There's nothing the matter with the Old North State except that there are too many of its patriotic citizens getting up every morning to the tune of a Connecticut alarm clock, pulling on a pair of Massachusetts overalls over a pair of New York shoes. Washing their faces in a Wheeling tin basin with Cincinnati soap and wiping with a South Carolina towel. Going into breakfast, eating Florida oranges, and Iowa bacon, pancakes from Kansas wheat spread with Wisconsin butter and floating in New Hampshire maple syrup. Stewed California peaches, canned Minnesota milk, Brazilian coffee and Louisiana sugar complete the meal. Everything prepared on an Indianapolis stove, served on Maryland dishes and eaten with Nevada silver.

Going to the barn with a Pittsburgh roof and Ohio windows, they put the Chicago harness on the old Missouri mule and hitch him to the Illinois plow.

Later in the day riding to town over Trinidad asphalt in a Detroit automobile equipped with Akron tires and burning Texas gasoline, they stop for a quart of Pennsylvania oil and a couple of Georgia Coca-Colas.

Drawing out a little money from a New York bank they drop around to pay their taxes and get a receipt printed in New Jersey.

That night crawling into a bed made in Michigan and pulling a New England blanket over them they lay and cuss the only North Carolina grown product on the farm—the old hound dog, who believes in the slogan, Live-At-Home.
No subject has attracted more attention than the mechanization of agriculture. The tractor, around which mechanization revolves, is much more dynamic and, in a sense, much more colorful than the slower moving horse and mule. Then, too, this is a dynamic age in which mechanization rules supreme. Never before in history have power-driven machinery and equipment been more widely and more effectively used in the service of mankind. And the end of mechanization is not yet in sight. With the discovery of atomic power, it would be rash indeed to predict what might or might not happen.

This emphasis on mechanization, although desirable, tends to divert attention from the essential conditions of farming. It is a fact that farming, at least for the present, cannot be completely mechanized. There are large areas in which the horse and mule, as a form of power, still reign supreme and where horse-drawn equipment is used. It is to the facts about this segment of our farming that I shall direct your attention.

THE TREND IN WORKSTOCK AND TRACTORS

The decline in the number of horses and mules and the increase in tractors are well known to all of you. From 1910 to 1946, horses and mules for the United States as a whole, declined from about 23 million to about 11.5 million. On the other hand, the number of tractors increased from 1,000 to almost 2.5 millions. If these trends should continue, we could confidently say that farming will become completely mechanized. But since 1940 the rate of increase in the number of tractors has declined. 1/ Between 1920 and 1930 the number of tractors increased from 246,000 to 920,000, or an increase of 106%. The following 10 years, or from 1930 to 1940 the increase was 68%. Since 1940 the annual rate has declined from 7.7%, between 1940 to 1941 to 1.6% between 1943 and 1944. 2/ (See chart)

The rate of displacement of horses and mules by tractors has been about 1 to 4, or one tractor has replaced about 4 units of workstock.

THE GEOGRAPHIC DISTRIBUTION OF WORKSTOCK AND TRACTORS

The mechanization is not solely a function of the number of tractors in use. It is possible to mechanize with animal power. But, generally speaking, mechanization is more complete when tractor power is used. Assuming this to be a fairly accurate statement, it is rather interesting to find that 53.5% of all farms in the United States are operated largely if not solely with animal power; 18.9% use both mechanical and animal power; and only 4.5% use mostly tractor power. 3/ The balance, or 23.1% depend upon man power or hire animal or tractor power when needed.


2/ The increase from 1944 to 1945, because of war effort, was about 27%. It is very doubtful if this rate can be maintained.

3/ USDA Technical Monograph, 1940. PP. 82, 83, 84.
Another interesting fact is that the type of power used on farm varies markedly from one geographic area to another. In the New England States about 45% of all farms depend upon man power or hire horse or tractor power when needed; 35.6% use workstock almost exclusively; 11.9% use both animal and tractor power, and 7.6% use tractor power only.

A similar situation is found in the Middle Atlantic States. In this area the distribution of the farms with respect to the power used is as follows: 42.1% use workstock mostly, 25.4% use tractor and animal power, 8.1% use tractors only, and 24.3% depend upon man power or hire animal or tractor power.

