T H E S I S

ooo

# HISTORY AND DEVELOPEMENT OF THE PLOW AND REAPER

by

Lee S. Clarke

upon graduation from the

K A N S A S  S T A T E  A G R I C U L T U R A L  C O L L E G E

1907.

# HISTORY AND DEVELOPEMENT OF THE PLOW AND REAPER.

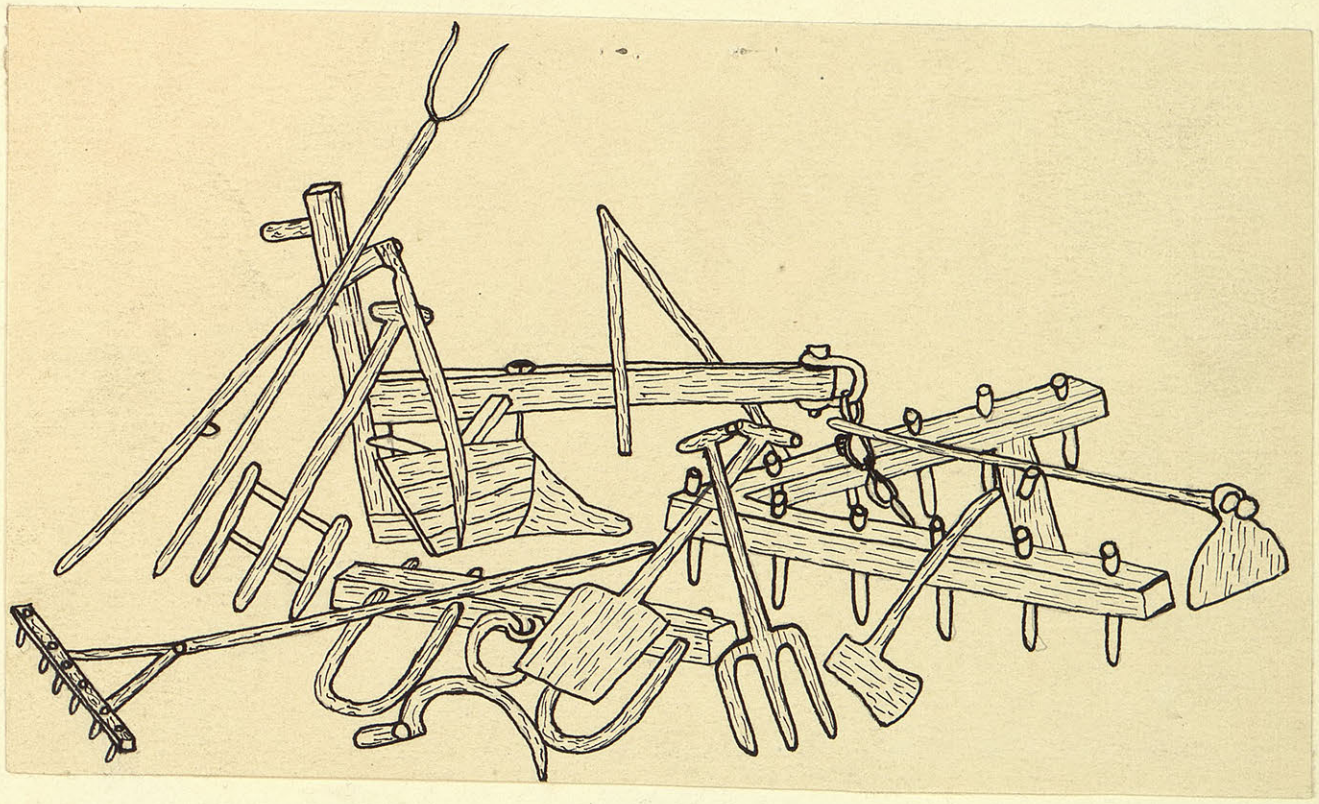
°°°
°

There is no branch of farm industry in which the improvement has been so marked during the last half century as that shown in the developement of the important farm implements. This improvement has come, largely with the increase in the demand for superior tools, as the progress of civilization has demanded more of the comforts and luxuries of life. However, there was a long period in American farming, as well as that of other countries, in which the hired man was looked upon favorably who had strong arms and sinewy muscles for the difficult manual labor by which practically everything was accomplished. This condition existed until soon after the beginning of the ninteenth century when the increasing population and demand for improvements, called for something better.

