AGRICULTURAL MACHINERY

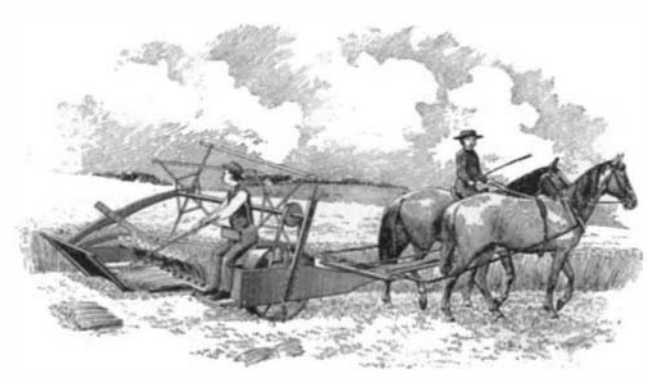
Before the building of the reaper it could be truly said that those who earned their bread by the labor of the harvest did so by the sweat of their brows. In the heat of midsummer, without protection from the beating sun, in a stooping position, the toilers of the world gathered the harvests. So excessive and trying was the labor that the wages at harvest time were double those of other seasons of the year, and the farmer engaged his help months in advance for this rushing period.

A little more than half a century of American invention in harvesting machinery has worked wonders as great, and has contributed as much to the wealth and prosperity and the civilized progress of the world, as has the spinning jenny and power loom in manufactures and the railroad in transportation.

The modern self-binding harvester is drawn into the field in the morning, and by night twenty acres are cut and bound into bundles with cord bands and left in windrows for convenience in shocking. This machine does the work of twenty men and does it better, saving enough grain over hand labor to pay for the cord used in making the bands. To such an extent has the industry of producing these machines progressed that 150,000 machines of this type are produced yearly, the manufacturers in the city of Chicago alone turning out more than three-fourths of this number. They are sold world wide, and every self-binding harvester contains as its fundamental elements the inventions of American artisans and mechanics. The scythe has given way to the mowing machine, and the extreme labor of the harvests and the crowds of extra help are seen no more on the farm.

The number of mowers annually produced exceeds the number of self-binding harvesters, and while they are not such savers of labor, still each machine does the work of five men with scythes. A conservative estimate of the number of self-binding harvesters that will be in use in the harvest of 1896 would be 400,000, and more than that number of mowing machines. In no country are these machines used so universally as in America, and the tremendous effect of their use in the production of grains and stock can scarcely be realized. The agricultural prosperity of the land depends upon them. The great prairies of the West were only developed by their aid. It is only by their use that the American farmer can compete with the myriad hordes of cheap laborers in the old world, and close students of the political history of our country lay the preservation of the Union to the fact that the reaper allowed the gathering of the harvests, and the progress and development of the Northwest, to proceed during the time of the great rebellion.

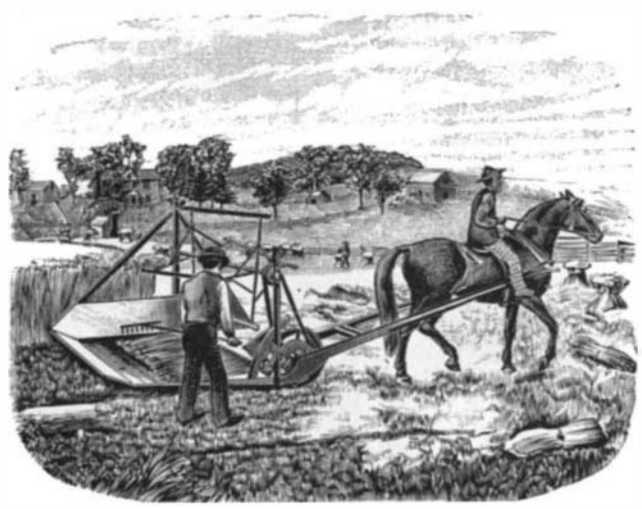
It takes but a few years beyond a half century to include the invention and building of the first practical reaper, and the important steps of improvement that have taken place upon it to develop it into the effective modern machine of to-day. At the beginning of the century there was no reaping machine. The Royal Agricultural Society of England at that time offered a prize for the production of a successful reaper, and continued this offer for forty years. The carts that the ancient Romans used on the plains of Gaul, that were pushed ahead of the ox and which were fitted with combs that stripped the heads of grain from the stalks, causing the heads to fall into the body of the cart, were not machines, inasmuch as they had no gathering, severing, or automatically operating devices upon them. However, in all history, down to the year 1828, these carts are the only practical operating devices mentioned for gathering grain. In 1828 an Englishman, Rev. Patrick Bell, built a machine that did some work in the field. It was used for a few years and discarded. After the first World's Fair, which was held in London in 1851, it was, however, revived and changed so as to incorporate ideas from the American machine on exhibition at this fair. Even with the added features it was not a success, and soon disappeared from the market.