The East North Central and West North Central States have almost identical distribution of farms with respect to use of power. In these two geographic areas about 41% of the farms depend almost solely upon animal power, between 35 and 40% use both types of power, 5.7% use mostly tractor power.

The situation is quite different in the South Atlantic States, the East South Central, and West South Central. In all of these areas about 66% of all farms depend upon animal power almost exclusively. The number of farms using both types of power varies from 3.3% in the E. South Central to 9.6% in the W. South Central. Farms operated by tractor power are less than 1% in the South Atlantic and E. South Central and only 5.4% in W. South Central.

The distribution of power on farms in the Mountain States is about the same as the U.S. as a whole. In this section 54.4% of the farms use horse power mostly, 22.5% use both horse and tractor, and 6.4% use tractors almost exclusively. In the Pacific States the situation is quite different. Here only 30.1% depend largely upon animal power, 14.4% use animal and tractor power, and 13.3% use only tractor power. In one respect the Pacific States resemble the New England States in that a large number of farms depend upon man power, or hire horse and tractor power.

THE SIZE OF THE FARM AND MECHANIZATION

There are many factors which affect the degree of mechanization, such as topography, type of crops grown, available capital, and the size of the farm. Of these, perhaps the most important factor is the size of the farm. At least, it can be said that mechanization is a function of size. For the U.S. as a whole the percentage of farms using tractor power almost exclusively increased from about 3.0% for small farms to 14.5% for very large farms. On the other hand, the farms using animal power decreased as the size of the farm increased. For the U.S. as a whole the percentage of farms in this category decreased from as high as 67.7% for small farms to 19.17% for large farms.

This tendency of the size of the farm to be directly correlated with mechanization holds for all sections of the U.S., although it is more pronounced in some sections than in others. In the South Atlantic States, for example, about 63 to 84% of the medium sized farms depend upon animal power, whereas large farms depend either on tractor power or a combination of animal and mechanical power.

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4/ Data are not available showing the relationship between the size of the farm in acres and the type of power used. In this discussion the size of the farm is measured by the amount of products sold, traded, or used in the farm household.
Very large farms in all sections depend largely on tractor power. For the U.S. as a whole 14.5% of the very large farms depend almost solely on tractor power. For the geographic sections the data are as follows:

<table>
<thead>
<tr>
<th>Region</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>New England</td>
<td>15.7%</td>
</tr>
<tr>
<td>West North Central</td>
<td>9.2%</td>
</tr>
<tr>
<td>West South Central</td>
<td>5.0%</td>
</tr>
<tr>
<td>North Atlantic</td>
<td>36.2%</td>
</tr>
<tr>
<td>South Atlantic</td>
<td>16.5%</td>
</tr>
<tr>
<td>Mountain</td>
<td>6.6%</td>
</tr>
<tr>
<td>East North Central</td>
<td>12.3%</td>
</tr>
<tr>
<td>East South Central</td>
<td>4.9%</td>
</tr>
<tr>
<td>Pacific</td>
<td>22.9%</td>
</tr>
</tbody>
</table>

NEW DEVELOPMENTS

The dramatic entrance of mechanical power into farming and the remarkable results which have been obtained by its use have tended to divert the attention of agricultural engineers and economists from the small to the large farms. The large farm fully mechanized has all too often been the goal of investigators. It is just beginning to dawn on our agricultural leaders that this goal cannot be attained, and that attention must be redirected towards mechanization of the small and medium sized farms. This also has become the concern of implement manufacturers and they are beginning to use their resources in the production of smaller power units with appropriate attachments.

From such research as has been done on this problem, it seems clear that animal power as well as mechanical power must be used in the mechanization process. This seems imperative in view of the numerous situations in which mechanical power cannot be used at all or only to a limited extent. Although not much thought or effort has been directed towards this end, it is encouraging to find that at least a beginning has been made. In not a few instances horse-drawn implements have been devised and put into use which economize land, labor, and materials to a surprising degree. A few recent developments may be mentioned:

1. "Once-Over" Planter and Fertilizer Distributor
   Only satisfactory side placement fertilizer distributor for 1 horse. Mfg. by General Foundry and Machine Co., Sanford, N. C.


