AGRICULTURAL ENGINEERING

By C. L. Zink, B.S.

Agricultural Advancement An Engineering Problem; High Power Machinery for Low Cost Production; Future Bright for the Agricultural Engineer

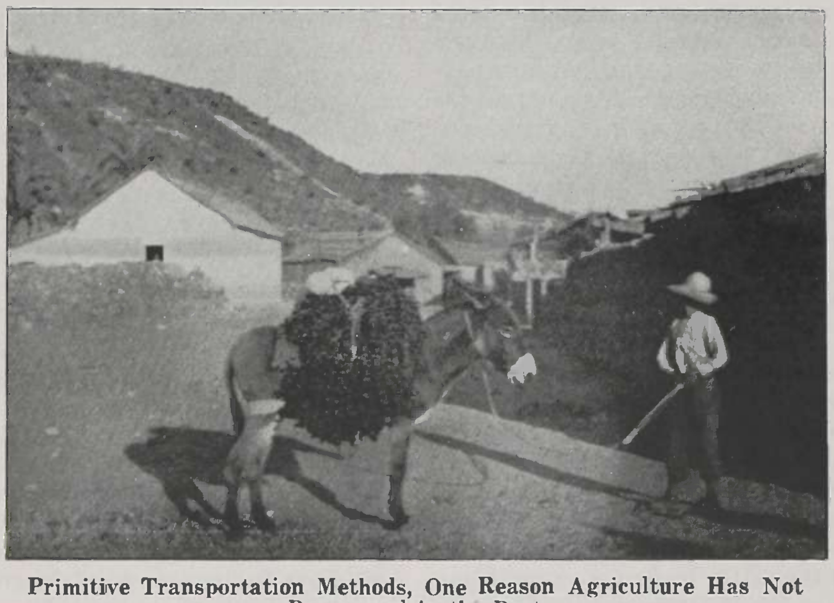
TO MANY PERSONS the term, agricultural negineering, is an unfamiliar one. They think of an engineer as the man who operates engines or perhaps the surveyor with his transit and chain. Both of these are members of long established branches, mechanical and civil engineering. However, there are other divisions of engineering, the electrical, chemical, structural and mining, as well as the agricultural, with which we are now most concerned.

"Engineering is the art and science of organizing and directing men and controlling forces and materials of nature for the benefit of the human race." "Agriculture is the industry concerned with the production of raw materials for food, clothing and shelter." Agricultural engineering, then applies the principles of engineering to the furtherance of agriculture.

The purpose of agricultural engineering is well expressed by the American Society of Agricultural Engineers, a technical organization of high ideals, in stating their aims and objectives as follows: "To develop individual and group leadership based on higher efficiency, greater productive capacity and better operating practices among those engaged in the production of raw materials for food, shelter and clothing, through the application and use of engineering principles in the industry of agriculture. The aim of this objective is directed toward creating a desire for, and the capacity to enjoy, higher standards of living, better working conditions, adequate educational facilities and equitable social progress for those engaged in the agricultural industry."

America dominates the agricultural world purely because the engineer has given her the equipment to do so. Agriculture plodded along for centuries with the sickle, the flail, and the crooked stick as her implements of production, and it is only within the last one hundred years that hand labor has been replaced by machinery. Secretary W. M. Jardine stated in an address at New York City, "The most impressive development of all time in agriculture has been the advent of modern farm machinery. Could the farmer of Pharaoh's time have been suddenly reincarnated and set down in our grandfather's wheat field, he could have picked up the grain cradle and gone to work with a familiar tool at a perfectly familiar job. And then, within the space of twenty years, the methods of crop production underwent greater changes than they had in the previous 5,000 years. At one stride we covered ground where fifty centuries had left almost no mark of progress whatever."

Beween the years 1850 and 1925, the steel plow, the threshing machine, the binding machine, the mower, and the reaper came into use and, according to the twelfth census report the year 1850 marks the end of the hand age.



Primitive Transportation Methods, One Reason Agriculture Has Not Progressed in the Past

This is truly an era of machine production. The manufacturing industry, however, directed by engineers, has advanced farther than has agriculture. Under present average conditions the farmer must work over two and one-half hours to produce that which will purchase the result of one hour of the industrial worker's labor. This unbalanced economic condition must be remedied before those engaged in agricultural pursuits may attain the standards of living enjoyed by those employed in industry. Well informed men in all circles know that the production costs per unit on American farms must come down. The farmer can no longer depend upon prices alone, over which he has little or no control, to yield a profit.

There must be smaller expense in raising a bushel of corn or a ton of hay. Serious competition in this country is eminent, particularly between producers of wheat, cotton, and dairy products. The most serious competition is in the world markets. This can be successfully met only by lower costs.

The cost of producing a crop may properly be divided into power, labor, use of land, fertilizer and seed. Of these, the last three are for the most part fixed. The remaining two, power and labor, make up 40 to 85 per cent of the production cost of corn, wheat, oats and cotton, according to data secured by the U.S.D.A. Bureau of Agricultural Economics, and state agricultural colleges and experiment stations. These costs can and are being reduced by time saving machinery and methods. G. W. McCuen, professor of agricultural engineering at Ohio State university, has for several years been conducting an experiment on raising a corn crop using exclusively motor driven equipment and has found it to be both practical and economical. He succeeded in reducing the time necessary to grow and harvest an acre of corn from 26 to 5.77 man-hours. Many other examples just as noteworthy may be found where engineering has lowered agricultural production costs.

