees the cutting bar, 15 to 25 feet in length, slicing its way through the standing grain, and on the other side he witnesses the steady delivery of the grain in sacks, ready to be hauled to the railway elevator. The largest of these machines are to be found in operation on the Pacific coast. They are either hauled by teams of from thirty to forty horses, or by large steam traction engines. The biggest of these, a Best machine, is hauled by a traction engine of 110 horse-power. The cutting bar is 25 feet long, the separator or thresher measures 54 inches, and has a capacity for cutting and threshing 65 to 100 acres of wheat per day, the amount depending upon the condition of the grain to be harvested. The cutting bar of the horse-drawn machine is 16 feet long, and the thresher measures 36 inches. This machine can cut from 35 to 40 acres per day. The harvesting expenses, when using the steam harvester, are from 35 cents to 50 cents per acre, and the horse-drawn machine operates at an expense of from 50 to 70 cents per acre.

There are but few statistics obtainable with relation to the early growth of grass-cutting and grain-reaping machinery. In 1840 there were three reapers made, and less than that number of people were employed upon them. In 1845, 50 people were employed in the manufacture of 500 machines. In 1850, the production had increased 3,000; and in 1860, 20,000 machines were produced, in the manufacture of which 2,000 people were employed. About the year 1880, shortly after the automatic cord binder was perfected, there was an immediate and marked increase in the output, so that by 1885 there were more than 100,000 self-binding harvesters built and sold, and 150,000 reapers and mowers, 20,000 people being engaged in their production.

Although the American harvesting machine has exerted the most potent influence in the development of the arable lands throughout the world, there has been a similar advance in the improvement of other agricultural implements, and a similar growth in the magnitude of the industry devoted to their manufacture. For the following statement of the progress made as shown by a comparison of methods, old and new, we are indebted to Mr. M. R. B. Owings, of the International Harvester Company:

PLOWING BY OLD METHODS AND NEW.—The old wooden beam walking plow has been superseded by the modern steel-beam riding gang plow. Throughout the great Northwest, and in nearly all the region west of the Mississippi River, the plow drawn by a traction engine has long since passed the experimental stage. Several 16-inch plows are drawn by a 20-horse-power traction engine. On a large farm, where three or four such outfits are in operation at the same time, it is not difficult to understand how thousands of acres of good wheat land can be plowed, harrowed, and seeded within a comparatively short time; for tractors are also used to operate seeding machines, both the pulverizing and seeding being done in one operation. With the old-style plow, two acres per day could be plowed, at the cost of $2.50 per acre. With the gang plow drawn by gasoline tractor, one and one-fourth acres can be plowed in an hour, at the cost of 75 cents an acre. If the plows are drawn by a steam tractor, the cost is $2 per acre.



This machine cuts the wheat, threshes it, and delivers it ready sacked in one continuous operation.

REAR VIEW OF A 50-HORSE-POWER HARVESTER COMBINE.

SUMMARY OF THE AGRICULTURAL MACHINERY INDUSTRY, 1850-1895.

	Census.			
	1905*	1890	1870	1850
Number of establishments	648	910	2,076	1,333
Capital	$196,740,700	$145,313,997	$34,834,600	$3,564,202
Salaried officials, clerks, etc., number	7,199	3,717	(4)	(4)
Salaries	$7,572,646	$3,704,667	(4)	(4)
Wage earners, average number	47,394	38,827	25,249	7,220
Total wages	$25,002,650	$18,107,094	$12,151,504	$2,167,868
Miscellaneous Expenses	15,178,098	11,129,548	(6)	(6)
Cost of materials used	48,281,406	31,603,265	21,473,925	2,445,765
Value of products	112,007,344	81,271,651	52,066,875	6,842,611

* Exclusive of the statistics of 93 establishments engaged primarily in the manufacture of other products. These establishments made agricultural implements to the value of $1,349,679.

THRESHING MACHINES.—The threshing outfit commonly used thirty years ago consisted of the old-fashioned separator and the now antiquated horse power. There were one or two band cutters; and one or two feeders, according to the width of cylinder, were required to feed the grain into the machine; three or four men measured and sacked the grain, while three

The harvester is shown at work in the wheat field of an Idaho corporation that owns 10,000 acres. The average yield on this ranch is 30 bushels to the acre.