Tennessee Valley Authority -

1. Seeder to sow small grain in sod without destroying sod.
2. Lime spreader.
3. Fertilizer Distributor.

It seems that the following conclusions may be drawn from the data presented:

1. The rate of mechanization by the use of mechanical power is declining and will continue to diminish.

2. The number of workstock on farms is declining and no doubt will continue to decline as long as mechanization of farm operations is increasing either by the use of animal or mechanical power.
3. At present a large number, at least 50% of all farms depend almost solely upon workstock as a source of power. To these farms must be added those which depend upon both workstock and tractors as a source of power. It may be that as high as 75% of farm operations are dependent upon workstock as a source of power.

4. Less than 5% of the nation's farms are completely mechanized.

5. The degree of mechanization varies geographically. Assuming that mechanization is a function of tractor power, the farms in the South Atlantic, East South Central, and West South Central are the least mechanized and the Middle Atlantic, E. North Central, W. North Central, Mountain, and Pacific areas are possibly 30 to 45% partially mechanized. The highest percentage of farms which are fully mechanized are found in the Pacific States.

6. Mechanization is also a function of size. In all areas mechanization increases as the size of the farm increases.

7. The major task for the future is to mechanize the farm operations on the small and medium sized farms. This must be done by devising horse-drawn as well as tractor-drawn equipment which will economize land, labor and materials.

8. There is no evidence that horse drawn equipment can be or will be completely eliminated, although the number of workstock will decline. This decline will be the result of the more efficient use of animal power brought about by improvements in horse-drawn equipment, and the result of an increase in mechanical power units better adapted to small and medium sized farms.
In the older cotton belts of the Nation from 60 to 75 hours of man labor are required to produce an acre of cotton up to time of harvest. This excessive labor requirement is due to the use of one horse(mule) machinery and hand methods for chopping, hoeing and other cultivation work. On tractor-operated farms in West Texas, where the cultivator type of tractor is used for all cultural work, the labor requirements per acre, for cotton up to picking time, have averaged 10 man-hours per acre. With mechanical power one man has been able to care for 200 acres of cotton up to harvest time as compared to 15 to 20 acres per man in the older regions.

The preharvest labor costs under such varying conditions show a wide range per pound of lint cotton produced. Under certain conditions where mechanical farming is practiced these may be as low as 0.16 man-hour per pound, while in the older cotton belts with much hand work the preharvest cost of lint cotton is about 0.45 man-hour per pound. The total man labor requirements which include harvesting, for producing a pound of lint cotton in the above districts range from about 0.7 hours of man labor for the eastern states to about 0.2 man-hours in the western cotton district of Texas.

There is a similar differential in the man labor requirements in corn production between the corn producing sections of the old South and the great corn belt of the northern central states. In the former where small equipment prevails about 2.5 hours of labor are required for producing a bushel of corn and caring for the stover, while in the latter area with larger equipment about 0.5 hours of labor are necessary when the ears are husked.
by hand. Recent developments with larger mechanical equipment, including harvesters, indicate that corn may be produced with as little as 0.10 man hours of labor per bushel. In wheat production the requirements range from 2.5 hours of labor per bushel for the southern states to about 0.3 hours in the Pacific Northwest.
American Agriculture has been divided into three great power periods: (1) Human, (2) Animal and (3) Mechanical. The human power period began with earliest history and lived for thousands of years giving way about 1850 to the animal power period which has definitely passed its peak of application. The peak of animal utilization came in 1918, but since that time the number of animals has decreased each year at a very uniform rate. In 1918 there were 22,500,000 horses and mules in U.S.; in 1926 there were only 14,500,000 this being a decrease of about 500,000 per annum. If this rate should continue, the horse for agricultural power in American will soon disappear. While it is apparent that animal power is destined to decline in importance, it is not likely that it will be entirely eliminated as a source of farm energy for many years and particularly is this true of the Southeast, because of certain climatic and topographical conditions, but with economic pressure of the strongest kind this section of the country must enter the mechanical farm power period or be last in the all powerful competition of other agricultural sections.
The early applications of mechanical power were for stationary operations, but the bulk of farm work has always been done by a mobile power plant. The first endeavors of manufacturers to apply the internal-combustion engine to drawbar work on the farm resulted in heavy, awkward units having exposed gears and poor lubrication systems. These were not satisfactory or of wide application principally because the thought of these pioneer designers apparently was centered about the actual substitution of the tractor for animal power. The efforts to make a horse out of the tractor were practically fruitless for all operations except plowing. Fortunately plowing represents one of the greatest energy consuming operations in agriculture and this outlet for the tractor lent encouragement both to the designer and to the manufacturer.