Mechanical inventions gradually commenced to interest man because the few rude and imperfect implements in use at this early day were of home manufacture and naturally of poor workmanship because of the lack of proper tools to work with.

There was apparently little idea of division of labor and the "jack of all trades" filled theplace which now requires the labor of several individuals. As long as such a condition existed, it is little wonder that progress was slow, but an awakening took place in which improvements along

the important lines followed rapidly. The following drawing shows the forms of the implements of 1790:



Evolution of The Plow.

oo

The evolution of the plow is perhaps of the greatest importance, as this is the fundamental implement of agriculture.

Sculptures on ancient monuments, dating back four-hundred years, give evidence that a form of plow was then in common use and had probably been in use for centuries. It is believed by bible critics that the book of Job is one of the most ancient writings, yet the first chapter alludes to the plow: "The oxen were plowing and the asses feeding be-

side them".

One of the most primitive forms of plows is simply a crooked branch of a tree, but this could only slightly stir the soil and could not turn the furrow. Later this wooden form was pointed with iron which added to its lasting qualities.

The fundamental idea of our present plow seems to have been derived, largely, from Holland. A form similar to the plow of today was used in the beginning of the eighteenth century and soon after this Holland model was introduced into Yorkshire, England, and became popular among progressive farmers. From this time on, the improvment of the plow was rapid.

In 1730 Jethro Tull, who had made a careful study of the science of tillage, saw that implements were needed to divide the soil more perfectly not only before the seeds were sown but afterwards as well. He understood well the needs of English agriculture and although he made many mistakes, he still accomplished a wonderful thing by perfecting a form of small plow or cultivator for use in stirring the ground for growing plants. The Berkshire plow, then in common use, was soon superceded by others which had over-hanging moldboards and a single coulter placed close to the standard or shin of the plow. Tull had no means of determining the loss of friction due to the weight alone, amounting in some cases to 30% of the entire draft, nor did he suspect how greatly the draft of the plow was increased by added coulters.

Later the plow of Scotland came into prominence and some

of its distinctive features have been retained in Europe to the present day. Its extreme length and lack of width and twist indicated that narrow straight furrows must have been then as they are now, the pride of the Scotch plowman.

The British agriculturalist in his zeal for straight furrows and easy draft, overlooked pulverization, which is, or should be the chief object in plowing. Great Britan next came with her wedge-shaped implement, which in some localities, is still preserved. Such plows are adapted only to land free from stumps and stones and they illustrate the English idea of plowing flat furrows.

This differs radically from the American method which seeks to break up the furrow by bold, over-hanging moldboards. The above illustrations show that until very recently the chief effort of the plow maker has been directed largely toward producing an implement of light draft by constructing it on sharp, wedged lines, with little reference to the pulverizing efficiency. Observation leads to the conclusion that in England, twice as much surface tillage is given in preparing the seed bed as in America, due without doubt, to the imperfect principle on which their plows are constructed. From this it is quite evident that the plow had developed in England and America on very different lines.

It is recorded that as early as 1617 some rude plows were set to work in the Virginia plantations but in that year the Governor complained that the Colony suffered for want of

skillful husbandmen and necessaries to operate the implements to the best advantage. Perhaps this date and incident marks a turning point for future developement of American agriculture. In 1648 many such plows were in operation not only in Virginia but also in other colinies as well, showing that the people were awakening to what was needed for their welfare and protection.

In 1785 Robert Ransome of England succeeded in making plow shares of cast iron. This was a great step in advance of the old method, by which each share was formed according to the skill of the blacksmith. Until this time most of the improvements of the plow were lost at the death of the genius who had invented them. In 1803 Ransome discovered and patented a method for case hardening or chilling the shares. The ordinary cast iron point soon became blunted or broken and as it could not be sharpened, a new one had to be put in its place. The case hardening of about 1-16 of an inch on the lower surface preserved, to a considerable extent, the sharp-edge, since the upper and softer portion wore away faster than the lower. The bridle and clevis at the end of the beam, to control the width and depth of the furrow, was also a valuable addition.

In America, however, the English plow could not be used to advantage because of the many stumps and stones of New England and the Middle States. While we brought from England and Holland many ideas, yet the foreign idea of the plow had to be radically modified to suit American adaptations.

