THE TRACTOR

Selling it as an
Agricultural Implement
and Fitting it to the
Different Crop Areas

Compiled and Published by
The
CAPPER FARM PRESS
Topeka, Kansas.

APR 15 1920

THE TRACTOR

SELLING IT AS AN

Agricultural Implement

AND FITTING IT TO THE

Midwest Crop Areas

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1920

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INTRODUCTION

This present text is issued in response to the constant demand for our former book entitled "Tractor Analysis." Important new data has made necessary a thoro rewriting of the first, second and third editions. This edition is, therefore, a completely new treatise and, like the others, seeks to set forth the value of power farming as the most important economic factor in the development and maintenance of profitable crop production in the great grain and livestock belt of the Middle West.

The compiling of this analysis has been the work of both the editorial and advertising staffs of The Capper Farm Press. In addition, various leaders in agriculture and several technical tractor authorities have lent their assistance. All told, some sixty men have been responsible for the facts set forth herein.

But this is not all. Theory has been proved by practice. To do this, some 12,000 farms were visited during the past five years by the compilers and distributors of this volume. During that time no less than 100,000 reports from individual farmers—both owners and non-owners of tractors—have been analyzed and their information utilized. From these various sources has been gained the ample and authoritative information that forms the basis for this brief exposition.

Acknowledgments

Special acknowledgment for specific help and contributions must be made to the agricultural colleges and experiment stations especially of Kansas, Nebraska, Oklahoma and Missouri; to the United States Weather Bureau and to the United States Department of Agriculture. Material and information compiled from various reference books and other sources will find their acknowledgment either in the text or in the appended bibliography.

FOREWORD

The Ideal Tractor—a Definition

“A tractor void of unnecessary weight and proportions, calling for high quality material and facilitating proper housing; built compactly, but not complicated, requiring neat and systematic assembly of parts; having equal facility for use with draw bar or belt; provided with positive drive, making for high tractive effort yet prohibiting dangerous leverages; giving ease and simplicity of control, adjustment and replacement of repairs; having wearing parts of standard interchangeable make; being free from excessive vibrations; provided with facility for cleaning intake air; adapted to use kerosene or other low grade fuel; and lending safety to the operator who in turn will have a clear view ahead.”

H. H. Fenton,
Industrialist Specialist,
Kansas State Agricultural College,
Manhattan,
Kansas.

THE TRACTOR

CHAPTER I

The Reason Why of the Tractor

Not Only True But Interesting

Although the tractor is a comparatively new tool in the history of American Agriculture, its literature is already a large one. And more volumes might yet be written concerning it, not necessarily scientific and highly technical but books that would capture the interest of any reader. There would be the story of that pluck and initiative which makes possible the coming of any great innovation. The epic of the wheat and the corn in all its romance would be set forth were space available. But behind the impersonal tabulations of figures and data, the color and the flash of high romance is lurking, and those who know it may read between the lines.

A New Era Begins

Any history of the evolution of agriculture must recognize that all advancement in crop methods from the very beginning has been an adaptive process. Thus the tractor, in its revolutionizing of present-day agricultural procedure, is but one more step in that process toward perfection which dates its progress upward from the sharpened stick of the barbarian farmer to his power-equipped descendant of this present age. Like all other improvements of its kind, it was the need of increased production that provided the chief incentive for the development of tractor farming. After the repudiation, through the sad experience of failure, of those small-farm, eastern methods that the first western agriculturalists had brought to their own holdings in the Middle West, rural leaders as far back as the 80's saw the necessity of reformation. Although improved machinery to some extent had come into use, there was still being continued many mistaken notions of crop procedure. Although grain farming was even then the principal occupation of the people there was by no means enough livestock fattening and dairying carried on

A Change for the Better

But the reformation asserted itself with relative swiftness. The Howard Act (1887) enabled each state, thru the establishment of an experiment station, to work out its peculiar and individual agricultural problems. The second Morrill Bill (1890) still further extended the usefulness and influence of the state agricultural colleges. These new tendencies in western agriculture were given definite stability and recognition in 1897 when, under the leadership of James Wilson, Secretary of Agricul-

ture, was inaugurated that "unit system" supervision which gave material backing to the various state policies of agricultural advancement. This was the beginning of what is now the definite "unit-supervision" of the department. So-called safe farming within the limits of definitely oriented crop areas is now the recognized practice. The principle of correct farm-procedure as recognized today, not only in the Middle West but thruout the nation, is that principle which seeks to recognize the peculiar adaptability of certain crops to certain peculiar climatic and soil conditions.

New Crops

Without going into the history of those changes which have brought new crops into the Middle West, crops which range from new breeds of wheat and the various grain sorghums and legumes, it should be stated that the tractor has taken its place as the inevitable concomitant of these newly created farming conditions.

The introduction of various new crops, each suited to its own peculiar locality, was the direct answer to the cry for increased production. This sort of production meant new methods; it involved the breaking of virgin areas. The exploitation of new farming districts with those extensive methods of crop cultivation which had always been their ideal, even in the half-attained practice of Middle Western agricultural states, meant the casting about for more efficient agricultural implements. While the horse hitherto had been a most efficient power-unit to the extent of his very definite limitations, there was felt the need of some new motive power that would complement that farm power machinery already in extensive use thruout the wheat and corn belt.

The Gas Engine

The adoption of the gas engine with its relative cheapness, its durability, flexibility and low cost, both original and of maintenance, pointed the way to the solution of this new problem. The extensive exploitation of new fuel fields provided a still greater incentive. The tractor, and particularly the gas engine tractor, including both the gasoline and kerosene types, was the logical result. It should be explained that this volume does not attempt to deal extensively with the steam tractor, which, although it has played a commendable part in the first era of power farming, is, by its very size and comparatively high cost, almost eliminated from consideration in comparison with its cheaper and just as efficient cousin, the gas engine tractor.

Hand-sowing of grain before farm machinery revolutionized agriculture

Modern power-farming in the wheat belt. One operation plows, harrows and sows the crop

ILLUSTRATION 1

The Age of Machinery

It should be said in passing, as an interesting side light, that there is an almost exact ratio of growth between the increase in farm wealth and the increase in the use of farm machinery. Farm wealth increased from less than 4 billion dollars in 1850 to more than 20 billion dollars in 1900. In the last nineteen years it has leaped to 65 billion dollars—more than fifteen times as much as it was sixty-nine years ago, and more than three times as much as it was twenty years ago. This remarkable increase which totals today 65 billion dollars is matched by the 350 million dollars or more of farm machinery now manufactured yearly. This rapid increase in farm wealth not only furnished the cash with which to undertake experimentation and with which to buy the results of these experiments but it also indicated how rapidly productive

methods had gone forward and how closely farm wealth can be measured in terms of those agricultural methods and implements—of which the tractor is inevitably important—which make for increased production. Ten years ago may be set as that period which saw the beginning of tractor farming and particularly the use of the gas engine tractor.

Conclusion

But before passing to a description of the tractor and its application to modern farming methods, it may be perhaps more logical to define definitely in the next chapter the limits of tractor farming and something of the peculiar climatic, geographical and physical conditions which make the Middle West the ideal tractor market.

The great alluvial basin lying between the Alleghenies and the Rockies is the natural home of the tractor

CHART 2

CHAPTER II

The Tractor Belt Defined

The Middle West

Roughly speaking, the tractor belt includes those vast areas of alluvial prairie land that lie on each side of the Mississippi River between the Appalachian Mountains to the east and the Rocky Mountains to the west. It is an area given over almost entirely to various kinds of grain crops, particularly wheat and corn, but not excluding by any manner of means, such other crops as cotton and hay and the various legumes that extensively enter into the agricultural wealth of this section. Neither does this delimitation lose sight of the fact that there are other parts of the country in which the tractor can be and is profitably used. But this volume is mostly concerned with the so-called great plains region.

Tractor Farms

Thru successive causes, not necessary to discuss here, 160 acres has become the average size of farms in this region. Putting the limits of the tractor area in slightly more precise terms, we may say that the line where 160-acre farms begin starts from Duluth, runs to Minneapolis and then bears off southwest, passing St. Louis and penetrating the eastern parts of Oklahoma and Texas. West of this line, and including those upland

plains of the eastern Rocky Mountains, now just developing to dry farming, constitutes the natural tractor belt and includes that territory where the horse, as an efficient power unit, approaches the limits of his efficiency. The other north and south line will start almost at the center of Ohio and progress southward following the junctures of the Appalachian foothills with the prairies, taking into account, however, much level valley "tractor" land along the upper hill reaches of those larger eastern tributaries of the Mississippi.

Another Boundary

Within this same area there may be still made another boundary—that western line which marks the limit of heavy crop production. In other words included within the whole we may find a pretty definitely defined area which we may characterize without paradox as the area of "intensive extensiveness" where the emphasis is almost entirely put upon the two principal crops of wheat and corn, with an included sub-division, in each instance, of spring and winter wheat, and maize and the various grain sorghums. Such a line follows the western boundary of Nebraska and Kansas and runs thru the Texas Panhandle clear to the Gulf. This limitation has an added signifi-

In the Mid-West the bulk of rainfall comes within a short period. Hence, plowing must be done quickly. The tractor affords the best means for rapid plowing

CHART 3

cance when we consider that its western boundaries are those **first set by the horse** and within which, quite naturally, since the process of crop production was already highly developed, the tractor finds its first field of exploitation. But, as has been previously intimated, beyond this western boundary lie endless acres, hitherto unfitted to previous methods of crop cultivation, which now depend upon the horse as the power unit. We may say, therefore, that the extent of tractor potentiality as an instrument of increased productiveness is limited only by the readiness and financial ability of those present-day pioneer farmers to push out into the semi-arid regions and, applying the new technique of dry farming, plus the tractor, open up a new empire dominated by the same kind of crops now extensively cultivated farther to the east.

Crops Grown

The tractor belt today produces 70 per cent of the cereal crops of the United States. In the North spring wheat and oats are successively cultivated. Farther down we enter the corn belt, producing two-thirds of the nation's crop. Then come Nebraska, Kansas and Oklahoma, the hard wheat and alfalfa belt, with an extensive overlap of the grain sorghums. The grain sorghums are even now in the Southwest assuming equal importance with corn as one of the principal crops, already occupying in the schedule of southwestern livestock feeders the same place which the combined clover and corn crops bear to the feed

schedule of more northern sections. In addition, in a fairly circumscribed area of the Southwest, cotton assumes the principal role as a crop of "tractor importance."

It has been estimated by the *Farm Implement News* of Chicago, as well as by other authorities, that fully 65 per cent of all tractors in use in the entire country are owned in the region described. The immediate corollary of this fact is found in those statistics which reveal that on three-fifths of the farms of 175 acres—numbering 1,153,000 in this region—are found approximately 35,000 to 50,000 tractors. These facts will be later discussed in the estimate of the potential market for tractors but are given here to substantiate still further the fact that the Middle West is the tractor country and the tractor market, *par excellence*.

Climatic Influences

Reference has already been made to the fact that the tractor will extend the possibilities of dry farming in those relatively undeveloped regions immediately to the east of the foothills of the Rocky Mountains, an area estimated at 350 millions of acres. But in the already established grain belt the tractor has a peculiar place, especially as we go toward the Southwest. In this region the dominant factors of a moderate rainfall and excessive sunshine, plus a relatively high wind velocity, have produced peculiar local conditions that heretofore have frequently proved too much for those methods of cultivation which depended upon the horse. For instance, while

One ability of the tractor to plow deeply and seasonably makes for the maximum of moisture conservation and the complete turn-under of all weed growths

CHART 4

there is not very much difference in the rainfall of McPherson, Kansas, and Kokomo, Indiana, there is a difference, 25 to 40 per cent greater, in Kansas and Iowa than in Indiana. It is this element of high winds and continuous sunshine that produces almost immediate evaporation. The rainfall itself would be sufficient if proper methods of moisture conservation could be introduced. Proper moisture conservation, in reference to the peculiar crops produced, means deep plowing in mid-summer, early plowing in the other seasons and extensive cultivation. This is not possible, however, thruout much of the region because of the fact that horse-drawn implements are not fast enough, nor the animal itself enduring enough, coupled with the shortage of farm labor, to do the necessary amount of work within the limits of a very definite period when weather conditions are the fittest. Dominating all this, is the fact that the horse, already exhausted with the heat of the harvest and the long drawn-out spring work, is in no condition to undertake the even more arduous labor of next season's crop preparation.

The Reason Why

This brief analysis explains in a nutshell why the tractor, an unfeeling machine, almost completely unhindered by any sort of weather conditions, is more economical in its application of power and cheaper in its fuel consumption for the production of power. Solely as an implement of plowing and cultivation it makes for greater moisture conservation, more extensive and intensive methods of crop cultivation and subsequently for a greater production. This production may be variously estimated as from 25-50 per cent greater in comparison with the same results produced by horse power farming.

These facts may be briefly illustrated by the

statement of J. C. Mohler, Secretary of the State Board of Agriculture of Kansas, who says, "in 1914, the first year of the war, Kansas planted 20 million acres to crops; in 1918, the last year of the war, nearly 21,250,000 acres. As the farmers had less help in 1918 than in 1914 it is logical to conclude that they were able to devote larger acreages to crops thru the more extensive employment of labor- and time-saving machinery, such as the tractor. Hence, this increase in acreage is partly attributable to the tractor, at least. In 1914 there were less than 2,500 tractors in use in Kansas; now there are approximately 9,000."

Practical Proof

These facts find an interesting confirmation in the results announced by *The Farmer* in a recent extensive tractor investigation, where we find for the states of Minnesota, North and South Dakota that over 48 per cent of the total of 408 tractor-farmers reporting, maintain that the tractor insofar as it concerns application of these scientific principles of crop procedure, more than justifies its preference over horse labor. What is true for Kansas and for these three northern states is equally true farther to the south. For instance, in Oklahoma, as determined by the Oklahoma Experiment Station, the average yield on wheat lands plowed by the old and by new seasonal methods, show a maximum difference of over 15 bushels to the acre and with an average difference of over five bushels to the acre. It has been estimated that if it were possible to control the soil moisture there, so that none might escape thru the plants, a rainfall of ten inches would be ordinarily sufficient to produce a fifty bushel yield of corn. Soil preparation that would insure getting the moisture into the soil is an important consideration. An ideal seed bed for a good corn crop in these regions is one

This chart shows value of early plowing for winter wheat (see Table 6, following page.)

CHART 5

with a loose, coarse surface and a subsoil with a moisture to a depth of several feet. Deep plowing in the fall or very early in the spring for this particular crop is the only method that will allow most of the moisture to penetrate and the soil to settle before planting time. Such methods can be attained efficiently and economically only by the use of the tractor.

The Big Problem

Thus, it will be seen that the big problem that the Middle Western farmer combats is not a shortage of rainfall but the quick evaporation of a very adequate rainfall. In general, the rainfall of the Middle West is seasonably well-timed, but owing to a high wind velocity and extensive sunshine, the land quickly becomes, at least in some places, almost semi-arid. During an average midsummer week plowed ground in the Middle West loses moisture equivalent to one-fourth to one-half of its rainfall. Bare land and land bearing weeds lose even more. While the cultivation of land has in itself no effect upon increasing or decreasing the Mid-Western average rainfall of approximately 30 inches a year, it has wholly the desired effect in conserving this moisture, as already explained. The proper breaking up of the land to prepare it to receive and retain rain is, therefore, the primary requisite of all crop procedure in this region. Men-

tion has already been made of deep plowing experiments in Oklahoma. Still further investigations have shown that land plowed in Stillwater, Oklahoma, on July 28, had in it at seeding time 16.5 per cent moisture; that which was not plowed until September 1st had only 9.5 per cent moisture, insufficient to germinate the seed sown on September 16th.

Winter Wheat

Let us consider winter wheat for a moment and see how it reacts to deep-plowing by the tractor under the peculiar climatic conditions and soil conditions already spoken of. Spring wheat is not extensively considered in this discussion since the principles of tractor farming in its cultivation have been practiced longer than is the case with winter wheat and because the exploitation of spring wheat methods have been more widely diffused thruout the country. For many years the state experiment stations of Oklahoma, Kansas, Nebraska and others have been publishing the results of experiments to show the proper methods of hard wheat production. Briefly summarized, we know that the best yield of winter wheat can be produced by plowing early in July. The reason for this early plowing, as has been explained, is solely for the purpose of moisture conservation. Experiments have shown that wheat planted in time, on ground prepared by

HOW DIFFERENT METHODS OF PLOWING AFFECT WINTER WHEAT YIELD

These eleven tests were made by the Kansas State Agricultural College at Manhattan, Kan., on adjoining plots of land. The only difference in the treatment of the different plots was in the plowing. The same kind of seed was planted in the same way on the same date—September 29th. The variation in the yield, therefore, was due to the different plowing methods employed. This table should be studied with Chart 5, on the preceding page.