The rapid development of the automotive industry has had a favorable effect upon the development of the gas tractor. The use of enclosed gears, high-pressure oiling systems, air cleaners and oil filters developed largely through automotive applications have been successfully applied to farm tractors. These have been great factors in the production of a highly dependable power unit for field operations under the extremely severe conditions common to agricultural work. A test completed in September 1923 by the agricultural engineering division of the University of California establishing a world's record for a non-stop tractor run is indication of the dependable performance of modern gas tractors. This tractor, one of the crawler types, was operated continuously for 408 hours at actual field work drawing a disk and float over land from which a crop of sugar beets had been
harvested. During the test the tractor traveled 1,329.97 miles covering an equivalent area of 1,290 acres. At the close of the test before any adjustments had been made on the engine, a maximum drawbar test was run producing 21.09 maximum horsepower or more than the manufacturer's rating.

During the 408 hours of the test the engine ran without a stop, the crankshaft making 28,989,513 revolutions. The tractor chassis ran a total of 384 hours 58 minutes, all in second gear. Of the remaining 23 hours 2 minutes, 17 hours 41 minutes were used in servicing the tractor and disk harrow, 2 hours 6 minutes in making tractor adjustments, 1 hour 12 minutes in replacing bolts in the disk harrow, 1 hour 2 minutes for reading of testing instruments, and 1 hour 11 minutes in adjusting the load, taking photographic records, etc.

The chassis of the tractor did not require any repairs or adjustments during the test. A leaf of the equalizer spring was broken the thirteenth day of the test. It was not repaired since it did not interfere with the tractor’s operation.

The engine did not need any adjustments of repairs that required stopping.

After the official stop of the test the engine was again started before any adjustments or changes of any kind had been made upon it and a test made with the following results: Maximum horsepower, 21.09; maximum pull, 3000 pounds. This was in second gear and on ground twice disked.
Engineering progress in harvesting machinery has been noteworthy during the twentieth century. The small grain harvesting methods have changed the most. The combined methods of cutting and threshing grains at one operation is now used extensively in the spring and winter wheat belts of North America. With modern machinery one man can harvest as much grain as thirty or more men could a century ago. The man labor in wheat harvest where combined methods are used has been reduced to approximately 3/4 hour of man labor per acre. Corn harvesting machinery has been slower in development but rapid strides are now apparent.