FRONT VIEW OF THE HARVESTER COMBINE SHOWN ABOVE.

to six men were kept busy stacking the straw in a cloud of choking dust.

The modern threshing machine is equipped with an automatic band cutter, self-feeder, automatic weighing and sacking device, and pneumatic swinging straw stacker, the necessary power to operate all of which being either a gasoline or steam traction engine. By the old method of growing wheat, the time required to produce a bushel is three hours. The modern harvesting machines can cut the time down to ten minutes; the old cost being 17¾ cents per bushel, as compared with 3½ cents per bushel now. The old threshing machine had a capacity of 175 to 225 bushels per day; the modern machines can handle 2,000 bushels and over in the same time.

Haying Machines.—A similar advance has been made in machines for handling the hay crop. The old revolving, wooden-tooth hay rake has given place to the self-dump, sulky, steel hay rake. This machine can be operated by a ten-year-old boy, who can do more and better work than could a man using the old method. The hay tedder enables the farmer to cure his hay quickly, and greatly improve the quality of the hay. By means of the hay loader, timothy, clover, or alfalfa can be taken direct from the swath and loaded on the wagon. With the modern sweep rake, the hay can be taken direct from the swath or cock and put into the stack with the hay stacker. Extensive use is also being made of the derrick hay fork, especially when the hay is to be put away in the mow.

Corn Machines.—Thirty years ago, much of the corn crop was planted by hand, cultivated with a one-horse walking plow, cut by hand with the corn knife, and put into the shock by main strength and awkwardness. To-day the check rower automatically plants the corn in hills exactly the same distance apart, so that the corn will be in rows, no matter in what direction you may look at the field; in other words, the young corn can be cultivated with a riding sulky cultivator both ways, east and west, as well as north and south, which of course thoroughly destroys all weeds. When the crop is matured, the modern corn binder cuts and binds the corn into bundles ready to be put in the shock. One man with a corn knife can cut about one acre of corn in a day; the modern corn binder cuts and binds six to ten acres in a day.

The corn husker and shredder has been developed and perfected within the last twenty years. This wonderful machine enables the corn grower to double the value of his corn crop. Heretofore, corn has been husked by hand, and the stalks have been allowed to stand in the field and go to waste; for cattle will not eat standing corn stalks. Cutting corn by hand was a slow and laborious task at best; but with the modern corn binder the farmer can cut his corn crop promptly, at the time when the nutritious juices are still in the stalk. With the husker and shredder he can husk his corn and shred the stalks, leaves, and husks into stover, which can be put away in the mow the same as hay, or can be baled. Cattle, horses, and sheep can be fed on shredded fodder all winter, and they will be kept in good condition without any other feed. In the United States nearly one hundred millions of acres are devoted to growing corn. About two tons of corn stalks are grown on every acre. The modern improvements made in the machines used for handling the corn crop make it possible for the farmer to save two hundred million tons of corn fodder, which, when shredded into stover, is fully equal in feeding value to good timothy hay. At the low estimate of $5 a ton, the husker and shredder alone, if the whole corn crop were shredded, would annually add one billion dollars to the agricultural wealth of the country. The corn sheller enables the farmer to shell his corn quickly, if he does not wish to market his crop in the ear.

Cream Separator.—In the old days, the milk was strained into crocks and put away in the cellar over night. The cream was skimmed from the crocks, and laboriously churned into butter by hand. This old method left the skimmed milk almost valueless—cold, sour, and diluted to such an extent that it had little value for feeding purposes. When the cream separator is used, the skimmed milk is both sweet and warm, and is much relished by calves and pigs. A great deal of work involved in handling the milk is saved by the use of a cream separator. The milk does not have to be carried into the house or to the cellar, or to the spring or cooling tank; there are no unnecessary cans, crocks, pans, and other vessels that must be washed. The cream separator enables the farmer to double his dairy products with less than one-third of the work involved in handling the milk the old way. The yearly income from a good cow should be $89.25. Under the old methods the yearly loss was $22; which is altogether eliminated by the use of the cream separator.