Methods of Preparation—	Yield per Acre		Cost per Acre Preparation	
	Bushels	% of Increase	Cost	% of Increased Cost
1. Disked, not plowed.....	4.29		\$1.95	
2. Plowed September 5, three inches deep.....	14.46	237	3.05	56
3. Plowed September 15, seven inches deep.....	15.79	268	3.55	82
4. Double disked July 15; plowed September 15, seven inches deep.....	23.57	449	4.35	123
5. Plowed August 15, seven inches deep; not worked until September 15.....	23.62	451	3.55	82
6. Plowed August 15, seven inches deep.....	27.74	547	3.90	100
7. Double disked July 15, plowed August 15, seven inches deep.....	32.68	662	4.70	141
8. Plowed July 15, three inches deep.....	33.46	680	4.45	128
9. Listed July 15, five inches deep. Ridges split August 15.....	34.35	701	3.75	92
10. Listed July 15, five inches deep. Worked down.....	35.07	715	3.70	90
11. Plowed July 15, seven inches deep.....	38.36	794	4.95	154

TABLE 6

early plowing increased in yield from 30 to 40 per cent. The amount of seed sown to produce this result also varies according to the time and preparation of the seed bed. For example: Two bushels of Turkey Red planted on September 25 go as far as four and one-half planted on October 15 or eight bushels planted on November 15.

Plowing

It should be remembered that plowing is the most costly of crop operations and that the cost of plowing increases in direct proportion to the depth plowed whether the power employed be horse or tractor. But it is still further to be remembered that deep plowing is relatively cheaper, in proportion to the speed and time, with the tractor than with the horse. The average maximum depth according to the best authorities is approximately seven inches,—the ideal tractor-drawbar penetration. Furthermore, this is a depth which as found by experiment accomplishes in the soil turnover both the incorporation of all former crop residues and, in addition, effectually cleans the surface for the subsequent tillage and seeding. There has been a tendency on the part of some tractor enthusiasts because of the great reserve power to be obtained—to advocate even deeper plowing. Official bulletins from the Dry Land Farming of United States Department of Agriculture report that deeper tillage than this in some ten states in the Middle West does not pay. The necessity for deeper plowing can be overcome without a reduction in crop yield

by practicing a rotation of crops. But a rotation of crops requires a flexibility in the unit of farm power. This flexibility can be best obtained by the use of the tractor.

But as has been so often emphasized only the most general principles are cited here and in all instances the highly variable factors of local soil and climatic conditions must govern all plowing procedures and crop rotations. The point to understand is this: with the present scarcity and high cost of farm labor, combined with the need for deep and extensive plowing the tractor, in comparison with the horse, costs less, accomplishes more, and consequently, both quantitatively and qualitatively, yields a maximum of production.

Limitations of the Horse

Such is the ideal procedure for the production of bumper winter-wheat crops. But such a procedure is barely possible with the horse as the power unit. To illustrate: the horses have just finished harvesting the wheat, and almost immediately the corn, kafir, cotton and other crops need cultivation. Hay time is next on the program. And all the while the horse has been hard at work under terrific heat conditions to which he is in no wise acclimated. Plowing of a necessity is put off, sowing is delayed and when it is done, the seed is put into a soil already half-depleted of the precious moisture content. The factor of weeds allowed to grow, because of lack of time to eradicate also enters. The result is only half or three-fourths of a crop and sometimes not even that.

SALES OPPORTUNITY CIRCLIS
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WHEAT

Yields under different treatment

- 1 Disked at Seeding
- 2 Plowed Deep in September
- 3 Plowed Shallow in July
- 4 Plowed Deep in July

GROWTH OF PLANT FOOD

Increased by Deep and Early Plowing Which Is Practical Only With a Tractor

CHART 7

Corn

What is true of wheat crop procedure is also true of corn. Deep plowing early in the fall or medium deep plowing in the spring has peculiar application to corn culture. Corn should be planted early in order to produce the necessary crop, because early-planted corn ripens first and usually produces an earlier and better yield. Early-planted corn because of its slow, tough growth is not so susceptible to drouth as corn planted later. In addition, such corn derives more benefit from the conserved winter and spring moisture supply, has a better rootage before the advent of summer drouths and consequently stands a larger chance of maturing when these conditions materialize. All told, the chief essentials of crop production are heat, soil fertility, tested seed, sufficient water and adequate cultivation methods—of the first three of these factors the Middle West has an abundance. Water it has, too, but only in terms of a proper method of moisture conservation. By controlling evaporation the success of the corn crop is more nearly assured and the corn is successfully carried through the ear-forming period to a future of early and full maturity.

The tractor is the fulfillment of these conditions. It can prepare the ideal root bed that is demanded by corn in these regions as the horse cannot economically do, because it can do it more quickly and thoroly. Time is the important factor where there are larger acreages. As the plowing must be done at a certain time to obtain maximum results, the tractor is capable not only of plowing deep at a high rate of speed as compared

with the horse, but with the use of a minimum amount of farm labor.

Grain Sorghums

What has been said of corn and wheat applies largely to the various grain sorghums. These crops combine many of the good qualities of both corn and clover. They make excellent forage and the grains themselves have high feeding values. But their peculiar virtue lies in their adaptability to the general semi-arid conditions found in the extreme Western and Southwestern part of the so-called tractor belt.

Hitherto, because of the very natural adaptability of this crop to the territory, farmers have frequently become careless as to their methods of crop cultivation. The very hardness of the crop itself and the fact that it will yield the maximum return with a minimum of effort, has tended to make many farmers neglect proper tillage methods. But no other crop will respond more quickly and valiantly when planted and cultivated as it should be done than the grain sorghums. Its present acreage of over six million acres—almost half of the wheat acreage of Kansas, in itself a typical grain state—can be greatly increased and made to yield in a corresponding ratio under the influence of tractor cultivation. What has been said concerning corn and the application of early and deep plowing, coupled with prompt planting and early and extensive cultivation, will make not only for a heightened resistance to drouth conditions but an increased yield greatly in excess of that usually attained.

SALES OPPORTUNITY CHARTS
PUBLISHED BY
THE CAPPER FARM DRESS,
TOPP, KANSAS

GRAIN SORGHUM BELT

Grain sorghums have become the important corn crops of the Southwest because of their drouth resistance. The natural belt for this crop is west of meridian 100

CHART 8

Other Results

Erratic and variant harvests, ranging from "middling" success to absolute failure are the inevitable results as long as "horse" methods are followed. There has not been room to discuss all the advantages of deep plowing yet there are some others that may be mentioned at this point. The farmer wages a continuous battle against weeds and insect pests. In those fields where early plowing, deep and varied, had been carried on the root penetration of weeds is entirely discouraged. By the same token fall plowing by tractors, impossible with worn-out and exhausted horses, effectively turns under those weed crops still un-

touched. Insect pests are also eradicated. Insects not allowed to hibernate and live thru the winter produce no insects in the spring. Deep plowing, discing and dragging all serve to kill those insects that burrow just beneath the ground or penetrate to the frost line. All the various pupae are easily destroyed. The list includes grasshoppers, cut-worms, corn-ear worms, boll weevils of the cotton plant and numerous other crop pests that hibernate beneath the ground during the winter. In addition, to be reiterated again and again, such seasonal plowing conserves moisture and thus attains the ultimate ends of all Mid-Western farming methods.

COMPARING THE HORSE AND TRACTOR

CHART 9

Division of horse labor in actual practice on a farm where the production is largely wheat

CHART 10

Division of horse labor as it should be distributed to secure maximum results

CHAPTER III

Which Power: Horse or Tractor?

The Horse Versus the Tractor

The farm tractor has displaced, on an average, one-fourth the number of horses used on Kansas and Illinois farms before the tractor was bought. But the tractor can supplant the horse for heavy work on the farm only when the farmer ceases to think of work in terms of horses and begins to think of it in terms of engines. Just as the horse power in the past supplanted man power and the hoe, so tractor power will supplant the horse and will be computed on lines of thought quite as radically different. It took man many ages to realize that by using horse-drawn machines, he could greatly increase his agricultural efficiency. He thought too long in man terms. Today few men realize the extent to which the tractor can take the place of the horse and do many things the horse cannot so profitably do. It is replacing the horse for the same reason that the horse replaced the man and the hoe.

Cost of Horse Versus Tractor.

Within the last few years many sets of figures have been published to prove that tractor farming is cheaper than horse farming. And there has also been published much matter to prove the reverse. Most of these figures are based upon what each type of power can do and not what they actually do accomplish. On account of the ability of the tractor to maintain hour after hour its full ca-

pacity in continuous drawbar labor, it has an added advantage over the horse or mule. It has been found by actual test that the best plowing is accomplished when the speed ranges from $2\frac{1}{4}$ to $2\frac{1}{2}$ miles an hour. Plowing turns under all stubble, weeds, grass and fertilizer, and pulverizes the ground. Up to a certain speed the faster a plow travels thru the ground the better it breaks up. The average team, while it will walk fast enough for a time, cannot keep up the pace all day that is necessary to do the best plowing.

Horses Not At Home.

All sentiment aside it should be clearly recognized that the horse in the wheat and corn belt is merely an incomplete power unit. He has never been fully acclimated in this Middle Western area of hot summers and freezing blizzards. The wild horse that ranged the western prairies years ago moved north and south with the seasons. Our present-day horses turned loose to shift for themselves would like their ancestors spend their summers in the north and winters in the south. Further than this the horse is not as efficient in the West as in the more eastern states; yet the demands upon him are much greater. The frequency of heavy rain storms during the summer, and the erratic weather changes that take place without warning during the period from spring to summer, has demanded a farm power unit that is much more flexible and more enduring than the horse can pos-

A man on a tractor pulling four bottoms can turn two and seven-tenths as much ground, under ordinary July conditions, as the man with a two bottom plow pulled by horses

CHART 11

sibly be. It is the ability of the tractor to do heavy work quickly—plowing, seeding, discing and harrowing—under all conditions of wind and weather that has made it the logical unit of farm power and has enabled it to surpass the horse.

Horse Figures.

Yet there are those who thru sentiment or obstinacy refuse to recognize the limitations of the horse. Let us consider definitely what he can actually do. Various experimenters, including Troutwine, King, Sanborn and others, have definitely established that in a full working day of fourteen hours a horse exerts a pull on its traces equal to 1-10 to 1-8 of his weight. Under emergency conditions and for a short time only this can be increased to 1-2 of his weight. In order to produce the largest day's work, the maximum speed at which a horse can travel is 13-4 to 23-4 miles per hour. Furthermore, in the chapter on the subject in Bulletin 73, Bureau of Statistics, Department of Agriculture, it has been definitely established that from April to November, the active months on the farm, tests upon 135 horses, established that the average of actual work was 4.33 hours each week day, or a grand total of 906 hours for the season. For the four inactive winter months, comprising 104 working days, the average was seventy-seven hundredths hours per day. These figures can be more definitely grasped in the table of comparisons between the relative power of horse and tractors. Any computation of a horse's power must also consider his relative cost of maintenance compared with the cost of gas and kerosene fuel for a tractor necessary to produce the same ratio of work. And it is interesting to note in this connection, as a glance at the feeding costs table on page 21 will demonstrate, that the cost of extra or increased power on the part of the horse is relatively higher in terms of greater food consumption ("horse engine fuel") than is the same result when accomplished by the tractor. The measure for mechanical power still remains that fixed by Watt: the ability to raise a pound thirty-one feet in one minute. Figuring on this basis, a 1,500 pound horse, traveling 2 miles per hour and pulling one-tenth of his weight, will develop exactly four-fifths of a mechanical horse power. If he travels $2\frac{1}{2}$ miles an hour, which is unusual, he will develop one mechanical horse power. The average farm horse

weighs much less than 1,500 pounds, and will, while working continuously, develop from two-thirds to four-fifths of a horsepower. Even a cursory comparison of these figures with the work accomplished by a tractor under similar conditions will establish the greater efficiency of the latter.

Horse One-Tenth—Tractor One-Third.

All sentiment again put aside, the fact remains that the tractor today affords the most efficient way of obtaining mechanical horse power for any sort of drawbar work. An 8-16 tractor traveling at the rate of 2 miles per hour, will develop at least 8 mechanical horse power. It can perform this amount of work continuously hour after hour. A pull of 1,500 pounds is equivalent to practically one-third the weight of the tractor. There you have it. The horse pulls about one-tenth of his weight, and the tractor about one-third of its weight.

Some Pertinent Figures.

There has been a large number of figures compiled on the relative costs, cost of operation, relative efficiency of horse and tractor labor in all crop and other farm operations. These figures have been gathered from a variety of sources and cover a number of different localities.

The United States census report, 1910, in analyzing the crop capacity of the average Middle Western farm presented the following table of crop allotments:

- 30 acres of oats and wheat.
- 50 acres of corn.
- 20 acres of hay.
- 60 acres to include pasture, orchard, rough land, building and feed lots.

It is estimated that such a farm, representing the average small farm of the tractor belt, would require for its successful working six horses or mules and one colt.

How It Works Out.

Farm Power, taking these figures and working them out in connection with certain figures of work done per day as taken from consolidated reports submitted by various central states farmers, arrives at the following:

How deep tractor plowing makes for maximum root penetration in the sub-soil

CHART 12

50 Acres of Corn Land.

Plowing—4 horses, 16-inch gang, 4 acres per day	12½ days
Disking—4 horses, 8-foot disk harrow, 15 acres per day	3⅓ days
Harrowing—(3 times), 3 horses, 3-section harrow, 30 acres per day	5 days
Planting—2 horses, check row planter, 12½ acres per day	4 days
Cultivating—(4 times), 2 horses, 1-row cultivator, 10 acres per day	20 days
Harvesting—3 horses, corn binder, 8 acres per day	6¼ days
Total—51.08 days, or 1,450.5 h. p. hours.	

30 Acres of Wheat and Oats.

Disking twice—4 horses, 8-foot harrow, 15 acres per day	4 days
Harrowing—3 horses, 3-section harrow, 30 acres per day	1 day
Drilling—3 horses, 12x8 drill, 15 acres per day	2 days
Harvesting—4 horses, 8-foot binder, 15 acres per day	2 days
Total—9 days, or 330 h. p. hours.	

20 Acres of Hay.

Mowing—2 horses, 5-foot mower, 10 acres per day	2 days
Raking—2 horses, 8-foot side delivery rake, 15 acres per day	1½ days
Loading—2 horses, 6-foot loader, 10 acres per day	2 days
Total—5½ days, or 110 h. p. hours.	

“The total horse power hours of field work required for these three crops is 1,890.5. At 12.5 cents an hour the horse cost is \$236.30. This does not include any expense for man labor.”

Continuing this analysis, let us assume that the average farmer on such a 160-acre farm could sell his four horses at an average price of \$150. (These figures were for 1916 and deductions should be made up or down as the market price for horses and mules and various other items that enter into this cost account have varied.) The \$600 brought from the horses would partially pay for a 8-16 H. P. gasoline tractor or would be three-fifths of the cost of at least two well-known models rated at 10-20 H. P. and selling at \$1,000.

Let us compare the cost of the same work as done by the horse and as done by the tractor:

“In the first place, the tractor will do all of the operations mentioned above with the exception of planting and cultivating the corn, and perhaps operating the side delivery rake, and for this work and other light horse jobs we have kept two horses and the colt. (Figures based on 10-hour day).”

50 Acres of Corn Land.

Plowing—8-16 tractor and two 14-inch plows, 5.6 acres per day	9 days
(If pulling three 14-inch plows, 8.4 acres per day, 6 days.)	
Disking and harrowing in one operation:	
8-16 tractor, 8-foot disk harrow with 2-section peg, 20 acres per day	2½ days

High temperatures during the summer, which are essential to grain crops, are a handicap to the horse. Hot weather does not lessen tractor efficiency in deep plowing; it does that of the horse

CHART 13

Harrowing twice—8-16 tractor with 3-section harrow, 35 acres per day	3 days
Planting—Use the team and planter.	
Cultivating—Use the team and cultivator.	
Harvesting—8-16 tractor and corn binder, 8 acres per day	6¼ days
Total	20¾ days

30 Acres of Oats and Wheat.

Double disking and harrowing in one operation:	
8-16 tractor with 8-foot tandem harrow and 2-section peg, 20 acres per day ...	1½ days
Drilling—8-16 tractor with 12x8 drill, 20 acres per day	1½ days
Harvesting—8-16 tractor with 8-foot binder, 20 acres per day	1½ days
Total	4½ days

20 Acres of Hay.

Mowing—8-16 tractor with two 5-foot mowers, 20 acres per day	1 day
Raking—With a 2-horse team.	
Loading—8-16 tractor with windrow loader, 13 acres per day	1½ days
Total	2½ days

Note: These are July, 1916, average prices—kerosene, 8 cents, gasoline, 18.5 cents. The cost in any particular territory may be obtained by using local prices.

"Here is 27¾ days' work with a tractor which will require 15 to 20 gallons of low-grade kerosene at 8 cents per gallon, and one gallon of lubricating

oil at 35 cents—total fuel per day \$1.95. Adding to this a liberal amount for depreciation and repairs, interest at 6 per cent, and a day's operation (counting 100 days' work per year), will cost about \$4, total for 27¾ days is \$111. The horse labor for planting, cultivating and raking amounts to \$63.75, which added to \$111 makes a total of \$174.75, or, the tractor does for \$111 work which, when done with horses, costs \$172.55. This is a clear saving of \$61.55, and the crops were put in in 12½ days' less time.