THE McCORMICK REAPER OF 1845.

The first step in the progressive development of the reaper was the placing of the raker upon the machine.

In 1831, Cyrus H. McCormick, of Virginia, built the first practical grain harvesting machine. It contained the essential elements that have been found in every grain harvester that has proved a success from that day to this. Looking back upon the work of the last sixty years in the department of reaping machines, it will be seen that thousands of ideas have been advanced. Almost every known mechanism has been tried for severing, gathering and handling the cut crop, but through all this time and all these experiments the machines that have contained the elements invented and arranged as in the first machine built by Cyrus H. McCormick have been the only ones that have been of use in the real labor of the grain harvest. The first machine had a main wheel frame, from which projected to the side a platform containing a cutter bar, having fingers through which reciprocated a knife driven by a crank; upon the outer end of the platform was a divider projecting ahead of the platform to separate the grain to be cut from that to be left standing; a reel was positioned above the platform to hold the grain against the reciprocating knife, and to throw it back upon the platform, and the machine was drawn by a team walking at the side of the grain. This machine was the first to contain these elements, which have invariably been embodied in every grain harvesting machine made from that day to this. They are the essential elements of a reaper, without which no grain harvester can be built. This machine was successfully operated on the farm of John Steele, near Steele's tavern, Virginia, in the summer of 1831. In 1833 Obed Hussey built a machine and operated it in the field. It was similar to the McCormick machine, except that it had no reel and no divider. It also had no platform upon which the cut grain could accumulate and be raked to one side out of the way of the path of the wheel in the next round of the field. These two machines were operated year by year down to 1845, and were the only machines up to that time that were capable of successfully harvesting grain.



THE FIRST PRACTICAL REAPER.

Invented and built by Cyrus H. McCormick in 1831.

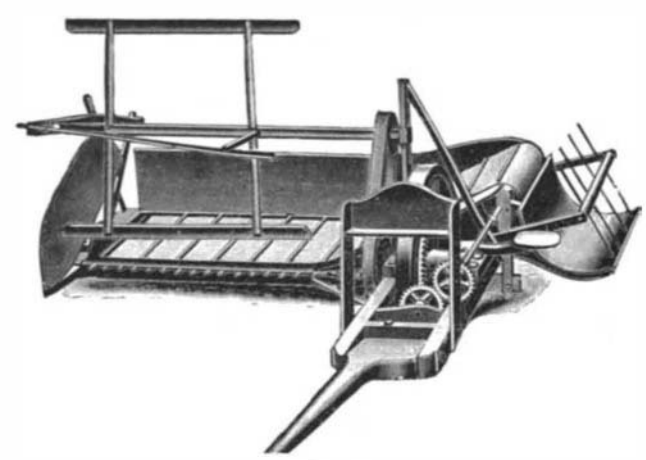
The first step of importance in the development of the practical reaper of 1831 was the addition of the raker's seat, which McCormick invented and applied to his machine, a device by which the raker could be carried upon the machine and as he rode through the field rake the grain from the platform to the ground, whenever sufficient grain had accumulated to form a bundle. A cut of the machine, with the raker in position, is here shown. Up to the time of the invention of the reaper, in 1831, a diligent search of the Patent Office records of all countries, and of the files of scientific journals, agricultural papers and mechanics' magazines, shows that there was but one German, two French, twenty-three British and twenty-two American inventions referred to, and but a small number of these were patented. Of this number but one machine survived a test in the field, and it has been shown by the experience of half a century that this machine (the Bell) did not contain the essential elements necessary for the production of a successful reaper.

In the early days of the use of harvesting machines the reaper was used to cut grass, or as a mower, and in 1849, A. J. Purviance, of Ohio, obtained a patent for the removing of the platform of the reaper, so that the grass when cut by the knife could pass back over the finger bar upon the ground, and the machine was thus more conveniently made a combined machine, or one that could both reap and mow. In the spring of 1851, McCormick placed his reaper on exhibition at the World's Fair at London. Hussey also had his machine on exhibition, and they were the only reapers there shown. The machines were tested in the field, and the Grand Council medal, which was one of four special medals awarded for marked epochs in progress, was awarded the McCormick. The judges at that fair were reminded that other efforts had been made toward building reapers twenty years before, in England, but they referred to the McCormick machine as being worth to the people of England "the whole cost of the exposition." When the machine was put into the field for trial it astonished all who saw it operate, and from this exhibition of the reaper, made at great labor and expense by Cyrus H. McCormick, dated the introduction of the reaping machine to the people of all lands. At a later exposition, after again winning the Council medal, Mr. McCormick was decorated by the French government as an officer of the Legion of Honor for "having done more for the cause of agriculture than any living man."