Cotton harvesting consumes from 30 to 50 per cent of the total man-hours required for production. The development of a harvester for this crop is the control in mechanization of cotton production. The research work conducted by state and federal experiment stations and the field development work conducted by implement companies have great accelerated progress in cotton harvesting during the past three years. Further encouragement has come from improvements in ginning machinery. The developments have been along two general lines: First, by simple methods of stripping the cotton bolls from the plant and later removing the burrs from the seed cotton previous to ginning, and, secondly, by mechanically picking the seed cotton from the burs in the field. The former method has many drawbacks particularly in the older cotton producing sections. It is, however, a simple method which has been economically employed in the western cotton belt of Texas.
The mechanical pickers are practically all of the spindle type. As yet these are rather complex machines but there is much encouragement in the results obtained thus far from their use. Results already obtained in harvesting cotton mechanically have shown that such harvesting is possible without lowering the quality of the product. With all these phases of cotton production mechanized it should be possible to produce this farm commodity at a much lower cost than now prevails.
Measurements to determine wear were made only on the parts of the engine most subject to wear, not on transmission of final drives. The wear on cylinder walls, piston, wristpins, crankpins, and crankpin bearings was found to be too small to be measured by the micrometers available. The wear on the top piston rings and ring grooves was measureable but so slight that in no case was replacement necessary or desirable. In fact, these parts were just "nicely run in" and ready to begin their life work. The field was quite dusty and had the design not been such as to exclude dust from the carburetor and breather and to remove foreign matter from the crankcase oil, the final condition of the engine would undoubtedly have been less satisfactory.
Classification: 11.304
Title: Power Farming, Nebraska, in 1929
Author:
Pub. In: Farm Stage News
Issue: Jan 9, 1930
A day or two spent getting the farm machinery under cover and in condition for winter are the most profitable a farmer can spend. A winter outdoors depreciates machinery 15 per cent. Figure that percentage of the cost of the machinery and implements and it will be readily discovered what wages the owner earns on the time spent. Implement sheds do not have to be elaborate or expensive buildings. Weather tight is the big thing, and a good cleaning and greasing of unpainted metal parts will carry the machinery through the winter in good shape.
When work has been finished with a cultivator, a reaper or mower, the weather is fine and it's a temptation to leave it in the field. Then the first rain provides a coating of rust that soon eats into the metal. Machinery is more often rusted out than worn out. A machinery shed or an implement house will prolong the life of the machinery a considerable number of years, and saves its cost because replacement of machines is not necessary for a number of years more when they are given the proper care.
FARM MACHINERY PRICES ARE LOW

By

D. S. Weaver, Agricultural Engineer, State College

The price of any commodity is high or low by comparison and it is a very well known human trait to reconcile the mind to the purchase of things that give pleasure, no matter what the price, while items used in business are purchased only after very cold-blooded consideration. The farmer is no exception in this respect and often expresses dissatisfaction with the price of a new piece of equipment, necessary to the economical production of his crop, without realizing, that with very, very few exceptions his dollar is buying more in the way of materials and labor when he purchases a new farm machine than in anything else he uses. Take, for example, the following articles which are commonly used on the farm, with their respective prices in cents per pound of weight: Milk can 21; shovel 25; washing machine (hand) 17; food chopper 36; lawn mower 22; wringer 26; carpet sweeper 59; steel range 11; hand hay fork 47; garden hoe 48; and scythe 62.

Now compare these with the average per pound price of the following pieces of farm equipment, corn planter, cultivator, corn sheller, disk harrow, smoothing harrow, sulky plow, grain binder, mower, hay rake and wagon. Their average price is 10.9 cents per pound. It is to be noted that included in this list are some of the most expensive and complicated of ordinary farm machines such as the grain binder and mowing machine. On this basis, a mowing machine priced like a lawn mower would cost over $170.00 instead of $75.00, and an average grain binder priced pound for pound
with a kitchen range would cost over $350.00 and look at the intricate construction of a grain binder as compared to the stove.

While it would be very desirable if prices for farm machines, and other commodities as well could be maintained at a fair fixed ratio with farm products, such a condition is obviously impossible. Actually, there is no more relation between the prices of farm products and of farm machines than there is between the prices of farm products and automobiles, radios, or any other manufactured article. True it is, that farm product prices have some effect upon wages paid to produce manufactured articles but such effects are always slow, for wholesale prices are relatively slow in affecting retail prices for more or less the same reasons that retail prices are slow in affecting wages.

Less than five cents of every dollar received from the sale of farm products was spent for new farm equipment during the period between 1924 and 1930. Included in this small sum of five cents from each dollar were not only tractors, power farming equipment and all field implements but also, silos, barns, dairy and poultry equipment; windmills, bee keeping supplies, hand tools, lawn mowers, lighting plants, water systems and spraying outfits. Contrast this five cent expenditure with 12½ cents for hired labor; 8 cents for taxes and 7½ cents for interest on indebtedness. Estimated expenditures for automobiles was 15 to 20 cents for each dollar, for food 20 cents and 15 cents for clothes while feed and fertilizers took at least 10 cents more.
Consider some of the differences between producing farm crops and producing farm machinery. (1) The cash outlay in crop production is relatively small, which is one reason why so many men engage in farming. Labor is the most important item and most of this is supplied by the farmer or members of his family, while the implement manufacturers produce entirely with hired labor which must be paid in cash each week and all raw materials, fuel, power, etc., require a cash outlay. (2) Farm crops are produced for a cash market which consumes practically the entire output within a year. Farm machines are paid for on long-term payments and are not consumed for twenty years or more. (3) Farm products find practically a certain market, the same amount being consumed, year after year, regardless of conditions, for people buy feed even if they go without other things, while the market for farm machines is extremely variable because old machines can re repaired in an emergency, others borrowed or hired. (4) Most farm products are salable throughout the entire year, while farm machines must be produced well in advance of the season in which they are to be sold, and if not sold that season must lay over until the corresponding season next year.