"This, however, does not indicate the difference in profit in handling the job with a tractor rather than with horses. Selling four horses leaves the farmer with \$365 worth of feed to put into butter fat or beef. This amount, will keep ten cows, which can return a net profit of about \$300. Take out of this \$300 profit, the \$111 which it costs to operate the tractor, and there is still left a net profit of \$189 a year in cash, and a saving of 12½ days of man labor. (The \$365 worth of feed saved would more than equal the value of the manure providing all the horses were maintained.)

"Farm labor is worth at least \$1.50 per day, including board. Here is a saving of \$18.50, a total of \$207.50 for the year, not including the saving in belt work.

"Add to this the profit which can be made by having available belt power at about 2 cents per horse power hour for all the miscellaneous work that comes about almost every day in the year, and it is apparent that a good tractor burning kerosene could pay for itself long before it is worn out.

CHART 14

Relative efficiency of a man with a four plow tractor compared with one who used a two bottom horse drawn plow

Work Done in Season

"The saving of 12 $\frac{1}{3}$ days of labor which were figured at \$1.50 per day can be made far more profitable. On any farm, even with ample horses to take care of the work, seasons are sometimes against the farmer. Good spring plowing or seeding weather may be of short duration, with a result that not all the acreage planted is cultivated. Again, a day gained in the harvest is oftentimes of far greater importance than the \$1.50 saved in labor. With a tractor on the job you can work twenty-four hours a day if necessary to take advantage of the weather. Besides this, the days gained may give the farmer an opportunity to do work for the neighbors at a good profit."

Another Set of Figures

These figures as to the extent and cost of horse labor may be interestingly compared with a set that recently appeared in *Successful Farming*, October, 1919, under the title "The Cost of Farm Horse Labor," as compiled by W. E. W., Indiana. The soil on this particular farm whereon the cost accounts were kept is rather heavy clay with strips of creek bottom soil. The regulation Middle Western staple crops were put in, but included during the year, 13 acres of soy beans. The rest of the acreage ran 50 of corn, 30 of clover, 60 of wheat, and 12 of oats.

Never more than 4 horses were used in the fields at any one time. Two operators were employed most of the time, and three during the rush and harvest season.

The Division of Labor

The following table gives the number of hours of horse labor for each crop during each month of the year:

Month	Crop	Hours	Total
January	Woodlot	48	48
February			..
March	Oats	64	
	Repairs	65	129
April	Wheat	34	
	Repairs	42	
	Corn	91	167
May	Corn	542	
	Farm Repairs	128	670
June	Wheat	10	
	Orchard	50	
	Farm Repairs	14	
	Corn	370	
	Clover	164	621
July	Corn	115	
	Orchard	15	
	Farm Repairs	30	
	Oats	51	
	Wheat (1918)	215	
	Wheat (1919)	190	616
August	Wheat (1919)	198	
	Oats	180	
	Orchard	5	
	Farm	40	
	Clover	20	
	Corn	25	468
September	Clover	72	
	Corn	124	
	Farm	50	
	Orchard	10	
	Wheat (1919)	215	471
October	Wheat (1918)	48	
	Orchard	6	
	Farm	60	
	Corn	164	
	Clover	72	350
November	Corn	283	
	Farm	10	293
December	Corn	168	168
Total			3,995

The Grand Total

The following is the grand total of comparative horse labor required for each crop:

Clover	328
Corn	1,889
Oats	295
Wheat	250
Wheat (1919)	651
Orchard	86
Farm Repairs	279
Miscellaneous	713

Total. 4,500

hours of horse labor for the year.

It will be seen from this that the total number of 10-hour days for the 4 horses was 450 or a little more than 110 apiece for each horse. (Note that the miscellaneous total of 4,500 hours is larger than the total showing in the monthly table. This is because small items of miscellaneous farm labor have been left out of the monthly labor sheet.)

Food Amounts

The food consumption for the horses during the entire year was as follows: 212 bushels of oats; 18 bushels of corn; 3 tons of hay.

Costs were as follows: 65 cents for oats; \$1.50 for corn; \$1.30 a ton for hay; \$254.80 the total feed cost, not including pasture thruout the summer, straw, etc. It should be understood that these are on-the-farm costs and not dealer's prices.

We may figure pasture costs at \$1.50 per head a month or \$48 for the 4 head 8 months. Miscellaneous costs to include interest on investment, labor, horse shoeing, veterinary fees, etc., would amount to \$70 more, making the total cost for the four horses \$372.80 a year. The total cost for each horse would average about \$93.20. Dividing \$372.80 by 4,500, the number of hours the horses work during the year, the total cost of horse labor per horse would be 8.3 cents.

Relative efficiency curves: Horse and tractor

CHART 15

Some Deductions

In a further analysis of the table, there will be found, as many authorities have often asserted, that the farm horse is only really busy during 5 months of the year or roughly from May 1st to October 1st. Of course, thruout the year there is a wide variety of odd jobs and minor labor that the horse is called upon to perform but the principal employment is during the time indicated—the hottest part of the year. No account is rendered as to the value of the manure returned. The manure value is almost always a variant factor according to the methods employed for its conservation.

Tractor Savings

Comparative tractor costs for the same amount of labor would be under average use, one-tenth to

two-tenths lower, with an annual average advantage of from 12 to 40 days of belt work added, not possible with mere horse labor. Besides this, there is the humanitarian advantage of not working horses during the excessive heat between May and September.

The tractor, at a slightly higher initial investment, accomplishes most of the crop operations that the horse performs and many that he cannot. Moreover, judged by the extent and thoroughness with which the work is done, the tractor, an unfeeling powerful machine, unaffected by weather or soil conditions, costs less and endures, relatively, as long as the average horse.

CHAPTER IV

The Status of the Tractor

Odd jobs of belt work make the tractor an all-round machine

ILLUSTRATION 16

Kinds of Tractor Work

Any tabulations of year-round tractor usage must take into account that the mean average of drawbar and belt work will vary according to working conditions, which in turn will be different from season to season and from year to year. There will also be years in which some of the drawbar work as well as the belt work will be greatly increased in certain items. For instance, it is safe to say that the unusual conditions of 1919, which witnessed a superproduction of wheat, show a much higher average for all forms of drawbar work, particularly plowing, than in all probabilities will be witnessed for some time to come.

An analysis of the sixteen corn and wheat states, drawn from a variety of sources, discloses that at the head of strictly drawbar work, plowing occupies the largest number of days, followed in a more or less numerous variation by the following kinds of field work: discing, harrowing, seeding and cultivation, with at times a predominance of days devoted to the special operations of the harvest, including both wheat and corn. Other important operations which at times, according to

the locality and the season, have major prominence in the drawbar work accomplished by the tractor are: ditching, hauling wheat to elevators, road building, stump pulling and occasionally the moving of buildings.

Flexibility

The point to emphasize in any discussion of tractor usage is the fact that it is much more flexible and all-round farm power unit than is generally thought of or practiced. Too many farmers consider that tractor work is finished when plowing, harvesting and threshing are over.

The various drawbar operations are too frequently emphasized at the expense of belt work. There are relatively few farms that cannot provide a great amount of belt work for some type of gas engine, and particularly those larger jobs that task the capacity of any stationary gas engine under four horse-power. Recent investigations establishes that, with proper distribution of time, so as not to interfere with the major operations of the farm, from 75 to 100 days per year of maximum belt work can be found for any tractor of from four to six horse-power rating.

A tractor expert recently declared that ten day's usage of the machine under favorable conditions effect a saving in overhead expense sufficient to pay the interest on the investment, all repairs and upkeep, with a sufficient allowance besides for normal depreciation. It is easy to realize, therefore, that the return on the money invested increases as the amount of work that the tractor can do is extended. Active use of the machine results in less depreciation than if it is left standing idle. A great many farmers still have the false notion that idle farm implements require no care. It, therefore, follows that a machine in actual use frequently receives by necessity greater attention than when standing idle.

Estimating the Number

Any estimate that seeks to set either the actual number of tractors in use or the actual number to be in use at some time in the future is more or less approximate. But as has been mentioned, it is safe to estimate the number of tractors actually in use (1918) in the so-called tractor belt at somewhere between 35,000 and 50,000 machines. This estimate, which has been confirmed in the higher figure by the *Farm Implement Journal* of Chicago in a recent investigation, is based upon a combined analysis of the somewhat meager production returns and sales records, by no means including all makes of tractors, and the equally meager official and government lists.

Tractors in the United States. State Experiment Station Estimates, January, 1, 1920.

CAPPER STATES	No. of Tractors	State	No. of Tractors	State	No. of Tractors
Kansas	8,689	Alabama	400	Nevada	19 (1)
Nebraska	7,292	Arizona	23 (1)	New Hampshire	23 (1)
Missouri	8,368	California	15,000	New Jersey	107 (1)
Oklahoma	795 (1)	Connecticut	47 (1)	New York	1,210 (1)
Texas	10,000	Delaware	100	N. Carolina	452 (1)
Iowa	9,000	Florida	71 (1)	Ohio	7,500
Illinois	12,000 (2)	Georgia	542 (1)	Oregon	318 (1)
Indiana	1,852 (1)	Idaho	232 (1)	Pennsylvania	3,700
Minnesota	1,575 (1)	Kentucky	1,800	Rhode Island	80
Wisconsin	2,800	Louisiana	2,000	S. Carolina	387 (1)
S. Dakota	1,527 (1)	Maine	400	Tennessee	1,800
N. Dakota	2,137 (1)	Maryland	1,000	Utah	700
Arkansas	336 (1)	Massachusetts	91 (1)	Vermont	175
Colorado	525 (1)	Michigan	945 (1)	Virginia	2,500
Wyoming	186 (1)	Mississippi	377 (1)	Washington	209 (1)
New Mexico	375	Montana	808 (1)	West Virginia	90 (1)
TOTAL IN THE 16 CAPPER STATES.....		67,457	TOTAL IN THE 32 OTHER STATES.....		43,137
50% of states reporting gain 1920.			44% of states reporting gain 1920.		
TOTAL IN UNITED STATES.....		110,594			
(1) 1917 Figures			(2) Estimated 20% increase over January 1, 1919.		

Estimate of tractors in use, as given by State Agricultural Experiment Stations and Secretaries of State, Jan. 1, 1920

TABLE 17

Present Sales

The number of tractors so far sold has been strictly limited by the belief which the average farmer has had as to the greater adaptability of the tractor to the various production procedures of different crops. By the same reasoning, any estimate of future sales will depend upon much the same peculiar factors as has been before mentioned. The crux of the whole question centers about the necessity for education. When the full efficiency of the tractor as the common agricultural implement most fitted to develop the maximum crop possibilities of the Middle West is fully understood by farmers there will be realized a maximum of tractor sales and an equalization of tractor distribution.

An Error

There has been a serious error of some statisticians hitherto attempting to estimate the potentiality of tractor sales. The usual method has been to base the possible number of tractors that might be used in the Middle West upon the acreage of ground actually worked by the horse. But the tractor is the one power-unit necessary to open up the new acres where deep plowing and extensive cultivation has been hitherto impossible with horse power. Furthermore, there has been the assumption that there will be a decrease in the number of horses. Such an assumption may be largely a theoretical one. As has been frequently pointed out, the next decade in tractor development will not so much displace but supplement the horse. It might be more accurate to say that the horse will supplement the tractor. The peculiar virtue of the tractor is its ability to handle big jobs more quickly and more seasonably.

A Place for the Horse

But there still remains a vast amount of light work, particularly that concerned with the culti-

vation of corn and light draft hauling, in which the horse can be used to great advantage. In fact as the tractor assumes more and more the majority of heavy "extensive" farm work and extends the radius of new farm land there will be a corresponding increase in the number of possibilities of economical horse labor.

Life of a Tractor

Still another condition of annual tractor sales will be that determined by the kind and length of tractor usage obtained by individual owners. At present the average of estimates as to length of service varies greatly with some farmers, ranging from the high average of 9.4 years to less than three years with others. The majority of tractor owners in such representative communities as Kansas, Oklahoma, Nebraska, Iowa, North Dakota and Minnesota are of the opinion that tractors are improving and that the present-day machines actually last longer, under severe field conditions, than did the machines of 5 or 6 years ago. Until recently there has been a decided movement in favor of the lighter weight and handier gas engine tractor.

More Data

But 1919 has marked a reaction in the opposite direction; many favor a slightly heavier type of gas tractor. There is also an opinion that the larger machines stand up better than the smaller ones if for no other reason than that larger-sized machines are not likely to be overloaded. While a slight overload must be frequently accommodated the tendency of many farmers, due to ignorance or a natural pride in the capability of their machines, is to overload habitually. The result is a rapid deterioration that is not a favorable argument for the particular make of machine concerned.

Nine horses and three men doing the work of one tractor

ILLUSTRATION 15

Overload Warning from an Expert

There is a very interesting discussion of the whole question of overload, with a relative comparison between the horse and the tractor, in "Internal Combustion Engines and Tractors," by Major Oliver B. Zimmerman, International Harvester Corporation. It is herewith quoted from Chapter 12 of that book since it sums up most accurately and succinctly, both for the tractor manufacturer and user, various points at issue:

"Many a good tractor has gone to the junk heap years before its time for the sole reason that from the beginning it was overloaded. A good farmer would not think of working his horses until they fell in their tracks. The warning given by their heaving and panting would not pass unheeded. But with a tractor the heaving and panting, slowing down of the speed, knock or pound in the cylinder, killing the engine by a load it cannot overcome, seem to go unheeded. As a result, one part after another gives way, until the farmer finds himself all too soon with a worn-out tractor.

A Misunderstanding

"A misunderstanding of how much a horse can do and how much a tractor should do undoubtedly accounts for many an overload. We probably think one horse gives us one horse power, three horses, three horse power, and a tractor rated at 10 horse power on the drawbar more than three times as much power as a three-horse team.

The Exact Figures

"Does it? The average horse can exert a pull of about 200 pounds traveling at 2 miles per hour. $200 \text{ lb.} \times 10,560 \text{ ft. (2 mi.)} = 2,112,000 \text{ ft.-lbs. in 1 hour}$; $2,112,000 \div 60 = 34,200 \text{ ft.-lbs. in 1 min.}$; 1 horse power = 33,000 ft.-lbs. per min., therefore pulling 200 lbs. is developing a little more than 1 mechanical horse power.

"How much could horses do exerting just this amount of power? The average resistance of the passage of a plow thru the soil is about 5 lb. per sq. in. of the perpendicular cross section of cut. This resistance varies with different soil types and conditions as shown in the table herewith:

Table

In sandy soil.....	2 to 3 lb. per sq. in.
In corn stubble.....	3 lb. per sq. in.
In wheat stubble.....	4 lb. per sq. in.
In blue grass sod.....	6 lb. per sq. in.
In June grass sod.....	6 lb. per sq. in.
In clover sod.....	7 lb. per sq. in.
In clay soil.....	8 lb. per sq. in.
In prairie sod.....	15 lb. per sq. in.
In virgin sod.....	15 lb. per sq. in.
In gumbo	20 lb. per sq. in.

(The soil resistance per square inch of furrow slice turned varies greatly in different sections of the country. Tests made by the Hyatt Roller Bearing Company showed that Texas cornstalk stubble required an average of 8 pounds to the square inch of furrow slice turned, while Bermuda sod required 11 pounds to the square inch of furrow slice.)

"Suppose we used 14-inch plows and plow 6 inches deep. A cross section of this plow would be 14x6 or 84 square inches. At an average pressure of 5 lbs. per sq. in. we have 5×84 or 420 lbs. per plow. Two plows would require a pull of 2×240 or 840 lbs. We found previously that at 2 mi. per hour a horse pulled about 200 lbs. and exerted a little over 1 horse power. If the horse had exerted only 188 lbs. pull it would have been exactly 1 horse power. Dividing 840×188 , we find that we need practically $4\frac{1}{2}$ mechanical horse power to pull the two 14-inch plows 6 inches deep.

The Plowing Load

"As the plows start into the soil the horses must overcome 1,200 to 1,500 lbs. resistance, or they must exert from 6 to 8 horse power. They can do this for a short time. After the plowing is well started the resistance lowers, until it reaches normal, or about 840 lbs. or $4\frac{1}{2}$ horse power. Suddenly the plow strikes a root or a stone or hardpan. Up goes the resistance again to 8 horse power.

Reserve Power

"It must be apparent from this that it wouldn't be safe to go into a field with plows needing $4\frac{1}{2}$ horse power for ordinary work unless you had at least again as much power in reserve to take care of emergencies. A horse capable of pulling 1

This man is doing the work of at least two men and eight horses and is doing it better

ILLUSTRATION 19

horse power on an average can exert from 4 to 5 horse power for a short pull. It is this reserve power which enables horses to get thru with the work.

"The same reserve power is needed in a tractor. If $4\frac{1}{2}$ horse power ordinarily would handle the load, your tractor should have $4\frac{1}{2}$ more in reserve, or a total of 9 horse power. There are times in plowing when the resistance is doubled. When those times come, if you have no reserve, you put on an overload, and in just a few moments do an untold amount of injury to your tractor."

Another Warning

The same note of warning is sounded in Farmers Bulletin No. 719, as issued by United States Department of Agriculture:

"It does not pay to overload a tractor any more than it does pay to overload a horse. Three plows behind a two-plow tractor will cover only a little more ground, as a rule, than will two plows, because the tractor usually will travel a little slower, partly because the motor is overloaded and does not maintain its proper speed, and partly because the drive wheels will slip more with a load heavier than the machine was designed to pull. As a result, delays on account of small holes or slight grades will be more common, as will also mechanical difficulties."