The next progressive step in the development of the reaping machine was the application of an automatic mechanism to rake the grain from the platform to the ground. This work had, up to this time, been done by a man riding upon the machine. In 1849 Jacob J. and Henry F. Mann, of Indiana, patented a machine having 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, where it accumulated in a receptacle until a sufficient amount had been gathered to form a bundle, when the operator dumped the receptacle, leaving the gavel upon the ground.

In 1850 Homer Atkins, of Illinois, invented a device for giving a reciprocating, intermittent motion to a rake, in order to deposit the grain upon the ground, after it had been cut and reeled upon the platform. This machine marks the beginning of an era of self-raking reapers, that continued to be supplied to the market for twenty years. The self-raking reaper was the principal type of a grain harvester in use for more than a quarter of a century, and there were many improvements of minor importance made upon it, such for instance as the quadrant platform of Palmer & Williams, in 1851; the supplementary frame of Densmore, in 1852; the dropper platform of Lucomb, in 1855; the Dorsey continuously revolving reel raking device, in 1856; the Hubbard self-rake, the Wood platform rake; the Whitely improvements in reel rakes; the McClontock Young revolving reel gatherers, carrying a rake revolving around the reel shaft; the Burdick, Howard Dodge, Whitely and Miller improvements in rakes—all of which served their purpose in forming distinctive types of machines to cut and deliver grain in gavels on the ground. They were all attached to reapers whose principles were the same as those invented and built by Mr. McCormick in 1831, and which the Paris Exposition of 1865, in awarding him the grand medal, the highest honor, stated was for "the real inventor of the system which has insured in practice the success of the new implement which is now available for agriculture." After the expiration of Mr. McCormick's patent, in 1848, manufacturing establishments started in different sections of the country, and the building of harvesting machines became a great industry.

In certain sections of the country, however, particular types of machines were used, such, for instance, as a machine called the "Header." Such a machine was patented in 1849 by Jonathan Haines, of Illinois. It had the essential elements of the reaping machine, but was pushed ahead of the horses, cutting a wide swath and clipping the heads of the wheat, which were carried



THE MANN HARVESTER OF 1849.

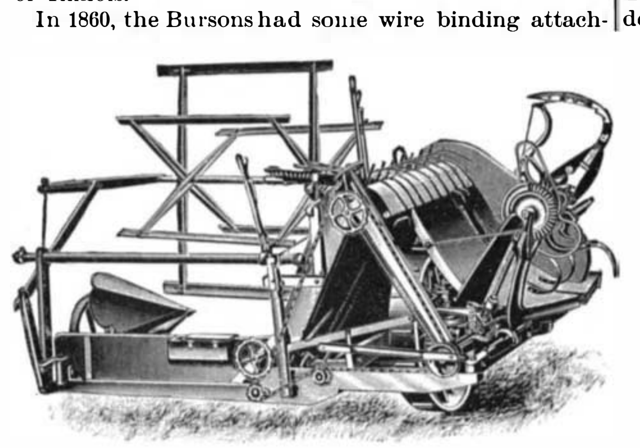
The second step in the development of the reaper was in applying to it an automatic device to remove the grain therefrom in gathers.

to the side of the machine on endless aprons and deposited in wagons driven at the side of the machine, and by these wagons carried to stacks. This machine was used in considerable numbers in dry countries, and has remained in use in limited numbers even to this day. In the summer of 1850 Augustus Adams and J. T. Gifford, of Elgin, Ill., built probably the first hand binding harvesting machine. It was a machine of the same type as that built by the Manns, in 1849, but it had, in place of the receptacle into which the cut grain fell as it left the traveling apron that conveyed it to the side, a platform upon which men were carried through the field, and upon which the grain fell from the endless apron, where it was bound by men carried upon the machine. This is probably the earliest example of a machine which afterward came into extended use under the name of haul binding harvester. But little was done with this machine by Mr. Adams, who afterward associated with him one Philo Sylla. In 1853 they built another machine upon which men bound as they rode, but which differed from the first machine in that it had a jointed cutter bar. Up to this time all machines that had been built had a stiff bar extending from wheel to wheel. In 1854 Cyrenus Wheeler, of New York, built a machine for cutting grass, that contained the jointed bar feature of the Adams & Sylla machine, and put into practical shape for the first time the modern form of the jointed bar mowing machine. Louis Miller, of Canton, Ohio, in 1858 made an invention that was an improvement in general form and construction upon this type of a machine. The Aultmans, with whom Miller was connected, had bought before this time the Sylla & Adams patent, and controlled for some years the building of jointed bar mowers and reapers.

In 1858, C. W. and W. W. March, of Illinois, invented their harvester. It was a machine of the Sylla & Adams type, as the grain after it had been cut and deposited upon an endless apron was carried to one side of the machine to men riding upon the machine, who bound this grain into bundles. It should be remembered that the self-raking reaper was the machine in general use up to this time, and men did the binding, walking from gavel to gavel. The Marsh Brothers thought that two men riding upon the machine could do as much work as four walking upon the ground, and their machine, which they continued to develop and perfect for several years, had finally, in 1864 and 1865, been got into shape so that it was practically operative. A cut of this machine is here shown, and it is interesting not only as marking a progressive step in the development of harvesting machines, but as furnishing the machine to which the automatic binder was successfully attached.