In 1780 Thomas Jefferson made a study of the plow in other countries and constructed an implement on what appears to be true mathematical principles but the invention failed to be of much pratical importance. Later Charles Newbold, of New Jersey, made the first American cast iron plow and secured a patent in 1797. Prejudice against this "new fangled" plow was so great that it did not come into general use, the farmers thinking that cast iron implements poisoned the land and caused weeds to grow. The latter is, of course, true because weeds as well as desirable plants, respond readily to an improvement in cultivation.

In 1794 John Smith produced a cast share which had a false wrought iron or steel edge riveted to it. The object of this was to make it capable of being sharpened from time to time, thus saving the expense of a new share when dull. In 1807 David Peacock, of New Jersey, constructed an improved plow which came to be very valuable and as the prejudice against the cast share had passed away, it came into common use. Peacock's plow was similar in some ways to that of Newbold's but of much more practical importance.

The reasoning of those interested in plow manufacture was somewhat as follows: In adjusting the moldboard, this additional point must be determined; the extent of the angle which the essential straight line should form with the bar of the share, for the smaller the angle the less resistance at entering the earth, but if the angle were to be very small the plow must have great length to obtain a furrow of proper

breadth and such length would of course increase the quantity of friction. The last clause is an error, because it can be readily seen that friction is not increased by lengthening the mouldboard, other things being equal.

As soon as the cast plow was secure, the next step was to make it of several interchangeable parts so that it might easily be repaired. Following this, immediately came inventions on draft-rods, clevices, and guide wheels. The lock coulters became common in the wooded districts and were a great improvement over those which allowed the roots to pass back of the coulter to the standard without being cut. In the latter case the plow had to be relieved by severing the roots which an ax, which as can be readily seen, was a great annoyance.

In recent years several changes have been made. The share, beam, and handles have been lengthened, and the handles placed lower and at a less acute angle than formerly.

The main object is to pulverize the soil and the only way to effect it thoroughly is by bending the furrow slice on a curved surface so formed that it shall be twisted somewhat in the manner of the screw. This was the idea of the inventors of 1839, which was of great practical importance.

In 1860 trench plows were made but were little used for deep tillage. Soon after, the subsoil plow came into use, but it was found to be more economical to loosen the subsoil by under drainage than to go to the expense of loosening it every few years by the use of the subsoiler.

The first western immigrants found that the open prairies were easier to reclaim and were far richer than the fringe of wood that bounded upon them. By mean of ten or twelve yoke of oxen the great breaking plows were forced through the tough sod, but with them very little depth of breaking could be accomplished because of the lack of proper construction.

Between 1860 and 1870 a glass plow was invented, but this failed to meet the expectations because of its being easily broken, and its failure to scour properly. The next effort was to construct a plow with a steel moldboard which was hardened by chilling the outer surface after heating in layers of charcoal. For several years the moldboards were hardened in hot oil in order to overcome the difficulties that were met with when only the outer surface was hardened. This was fairly successful but very expensive because in the operation many of them would twist or crack. To overcome this a layer of steel and a layer of soft iron were welded together to form the moldboard and this preserved the proper shape during the hardening process. The practice of carbonizing or chilling the face of the moldboard of both steel and cast iron plows has become more common. This process or a similar one is now in general use and plows constructed in this manner scour better and are more durable than formerly.

From 1861 to 1865 gang plows were constructed and were quickly followed by the sulky. The later plows were made heavier and all parts have been adapted to hard and stony

lands and to plowing in both stubble and sod, when the jointer attachment is used. The American plow has taken the form best adapted to working the land cheaply and thoroughly, without much reference to straight and beautiful furrows. Thus the evolution of the plow in the United States has been along new and original lines. Discovery after discovery has rapidly followed and as the inventor has the use of the best of material it may be said that the American plow maker puts the very best implements on the market. No other country produces a number equal to that of the United States and as a result our implements are sent to all civilized countries on the globe.

Pulverizing of the soil is of great importance and hence the plow had improved through all these centuries and now America stands at the lead in general superiority of the most important of all farm implements, the plow.