To Resume—Tractor Life

But the market seems "set" in the direction of the "light" or "medium" tractor; almost every day sees the introduction of a new make. All things considered, we may estimate the life of the

tractor at not less than six years, with a maximum working life full time, and with a complete utilization of maximum power, of between 900 and 1,200 days. It should be understood that this is the maximum limit and presupposes a first-quality machine, first quality care and expert operation.

Average Tractor Life

Perhaps it is safest to accept a more conservative estimate which puts the average life of the tractor at 9 years, including drawbar and belt work, at 51 annual days—a total working life or roughly 460 days. But these or any other estimates are strongly conditioned not simply by the factors mentioned above but also by the proportion of field and belt work. A tractor deteriorates more quickly under drawbar work than when used for belt power. Extraordinary seasons, under the impetus of superproduction such as 1918 and 1919, are still further factors in that deterioration which consequently lessens the life of the tractor. And as tractors increase in size and horse-power rating there is also a proportionate increase in the speed at which various operations may be accomplished. Thus will be seen some of the difficulties of estimating the potential market for tractors.

However, one must take into account that fact already touched upon: the initial amount of capital invested by a given farmer is governed pretty largely by the immediate economic conditions of each year. Consequently the level of farm economic stability, both local and national, is largely determinative of any ultimate purchase of tractors.

CHART 20

CHAPTER V

The Tractor Market

Current Potential Figures

In the beginning of 1919, the number of horses and mules in the 16 corn and wheat states numbered 16,047,000 with an estimated value of \$1,532,969,000. (It is, of course, understood that these figures vary from month to month but they have held fairly constant during the entire course of 1919 and may be, therefore, taken as an approximately accurate index.) The interest on such a horse and mule investment at 4 per cent is \$61,318,760.

The estimated number of tractors in use in the same region at the beginning of 1919 was approximately 35,000 machines. The average value of tractors under present market conditions may be estimated at \$1,400, giving us a total investment of \$49,000,000 with an interest return at 4 per cent of \$1,960,000.

Horse Preponderance

These two sets of figures show graphically enough the tremendous preponderance still of the horse as the Middle Western farm power unit, and will still further exemplify why the supplementation of horse and mule power by the tractor may be a somewhat extended procedure.

But we may assume that the next five years,

owing to the demands, more and more constant for an increased production of foodstuffs, will see the era of power farming increase very rapidly. We may, therefore, make some interesting estimates in concrete figures of the tractor market for the next five years.

The estimated tractive efficiency of a horse or mule may be put at 60 per cent of 1 horse power. The total horse power efficiency of all farm draft animals for the 16 Middle Western states would, therefore, equal 9,628,200 horse power. To be conservative 50 per cent of this total should be deducted for animals not in use or under three years of age. This deduction gives a total of 4,814,100 horse power as the coefficient of probable horse power, more or less constantly in use on the farms of these 16 states.

Percentage of Tractor Substitution

We may reasonably assume that of this 4,814,100 horse power three-fifths of it may be displaced by tractors within the next five years. Multiplying 4,814,100 by three-fifths we have a total of potential tractor horse power of 2,888,460 as a minimum of tractors in use by 1925. The drawbar capacity of the average tractor is 10 horse

POTENTIAL MARKET FOR TRACTORS IN THE 16 CAPPER STATES

Capper States	Number	
Kansas (1)	40,225	Every farm of 100 acres or more operated by the owner is a potential market for a tractor. No tenant operated farms are included in this computation.
Nebraska (1)	33,545	
Missouri (3)	37,125	
Oklahoma (2)	22,506	(1) Potential sales estimated at 70% of all farms over 100 acres operated by owners.
Texas (3)	35,221	
Iowa (1)	45,899	
Illinois (1)	41,259	(2) Potential sales estimated at 60% of all farms over 100 acres operated by owners.
Indiana (1)	31,334	
Minnesota (1)	48,460	
Wisconsin (1)	61,517	(3) Potential sales estimated at 50% of all farms over 100 acres operated by owners.
South Dakota (1)	24,870	
North Dakota (1)	29,405	
Arkansas (3)	11,612	Basic figures from U. S. Census, 1910. Estimated increase in potential market for tractors due to increased acreage under cultivation 10 per cent of figures given in table.
Colorado (2)	13,790	
Wyoming (2)	4,205	
New Mexico (3)	8,447	Compiled by Bureau of Research THE CAPPER FARM PRESS.
Total	489,620	

TABLE 21

power. The potential tractor sale would, therefore, be 288,846. Of the original number of tractors already in use (35,000) we may assume that during the next five years, 75 per cent of them will become outworn or otherwise replaced, a number totalling 24,250. The ultimate total will be still further increased by estimating the amount of horse power to be assumed by tractor belt work and which is now performed by stationary gas engines. There is at present no accurate census (1919) of stationary gas engines in use on Middle Western farms. But it is conservative to estimate that number at roughly 650,000. The average horse power rating of these stationary engines may be put at 15 or a total production of 9,750,000 horse power. At least 75 per cent of this total rating will be ultimately displaced by tractors of an average belt power rating of 20 horse power, which by the process of division, would give us an added total of tractors of 487,500. But of this total some fraction would necessarily have been included in those tractors already bought for general farm use; in fact, this actual percentage would be relatively large. In consequence of this fact, we should for safety's sake deduct 50 per cent which would leave us a total of 243,750. To these figures we may also add a total of 5,000 machines that will be bought exclusively for road making or other semi-rural use. This is a conservative figure in view of the present plans of the Middle West to build and construct some \$600,000,000 of hard-surfaced highways.

Summary

The total figures may be tabulated as follows:

General farm use based on substitution of horse and mule power by the tractor.....	315,096
Based on displacement of stationary gas engines by belt tractors.....	243,750
Adding for road construction purposes, etc.	5,000
Total	563,846

Some Exceptions

No account is made in this estimate of the potential market for the substitution by tractors of other horse power units now in use, such as: windmills, water power and steam tractors. Windmills and water power will not be displaced; they are more likely to increase. Of these factors, the only one likely to suffer substitution would be steam tractors. The number of these is not relatively large and their proportion has been more or less constant in the last two years and will remain so in view of the wide-spread acceptance of the medium-weight, medium-priced tractor.

We may, therefore, fix the potential market for gas engine tractors that will develop during the next five years at between 500,000 and 600,000 with the mean average of 550,000 as being a probable figure.

Another Estimate

If we are to accept the estimate of one authority that within the next few years over a million tractors would be sold on the farm market thruout the entire country, we might, pro-rating this figure according to the agricultural resources of the Mid-Western states, work out a slightly higher figure for the potential market.

For instance, the 16 wheat and corn states produce on an average two-thirds of the total agricultural wealth of the entire country. There is no reason to suspect that there will be any change in this status during the next five years. In fact, pro-rating the total of this capacitative contribution to the agricultural wealth of the country, we may work out a rough potential tractor sale of some 666,000 tractors, not much beyond the figure previously estimated.

Still Another Estimate

It is interesting to compare these two estimates with another, recently compiled by the Bureau of Research Capper Farm Press. The figures in the above table were obtained by assuming that

The Potential Market for a Half-million Tractors

CHART 22

every farm of 100 acres or more is a potential market for a tractor. In the computation no tenant-operated farms are included. This fact is noted in particular because, owing to a fairly well-established economic sales law, we know that "as tenantry increases the purchase of farm machinery declines." Tenantry is greatly on the increase, especially in Iowa and other states; this condition would, therefore, tend to reduce the total figures to those obtained by the two other estimates. Other conditions affecting the estimate are given below. The table follows:

Capper States	Number
Kansas (1).....	40,225
Nebraska (1).....	33,645
Missouri (3).....	37,125
Oklahoma (2).....	22,506
Texas (3).....	35,221
Iowa (1).....	45,899
Illinois (1).....	41,259
Indiana (1).....	31,334
Minnesota (1).....	48,460
Wisconsin (1).....	61,517
So. Dakota (1).....	24,870
No. Dakota (1).....	29,405
Arkansas (3).....	11,612
Colorado (2).....	13,790
Wyoming (2).....	4,205
New Mexico (3).....	8,647

Total.489,620

1. Potential sales estimated at 70% of all farms over 100 acres operated by owners.
2. Potential sales estimated as 60% of all farms over 100 acres operated by owners.
3. Potential sales estimated as 50% of the farms over 100 acres operated by owners.

Basic figures from U. S. Census, 1910.

Estimated increase in potential market for tractors due to increased acreage under cultivation, 10 per cent of figures given in table. This would make a grand total of 538,582.

Other Determinents

Some of the other elements affecting estimates of the potential market on which might in the future influence the market already established are:

1. Ratio of increase in tractor use since 1910.
2. Ratio of increase in manufacturing since 1910.
3. Estimate of "absorptive" capacity of still undeveloped tractor areas.
4. Determination of proportion of tractors to population in any given highly developed region already converted to the use of this power unit with a pro-rated estimate for the rest of the country.
5. An inquiry into the fact that as tenantry increases the purchase of farm machinery decreases. This condition, established thru the investigation of Bureau of Research, The Capper Farm Press, would consider the large increase of tenantry in such states as Iowa, Nebraska and Kansas.

Where market conditions favor immediate sales of tractors from logical distribution centers

CHART 23

6. A tabulation of the number of tractor inquiries, letters, communications, etc., addressed to the editors of leading farm journals. The increase in this index in the editorial offices of The Capper Farm Press has been roughly 50 per cent greater than 1915, and will continue to grow greater as the effects of this publication's vigorous campaign for complete farm motorization makes itself even more felt among its readers.
7. A tabulation of the growth of tractor advertising as it has appeared in leading implement and farm journals. Figures for The Capper Farm Press since 1915 indicate a growth in this direction of between 45 and 60 per cent, with the peak in each year coming in February and June.

Advertising

Incidentally in this connection, it is hoped the tractor manufacturers and distributors will make no false deductions as to the potential market because of the seeming lack at times of interest in tractor shows, exhibitions and the larger demonstrations. It was a natural disappointment last year (1919) that the Wichita Show, one of the largest and most complete of its kind, drew comparatively so few farmers. But it should not be forgotten that the exhibition was given in the harvesting season, at a place inconvenient in re-

lation to Wichita itself and in addition received more extensive advertising among the trade than among the farmers.

Tractor Shows

The admission by the tractor interests that the day of the big national "stunt" is past was recognized on December 2nd and 3rd, 1919, when the tractor and thresher department of the N. I. V. A. decided to do away with the National Tractor Demonstration and to recognize the field test as the one best way of interesting and selling the farmer.

He already accepts the idea of the tractor. But he hates to think that *ultimately* he pays for the "big show." Most of all he demands not a spectacle or "arranged" performance but a "catch-as-catch-can" field demonstration. Thus the various county shows and those tests conducted by the local dealers upon the very farms themselves of the prospective buyers is the one most productive method of selling. Certainly it is the one method that best fits in with the "try it yourself and be convinced" policy that every leading farm paper now advocates editorially and otherwise in the purchase of a tractor.

Extra Markets

No mention has been made of what might be called "extra sale possibilities." Among these

The day is gone when the hired hands were so plentiful they were in each other's way

ILLUSTRATION 24

additional conditions that will influence a future tractor market may be mentioned three:

1. There are sixty million acres of swamp lands which, according to the estimate of the Interior Department are convertible into tillable areas. The extensive ditching, evacuation, tiling and deep tilling that would be necessary in such projects can best be performed by tractors. The ability of the tractor, particularly of the caterpillar type, to keep its footing and lay its own track is nowhere better demonstrated than on wet land where a horse or mule would be helplessly floundered.
2. The Interior Department estimates that there are over 200 million acres of cut-over land awaiting development. Here is an immense field for the tractor and especially in such drawbar work as stump pulling, heavy root plowing, leveling, etc., preparatory to the utilization of the land for agricultural purposes. The comparatively new potato fields of Northern Wisconsin and those of hilly Aroostook County, Maine, indicate in a small measure the possibilities of tractors in this direction. There would be also a multitude of belt tractor work in the sawing up of waste lumber, etc.
3. As hard-surfaced highways are more and more extended there will come a proportionate increase in the use of tractors in road making. Some idea of this potential use may be gained by considering the fact that in 1919 there was already passed or pending, in the 16 states of the Middle West 600 million dollars of bond issues for hard-surfaced highways. At present, out of the 1¼ million miles of highways in these same states, only a scant 100,000 miles or 7.4 per cent are hard-surfaced.

Still New Markets

No mention is made of the immense foreign market awaiting at our door in the tropics and semitropics, where lie undeveloped millions of acres of great agricultural potentialities that await only clearing and subsequent power farming to be made productive.

Irrigation and the Tractor

But within the limits of the United States, and strictly within the limits of the tractor belt as previously defined, here is still another immense field of possibilities in the extension of irrigated farming. Already in parts of Colorado and farther north not to mention certain new experiments in Western Kansas, this has been. There are small pumping outfits now in use for 5, 10 and 15 acres of garden, small fruits, orchards, etc., all run by belt tractor power. And the day is soon coming when under the necessity of still greater production the present irrigation farming will not only be practicable but imperatively necessary. Japan, with a rainfall hardly greater than any part of our own grain belt, produces on a single acre, by irrigation, two and three crops a year averaging \$160 to the acre. Some of this farming is wheat and the majority of it is small grain culture. Of course some of the high fertility is due to fertilization but the day of fertilization in the somewhat older corn and wheat land of the Middle West is already not far distant. In this same region it is inevitable as population increases that more rigid delimitation in the size of farms must be made with the subsequent adoption of a more intensive agriculture. As these methods arise they will of necessity involve tractors. Even today there is an increase in the localization of the various farm operations, perhaps best seen in the purchase of small individual threshing machines. This increase in small threshing units has also advanced the use of the small tractor as the power source.

Production

Of course all predictions of the future tractor output are fundamentally conditioned by the fact that productive methods in agriculture will never grow less. The price of all food products has shown a steady average increase since the so-called over-production period ended in 1897. With the production cost of food products steadily rising there will also be an increase in the price of food products to the consumer. To be sure the last five years, and particularly the last two years, have witnessed an abnormal increase due to the war. But the average increase, when plotted, shows a progressive advance. This advance is due to the fact that relatively production, despite an

The tractor will work at night when crops must be saved

ILLUSTRATION 25

advance in producing methods, is not keeping up with the constantly increasing consumer demand. In fact there is indisputable evidence that the present high peak of food products indicates that we are facing a so-called period of starvation just as acute in its relative extent and intensity as that which existed when the American farmer equipped with only hand tools and the horse, was barely able to produce enough food for his own family.

A New Farming

Boiled down the whole question resolves itself into a question of extensive versus intensive farming, with the first method making for under-production, a shortcoming due not so much to the actual total number of acres farmed as to the yield obtained. In fact, in certain older countries such as China, Japan, and even France and Italy—regions having no more rainfall than our Western plains—there are much larger grain yields an acre than with us. It has been the American tendency to be misled by the fact that our man yield an acre is high. As is the case in all extensive systems of agriculture, the acreage yield is low. In America the average acreage yield of wheat is scarcely above 14 bushels; in France, especially in the great grain regions of Normandy along the Seine Valley, it jumps to almost 30 bushels; the Central Hungarian plains show almost the same figure; while even Japan, less fortunately endowed in fertility than these two other areas, shows the relatively high yield of 24 bushels. On the other hand, however, the yearly income for each farm family in America averages about \$1,000, with this figure showing each year a slightly higher progression. The same figures for France run, under normal peace conditions, about \$570.

Consumption

It is not necessary to explain the economic doctrine which demonstrates that there is relatively a greater return for the French farmer than for the American farmer. While the total aggregate annual farm wealth of America makes a good talking point the value of such wealth is more purely a quantitative fact than a qualitative one. Under normal peace conditions each family in the United States consumes between 5 and 6 bushels

of wheat annually, together with an average consumption of one-half ton of meat a year. But under the new conditions, imposed by an era of industrialism, relatively fewer people practically live on farms; more people than ever before are engaged in occupations that are non-productive judged from the ability to support themselves and provide their own food supply. A century ago over nine-tenths of the total population lived on farms and were directly dependent upon agriculture for a living. In 1910, however, and increasingly so in the decade that has elapsed since that time, only one-third of the people were engaged in strictly agricultural pursuits. Such a condition means that those people who do remain on the farms, relatively a much smaller number than formerly, must not only support themselves but in addition must support three urban non-productive families. The time is not far distant when this figure will be increased to four. Under the lash of war conditions this figure actually has reached five or six families.

The New Farming Again

The problem then becomes one, as has often been reiterated, of increased production. This increased production must be met by an extension of agricultural population to include new and unopened areas of potential farm land. In addition, it must take cognizance of more extensive methods of agriculture upon those areas already producing. With a lessened man-power, plus a rising labor market the only way in which the farmer can meet the situation and fulfill the demands, not only of himself but of an increasing and dependent industrial population, is thoroly to motorize his farm. In other words he must make himself one with the spirit of the age. That spirit is expressed in terms of the machine. The tractor is the only answer. Hence any estimate of the potential future of this implement must recognize exactly and analyze even more delicately the precise limits of a newer production that the economic and social conditions will enforce upon the farmer.