The next step in the progress of development toward the modern self-binding harvester was the attachment of a binding device to the reaping machine, to take the grain that had been cut and raked into gavels and bind the same automatically into bundles. John E. Heath, of Ohio, was the first to submit his ideas on the way to form a binder, to the Patent Office. He did this in 1850. In 1851, Watson, Renwick & Watson, skilled theorists, some of whom had been connected with the Patent Office in Washington, filed an application for a self-binding harvester. The specification was very long, and they endeavored to include in it all the ideas they could think of that might possibly be some time worked into an automatic self-binding harvester. No machine of the kind was built by them, and this patent is an example of thousands of devices that have been submitted for patent, which would have been impractical if put into operation. In 1856, C. A. McPhitridge, of St. Louis, filed an application for a patent, which, as we look back over the art, with the knowledge gained from years of experience in the field, is seen to have contained ideas approaching some that are now practical. Probably the first to complete a binding attachment that was partly automatic, and to attach it to a reaping machine, were H. M. and W. W. Burson, of Illinois.

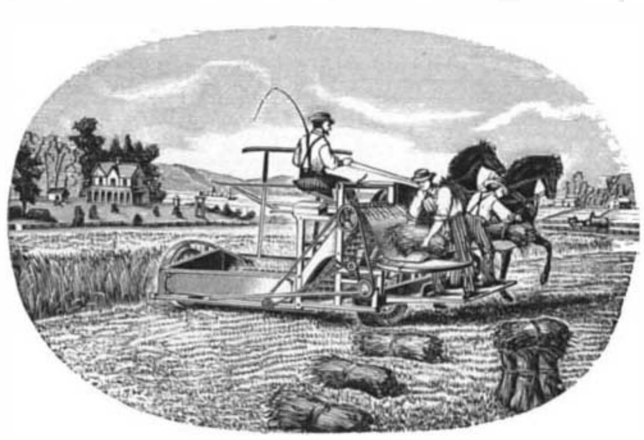
In 1860, the Bursons had some wire binding attach-



THE LOCKE WIRE BINDER OF 1873.

The fourth step in the practical development of the reaper was the placing of an automatic device upon the machine to bind the grain.

ments attached to reaping machines, and in 1863 they built one thousand machines. They were not, however, automatic machines, being assisted by hand labor, and did not do enough of the work to be profitable. In 1864, Jacob Bethel, of Rockford, Illinois, obtained a patent for a very important invention in binders. He showed and claimed for the first time the knotting bill, which loops and forms the knot, and the turning cord holder for retaining the end of the cord. He, however, did nothing more with his invention. Sylvanus D. Locke, of Janesville, Wisconsin, during these years was working upon a wire binder. He took out many patents, and in 1873, after associating himself with Walter A. Wood, built and sold probably the first automatic self-binding harvester that was ever put upon the market. The different builders of reaping machines were at work at this time perfecting automatic binders which they were attaching to harvesters of the Marsh type, by removing the platform upon which the men stood, and placing the automatic binder so as to receive the grain as it is delivered from the elevator of the harvester. S. D. Carpenter, of Madison, Wisconsin, James F. and John H. Jordan, of Rochester, N. Y., Spaulding, of Rockford, and Withington, of Janesville, did good work in the development of the automatic binder that bound with wire. The use of wire, however, as a binding material met with opposition, and the inventors turned their attention to perfecting an attachment that would bind with cord; and to Marquis L. Gorham, of Rockford, Illinois, who built a successful cord binder and had it at work in the harvest field in 1874, must be given the credit of producing the first successful automatic self-sizing binder. It bound with cord and produced bundles of



THE MARSH HARVESTER OF 1860.

The third step in the progressive development of the reaper was the placing of men upon the machine to do the binding.

the same size. It was like McCormick's reaper—a machine that contained the essential elements that have been found in every grain binder since its time. The grain in this machine is delivered by the elevators of the harvester upon a platform, where it is seized by packers, working alternately at the center of the grain, and carried forward, wisp by wisp, into a secondary chamber, where it is compacted by the packers against a yielding trip, so that when sufficient grain is accumulated, the trip would yield and start the binding mechanism into operation. The cord is carried on the machine in a ball, one end of which is threaded through the needle and fastened in a holder. The grain is forced against this cord by the packers, and when the binder starts the needle encircles the gavel, carrying the cord to a knotting bill of the Bethel type, and the end is again seized by the rotating holder, the loop formed, the ends of the band severed, and the bundle discharged bound from the machine, at which time a gate, which has during the binding operation shut off the flow of grain, retracts, and the operation is again repeated. This is the plan of operation of every self-binding attachment that is made even to this day. The grain is cut and delivered upon the apron by the devices that McCormick combined and arranged more than half a century ago. It is carried onward and upward to a deck binder by Marsh's plan, and selected from the continuous swath and formed into gavels, which are bound and delivered by Gorham's plan. The most ingenious inventors of the world have, after twenty years, failed to devise a better plan. In 1879, John F. Appleby took out a patent on a machine upon which he had been working for the past four years, which in the arrangement of the devices was an improvement to that of Gorham. It, however, contained the principles of the Gorham machine, which he had seen in operation in the field before he began to work upon his twine binder. The modern twine binder is in the form of its devices and the arrangement of its parts built upon the Gorham plan, as improved by Appleby.