Gasoline Engine.—Among the improvements which have helped to transform drudgery to a pleasurable pastime on the farm, the gasoline engine must be given a prominent place. When we were boys on the farm nearly all the odd jobs were done by hand. The wood pile and the corn crib were always full of terrors for the average farm boy; but the gasoline engine has wrought a magical change. This mechanical handy man will furnish power to operate the cream separator, to churn, and to feed the ensilage cutter, and it will saw the wood and shell the corn, and do innumerable other chores that are familiar to everyone who has been brought up on the farm. The gasoline engine is both an economical and reliable power, and it needs but little attention. A 10-horse-power engine of good design uses about one gallon per hour when doing its full 10-horse-power work. The trolley car and the telephone are doing much to bring the farm into closer touch with the larger cities; but it is the gasoline engine that is doing most to keep the boy on the farm. It is made in various styles and sizes, to suit the needs of the ten-acre farm as well as those of the ten-thousand-acre ranch.

Manure Spreader.—A great deal has been written about the abandoned farms of New England; and were it not for the improvements made on the manure spreader, now so generally used, the same doleful story would be written about many farms in the Ohio, Mississippi, and Missouri valleys. This region has always been known as the garden spot of the world; but even the marvelous fertility that is so common in Illinois, Ohio, Iowa, Missouri, and other States, noted for their bounteous crops, would soon become exhausted if the soil were not replenished with plant food. The manure spreader makes it possible for the farmer to renew the fertility of his soil every year. Instead of growing fifteen bushels of wheat to the acre, he fertilizes his ground properly, and reaps a harvest that will average thirty bushels to the acre; indeed, many fields have been known to yield as much as fifty bushels per acre.

The modern farmer is working with a well-defined purpose. His constant aim is to do less work that requires muscle and brawn, but more brain work. He purposes to purchase machines that will do the drudgery and irksome tasks, while he himself can find time to solve the problems of farm management. A little head work, properly applied to the management of a farm, will often turn loss into profit.

A Zeppelin Polar Expedition.

The object of the Zeppelin Polar Expedition Society, recently organized in Germany, is sufficiently explained by its title. The executive committee has decided to send a preliminary expedition to Spitzbergen, in the summer of 1910, for the purpose of studying the ice of the polar sea and determining the conditions which must be satisfied by a dirigible balloon operating in the polar regions. The committee attaches great importance to new improvements which will enable Zeppelin balloons to make long journeys, and deems it necessary to make preliminary voyages over sea in order to solve numerous problems which are very important to the practice of aeronautics in such conditions. An airship will be at once designed for over-sea flights and should be completed by the beginning of the year 1911.

It might be thought that, as Peary and Cook have reached the pole—and found nothing there, as could have been foreseen—it is useless to send out a polar expedition in an airship, but this view would be erroneous. In previous expeditions the explorers have had neither leisure nor facilities for the collection of important scientific data. If the Zeppelin expedition is successful its members will be less hampered by lack of time, and less exhausted by fatigue and privation. Hence they may be expected to make scientific observations of great value.

Aging Wines with Ozone.

The quality of wine is greatly improved by natural aging in wood or glass, but this method keeps a large amount of capital unemployed and involves a loss of 4 or 5 per cent by evaporation. The same improvement in the wine can be accomplished more rapidly by the action of oxygen. Boussingault proved that exposure to oxygen makes new wine less acrid and hastens the deposition of impurities in the form of lees. It is asserted, furthermore, that wine does not improve by age, either in wood or in glass, unless it has already absorbed a certain quantity of oxygen from the air, and Pasteur has proved that wine deprived of oxygen is not altered by keeping.

Artificial aging has often been tried but it has been found impossible to obtain the desired result by the introduction of either pure oxygen or pure ozone. The process patented by Alfred Dorn, a few years ago, appears to be more successful. It consists in the introduction of oxygen, and its transformation into ozone in the interior of the mass of wine. A tubular electrode connected with an oxygen tank and an induction coil is inserted into the cask, and a portion of the oxygen thus introduced is converted into ozone by the electric current. The operation is continued for a period varying from twenty to ninety minutes, according to the quality and quantity of the wine. For distilled spirits it may be necessary to continue the treatment six hours. This rapid treatment must be followed by natural aging for a short time, but new Bordeaux wine acquires by this method, in from forty to sixty days, the quality of wine kept for many years in bottles.