Farm Labor

As an exemplification of the foregoing discussion it may not be in apropos to cite one or two actual conditions which illuminate the theory. Let us consider the rise in the farm labor market.

ILLUSTRATION 26

Not many years ago the average farm hand received about \$15 a month with board and washing. This wage gradually increased to \$20 and \$25, then \$30 and \$40 as a general average. Today farm hands receive anywhere from \$50 to \$80 a month "and found"; and under stress of extraordinary conditions such as the wheat harvest this wage will approach \$225 to \$240. But even at that price farm hands are often unobtainable. The shorter hours, the higher wage-scale paid by industrial concerns, the more illusory environments of city life and the sapping of man power by war have all contributed to deplete the farm labor market.

Some Pertinent Figures

The remarkable increase in farm wages in Kansas in recent years is shown in the estimates by Edward C. Paxton, Kansas field agent for the Bureau of Crop Estimates. The average harvest wage paid in Kansas in 1919 was 131 per cent of the 1918 price and 253 per cent of the 1913, or pre-war price. Harvest laborers received, on the average, \$5.42 per day and board in 1919, as compared with \$4.14 in 1918 and only \$2.14 in 1913.

While farm wages for ordinary labor, other than harvest work, have not been as high, they do show an even more noticeable increase. Such wages have risen from an average of \$1.53 in 1913 to \$2.74 in 1918 and \$3.71 in 1919, including board.

Shorter Hours Also

For farm labor, where hired by the month with board, the Kansas farmer paid in 1919 an average of \$49.50 per month; in 1919, \$40.80 and in 1913 only \$24.

"These estimates," says the report, "probably do not reflect the actual increase in cost of farm labor as it enters into cost of production since 1913, due to the fact that number of hours of labor have been disregarded. It is safe to say that the average farm hand in 1913 worked two hours per day longer than in 1919. The length of

the work day did not become involved in farm labor until long after it had been a strike issue in the industrial world. It is also possibly true that the harvest labor used in 1919 was really less experienced and efficient than that supplied in 1913.

To Command a Premium

"The price of farm labor in recent years has shown a trend to approximate the prices prevailing in the industrial market. Because of the relative conditions under which farm labor and city labor are performed, it is even conceivable that the time may soon come when farm labor will actually command a premium.

In the Old Days

"Historically, it is of interest to compare farm wages now with those paid in 1893, when the financial condition of the country was at very low ebb. In 1893 the Kansas farmer hired labor by the month for an average of \$16.27 with board, and \$24 without board. Today he pays three times as much. In 1893 harvest hands commanded \$1.15 and board, or \$1.44 and found their own. Last summer the harvest hands were paid 4.71 times as much. In those 'good old times' in 1893 Kansas farmers were hiring day labor thruout the year, for ordinary farm work, for the magnificent sum of 85 cents and board, or for \$1.10 when the hand found his own meals and lodging. Ordinary farm hands have been receiving 4.37 times as much during the past year."

Power farming is the only answer to such conditions as these.

Decrease in Farm Population

The standard of intelligence of farmers, no matter of what nationality, is directly related to the income derived from farming as compared with that derived from other occupations. If farming is permitted as is now the case, to become less profitable per capita, in comparison with

other occupations, it is inevitable that the profession will be gradually given over to persons less intelligent, less efficient and less progressive than those now occupying farms.

The increase in farm tenantry while not entirely attributable to this cause is partially so. It is safe to say that the 1920 census will show as did that of 1910, that a number of corn and wheat states have an actual loss in farm population. By some authorities, and particularly on the part of a somewhat superficial press, much hue and cry has been raised over this fact. Some of it is justified. That loss of rural population caused by a narrow and meager social life, insufficient and badly managed country schools, causing the younger generation to leave the farm for the city, is indeed something to cause genuine alarm.

Power Farming

But a sounder analysis of the decrease will show that in reality the loss in farm population is simply an indication that the new age of power farming has begun to show its first results. The peculiar virtue of improved farm machines, a virtue that increases in extent the more completely it is embraced, is that it enables one man to do the work that required three under the older system. In addition the partial success of power farming has enabled a number of the more elderly farmers to retire and has, by the same token, led other farmers to seek newer areas westward toward the Pacific. All these signs indicate fundamentally sound economic progress and a satisfactory adjustment of the farmer's profession to the demands of the new industrial era.

Increased production demands deep plowing, not a mere "skinning" of the top surface and the creation of a hard pan impervious to moisture penetration

CHART 27

CHAPTER VI

Tractor Facts

The New Age

The Capper Farm Press thruout this study of the tractor wishes to emphasize above all else, one general fact. It advocates the tractor and its extended use because it believes that the farmer of the present is coming more and more to use power farming and because it believes that the farming of the future will be almost entirely power performed. The immediate need of the world today is for increased production. Increased production demands an extended and a quicker as well as a more consistent power than that supplied by the already depleted man labor and horse power. Tractor farming is, therefore, a step in the higher economic evolution of the age. Viewed from this point the mere sale of tractors is incidental. It is fully recognized that the horse has its place and will continue to fill it but he has limits just as clearly defined, beyond which it is bad economy and inhumane to employ him.

Tractors Not Perfect

Likewise it is just as clearly recognized that the tractor is not a perfect instrument. Like the steam engine, the automobile or any other piece of mechanism that has today attained its degree of perfection, the tractor must suffer various evolutions of type before it approaches its maximum efficiency. Even now it is so efficient that no longer is it a question of whether the tractor is practicable but which is the proper size and type to buy. Of course there still remain many difficulties to be solved, various technical problems that involve not only the application of the power but the generation of that power itself. But such mechanical imperfections are not insurmountable. The maximum thermatic values of the various fuels are fast being utilized and stabilized. When farmers' experience under the widely varied climatic and soil conditions of the wheat—corn belt is finally analyzed, the tractor will have approached its practical ideal of standardization.

Tractor Improvement

Great progress has already been made in simplification and flexibility by tractor manufacturers, not only because they recognize that it is for their own economy and convenience but also because the more quickly comes standardization, the quicker and wider will be the sale of machines. The last four years has seen the coming of the medium and small tractor, itself an effective stimulation to broader power farming. Such an extension marks the gradual invasion of power farming, as formerly practiced only in the most "extensive" farms with the larger steam tractor,

in o the domain of the medium and smaller farm. In other words the demand of the farmers themselves has forced upon the manufacturer the necessity of quantity production; this necessity is already being answered in no uncertain terms by a half dozen manufacturers.

That the tractor is fast being pushed toward a more practical efficiency is shown by the numberless small-tractor manufacturers that have come upon the market within the last two years, each offering some one or more features tending to make the tractor cheaper, a more flexible and more efficient farm machine. To be sure many of these machines will disappear thru lack of proper financing; many more in the test of actual farm use will betray their mechanical shortcomings. But their very presence in the market is an encouraging sign of inventive interest and a recognition that power farming has come to stay.

How fast the increase in the volume of tractor business will be in the next few years is very difficult to determine. As before reiterated, granted a certain stability in market conditions and a continued general prosperity, the principal general premise upon which all estimates must be made is that of education.

Education Necessary

Education must include the farmer, the dealer, the manufacturer and remotely the general public. The vehicles of this educational process are already in operation. The United States Department of Agriculture, the various agricultural colleges, the farm press of the country, without exception, are hammering away on the farmer. Dealers and distributors, backed by the manufacturers, are employing various means of propaganda. But none of these agencies can but admit the fact that tractor progress must be a natural growth based on "the buying conviction" that follows demonstration in the field. While the large majority of all dealers agree with the opinion of representative tractor owners, opinion varies only as to the rate of progress. After all this is not so important; the farmer should not be merely "persuaded." His first and even last purchase of a tractor should be inevitably the result of a profound conviction that by so doing he is benefiting himself and increasing the stability of the profession itself.

The Farmer a Business Man

A great deal of disappointment was manifested last year by tractor manufacturers in the apparent lessening of the farm interest in the tractor, a fact made very visible by decreasing sales in

Intensive motor farming. Planting, plowing and harrowing at one operation

ILLUSTRATION 28

many localities. Curiously enough the real reason for this was not readily grasped. In the first place it is not sufficiently understood that in general the attitude of the farmer toward his business is that of any far-sighted manufacturer and producer. Especially do the extensive farmers of the wheat belt regard their investment in machinery and other implements, not as something temporary but as something that will ultimately yield a maximum return.

In other words, an insufficient first return on a relatively large amount of capital invested does not deter the farmer from making such an investment when he sees clearly that the future will bring an increased and higher average of earnings on the original sum invested. By the same token it is not generally recognized that the investments of farmers in any sort of farm equipment are strongly dominated by local crop conditions. A certain sales executive of a large cheap-priced automobile was at a loss recently to explain why a certain arbitrary fixage of distribution had been exceeded and the demand was greater than the supply. He attributed such a fact to the efficiency of his own sales methods when, in reality, had he taken the trouble to investigate, he would have found that an unusual wheat and corn crop, combined with a successful first season with tractors, had made money for these local farmers and that in consequence his sales of this machine, already a reality in the farmers' mind thru judicious and long continued advertising campaign in the farm papers had leaped beyond the number originally estimated.

The Reverse Process

By the same token the reverse process of sales diminution is well exemplified in the results cited by *The Farmer* in its recent tractor investigation. Here it was found that 51 per cent of local tractor dealers, upon investigation, discovered that the sale of tractors had decreased in the spring of 1919 because the land had been too wet for plowing. Forty per cent of the bankers in the three states of Minnesota, South Dakota and North Dakota substantiated the opinion of the dealers. Over 16 per cent of these same dealers report that the next largest factor of farmers' indifference was the lack of cash. These last two factors are correlative. But the original assumption of both manufacturers and distributors had been quite the contrary. They had thought sales had declined owing to an inherent disinclination of farmers to pay a seemingly abnormal price in the face of an indicated sharp decline in the market.

The tendency of the farmer is frequently to invest his crop returns at the moment he gets them and this explains the fact that the late spring found many farmers without large amounts of ready money. But the principal deduction to make and one that could be substantiated thru a study of other local conditions is that the farmers' purchasing power is in direct ratio to immediate seasonal, soil and climatic conditions.

Need of Standardization

Standardization of the tractor will undoubtedly come even as it has already arrived in the auto-

Weather Bureau reports enforce the need of moisture conservation. Quick plowing and frequent surface cultivation are essential. The tractor is a necessary machine for this purpose

CHART 29

mobile and to a certain extent in the motor truck industry. The Society of Automotive Engineers is already at work upon the problem but as yet has made no definite announcement of its conclusions.

Governing Factors

Those factors that will ultimately determine the power rating, the quality and quantity of construction and the makeup and superficial appearance of the tractor may be summarized as follows:

1. As time goes on the test of actual field usage will eliminate, as before intimated, many of the experimental or "freak" types that are already on the market or soon will be. This condition is accurately exemplified in the evolution of automobile types during the past twenty years.
2. Actual capital and extended financial affiliations will tend, under our present economic system, to eliminate a large number of tractor makers. This will not, as is frequently thought by a fallacious public opinion, eliminate those tractors of inadequate financial backing but whose mechanical principles are really sound and practical. The tendency of all big industries is to absorb unto themselves by legitimate business absorption and expansion the best that weaker competitors have produced.
3. The command of materials market by large manufacturers will also be a determinant of standardization. As the tractor industry

resolves itself into a relatively small number of manufacturers, with production schedules keyed to a higher pitch, the raw material market tends to become stabilized, with the result that buying costs are practically the same for all competitors. Standardization in the actual manufacture becomes the inevitable next step.

4. Selling methods based upon a legitimate demand. This last point perhaps deserves a somewhat extended discussion.

Selling Methods

The two elements of buying and manufacturing being, therefore, almost automatically regulated, the next actual determinant of standardization, wherein some variation may be expected, will be found in the sales policies of the different firms. Even these, making all due allowance for the personal equation of both the home office and the field sales force, tend to become stabilized in themselves.

Ultimately, as has been many times pointed out, selling resolves itself into but one soundly economic method; that system which markets its product solely on its own merits as a practical performer; which is produced in response to the natural needs of supply and demand; and which disregards, as being uneconomic and wasteful, any sales policy that seeks arbitrarily to market a product regardless of merit or demand by the mere exploitation of clever advertising and propaganda. We might point out that the adherence to

such a sales policy of "natural absorption" is in itself inevitable of adoption if sound economic principles are to be regarded. It tends not only to standardize itself but to standardize the whole industry. All idiosyncrasies of local likes and dislikes in consumer demand put aside, it is only a question of time before the fundamental factors of soil, climate and the actual buying power of the consumer will determine both the type and price as well as the sales methods of any tractor.

Effects of Standardization

The discussion of this last phase of the standardization process of any product might be continued indefinitely. Many economists have pointed out that a long drawn out and costly system "of stumbling thru," with cut prices and the ruthless elimination of weaker competitors might well be avoided by a pooling of all inventive, capital and selling resources. This has been done to a large extent in the steel industry, to a less extent in the automobile trade and to an appreciable extent in the implement industry. Of course, the excuse for being of our present system is that initiative and personality are constantly being developed under the stress of competition and that ultimately a better product is evolved. But such a system is costly both to the manufacturer in his production and sales and ultimately so to the consumer. Any tendency, therefore, toward standardization which, while not removing the individual spur of originality and inventiveness, will tend to simplify and make cheaper all steps in the making and selling of tractors will be of immense benefit to all concerned.

Service

Yet, in the last analysis, the whole question is concerned with that of service. At present the

very thing which prevents some manufacturers from venturing into new territory, and which deters the farmer from investing in a given tractor is precisely the impossibility of giving and receiving an adequate repair service. Standardization in the process of manufacturing and selling will also tend to standardize service. Simplification of parts will make a machine not only easy to operate but more capable of being repaired by the farmer himself. Dealers in parts can be the quicker and the more cheaply supplied. It costs money to maintain an extensive repair service. In itself the existence of such a system may be more or less an admission of fundamental weakness on the part of the machine itself.

Ultimately the cost of such a service must be charged to the buyer of the tractor. It is a much better sales argument to offer a machine that can be easily repaired either by the farmer himself or by the nearest service dealer. It is commendable indeed for a manufacturer to be willing to send on repair missions a mechanic 40, 60 or 100 miles, but it does not have the same force for a sales argument as being able to offer a machine so simplified and standardized that the need of an expert in repairing it is not necessary.

Inexpert Operators

It is undoubtedly true that probably only 25 per cent of present farm owners may be considered expert operators. An even smaller per cent may be characterized as expert repair men, but it should be remembered that as the tractor market extends and the influence of various tractor schools, including the free service of the agricultural colleges, becomes more and more extended that the percentage of farmers able to operate and repair their own machines will constantly rise.

CHAPTER VII

State Standardization

Some states are recognizing the need for tractor legislation. Such legislation aims to protect the farmers and to simplify the tremendous confusion that now exists in the field of tractor specifications. It must inevitably force manufacturers to standardize rigidly their products.

For instance, the requirements of the new Nebraska tractor law which recently became effective are already having results.

We quote from a recent number of *Farm Implement News*:

"The law seeks to prevent the sale of experimental models of tractors, to prevent misrepresentation in making sales, and to require all tractor manufacturers to carry a complete stock of repair parts within the state. In general these points are essentially those which tractor manufacturers, thru their organizations, have been attempting to foster. Accurate horse power tests have been recognized for some time as a necessary feature of the tractor industry. The new law may do much in Nebraska toward eliminating incompetent machines and toward standardizing power ratings so that the Nebraska farmer may know exactly the kind and size of machine to purchase for his needs."

Tests

"The results of this legislation may be summed up briefly in the following 9 tests and one provision:

(a) Limbering-up run at one-third, two-thirds and full load for about 12 hours. (b) Brake horse-power test at rated load to show whether or not the tractor will carry continuously its rated load on the belt and to show fuel economy; duration of test, 2 hours. (c) Brake horse-power test at vary-

ing load to show governor control and fuel economy; time, 1 hour. (d) Brake horse-power test at maximum load to determine greatest load tractor will carry with governor set for rated belt load; time, 1 hour. (e) Brake horse power test at half load to determine fuel economy; time, 1 hour. (f) Draw-bar horse-power test at rated load to see if the tractor will pull its rated draw-bar load continuously on the cinder track, and to determine fuel economy; actual running time, 10 hours. (g) Draw-bar horse-power test at maximum load to determine this load on the cinder track and show fuel economy. (h) Miscellaneous tests will be conducted to make observation on any special features. (i) Endurance test to detect any features which may give continual trouble. It will take a tractor a total of 40 hours to complete these tests.

"The results of these tests must compare favorably with the advertising matter used by the company making the tractor or the machine cannot be sold in the state. Furthermore, the manufacturer must have adequate supplies of repair parts within the confines of the state in order that prompt replacement service may be rendered."

But such a law if passed by each state, each with its own local variation, might defeat its own end. What is really desired is standardization, not sectional but national. What is necessary, therefore, is not so much state standardization tests but a national tractor standard to which all tractor manufacturers must conform. But some tractor manufacturers despite the example set for them by their automobile confreres seem loath to solve the problem of standardization. Unless they take command of the situation themselves, however, they will be forced to do so by the passage of such state laws as Nebraska has already in force.