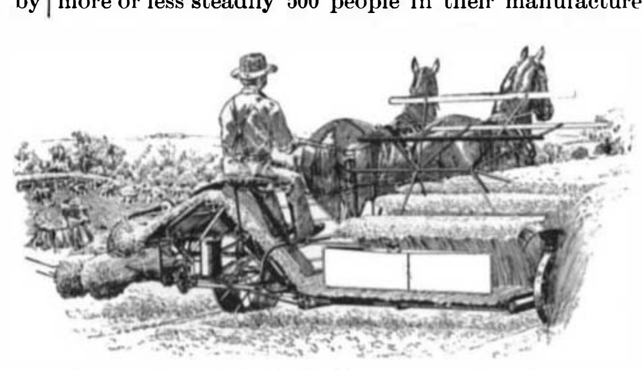
It may be stated that there is a machine built and in practical operation in the dry climate of California that cuts, binds, thrashes and sacks the grain by a single operation. These machines are, however, useful only in very dry climates and are made only in limited numbers, perhaps fifty being built and sold each year. The plan upon which they are built was described in an application for a patent to H. Moore and J. Hascall, Kalamazoo, Mich., June 28, 1836.

The work of the pioneer who enters a new field in invention and develops a new machine is one requiring the greatest persistence, endurance and faith in the ultimate success of the undertaking. In reapers not only did the machine have to be made capable of successfully doing its work, but being a field machine that was to be drawn over the rough fields of the average farm, and handled by all classes of men, and removed long distances from places of repair, it had to be capable of standing hard knocks of every description, simple, easily understood, and difficult to get out of repair. Not only did Mr. McCormick, as the pioneer inventor, have to design a tool of this kind from the foundation, but he had to educate the people to an understanding of the possibilities of his invention, and to the advantages to be derived from its use. Historians have eulogized the pioneers that pressed ahead into the wilderness, among savage Indians, and there cleared farms and made themselves homes, and opened the country for settlement. But the toils and struggles and privations that these pioneers overcame cannot be compared to the years of thought, experiment and toil, the disappointments, the lack of resources and the discouragements that surround an inventor who enters a new field of invention. Mr. McCormick invented his reaper in 1831, and worked with it until 1840 before making a single sale; during the years 1841, 1842 and 1843 those reapers that he made at the home farm in the small blacksmith shop were placed with difficulty, even though they did remarkable work, and showed a great saving in labor. The farm laborers of the country were adverse to them, and threatened any farmer who sought to use one.

As an example of the toil that was necessary to get agricultural machines into the field, it is known that Mr. McCormick made machines in Virginia which were carried over the mountains by team from Lexington to Richmond, and thence by canal to the ocean, by vessel to New Orleans, and up the Mississippi River to distributing points at Cincinnati, Louisville, Dubuque and St. Louis. Being without means, his endeavors to induce manufacturers to produce his machines were time and again failures, and it was not until he had gone personally, on horseback, among the farmers of Indiana, Illinois, Ohio and Kentucky, and obtained from them written orders for his machine that he induced a firm in Cincinnati to manufacture them. It was then necessary to follow these machines into the field, to instruct the farmer in their operation, and to warrant them to give satisfaction, and to remove every possibility of any loss to the purchaser before they could be finally induced to pay for them. This course was continued by Mr. McCormick with unremitting toil for several years, until the reputation of his reaper had spread over the land.

It was then that the usual vicissitudes that surround an inventor who has a valuable invention began to annoy him. Infringers began manufacturing his machine without authority. He began suits; his patents were attacked; interferences were arranged against him, and day by day he saw the grant made him by the government expiring and his returns from it being eaten up in endeavoring to protect his rights. Through all this, so great was the tenacity and so strong was the faith of Mr. McCormick in his reaper, that he took it to the first World's Fair, held at London in 1851, and there astonished the world with its operation. Those who had been the most sarcastic in deriding the invention became the loudest in its praise.