That farm machines, under such conditions, sell at lower prices pound for pound, than any other similar manufactured articles is proof that they are low in price, which is made doubly convincing by the fact that there are practically no foreign machines imported in spite of the fact that no tariff protects the manufacturer. Most other similar manufactured articles are well protected by a high tariff, but so far, no foreign competition has found an opportunity to make a profit in farm machinery in spite of the fact that their products can enter this country tariff free.
THE RELATION BETWEEN THE TRACTOR AND EDUCATIONAL INSTITUTIONS.

During the past few years both the agricultural colleges and manufacturers of tractors have begun to realize the value of co-operation. Both are serving the same class of people, the agriculturists, and each has something that is of value to the other. The college is in a position to demonstrate the different tractors to students, who in turn pass on their knowledge to those at home so that a manufacturer with a tractor at a college knows that his product is talking for itself much more effectively than he ever could thru catalogues and magazines. That the tractor companies are glad to have their tractors used at the colleges for instructional purposes is evidenced by the fact that they so willingly loan them out for that purpose.

That this spirit of co-operation has grown up speaks well for the progressiveness of the manufacturers and the fairness which those in charge of the work at the colleges have shown by refraining from discrimination. On the face of the matter it would seem to be difficult for an instructor to keep from allowing natural prejudices from cropping out but it is actually being done by teaching the students what is best from a theoretical point of view, letting them apply the theories of mechanics and gas engine principles to the tractors they study and allowing them to form their own judgement in the matter. Those at home place a great deal of confidence in the judgement of the son at college and he is often the one who decides which tractor his father buys. That this comparison of tractors by the students is good for the industry as a whole is scarcely debatable. It assures the manufacturer of a good tractor a wider and better method of reaching the farmer while the low class machines that might have good sales based on persuasive selling talks cannot stand before the tests and criticism of trained men. The producers of high grade tractors should welcome such a con-
resultant publicity to the winner. Moreover it is a difficult matter for the judges of such a contest to satisfy all of the competitors. The writer knows of one such contest that resulted in not a little bitter feeling and is convinced that such contests, if held at all, should not be under the auspices of a college. It must always be kept in mind that the first duty of a college is to serve the people and that any publicity that tractors may gain thru a college must be in the regular line of educational work and not ostensibly an advertising campaign.

There is yet one other matter which brings the colleges and the tractor manufacturers together, tractor testing. Of course each company can and does make its own tests but some of the more progressive companies are now requesting each of the State Colleges to run a test for them. Whoever originated this idea must have a keen insight into present conditions and deserves a great deal of credit for it is based on good psychology. He must have sensed the change that is taking place in the farmer's mind concerning colleges and college training and has made use of this fact, that the farmers are placing increasing confidence in their State Agricultural College and will give more weight to a test performed there than to one held by an unknown company in a far city with no one to question the truth of the results. That is the reason why the colleges are continually receiving requests to make tractor tests and it presents a problem that ought to be solved immediately and a worthy precedent set.
Wayne County Farmers Prepare to Fight the Boll Weevil.

The accompanying picture was taken on the farm of Mr. B.G. Thompson, near Goldsboro, Wayne County. It shows a popular make of horse drawn cotton duster at work in small cotton where weevil have been found.

The dusting demonstration was held on July 6, 1928 in connection with a riding cultivator demonstration put on by the County Agent, Mr. A.K. Robertson and Prof. D.S. Weaver, Agricultural Engineer at State College. A large crowd attended the demonstration and both the cultivators and the duster attracted a great deal of attention.