CHAPTER VIII

Tractor Repair Service

One of the facts which greatly influence tractor sales with farmers is that which is concerned with service. The farmer is a peculiar and interesting individual, and an investment represents to him something that must be permanent and continuously effective. Performance of farm equipment must justify the advertisement of the manufacturers and the claims of the dealer. When these conditions are not fulfilled and the tractor breaks down dissatisfaction is sure to arise. Dissatisfaction is increased to the everlasting prejudice of all parties concerned when the repair service is neglected or inefficient. At present, the principal difficulty seems to be the impossibility of rendering a quick service in the height of the work season.

Either dealers do not carry a large enough stock of repair parts and supplies, or there is an insufficiency of repair men or the calls are so numerous and the distances so great that some tractor is sure to be idle when most needed. It should be said in passing, however, that a general analysis of dealer opinion covering the 16 states of the corn and wheat belt shows at least 25 per cent of all dealers interviewed declaring themselves ready to render general repair service to the full extent of their ability. Even if these figures are pretty closely matched with that proportion of dealers whose contracts from manufacturers require such a service, the fact remains that most dealers out of a really sincere desire to advance the community are willing to give repair service to the limit of their ability.

Suggestions as to Remedy

In fact the determining factor that prevents a large percentage of dealers from giving a greater and wider service is that of absolute physical inability rather than an unwillingness.

Various solutions have been suggested such as the establishing of central repair stations to overcome this difficulty. Some farmers, as well as dealers, have expressed the opinion that a minimum cost basis on all repairs rendered should be established thus eliminating "free" calls for petty, inconsequential or "cranky" causes. The principal objections to the establishment of small local central repair stations is their expense and the unnecessary duplication of parts requiring excessive stocks. Since the time element is the biggest repair factor in the height of the work season, some system should be devised that will enable repairs to be made quickly and efficiently.

A Concrete Plan—The Traveling Repair Shop

After an extended investigation and including all classes of opinion on the subject, it is the conclusion of the Bureau of Research of The Capper Farm Press that the best solution of the question lies in the equipment and maintenance by either the manufacturer or the dealer of a traveling motor truck repair shop for tractors. The idea has been worked out by some dealers in England with success. The experience of the A. E. F. motor transport service further confirms this procedure. It is perfectly feasible to mount repair shops, sufficient for most ordinary repairs, on a heavy type motor truck. Such an arrangement was the practice of all the armies in Europe. If it can be applied to motor trucks it can likewise be applied to tractor service. It should not be forgotten in addition that a large majority of tractor breakdowns are those which can be remedied by the replacement of some minor part or by the service of a deft mechanic. To meet this situation there might be in addition put in operation a so-called "flivver service" such as any automobile dealer of repute everywhere maintains for his tire customers.

Another Concrete Plan

H. C. Buffington, Motor Engineer, Minneapolis Steel and Machinery Company, member of the Society of Automotive Engineers, as long ago as 1917 suggested a very practical system of tractor service. The outline of his service scheme is herewith quoted, as presented by Mr. Buffington at the tractor meeting of the Society of the Automotive Engineers, at Fremont, Nebraska, August 9, 1917:

"In order to work out the system, let us take one state, North Dakota, for an example, and create a new department. Call it the Department of Tractor Service for convenience, with headquarters at Bismarck. Then let us locate sub-quarters, all being geographically situated to cover the state effectually. Say, for example, Minot for the Northwest, Devil's Lake for the Northeast, Dickinson for the Southwest, and Sioux Falls for the Southeast. Next, employ expert field men, and assign them to certain territories.

"The far-reaching scope and power of a body of men such as might be organized under this plan can hardly be realized until we go over a few of the items of information that can be gathered.

"First—The department would have an exact record of all tractors in the state.

"Second—The department would know just when a tractor is standing idle.

"Third—The department would have a record of farmers handling undeveloped land, land to break or seed crops to harvest, such as the season, of course, would determine.

"Fourth—The department would know the exact date on which a tractor is shipped from the factory, which road it would go over, and to whom it would be shipped.

"Fifth—It would be a part of the department's duties to know why the supplies of fuel, oil, or repair parts, are not taken care of promptly.

"As can readily be seen, there is no limit to the possibilities of such a department's service under this plan. All the work of gathering the necessary information can be accomplished without waste of time and space."

Co-operation

The extent to which some manufactures and dealers fail to grasp the necessity of a complete repair and replacement service for tractor users is nowhere better exemplified than in those letters of complaint constantly being received by the editors of all leading farm journals. The spirit of these letters, as well as the editorial attitude, cannot be better illustrated than by quoting a characteristic one, recently received by The Capper Farm Press, and its answer. It states its own case, and the inference if not the moral is plain: free repair service to include necessary replacement, and realization of the fact that actual field tests are more accurate than laboratory ones.

Tractor Trouble

"Can you suggest to me what to do with my tractor which I bought in the spring of 1916? Its weakest point I think is its connecting rods which have broken three times, and twice the crank case was smashed up badly. The company of course desires to put the blame on me. One of the worst of these smash-ups occurred just 2½ hours after the company's own expert had overhauled the engine and had adjusted the connecting rods. Since then I have been careful to keep the connecting rods just tight enough, but in spite of my special care they fly to pieces. The company always refer me to some of their new models in their replies. Is there no redress and must others like myself who bought tractors of the former model pay for the company's experimental tractors?"

John W. Yost.
Huerfano, Colorado.

The Editor's Reply

"You are not the only victim who has had to pay for the mistakes in design and construction of some of the so-called modern tractors. Some companies are so short-sighted that service to a purchaser is an entirely secondary matter with them. Where the demand exceeds the supply this condition is likely to prevail. This of course is the situation at present. It is manifest from your statement of the facts that the company to which you refer in your letter is in such a class.

"It is needless for me to attempt to point out possible difficulties in the operation of your tractor, for undoubtedly the company has already pointed those out to you. Under normal conditions the instructions given by any company regarding the handling of their own make of tractor should be followed above all else.

Change in Designs

"If I am properly informed, the new type of rod put out by this company provides more wearing surface than formerly, making it impossible to make your repairs from their new design. It is the practice of some owners when starting, to race their motor, with the idea of getting it out quickly on kerosene. Where the splash system is employed as on your engine, the lubrication may not be sufficient at first under such conditions, resulting in undue strains on the parts.

A Mistake in the Foundry

"It is not infrequent to find one particular part continually failing on a machine and this may be due to faulty material, faulty design or workmanship or faulty heat treatment of the parts. The writer is familiar with one manufacturer who was at one time having excessive repairs for one particular large annular gear on their tractor. The repairs became so numerous that had they continued it would have resulted in establishing a record for the tractor that would have stopped its sale entirely. There is little doubt in my mind that many farmers paid for such repairs, contributing to the experience of the company. Upon close investigation it was found that the entire difficulty in this instance was in the foundry practice as it was at that time. This particular tractor now has a very excellent reputation.

The Manufacturer Should Make Good

"Perhaps it may be faulty material or improper heat treatment in the case of your rods, but if you should wish to continue the use of your tractor, it would seem that the repairs would most logically come from the company. If the company is not even willing to come half way on their service, it will eventually become known to the trade and react to their own detriment. Unfortunately if they should take an attitude contrary with your own idea, it seems that no redress can be had and the honesty of the manufacturer will govern."

Tractor Training

But it should be recognized that as a tractor gradually passes the experimental stage and become standardized the necessity of repair service will be somewhat lessened. It will still further lessen as farmers become more expert operators. Probably today 25 per cent of farm operators are inefficient. Tractor schools, both those maintained as out-and-out institutions of learning, as well as so-called "Demonstration Schools" provided by various tractor companies and commer-

cial schools are already having their effect in this direction. Consolidated country high schools, too, as applied vocational agricultural mechanics become more and more a part of their curriculum, will add their influence in this direction.

Farm Objections

There are still many objections to the tractor and still a large class of farmers who if not actively opposed, are indifferent or skeptical. An analysis of these classes of farmers conducted in Oklahoma, Kansas, Illinois, Minnesota, North Dakota and South Dakota discloses that the majority of those causes which make farmers opposed are purely physical ones. The list of the causes comprise: wet fields, too hilly fields, too circumscribed fields, too heavy soil, etc. In another

class of physical objections are those which involve: too many types of tractors, too little developed horse power in draw-bar work, non-flexibility of tractor types, such as slow movement, inability to turn square corners, too limited tractor plows, insufficient repair service, etc.

It is obvious that the physical difficulties of the first named class will gradually disappear as the imperfections listed in the second class likewise disappear in the process of perfection. There are types of tractors today which can be used as successfully on wet land as on up-and-down country. Because the tractor was first successfully used to break long level stretches of virgin prairie sod, and because the tractor itself was a heavy steam engine affair, a great many farmers still think this machine, in its place most efficient, is the only type of tractor available. The right kind of education alone can remove such prejudices.

Coupled with heavy rainfall during a short period of time is the very high rate of evaporation caused by the winds. The tractor successfully combats this condition

CHART 30

CHAPTER IX

More Tractor Facts

Specific Objections

It may not be unprofitable to consider some farmers' objections and the handicaps under which the tractor of today works. The need of standardization has already been emphasized and the day is not far distant when this must come. It not infrequently happens that the prospective tractor owner is completely confused when he seeks to study the various tractors now on the market. The combination horse-power ratings, rotative speeds of both pulley and engine, tractive speed, draw-bar pull, 2-cycle as opposed to 4-cycle engines, caterpillar as opposed to spur-wheel types, 3-wheel as opposed to 4-wheel, etc.; all these things are being set forth in a bedlam of publicity and propaganda that serves only to confuse the prospective farm buyer.

For instance, there are tractors on the market with engine speeds differing from 1,000 to 1,800 revolutions per minute, forward speeds varying from 1 to 7 miles an hour, draw-bar horse-power development ranging from 2 to 45, 50 and even 60 horse-power ratings. Other varying specifications make it difficult for any one, unless he is a trained automotive engineer, to get head or tail out of the jumble. It is this confusion that sometimes makes the farmer hesitate to invest his money in a thing

he does not fully understand. Tractor advertising copy, frequently too technical in its language, increases the difficulty of the prospective purchaser.

Preferred Types

Then there is a wide difference of opinion, depending somewhat on the community, as to what is the best form and type of tractor for all-round farm usage. In the Northern spring wheat belt about 70 to 80 per cent favor a 2-plow or 3-plow machine with a very respectable number, still dependent on the community, favoring the 3- or 4-plow machine, particularly the latter. This opinion of the farm users is substantiated pretty closely by the combined opinions of dealers, bankers and non-owners. In contrast to this, the type favored farther to the South, particularly in Kansas and Oklahoma, is the 4-plow machine; altho the preference is influenced according to the crop that is being considered. Corn growers favor the light rather than the heavy type.

Difference of Opinion

There is also a wide difference of opinion as to what is the most advantageous and practicable way to operate, whether by one man operating

Tractors are being used to an increasing extent in the harvest fields. A farmer can keep going with an outfit of this kind, no matter how hot the weather gets

ILLUSTRATION 31

both the tractor and the following machine, or a two-man team. There is also the question of whether it is better to operate the implement from the seat of the former or the seat of the latter. The majority of opinion thruout the 16 states favors, however, the one-man operator and the point of operation from the seat of the tractor. It is rather interesting to note that non-owners are of the opinion that it is easier to operate from the seat of equipment than from the seat of the tractor. This in itself is an interesting psychological fact; it betrays that state of mind that naturally favors the thing with which it is most familiar. Another indication shows some farmers are dissatisfied with present types offered and also wish to postpone investing until a machine of the particular horse power, weight, etc., that their individual fancy desires is put on the market. By this same theory there is a wide variety of opinion as to what types of tractors are suitable for the local soil conditions in certain particular communities. In this latter case it will be usually found that the feeling which favors one type or one make over another finds its origin in that peculiar psychology always characteristic of any mass action in a rural locality. A certain community favors a certain type of machine because the first machines used were brought in by the most prominent and progressive farmers. The same phenomenon has been before frequently noticed and has greatly influenced certain dealer methods in the sale and distribution of certain makes of automobiles and farm trucks.

Which Fuel

There is still a difference of opinion as to which is the better fuel, gasoline or kerosene. Approximately 55 to 65 per cent of tractor owners in the 16 wheat and corn states are today using kerosene for tractor fuel with fully 55 per cent of this group agreed that not only is kerosene cheaper but, on the whole, just as efficient in view of its lesser price, as gasoline. In the past there has been a good deal of discussion as to the actual practicability of kerosene. Even today a majority

of tractor owners, including those who own kerosene machines, are of the opinion that this fuel causes more minor troubles of operating and a greater number of minor repairs.

Gasoline vs. Kerosene

The principal troubles and deficiencies are: less actual number of hours of work with kerosene than gasoline before it is necessary to drain the oil supply and fill with more oil in order to prevent lubrication troubles; more frequent cleaning of sparkplugs; more frequent overheating; more frequent difficulty with the fuel due to a small water content; and certain other minor difficulties that range from trouble with the bearings and pistons to the excessive carbonization and cracking of spark plugs. As a matter of fact, however, the balance of efficiency between the two fuels is pretty evenly maintained. If gasoline develops slightly more power and is cleaner to handle it is also more expensive in proportion to the amount of power it develops. However, it is also worthy of note that the trend of tractor development in so far as fuels are concerned, will be more and more in the direction of a heavier essence. The days is not far distant, owing to the limitation of fuel supplies, when the heavy base and crude oils must be used. Of course, as this becomes necessary changes in engine design will keep pace with the fuel necessities.

Attached Implements

Still another consideration that enters into the discussion is that which concerns the kind and type of machine, including kinds of attached implements, that should be used. In the very beginning of tractor usage, and even today, there has been the natural tendency of many farmers rather than to abandon entirely old implements to use them under more or less make-shift conditions with the new power unit. In the long run (this is not true economy altho, owing to limited capital, it is generally impossible for the farmer making his first investment in the tractor to

In making seedbeds for wheat and other grain crops the tractor has proved itself to be one of the most valuable machines on the farm

ILLUSTRATION 32

abandon entirely his former horse-drawn implements. But at least the plow and the disc should be made for the tractor and if possible the binder hitch, harrow and drill should also especially fit the new power unit.

A complete set of special tractor implements for the farmer who could afford it would include besides those mentioned the following: carrying truck, corn harvester, self-binder, 2-row cultivator, breaking-plow, drag, packer, clod crusher, 4-row corn cultivator, etc. For belt work it would include wood saw, ensilage cutter, feed mill, shredder, seeding and husking machine, potato digger, well driller, small stone crusher for cement work, small corn or wheat thresher, portable saw mill and other minor uses according to particular conditions.

The Dealer

There is also an uncertainty in the tractor situation which sometimes operates to cause jealousy in a given community and frequently limits complete distribution. This is because there exists a considerable difference of opinion as to whether a tractor should be sold by the already-established implement man, the garage keeper, the automobile dealer, or a specialist by himself. It is the opinion, however, of most Southwestern farmers, an opinion strongly corroborated by the farmers of the Northwest, that the regular implement dealer, by reason of his greater and larger familiarity with farm machinery and the needs of his farm community, is best fitted to handle the distribution of tractors.

Again the Dealer

In speaking of the position of the tractor dealer a word should be said as to the peculiar place he occupies in any farm community. Since 1850 there has been a gradual change in his responsibilities thru the encouragement of the implement manufacturers and their long-time credits.

Complete Selling Service

The live dealer realizes the responsibility of his position and undertakes to inform his clientele of precisely what he can offer in the way of machines and of subsequent repair service. Backed by proper selling organization in the factory, and backed in addition by a judicious advertising campaign localized in the newspapers and centered in the great farm papers of the corn and wheat belt itself, no tractor dealer need fear the problem of local sales. There is no limit in the power and influence he can wield especially if either he or the manufacturer takes advantage of The Complete Selling Plan originated and developed by The Capper Farm Press. The Complete Selling Plan puts territory, carefully analyzed for all its trade possibilities, directly into the hands of the dealer. It also opens up new tractor territory for the manufacturer, it develops every phase of a selling campaign, analyzes territory and secures distributors and dealers.

Proved by Experience

The influence of such a dealer-and-farm paper co-operation is proved by the experience of Kansas where analysis show that tractors have been sold more heavily in its so-called wheat belt than in other portions of the state. The reason for this is not only because the tractor is especially adaptable to wheat farming, but also because in this particular wheat belt there has long been carried on, thru the Complete Selling Plan, a campaign of education among farmers and dealers. The farmer has been made to see by actual demonstration just how the tractor is the ideal instrument for increasing wheat production. The agricultural colleges and experiment stations, ably seconded by the farm papers, have consistently preached the need of deep and early plowing, of the quick planting of large areas at seeding time, of fast harvesting when the grain is ripe. While

This harvester-thresher cuts a 9-foot swath and is pulled by a 10-20 kerosene tractor. Two men operate this outfit

ILLUSTRATION 33

these same arguments could have been applied under the same general conditions in Illinois or the Dakotas, the fact remains that the sale of tractors to Kansas wheat farmers has been the result of a deliberate campaign in education.