There are but few statistics obtainable in relation to the growth of the industry of manufacturing grain and grass cutting machinery. In 1840 there were three reapers made, and less than that number of people were necessarily employed upon them. In 1845, 500 machines were made, on which 50 people were employed, but not steadily. In 1850, the production had increased to 3,000, and in 1855 to 10,000, employing more or less steadily 500 people in their manufacture,

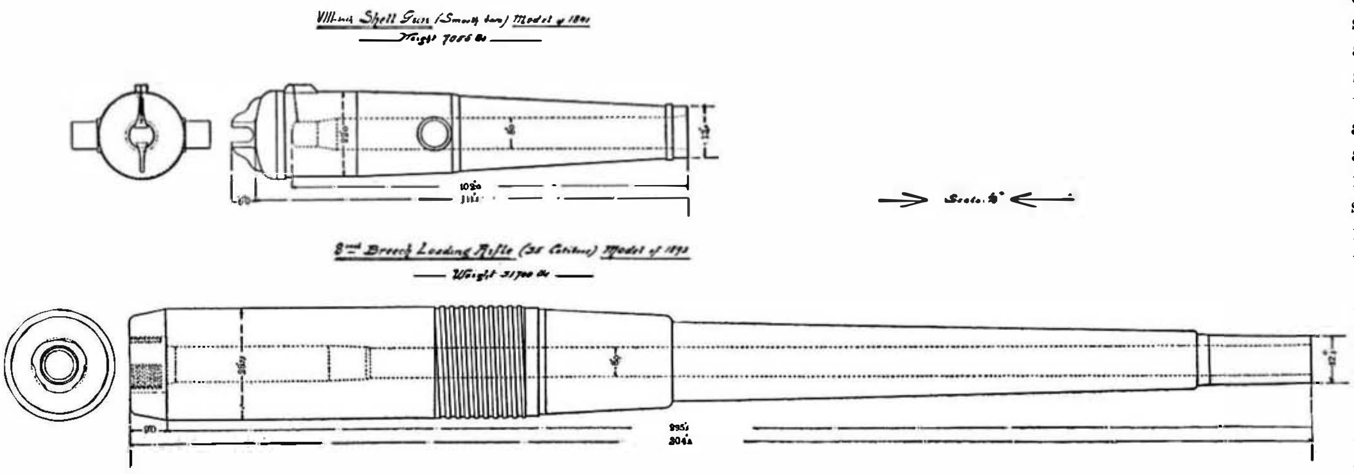


THE MODERN AUTOMATIC, CORD, GRAIN BINDER.

A machine which cuts, binds and carries the bound bundle into windrows.

with as many more agents and salesmen to get the machines upon the farm. In 1860 the output had increased to 20,000 machines annually, and there were more than 2,000 people employed in the industry. During the next ten years, the increase was not so rapid, but in 1870 the annual production was about 30,000, and 5,000 people were engaged in the industry. In 1880 this output had increased to 60,000, and 20,000 people were engaged in the industry. About this time the automatic cord binder was perfected, and the next five years showed a marked increase in the output. In 1885 there were more than 100,000 self-binding harvesters built and sold, 150,000 reapers and mowers, and 30,000 people were engaged in the various departments of the industry. 1890 showed another marked increase in production, but not so large as would have been the case had all the different harvesting machine companies continued the same proportion of increase in their output as did several of the larger ones. In this yea. two manufacturing establishments in the city of Chicago made more than 200,000 machines, half of which were binders, and the other half mowers and reapers, and these two institutions alone employed in their various branches of manufacturing and selling 10,000 employes. In 1895 the output of the largest of these manufacturing establishments in the city of Chicago was 60,000 self-binding harvesters fitted with bundle carrier and trucks; 61,000 mowers, 10,000 corn harvesters and 5,000 reapers. The number of employes materially increased, but the total number of employes in the business has not increased for the last few years.

There were exported in the year 1880 about 800 self-binding harvesters, 2,000 reapers, and 1,000 mowers. In 1890 this advance increased to 3,000 self-binding harvesters, 4,000 reapers, and 2,000 mowers. The Argentine Republic, Paraguay and Uruguay take most of the machines that go to South America, and perhaps one-quarter of the total exports are to these countries; another quarter goes to the colonies of Australia and New Zealand, while the remainder go largely to the Continent of Europe, where they harvest the grains along the banks of the Red Sea and the Volga in Russia, along the Danube, in France, and in Germany, Sweden, Norway, England and Scotland. From these figures it will be seen that the great user of the labor-saving device is the American farmer. It is only by employing these labor-saving implements that he is enabled to compete in grain raising with the hordes of cheap laborers of India, and with those on the plains of Russia.



COMPARATIVE DIAGRAM, DRAWN TO SCALE, SHOWING THE DIMENSIONS AND WEIGHT OF THE CAST IRON SMOOTH BORE 8 INCH GUNS OF THE MISSISSIPPI (1846) AS COMPARED WITH THE STEEL 8 INCH RIFLE GUNS OF THE MASSACHUSETTS (1896).

NAVAL AND COAST DEFENSE.