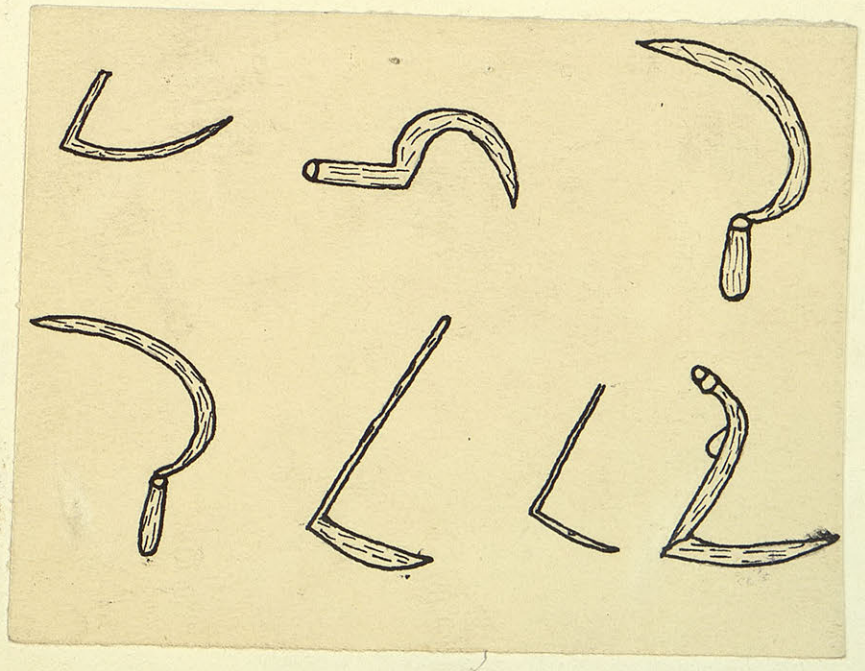
Evolution of the reaper.

°°
°

Next in importance is the evolution of the reaper. In the most primitive period while all agricultural work still consisted of hard manual labor, the sickle stood the unbroken test for centuries with comparatively few changes. The process of reaping is older than written history. We know that man existed before history and also that some small grains were raised because remnants of broken sickles indicate this. The implements found were of flint of the very rudest type and indicate the first stages of agricultural developement. The first record was found in Egypt and improve-

ment there should have been rapid because of the early settlement and the very fertile lands lying along the Nile. A tomb at Thebes probably built as early as 1400 or 1500 B. C. bears a painting which shows the various operations connected with the cultivation and harvesting of grain. The operations are shown in this same painting: Two men are cutting the grain just below the heads, and another two carry the grain to oxen which trample it out. Another picture illustrates men binding the grain in sheaves and placing them in piles.

The ancient Chineese and Japaneese used an implement resembling the sickle, and it is practically the same tool that is in operation today. From Egypt, the art of agriculture was passed down to Greece and the Romans also aided in furthering the developement of the common sickle. The following drawing shows the sickle forms of that time:



After the period of Roman progress agriculture as a whole began to decline and continued at a very low stage for about ten centuries or practically through the middle ages. In 1548 some of the types of the above drawings were used, and both the sickle and a form of the scythe were also in use. The scythe was simply an improvement on the sickle and hadmany forms, especially in the shape of the handle. The scythe became lighter as time went on and was passed through various double, forked, and iron forms, to the final crooked wooden form which is still used today.

With the developement in the American Colonies, came an improved form of the cradle scythe. The "American cradle" was simply an improvement on the earlier forms and cannot be classed as an invention. It was in common use before the beginning of the 18th century and rapidly took the place of the sickle. Once perfected, it spread rapidly to other countries either in the original form or in a form slightly modified. Today it is still used in various parts of Europe and in America where the conditions make the use of the reaper impracticable.

It is strange that the operation of reaping was carried on for centuries with the sickle and scythe as the only harvesting implements. However, this is ture and practically nothing was done toward the construction of the reaping machines until near the close of the 18th century, and twenty-five years passed before anything of a practical nature was constructed.

The first mention in history of a reaper, is that de-

scribed by Pliny during the 18th century. However, it was not a true reaping machine but a a header, consisting of a hollow frame mounted on two wheels and set with teeth along its front edge. These teeth caught the heads and tore them off after which they were raked into the box by an attendant. This machine was pushed by an animal from behind but the method seemed unsatisfactory and was finally discarded and forgotten for a century.

Now we enter into the age in which inventors began turning their attention to machines which would lighten the labor of harvesting. The first invention of any consequence was patterned after the ancient header of Gaul, and was later improved upon by an Englishman. In place of a single row of teeth, a cylinder fitted with rows of comb-like teeth was placed horizontally on the front part of the frame and was made to revolve by the power transmitted to it by the wheels. As it revolved, the inclined teeth caught the heads and carried them over the cylinder into the box.