Attitude of Country Bankers

One of the general objections frequently voiced both by prospective tractor users and by dealers is that country bankers are adverse to lending money for the purpose of buying tractors. While this statement may be true in certain instances, an investigation in several parts of the wheat belt discloses quite a different attitude of mind.

Oklahoma Opinion

In a recent trade investigation conducted by The Capper Farm Press in Oklahoma during the summer of 1919, every country banker of consequence in a territory lying just west of Oklahoma City, and comprising some of the best agricultural land in the state, was interviewed on the tractor question. Of the 35 bankers interviewed only one said that he would not lend money to a farmer of established probity in order that he might purchase a tractor. Several said that they would prefer to lend money for the purchase of a tractor than for the purchase of an automobile or a truck. The one banker who was adverse to lending for a tractor was a farmer himself and financially interested in the raising of draft horses. The inference is plain.

Increased Sales

In several widely separated towns in this territory it was found that local tractor sales in the summer of 1919, as contrasted with previous years, had increased from 60 to 300 per cent. Ten tractors were sold in one morning in a large wheat belt center; on another occasion eight tractors were sold in almost as many minutes. Both the farmer and the dealer were frank to attribute

this notable increase in tractor sales to the fact that increased crop production demanded increased farm power and that the principle of early plowing, in July or August, as advocated by John Fields these many years thru the columns of The Oklahoma Farmer, Oklahoma section of The Capper Farm Press, was at last being definitely recognized. In general the tractor demand, with one or two exceptions, was greater than the supply. In passing, it is perhaps interesting to note that the reduction in price of two well-known tractors, as well as the first marketing in that vicinity of another small-unit, low-priced tractor visibly stimulated the sales. Owing to the excessive heat and the loss of a number of horses in the 1919 harvest, it is not infrequent to see convoys of five to seven wagons, tractor-drawn, being hauled to the elevators thruout Central Oklahoma.

Northwestern Experience

In a very thoro investigation of the Northwestern tractor market conducted by *The Farmer*, St. Paul, Minnesota, over 55 per cent of certain country bankers, leading representatives of their profession in the three states of Minnesota, South Dakota and North Dakota, were of the opinion that the tractor had been a profitable investment for tractor owners. Likewise 68 per cent of the bankers were willing to lend money for the purchase of a tractor. These bankers just mentioned were not included in the whole investigation.

But the 704 bankers that reported on all the queries of the questionnaire in the entire tractor survey—men vitally interested in the advancement of their customers—reported over 85 per cent strong in their willingness to lend money to farmers for the purchase of tractors. Over 66 per cent would go further and directly encourage responsible farmers to make such purchases. Forty-five and two-tenths per cent were of the expressed opinion that the farmer who needs a tractor is justified in borrowing money where he can if he lacks cash. Seventy-six per cent were certain that tractor farmers would eventually, under the adoption

of new cultivation methods, be forced to fit their farms, by enlargement and otherwise, to develop the more economically the entire potential possibilities of the tractor.

Such adjustments generally mean an expansion of land; such expansion requires new capital. The banker stands ready to meet such an emergency. In the same community over 85 per cent of all tractor owners reported that their implements were a profitable investment. Over 66 per cent reported that thru their tractors and their ability to do custom work they had been enabled to earn on an average of \$774.50 extra in addition to that profit secured by working for themselves. All of these figures check very closely with those obtained in the Oklahoma investigation altho prob-

ably slightly lower than the figures for Kansas where, as has been previously explained, tractor interest and the tractor market have been more highly developed than elsewhere in the wheat belt.

The Quality of Opinion

In considering the figures it should be borne in mind that a banker reports for a community which roughly includes the entire trade radius of his particular town, while the individual farmer reports only for himself or at the best his immediate neighborhood. However, in every instance the relative relation of the banker's and the farmer's figures indicates the same general tendencies.

CHAPTER X

Tractor Advertising

Yet there is one more consideration that affects both the processes of standardization and the service policy. This is advertising. In the beginning of the game, advertising as a determinant factor in the marketing of a product was more or less subsidiary or auxiliary. Especially was this true of many of the older and long established products where the demand had already been created and where consequently advertising was not necessary to cultivate buyer interest. So it is even today in many of the older industries. One of the last things they consider in the placing and selling of the given product is the size and amount of the advertising schedule.

How Advertising Helps

But with the growth of advertising to the proportions it now assumes, with its own highly intricate method of stimulating merchandise demand, any new industry must reckon from the very beginning upon that assistance which advertising will lend in the successful marketing of its product. First of all, the process is generally to create a national or a somewhat extended localized interest in the new goods. After that comes a campaign to reinforce a closely co-ordinated distributor and retail organization. The last step is to continue stimulation of consumer demand by a constant re-affirmation of the particular virtues of the given product so that the consumer feels, thru habitual and self-inculcated conviction, that the particular product is indispensable to him and his comfort and profit. Many examples might be cited to illustrate this. But as yet advertising as applied to the tractor industry has not gone beyond the first two stages and in many instances has scarcely passed the first.

Creating Consumer Demand

The principle of creating consumer demand by the use of those media most closely in touch with the particular classes of people to be sold is well recognized. Perhaps the best analogy for the

tractor manufacturer is that furnished by the automobile trade. Here is an industry still young enough and still largely dependent for the extension of its products upon a continued stimulation and development of new consumer prospects. Hence the tendency in tractor advertising should be to concentrate upon those media which appeal most directly and with the greatest authority to the class that will be ultimately the biggest buyer of the machines. The automobile industry is already following this policy of concentration and it is not infrequent to find certain individuals in the list of automobile manufacturers staking their entire play for consumer demand upon a closely interrelated group of high-class magazines and newspapers.

Concentrated Media

It is, therefore, inevitable that the tractor industry must concentrate upon certain newspapers with a wide rural influence, less upon implement and trade journals and more and more upon certain farm papers.

The Best Media

The final selection among these last named periodicals must inevitably include such a medium as The Capper Farm Press. Here is a group of papers that represents exactly the ideal field for tractor advertising. Its circulation is confined exclusively to the so-called tractor belt; its various sections are the recognized voices of authority among over a million farm readers; it is infallible upon all matters of crop advice and crop procedure.

As a whole The Capper Farm Press comes very near to fulfilling every ideal condition of a tractor medium. It offers a long-established reputation in the exact geographical region and among the very class most likely and capable of buying tractors; furthermore it possesses the strongest sort of reader concentration and enjoys the most intimate kind of reader confidence.

The Buying Power of the Farmer and the Selling Power of the Farm Paper are the two potential factors which ought to be kept everlastingly in mind.

CONCLUSION

The foregoing Tractor Analysis has been compiled with but one purpose in view: service. It has long been the ideal of The Capper Farm Press, thru its Bureau of Research and other departments, to present accurately the soundest body of Middle Western farm opinion. In divers ways and thru various agencies, this presentation has in the past been of service not only to the farmer but also to that great body of merchants and manufacturers that are directly dependent on the agricultural market for the sale of their products.

This present volume, therefore, seeks to continue a tradition already established and already confirmed not only by the success of The Capper Farm Press in interpreting the agricultural practice of some 1,100,000 farm subscribers in the Middle West but, in addition, further substantiated by the multiplicity of its advertisers who have long recognized the peculiar and unique advantages offered by The Capper Farm Press in reaching the great and constantly growing farm market of the corn and wheat states.

In this last respect it may not be immodest to state that The Capper Farm Press has peculiarly justified the confidence of tractor manufacturers, distributors and dealers. It hopes that this present analysis will not only reaffirm a reputation already established but will extend it still further to meet the demands of an increased market and even greater prosperity.

Farm papers in general and The Capper Farm Press in particular are more than mere magazines that periodically represent a mass of miscellaneous information that more or less concerns farmers and farming. The right sort of agricultural paper aims to be more than informative: it seeks to inculcate facts; it endeavors to mould opinion; it undertakes to shape ideas and to direct their subsequent expression in terms of action. The various regional sections of The Capper Farm Press fulfil the requirements of the right sort of farm papers. They are absolutely dedicated to the principle of the greatest good for the greatest number of farmers. The Capper Farm Press is therefore a directive as well as a causative force in the socialization and economic life of the Mid-West farmers.

The Capper Farm Press has upheld from the very beginning in editorials and articles, the cause of tractors and power farming. It has supported every progressive project that promised the right kind of returns with the greatest subsequent economy to the farmer. It has done this not only because it has believed that the socialization of the countryside is more quickly accomplished thru the medium of power farming but also because it has believed that along with pure-bred stock and scientific crop culture, tractor methods are the inevitable attributes of progressive farming.

APPENDIX

There is appended certain statistical information relating to the agricultural resources of the 16 Capper states, as follows:

Classified statistical data that shows the extent and numbers, districts, dollars and cents valuation, etc., of the 16 corn and wheat states, better known as "The Capper States." Under this head are cited, in every available instance, figures up to and including 1919, compiled either from the official reports of the various federal and state departments or thru original investigations carried out by the Bureau of Research of The Capper Farm Press.

Value of Capper Territory

To give one a little idea of the values of these states the Bureau of Research, The Capper Farm Press has made a careful compilation of the value of all farm property in the sixteen Capper States from the 1910 Census. From these figures it will be seen that the value of all farm property in the sixteen Capper States is **over nine billion dollars more** than that of all the other thirty-two states. In these sixteen states 2,669,905 farmers have an average value for their farms of \$10,247. In the thirty-two other states there are 3,691,597 farmers with an average per farm of \$6,324.

These figures and graphs are merely given to show the intrinsic worth of such a territory as the sixteen Capper States.

VALUE OF ALL FARM PROPERTY *

U. S. Census 1910: \$40,991,499,090; increase of 100.5%, 1900-1910.

16 Capper States: \$25,017,926,835; average increase of 147.0%, 1900-1910.

The value of all farm property in the sixteen Capper States at the 1910 Census was over nine billion dollars more than that of all the other thirty-two states. Watch the 1920 Census!

Capper States.	Value of all Farm Prop'ty.	% Increase	No. of Farms.	Av. Val. per Farm.
Kansas.	\$2,039,389,910	136.0	177,841	\$11,476
Nebraska.	2,079,818,647	178.1	129,678	16,068
Missouri.	2,052,917,488	98.7	277,244	7,405
Oklahoma.	918,198,882	230.9	190,192	4,828
Texas.	2,218,645,104	130.5	417,770	5,311
Iowa.	3,745,860,544	104.2	217,044	17,259
Illinois.	3,905,321,075	94.3	251,872	15,505
Indiana.	1,809,135,238	84.9	215,485	8,396
Minnesota.	1,476,411,737	87.3	156,137	9,456
Wisconsin.	1,413,118,785	74.1	177,127	7,978
So. Dakota.	1,166,096,980	291.9	77,644	15,018
No. Dakota.	974,814,200	281.9	74,360	13,109
Arkansas.	400,089,308	205.2	214,678	1,864
Colorado.	491,471,806	120.2	46,170	10,645
Wyoming.	167,189,081	147.8	10,987	15,217
New Mex.	159,447,990	196.6	35,676	4,469

* 1910 Census figures; vol. 5, p. 82.

Value Farm Products

From the Crop Reporter issued by the United States Department of Agriculture we find the

total value of farm products including the livestock and poultry for the sixteen Capper States total \$12,308,355,000. In the thirty-two other states it totals \$11,279,059,000.

This simply means that the two million farmers in the sixteen Capper States have twelve billion dollars to spend while the three million farmers in the thirty-two other states have eleven billion dollars to spend.

VALUE OF ALL CROPS, 1918

Crop Reporter

U. S. Dept. of Agriculture

Value of all crops United States, \$14,090,769,000.

Total value farm products includes value of livestock and poultry products. (Crop Reporter, U. S. Dept. of Agriculture.)

	Value All Crops.	Value Crops. Live Stock and Poultry
Kansas.	\$424,298,000	\$854,153,000
Nebraska.	390,944,000	836,064,000
Missouri.	483,436,000	966,077,000
Oklahoma.	264,502,000	493,873,000
Texas.	895,651,000	1,173,070,000
Iowa.	821,920,000	1,610,052,000
Illinois.	879,679,000	1,416,866,000
Indiana.	507,563,000	864,793,000
Minnesota.	562,545,000	924,394,000
Wisconsin.	417,888,000	780,256,000
So. Dakota.	438,880,000	696,847,000
No. Dakota.	375,601,000	539,197,000
Arkansas.	331,479,000	470,517,000
Colorado.	153,639,000	330,694,000
Wyoming.	61,752,000	200,108,000
New Mexico.	40,711,000	151,397,000
Total.	\$86,849,488,000	\$12,308,355,000

Total value of all crops, livestock and poultry, Capper States, \$12,308,355,000.

Total value same items, 32 other states, \$11,279,059,000.

Total value of all crops, livestock and poultry in U. S., \$23,587,414,000.

Sixteen Capper States, 33% of the U. S., have 52.18% of the total value of all farm resources.

Thirty-two other states, 66% of the U. S., have 47.82% of the total values of all farm resources.

RELATIVE INCREASE IN VALUE OF ALL FARM PROPERTY, 1900-1910.

Value 1900.

Ratio of increase, U. S., 1900-1910.

Ratio of increase, 16 Capper states, 1900-1910.

The Bread Basket of America

Without bread man would starve. The superstructure of civilization rests on the wheat field.

The Capper States produce nearly three-fourths of the entire wheat crop of the United States. In every important item of agricultural production of the temperate zone, this great territory stands pre-eminent, without a rival, the world around.

WHEAT, 1918 VALUES

(U. S. Monthly Crop Reporter, Feb. 1, 1919.)

The 16 Capper States produce nearly three-fourths of all the wheat of the U. S.

16 Capper States total \$1,332,731,000; 32 other states total \$541,892,000.

Capper States.	Bushels.	Value.
Kansas.	102,008,000	\$202,996,000
Nebraska.	43,141,000	84,988,000
Missouri.	53,154,000	108,966,000
Oklahoma.	32,899,000	66,127,000
Texas.	8,920,000	19,178,000
Iowa.	19,650,000	39,300,000
Illinois.	60,991,000	126,861,000
Indiana.	49,427,000	102,808,000
Minnesota.	79,710,000	162,608,000
Wisconsin.	9,837,000	20,166,000
So. Dakota.	71,305,000	141,896,000
No. Dakota.	101,010,000	205,050,000
Arkansas.	3,048,000	6,389,000
Colorado.	13,335,000	26,003,000
Wyoming.	6,600,000	12,474,000
New Mexico.	3,334,000	7,001,000

The Corn Family

Corn, by the departed philosophy of yesterday, meant "more whiskey." It has always meant "more hogs and more property." The corn belt of the world is in the sixteen Capper States, and besides, the greatest acreage and the greatest yield of the grain sorghums are in the southwest states of the Capper territory.

CORN AND GRAIN SORGHUMS, DEC. 1, 1918, VALUES

(U. S. Monthly Crop Reporter.)

The sixteen Capper States produce nearly two-thirds of all the corn of the United States.

Sixteen Capper States total \$2,184,722,000; 32 other states total \$1,440,678,000.

Capper States.	Bushels.	Value.
Kansas.	63,630,000	\$95,009,000
Nebraska.	123,086,000	157,550,000
Missouri.	133,860,000	191,420,000
Oklahoma.	39,635,000	62,865,000
Texas.	93,075,000	157,552,000
Iowa.	375,624,000	458,261,000
Illinois.	351,450,000	421,740,000
Indiana.	169,554,000	201,769,000
Minnesota.	110,000,000	122,100,000
Wisconsin.	69,538,000	90,399,000
So. Dakota.	108,188,000	119,007,000
No. Dakota.	9,196,000	11,955,000
Arkansas.	35,100,000	63,180,000
Colorado.	12,815,000	17,492,000
Wyoming.	1,000,000	1,400,000
New Mexico.	7,832,000	13,023,000

The Kingdom of the Hog

Corn, alfalfa and hogs are the bulwark of the Mid-West farmer's prosperity. The relation to tractor farming is obvious. The Capper territory has ninety-five per cent of the Poland China hogs (the most widely distributed breed) of the United States.

PUREBRED POLAND CHINA HOGS IN THE UNITED STATES 1918 (1)

Of this most widely distributed and representative breed of hogs, the sixteen Capper States have nineteen-twentieths of all in the United States.

Sixteen Capper States 371,760, 95% of all in U. S.; 32 other states 19,480, 5% of all in U. S.

Capper States.	No. Head.	Per Cent.
Kansas.	48,880	13.14*
Nebraska.	69,720	18.75*
Missouri.	113,600	30.55*
Oklahoma.	22,120	5.95*
Texas.	19,960	5.36*
Iowa.	67,080	18.04*
Illinois.	9,360	2.50*
Indiana.	2,040**	
Minnesota.	1,600**	
Wisconsin.	680**	
So. Dakota.	5,600	1.50*
No. Dakota.	480**	
Arkansas.	5,480	1.40*
Colorado.	2,720**	
Wyoming.	240**	
New Mexico.	200**	

* Percentage of all in U. S.

** Less than one per cent of total for U. S.

(1) Estimate based on registrations for 1918 in the smaller of two Poland China records.

Important Changes in Crops in 1920

Reduced acreage of winter wheat indicates a record acreage of corn and other cultivated crops in 1920.