The student of the past half century of progress in naval construction in the United States is tempted to exceed the further limits of his subject. As, in the history of the steam merchant marine, he cannot refrain from mention of the Savannah, so, in tracing the development of the steam warship, he is constrained to go back to the time of the war of 1812 and record the fact that it dates from that year. It appears that, in spite of the splendid service which was being rendered by the navy during the course of that war, it was felt that the sea coast and harbor defense was insufficient, and as a measure of protection to the city of New York it was decided to build a powerful battleship which should rely mainly upon steam for its propulsion. A committee of the Coast and Harbor Defense Association of that day appointed Robert Fulton as engineer, and from his designs a large coast defense steam battleship of 2,475 tons was built and launched on June 20, 1814. According to the plans of the Fulton, as she was named, the paddle wheel was in the center, between what appear to have been practically two hulls, with the boiler in one hull and engine in the other. On her trial trip she made a speed of 5½ miles an hour with her armament on board. As originally designed, she was to have carried 32 heavy guns. Such was the first war steamer the world ever saw. Like the Savannah among transatlantic steamships, she was the pioneer of her class, and she anticipated by several decades the general introduction of steam into the navy.

The progress of the American navy during the past half century has been strangely intermittent, and it may be defined as a long stretch of comparative stagnation, relieved by periods of sudden and remarkable activity, in which the resourcefulness and inventive genius of the nation were shown to be merely dormant. The first awakening came in the great civil war; the second in the last decade—1886-1896—of the period of which we are treating, in which a new navy, comprising ships of the very latest type, has been placed at the nation's service.

Fifty years ago the United States navy was mainly composed of line-of-battle ships and frigates, some of which carried the scars and the glory of many a hard fought duel in the war of 1812. The Naval Register for 1846 gives the following summary of the number of vessels in the navy at that time: Ships of the line, 11; razee (Independence), 1; first-class frigates, 12; second-class frigates, 2; sloops of war, 23; brigs, 8; schooners, 6; steamers, 11; storeships and brigs, 4; a total of 78 vessels of all classes. Of the battleships, the most important was the grand old Pennsylvania, a giant for those days, of 3,241 tons and 120 guns, built in 1837. She had a full complement of 1,100 officers and men and cost $694,500 to build and equip. The other battleships were much smaller, being of about 2,600 tonnage and carrying 84 guns. The frigates of 1,726 tons carried 50 guns and the sloops of war averaged about 800 tons, carrying from 16 to 24 guns. The armament of these vessels consisted of from four to twelve 8 inch guns and from sixteen to seventy-two 32 pounders, according to the size of the ship. All of the guns were smooth bores, firing round shell.

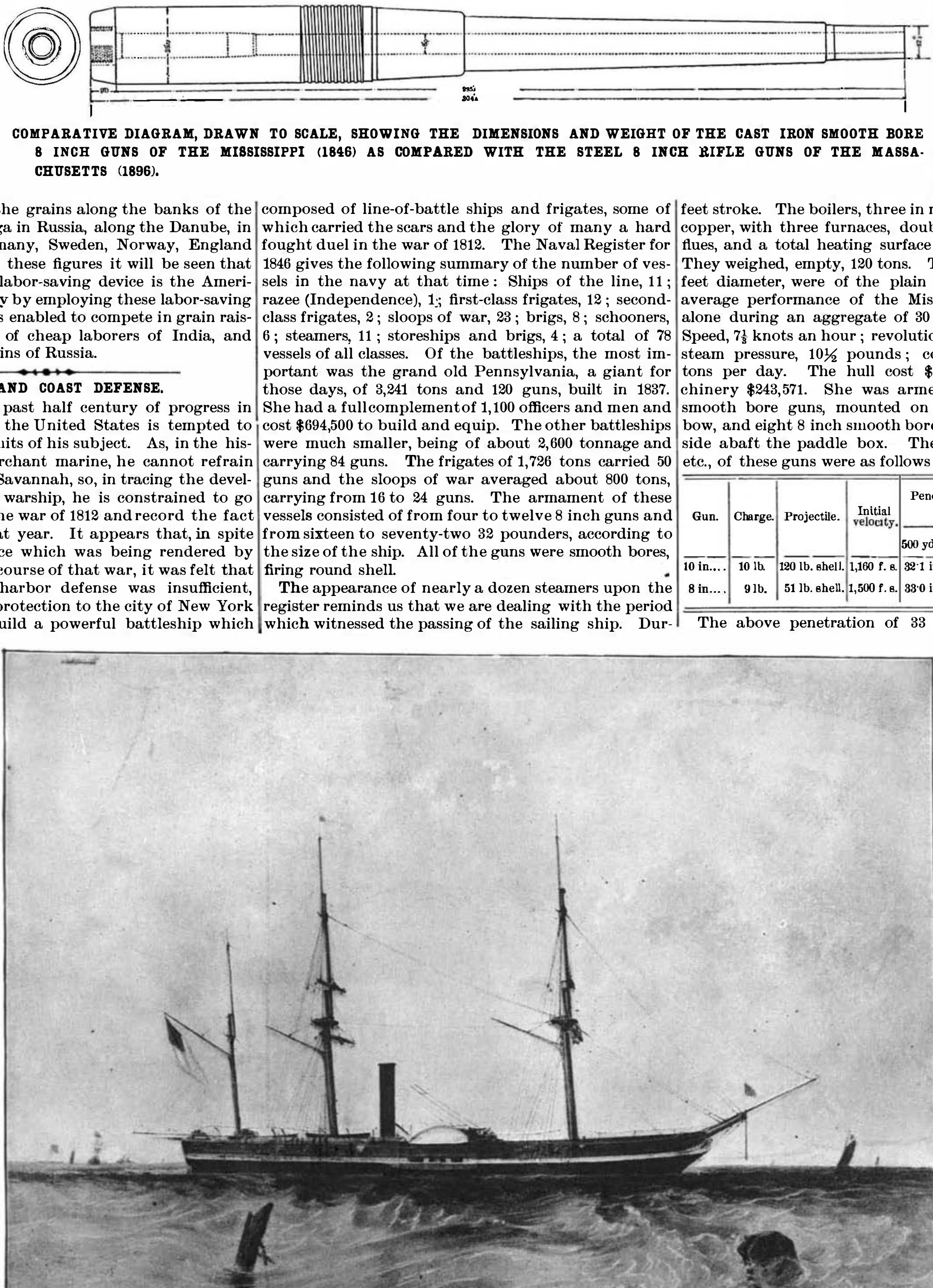
The appearance of nearly a dozen steamers upon the register reminds us that we are dealing with the period which witnessed the passing of the sailing ship. During the next fifteen years, which intervened before the outbreak of the civil war, only half a dozen sailing vessels were built, as against 33 steam warships. In addition to the service rendered by steam to ocean navigation in the merchant service, in the navy it brought further advantages of a tactical nature, which rendered it of special value. As compared with the sailing frigate, the steam frigate was independent of the wind and could place herself in the best position for a fight, giving or accepting battle as she pleased. This alone was sufficient to sound the doom of the grand old wooden two and three-deckers, with their towering topsides and lofty stretch of glistening spars and snowy canvas.