A revolving machine was next in importance and was operated by two horsed from behind as in the earlier forms. From 1805 to 1820 several minor forms were introduced but nothing of importance took place until Maun, in 1822 presented a model for the reaping machine. However, it was so complicated that it was of little use. During the next ten years he improved his machine which then consisted of a revolving cutter with a series of revolving rakes for carrying the grain to the swath. The special feature was a twelve sided cutter which was expect-

ed to be more efficient than a circular one. It did not meet expectations, however, and although used to some extent, it never came into general use.

Ogle, in 1822 presented a principle of cutter together with the reel which is found, in some form, in the present binder of today. This we must admit, was the beginning of the modern reaper and Ogle should be given credit for inventing the first reciprocating knife and other combinations which are lasting features of today. To Hussey and McCormick, the two great American inventors, belong the credit of being the originators of the wonderful developement in harvesting implements which took place during the next fifty years. The Hussey machine, introduced into England near the middle of the past century, consisted of a low frame mounted on two wheels, the larger being the driver which transmitted the power to the vibrating rod, bearing pointed blades or sections working through slots in iron fingers projecting forward from the cutter bar. Behind the cutter bar was placed a platform to receive the severed grain from which it was raked away by an attendant stationed near the drive-wheel. The machine was very simple and was without reel or complicated modifications.

The McCormick machine, introduced about the same time as the Hussey, was somewhat more complicated but had the same principles of the vibrating knife, excepting that in this case the knife had a serrated edge with only a wavy outline instead of the pointed sections, as in the Hussey machine. The reel

was added to make the cutter non effective, but no place was fixed for the raker who was compelled to walk. The knives of this machine had saw edges thus enabling the grain to be sawed into rather than a continual chopping as was formerly the case.

McCormick profited by the Hussey idea of the guards and Hussey made use of the McCormick principle of balancing the machine on two wheels. Hussey's cutting apparatus was the most unique and probably the most original, while McCormick's combination of so many features did wonders toward furthering the developement.

In the early trials of these machines the honors were taken by one and then by the other but while Hussey's machine was simpler and more durable, it pulled harder and had the disadvantage of requiring the wheat to be thrown aside before a second round of the field could be made, since the bundles were raked backward from the platform. In wet or green grain McCormick's machine had the advantage because of the more suitable arrangements for heavy work.

Prior to the year 1850 many inventions were placed before the public and within the next ten years, the mower became practically what it is today and another decade saw the foundation of the modern binder practically laid. The term "Harvester" may, in its broadest sense, be applied to the self binder as well as the header of the Western Plains and of Australia. Long before the self-rake had reached perfection, inventions were presented for various improvements, devising many forms

of machines. Even before a practical cutting apparatus had been produced efforts were being put forth toward making a device for heading and threshing the grain, and also to discover some mode of forming the cut grain into sheaves.

An improved harvester was built by Marsh in 1858 on his home farm but because of lack of material, this was not what he expected. Marsh kept at his work, however, and in the winter of 1860 and 1861, he constructed a machine that worked remarkably well. From this invention and superior management of several men, the Deering Harvester Company of today has mades its wonderful developement. While the harvesters were being improved the binding apparatus was also being perfected. Later, McCormick Bros. began the manufacture of the Withington type of binder which was the most successful of its kind ever put on the market. This was in great demand for some time but the cord binder soon came into use which doomed the wire type to extinction.

The Deering, McCormick, and Osborne companies at once obtained rights and began the manufacture of this type of binder in connection with the Marsh style of frame, adding various improvements ad they saw fit. This style of machine immediately leaped into popular favor and the binders of today are simply this style more nearly perfected. From that day until this the modifications have been in detail and not in principle. It is true that among the twenty odd manufacturing companies, there are found forms differing to this, but they

a

are not among the most popular machines. American harvesting machines are the most perfect in the world and today they are being introduced into many other countries.

In 1840 three reapers were made in America, in 1845 five-hundred were made and fifty men were employed, in 1850 three thousand were sold, and in 1860 twenty thousand were turned out by factories employing two thousand men. During the next ten years the increase was not so great, but in 1870 thirty thousand machines were built by twenty thousand employees. In 1885, one thousand binders and one-hundred fifty thousand reapers and mowers were constructed by thirty thousand employees. In 1890 two manufacturing establishments in Chicago made more than two-hundred thousand machines, half of which were binders, the other half being reapers and mowers, while in 1899 a single firm exceeded that number. As a result of this great developement, agriculture has been revolutionized which has meant a wonderful boon to the welfare of the United States and of the world.

Lee S. Clarke.