The official estimate of the U. S. Bureau of Crop Estimates (Dec. 15, 1919) shows a decrease of 23.2 per cent of winter wheat sown for 1920 crop as compared with the seeding for 1919. This leaves 11,719,000 acres in the United States on which wheat was grown in 1919 which will be devoted to other crops.

This indicates abnormally large planting of corn in the spring of 1920 and probably a large increase in acreage utilized for other cultivated crops. Increase in hay crops will probably be normal as these crops for the most part require a year for preliminary seeding. Alfalfa acreage shows a normal increase.

POTENTIAL MARKET FOR TRACTORS

IN THE 16 CAPPER STATES

CAPPER STATES	Number
Kansas (1)	40,225
Nebraska (1)	33,545
Missouri (3)	37,125
Oklahoma (2)	22,506
Texas (3)	35,221
Iowa (1)	45,899
Illinois (1)	41,259
Indiana (1)	31,334
Minnesota (1)	48,460
Wisconsin (1)	61,517
South Dakota (1)	24,870
North Dakota (1)	29,405
Arkansas (3)	11,612
Colorado (2)	13,790
Wyoming (2)	4,205
New Mexico (3)	8,647
Total	489,620

Every farm of 100 acres or more operated by the owner is a potential market for a tractor. No tenant operated farms are included in above computation.

(1) Potential sales estimated as 70% of all farms over 100 acres operated by owners.

(2) Potential sales estimated as 60% of all farms over 100 acres operated by owners.

(3) Potential sales estimated as 50% of all farms over 100 acres operated by owners.

Basic figures from U. S. Census, 1910.

Estimated increase in potential market for tractors due to increased acreage under cultivation 10 per cent of figures given in table.

Compiled by Bureau of Research THE CAPPER FARM PRESS.

TRACTORS IN THE UNITED STATES

STATE EXPERIMENT STATION ESTIMATES JANUARY 1, 1920.

CAPPER STATES	Tractors	Other States	Tractors	Other States	Tractors
Kansas	8,689	Alabama	400	Nevada	19 (1)
Nebraska	7,292	Arizona	23 (1)	New Hampshire	23 (1)
Missouri	8,368	California	15,000	New Jersey	107 (1)
Oklahoma	795 (1)	Connecticut	47 (1)	New York	1,210 (1)
Texas	10,000	Delaware	100	No. Carolina	452 (1)
Iowa	9,000	Florida	71 (1)	Ohio	7,500
Illinois	12,000 (2)	Georgia	543 (1)	Oregon	318 (1)
Indiana	1,852 (1)	Idaho	262 (1)	Pennsylvania	3,700
Minnesota	1,575 (1)	Kentucky	1,800	Rhode Island	80
Wisconsin	2,800	Louisiana	2,000	So. Carolina	387 (1)
So. Dakota	1,527 (1)	Maine	400	Tennessee	1,500
No. Dakota	2,137 (1)	Maryland	1,000	Utah	700
Arkansas	336 (1)	Massachusetts	91 (1)	Vermont	175
Colorado	525 (1)	Michigan	945 (1)	Virginia	2,500
Wyoming	186 (1)	Mississippi	377 (1)	Washington	209 (1)
New Mexico	375	Montana	808 (1)	West Virginia	90 (1)

Total in the 16 CAPPER STATES, 67,457. 50% of states reporting Jan. 1, 1920.

Total in the 32 Other States, 43,137. 44% of states reporting January 1, 1920

Total in United States, 110,594.

(1) 1917 Figures.

(2) Estimated 20% increase over Jan. 1, 1919.

Compiled by Bureau of Research THE CAPPER FARM PRESS.

TABLE
CROP ACREAGE BY YEARS
(Read figures as thousands: three ciphers omitted)
U. S. Government Figures
CORN

Year	Kan.	Neb.	Mo.	Okla.	Texas	Iowa	Ill.	Ind.	Minn.	Wis.	So. Dak.	No. Dak.	Ark.	Colo.	Wyo.	N. Mex.	Totals
1910	8,950	7,425	7,500	5,735	6,800	9,470	10,950	4,800	9,010	1,520	2,100	210	2,380	346	11	86	59,652
1911	8,700	7,425	7,400	5,735	6,800	9,850	10,750	4,850	9,290	1,520	2,100	210	2,380	346	11	86	59,652
1912	7,575	7,609	7,622	5,448	6,800	10,047	10,558	4,947	9,246	1,532	2,495	328	2,475	420	16	93	59,652
1913	7,320	7,610	7,375	4,750	6,800	9,950	10,450	4,900	9,240	1,050	2,640	375	2,475	420	17	85	69,217
1914	7,550	7,400	7,500	5,800	6,400	10,346	10,548	5,052	9,260	1,225	3,000	500	2,400	462	21	92	66,893
1915	6,950	7,400	6,775	3,950	6,800	10,050	10,200	5,137	9,260	1,690	2,950	510	2,500	475	25	125	66,187
1916	9,186	9,240	7,200	3,900	7,075	11,100	11,900	5,651	9,060	1,918	3,350	590	2,674	532	35	170	76,451
1917	9,430	6,934	6,593	3,250	6,900	10,434	11,900	5,128	9,270	1,710	3,183	484	2,700	610	40	160	67,066
1918	9,430	7,930	6,593	3,100	6,160	10,000	8,600	4,750	2,850	1,520	3,200	508	2,707	671	48	210	62,615
1919	9,430	7,930	6,593	3,100	6,160	10,000	8,600	4,750	2,850	1,520	3,200	508	2,707	671	48	210	62,615

Year	Kan.	Neb.	Mo.	Okla.	Texas	Iowa	Ill.	Ind.	Minn.	Wis.	So. Dak.	No. Dak.	Ark.	Colo.	Wyo.	N. Mex.	Totals
1910	4,490	2,394	1,881	1,567	700	532	2,444	2,256	4,000	186	3,650	7,700	87	403	56	41	29,357
1911	4,810	3,098	2,300	1,722	700	637	2,425	2,337	4,350	195	3,700	9,150	96	438	55	55	35,692
1912	5,956	3,422	1,900	1,470	735	650	1,483	1,260	4,355	188	3,615	7,990	94	453	76	55	33,237
1913	5,660	3,468	2,249	1,470	735	650	1,483	1,260	4,355	188	3,615	7,990	94	453	76	55	33,237
1914	8,660	3,876	2,743	2,350	1,050	890	2,600	2,450	4,200	190	3,715	7,510	101	460	90	65	36,606
1915	8,525	3,876	2,743	2,350	1,050	890	2,600	2,450	4,200	190	3,715	7,510	101	460	90	65	36,606
1916	8,170	3,640	1,950	2,050	1,350	560	1,425	1,620	3,465	188	3,650	7,150	235	600	170	113	37,336
1917	7,938	3,626	1,850	2,100	1,350	450	1,520	1,520	2,947	239	3,176	7,000	185	600	203	203	29,984
1918	7,938	3,626	1,850	2,100	1,350	450	1,520	1,520	2,947	239	3,176	7,000	185	600	203	203	29,984
1919	11,624	4,384	4,296	3,760	1,900	1,700	4,150	2,856	4,015	549	3,455	7,470	340	1,459	284	263	53,125

Year	Kan.	Neb.	Mo.	Okla.	Texas	Iowa	Ill.	Ind.	Minn.	Wis.	So. Dak.	No. Dak.	Ark.	Colo.	Wyo.	N. Mex.	Totals
1910	1,655	2,532	1,200	699	688	5,100	4,325	1,680	2,977	2,550	1,550	2,165	207	284	161	42	17,735
1911	1,720	2,975	1,125	936	865	4,958	4,200	1,700	2,977	2,550	1,550	2,165	207	284	161	42	17,735
1912	1,760	2,950	1,250	1,430	1,000	4,850	4,375	1,700	2,980	2,575	1,580	2,250	240	505	290	48	17,735
1913	1,760	2,950	1,250	1,430	1,000	4,850	4,375	1,700	2,980	2,575	1,580	2,250	240	505	290	48	17,735
1914	1,760	2,975	1,250	1,430	1,000	5,000	4,300	1,575	3,040	2,300	1,606	2,218	260	325	225	52	29,136
1915	1,760	2,975	1,250	1,430	1,000	5,000	4,300	1,575	3,040	2,300	1,606	2,218	260	325	225	52	29,136
1916	1,760	2,975	1,250	1,430	1,000	5,000	4,300	1,575	3,040	2,300	1,606	2,218	260	325	225	52	29,136
1917	2,284	3,038	1,480	1,150	1,425	5,412	4,000	2,002	3,250	2,575	2,138	2,275	330	551	285	45	32,625
1918	2,284	3,038	1,480	1,150	1,425	5,412	4,000	2,002	3,250	2,575	2,138	2,275	330	551	285	45	32,625
1919	1,574	2,133	1,417	1,500	2,250	5,670	4,102	1,855	3,220	2,339	1,850	2,400	420	249	315	65	31,329

Year	Kan.	Neb.	Mo.	Okla.	Texas	Iowa	Ill.	Ind.	Minn.	Wis.	So. Dak.	No. Dak.	Ark.	Colo.	Wyo.	N. Mex.	Totals
1910	1,655	2,532	1,200	699	688	5,100	4,325	1,680	2,977	2,550	1,550	2,165	207	284	161	42	17,735
1911	1,720	2,975	1,125	936	865	4,958	4,200	1,700	2,977	2,550	1,550	2,165	207	284	161	42	17,735
1912	1,760	2,950	1,250	1,430	1,000	4,850	4,375	1,700	2,980	2,575	1,580	2,250	240	505	290	48	17,735
1913	1,760	2,950	1,250	1,430	1,000	4,850	4,375	1,700	2,980	2,575	1,580	2,250	240	505	290	48	17,735
1914	1,760	2,975	1,250	1,430	1,000	5,000	4,300	1,575	3,040	2,300	1,606	2,218	260	325	225	52	29,136
1915	1,760	2,975	1,250	1,430	1,000	5,000	4,300	1,575	3,040	2,300	1,606	2,218	260	325	225	52	29,136
1916	1,760	2,975	1,250	1,430	1,000	5,000	4,300	1,575	3,040	2,300	1,606	2,218	260	325	225	52	29,136
1917	2,284	3,038	1,480	1,150	1,425	5,412	4,000	2,002	3,250	2,575	2,138	2,275	330	551	285	45	32,625
1918	2,284	3,038	1,480	1,150	1,425	5,412	4,000	2,002	3,250	2,575	2,138	2,275	330	551	285	45	32,625
1919	1,574	2,133	1,417	1,500	2,250	5,670	4,102	1,855	3,220	2,339	1,850	2,400	420	249	315	65	31,329

BIBLIOGRAPHY

INTRODUCTION

THE CAPPER FARM PRESS has been a noteworthy pioneer in the educational movement for motorizing the farm. Sufficient evidence of this claim is set forth in the attached bibliography of original articles appearing in the five Sections of THE CAPPER FARM PRESS, only during 1919 and in January, 1920.

If this record included all of our contributions to this great national service since the inception of the modern, practical tractor, it would make a book too unwieldy and cumbersome for widespread distribution.

Tractors, Uses of

1. About tractor farming—Oklahoma Farmer, July 10, 1919.
2. A team of tractors—Capper's Farmer, December, 1919.
3. Cover illustration showing tractor in use—Kansas Farmer and Mail and Breeze, April 12, 1919.
4. Cover illustration showing tractor in operation—Kansas Farmer and Mail and Breeze, February 8, 1919.
5. Cover illustration showing tractor in operation—Kansas Farmer and Mail and Breeze, February 22, 1919.
6. Cover illustration showing tractor with wheat drills—Kansas Farmer and Mail and Breeze, April 5, 1919.
7. Cover illustration with tractor at work—Nebraska Farm Journal, February 15, 1919.
8. Farmers find good use for tractor—symposium by Kansas farmers—Kansas Farmer and Mail and Breeze, March 15, 1919.
9. Firewood and the buzz saw—Kansas Farmer and Mail and Breeze, December 6, 1919.
10. Illustration showing depth of plowing—Kansas Farmer and Mail and Breeze, November 29, 1919.
11. Illustration showing tractor sawing wood—Missouri Ruralist, April 5, 1919.
12. Illustration showing tractor in operation—Kansas Farmer and Mail and Breeze, October 11, 1919.
13. Illustration showing tractor in operation—Capper's Farmer, February, 1919.
14. Illustration showing tractor at work—Missouri Ruralist July 5, 1919.
15. Illustration showing tractor at work—Nebraska Farm Journal, February 15, 1919.
16. Illustration showing Wallis cub tractor—Missouri Ruralist, April 5, 1919.
17. Illustration showing use of tractor—Missouri Ruralist, August 20, 1919.
18. Interested in tractors—Oklahoma Farmer, May 10, 1919.
19. Large fields for tractors—Kansas Farmer and Mail and Breeze, May 3, 1919.
20. Make the gas engine do the chores—Kansas Farmer and Mail and Breeze, August 30, 1919.
21. Missouri and the tractor—Missouri Ruralist, April 20, 1919.
22. Putting tractors in France—Capper's Farmer, November, 1919.
23. Plowing sandy land—Oklahoma Farmer, May 10, 1919.
Nebraska Farm Journal, February 15, 1919.
24. Power farming increases profits—Kansas Farmer and Mail and Breeze, April 12, 1919.
25. Tractor plows corn—Missouri Ruralist, September 5, 1919.
26. Tractor proposition in Wisconsin—Kansas Farmer and Mail and Breeze, February 1, 1919.
27. Three illustrations portraying tractors and their uses—Kansas Farmer and Mail and Breeze, December 6, 1919, October 25, 1919, and November 15, 1919.
28. This tractor never tires—Kansas Farmer and Mail and Breeze, June 7, 1919.
This tractor doesn't rest much—Nebraska Farm Journal, February 1, 1919.
29. Two illustrations portraying uses of tractors—Kansas Farmer and Mail and Breeze, July 15, 1919.
30. The tractor lightens work—Kansas Farmer and Mail and Breeze, January 11, 1919.
Oklahoma Farmer, February 10, 1919.
Nebraska Farm Journal, February 1, 1919.
Missouri Ruralist, April 5, 1919.
31. Two illustrations portraying uses of tractors—Kansas Farmer and Mail and Breeze, November 22, 1919.
32. Two illustrations showing uses of tractors—Kansas Farmer and Mail and Breeze, July 19, 1919.
33. Two illustrations showing tractors in use—Kansas Farmer and Mail and Breeze July 12, 1919 and October 11, 1919.
34. Two illustrations showing uses of tractors—Kansas Farmer and Mail and Breeze, October 11, 1919.
35. Tractors pulling stamps—Kansas Farmer and Mail and Breeze, July 12, 1919.
36. Three illustrations showing tractor in operation—Kansas Farmer and Mail and Breeze, March 1, 1919, March 1, 1919 and January 24, 1919.
37. Tractor used in derelict land—Kansas Farmer and Mail and Breeze, March 1, 1919.
38. Tractor at work in field—Kansas Farmer and Mail and Breeze, July 5, 1919.
39. To get the threshing done—Oklahoma Farmer, May 10, 1919.
40. Tractors with equipment—cover page—Oklahoma Farmer, July 25, 1919.
41. They saw wood and sawed it—Oklahoma Farmer, December 25, 1919.
42. Two illustrations showing tractor at work—Nebraska Farm Journal, February 1, 1919 and September 15, 1919.
43. With Missouri farm folks—Missouri Ruralist, July 5, 1919.
44. Wider use for the tractor—Nebraska Farm Journal, July 15, 1919.

Tractors, Kinds of

1. Buy a small tractor—Missouri Ruralist, February 5, 1919.
2. Careful tractor selection means economy—Missouri Valley Farmer, March, 1919.
3. Illustration showing Titan tractor—Missouri Ruralist, February 20, 1919.
4. Small machines for average farm—Missouri Ruralist, April 5, 1919.
5. Small tractor best liked—Kansas Farmer and Mail and Breeze, February 22, 1919.
6. Tractors show improvement in quality—Kansas Farmer and Mail and Breeze, March 8, 1919.
7. Tractor suited to size of farm—Kansas Farmer and Mail and Breeze, July 12, 1919.
8. Tractors fit farm—Oklahoma Farmer, April 10, 1919.
9. Tractors—to buy or not to buy—Nebraska Farm Journal, February 15, 1919.

10. The small farm tractor—Missouri Ruralist, March 5, 1919.
11. When selecting a farm power outfit—Nebraska Farm Journal, January 15, 1920.

Tractor Shows

1. Article on shows—Capper's Farmer, July, 1919.
2. Cover page showing tractor at work in field with headline, Tractor dominated the Missouri State Fair this year, etc.—Missouri Ruralist, August 20, 1919.
3. Cover page: Let's go to the tractor show at Kansas City—Missouri Ruralist, February 20, 1919.
4. Cover page: See the Automotive Show this month—Oklahoma Farmer, February 10, 1919.
5. Cover page showing tractor with headline—National Demonstration, etc.—Kansas Farmer and Mail and Breeze, July 12, 1919.
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Oklahoma Farmer, July 10, 1919.
6. Great tractor exhibition—Capper's Farmer, February, 1919.
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