The accompanying illustration, from a daguerreotype of the Mississippi, shows rig and general appearance of a war steamer of 1846. She was launched in 1841, and in 1853 C. B. Stuart, the chief engineer of the navy, speaks of her as having been altogether the most useful and economical side wheeler in the navy. Her dimensions were: Length, 220 feet; beam, 40 feet; moulded depth, 39 feet; tonnage, 1,692; displacement, 3,220. There were two side lever condensing engines, with cylinders 75 inches diameter by 7 feet stroke. The boilers, three in number, were built of copper, with three furnaces, double return, ascending flues, and a total heating surface of 6,000 square feet. They weighed, empty, 120 tons. The paddle wheels, 28 feet diameter, were of the plain radial pattern. The average performance of the Mississippi under steam alone during an aggregate of 30 days was as follows: Speed, 7⅓ knots an hour; revolutions, 10·65 per minute; steam pressure, 10½ pounds; coal consumption, 37 tons per day. The hull cost $306,683 and the machinery $243,571. She was armed with two 10 inch smooth bore guns, mounted on pivots, one on each bow, and eight 8 inch smooth bores, mounted in broadside abaft the paddle box. The range, penetration, etc., of these guns were as follows:

Gun.	Charge.	Projectile.	Initial velocity.	Penetration through seasoned white oak at			
				500 yds.	1000 yds	1500 yds	2000 yds
10 in....	10 lb.	120 lb. shell.	1,160 f. s.	32·1 in.	24·2 in.	18·2 in.	13·7 in.
8 in....	9 lb.	51 lb. shell.	1,500 f. s.	33·0 in.	23·0 in.	15·9 in.	11·0 in.

The above penetration of 33 inches through oak would be equal to a penetration of 3 inches through iron. This was the maximum performance of the guns of those days. To-day the penetration at 500 yards of the heavy guns carried by our ships has increased from 3 to 30 inches, an impressive evidence of the growth of heavy ordnance.

At the opening of the civil war the fleet of sailing ships consisted of 10 ships of the line, 10 frigates, 20 sloops, and a dozen brigs, store vessels and receiving ships. The steam fleet included 7 screw frigates built in 1855, namely, the Niagara, of 12 guns and 4,580 tons, and 6 of the Roanoke type, of 40 guns and 3,200 tons; 6 first-class screw sloops of 13 to 25 guns and 1,446 to 2,360 tons; 4 sidewheelers of 9



THE MISSISSIPPI—UNITED STATES WAR STEAMER OF 1846.

Displacement, 3,220 tons; speed, 7⅓ knots; armament, two 10 inch and eight 8 inch smooth bore guns; total broadside, 894 pounds.