Rats and Petroleum.

The treatment of stagnant water with petroleum, which is effectual against mosquitoes, operates also in an indirect manner on rats. Mr. Mandoul has made investigations on board "L'Imerethie" during September, 1907. These are abstracted in the Archives de Parasitologie. One of the holds of the ship, which contained silk cocoons, had been almost entirely devastated by rats. Their presence there had probably been due to the saccharine water from the fruits and ice placed near the hold in question. To this body of water, which it had been impossible to remove, petroleum was added. Two weeks later, on arriving at Marseilles, it was found that not one cocoon had been damaged by the roden Mr. Mandoul sought to find out how the petroleum had been so efficacious; he endeavored to determine the sensitiveness of the rat to petroleum. A sewer rat was subjected, during about forty-five minutes, to the action of the vapor of about 100 grammes of commercial petroleum in a closed atmosphere (a bell communicating with the exterior by a narrow orifice). The animal began to exhibit labored breathing and, during the last quarter hour, a lassitude in its movements. After these manifestations the animal licked the hairs of its beard; it was depressed and ate little. Three days afterward it was found dead in its cage. The autopsy showed that its viscera were very congested, and that the intestines contained some petroleum. Another rat was subjected to a diet of petroleum. It refused bread treated with petroleum, but accepted meats. It died after about a quarter of an hour. The author made inquiry in petroleum refineries, and upon boats which transport this product. Rats do not exist there or are very rare. Mr. Mandoul concludes that rats have a peculiar aversion for petroleum, which drives them away rather than poisons them, the aversion with which they are inspired resulting from their desire to seek shelter from its toxic action. In addition, the petroleum, thanks to its insecticidal effect, rids the rats of their parasites and of the infectious germs which they are able to transmit.

Chicory Coffee.

At the Congress of the French Association for the Advancement of Science, which was held in Lille, Mr. P. Dorveau gave a communication in which he studied the history of the usage of the roasted root of chicory, as a substitute for coffee—we are inclined to say, as an adulteration of coffee.

The author of this invention is unknown; perhaps he was not willing that future generations should know the name of him who conceived what many consumers cannot fail to call a misdeed; it is true that the growers of chicory, and the manufacturers thereof, have worked hard to erect a statue for him.

Not only is the name of the inventor unknown, but even the date of the invention has been seriously disputed, and is a question which has long been discussed. After examining the documents, Mr. Dorveau believes he has been able to establish that the Dutch used chicory in 1690. There was a delay of almost a century before its usage spread beyond the country of its origin; the Prussians were the first to adopt it in 1763; the French have been making use of it since 1771, and there has been a singular development of the usage of chicory in France since that date.

Valmont d'Bomare, in praising the usage of chicory in his dictionary of natural history, published in 1875, without doubt contributed more than anyone else to its widespread use.

How Long Will the World's Supply of Iron Last?

Less than 2 million tons of iron ore was mined in 1800, less than 11 million tons in 1850, and nearly 85 million tons in 1901. Some day the world's supply of iron will be exhausted, and the question, when this day will come, has already been discussed. According to Prof. Binz, the total quantity of iron ore contained in known and workable deposits amounts to about 8,000 million tons, distributed as follows: Germany, 2,200; Russia, 1,500; France, 1,500; United States, 1,100; Sweden, 1,000; Spain, 500; England, 250 million tons. As an annual production of 50 million tons of iron means an annual consumption of from 100 to 150 million tons of ore, the entire available supply of iron ore, as estimated above, will be exhausted before the close of the twentieth century. Apart from the fact that vast regions of the earth have not yet been explored in search of mineral deposits, this conclusion appears far too pessimistic for the reason that ores very poor in iron, which are not now worked but could be worked in case of necessity, exist in great abundance. Hence an exact answer to the question appears to be neither necessary nor possible, at present.