The individual farmer who wishes to increase his profits must consider three principal factors. They are quantity, cost, and price. The price at which he sells, less the cost of produc-

A Farmers' Rally Made Possible by the Automobile, a Development of Modern Engineering

tion multiplied by the quantity determines his net profit. As has been mentioned, little can be done about price, but quantity and cost can in a large measure be controlled. The problem is, then, to lower the cost of producing a bushel of grain or a pound of beef—or to increase the number of units to be sold.

Twenty to twenty-five hours of labor are used up in the production of an average acre of corn, yet it is possible by using more power to reduce the time to 6 or 8 hours, and even less. This results in more time to produce larger crops with an attendant larger net income.

A table from U. S. D. A. bulletin 1348 shows the influence of the use of power upon the crop production of a single worker. The figures in the first column denote in decimal fractions the number of horses per farm workers and those in the second column the value of each worker's crop production.

Italy	.19	$ 45
France	.37	90
Germany	.55	119
United Kingdom	.88	126
United States	2.05	292
Alabama	.81	112
New York	1.69	250
Iowa	3.86	595
Nebraska	4.71	910

It makes a profound impression upon me when I observe that in Italy five farm workers have only one horse among them and the crop production of each worker is worth only $45 while in my native state, Nebraska, each farm worker has at his command nearly five horses with which he produces crops worth $910.

Obviously there is a tremendous advantage enjoyed by the worker who uses the most power. It is in this respect that the American industrial worker is more favorably situated than his agricultural brother. To alleviate this condition by seeking ways and means for the farmer to use more power and that more efficiently is one of the purposes of the agricultural engineer.

The field of agricultural engineering has wide limits. Some of its divisions include research, instruction and production in irrigation, drainage, flood control, reclamaton and utilization of waste land, rural electrification, farm mechanics, farm machinery, farm power, rural architecture, farmstead planning, farm home utilities and sanitation.

Nebraska and Iowa pioneered in agricultural engineering instruction. In 1904, Nebraska offered secondary courses in forge work and farm machinery under Professor J. B. Davidson, now head of the Agricultural Engineering department of the Iowa State college. In 1908, Iowa offered a degree in agricultural engineering and the following year Nebraska adopted a degree course. In 1914, Professor J. B. Davidson was granted by the University of Nebraska, a professional degree in agricultural engineering, the first degree of this kind ever given anywhere. To Professor Davidson and Professor L. W. Chase, head of the agricultural engineering department of the University of Nebraska from 1905 to 1920, should go a large portion of the credit for the development of agricultural engineering.

The requirements for an agricultural engineering degree include a large amount of general engineering work. Courses in the civil, mechanical, electrical, chemical, architectural and applied mechanics departments are necessary. Preparation in physics and mathematics is the same as for other engineering degrees. The accompanying table compiled by Professor Ayres of Iowa State college shows the agricultural engineering curriculum in four outstanding universities.

Distribution of Agricultural Engineering Subjects at Four American Universities

	Gen. Eng	Agri. Eng.	All Eng.	Science	Gen Agri.	Cultural	Elective	Military
Average	34.1	22.6	56.7	14.7	11.1	9.1	5.3	2.9
Univ. of Minn.	25.2	28.6	53.8	15.3	8.6	8.1	11.4	2.8
Univ. of Iowa	29.3	26.4	55.9	13.6	19.0	6.3	2.7	2.7
Univ. of Nebraska	40.0	22.3	62.3	12.8	5.6	8.8	7.2	3.3
Iowa State Agri. Col.	41.8	13.1	54.9	17.0	13.1	13.1	......	2.8

Two important problems confronting the profession today are, (1) the $10,000,000 war being waged by the government against the corn borer, and (2) flood control, particularly on the Mississippi.

Sixty million acres are now infested by the corn borer, and entomologists agree that mechanical means are necessary to control it. This insect pest is the most serious that has ever faced American agriculture. It lives through the winter in the corn stalks and other coarse vegetation. When the corn is made into ensilage, the borer is destroyed. Agricultural engineers have designed equipment to pulverize the corn stubble which leaves the pest without a place of hibernation.

Regarding flood control on the Mississippi, well informed men are agreed that higher levees, reservoirs and spillways are not sufficient to control the flood water of the Mississippi, but that an extensive program must be carried out along the head waters of the Mississippi and its tributary rivers to prevent a too rapid run-off of snow and rainfall. This will call for terracing of sloping fields, reforestation and forest fire prevention.

Terracing sloping land would in a large measure eliminate erosion. This would be of tremendous value as "investigation by federal and state agencies indicate that twenty average crops do not draw as much fertility from the soils of the United States as is lost in one year by erosion."

Founded on the most basic industry in the world, agricultural engineering offers wonderful opportunities to the

(Continued on Page 16.)

THE STATE FAIR

Continued from Page 6

livestock, exhibited at this fair, are all examples of what is possible in the way of quality production, and serve as a measuring stick to guide the farmer in his efforts to produce the best. It is true that every farmer cannot produce the best, but seeing the best will better enable him to determine just how far he is falling short and give him a new determination to strive harder to reach the goal.

The State Fair, therefore, should serve as an incentive to the farmers of the state to produce the best and it is to the accomplishment of this ideal that it should be directed.

SPECIALIZATION

Continued from Page 6.

farm products, however, we do not wish to imply that diversification has not its value. Under the conditions generally encountered in the east at this time, it has its place, and since such is the case, it should confine itself to that region. Southwestern agriculture is particularly well adapted for specialization, and only when this is fully recognized will our agriculture assert itself and take its rightful place at the top of the ladder of prosperity and progressive agriculture.

DATE PROPAGATION

Continued from Page 7

ing season the offshoots should be irrigated frequently enough to keep the soil moist around the offshoot. The number of irrigations can be reduced during the winter months as long as enough water is applied to keep the soil in a good growing condition. The offshoots should be irrigated every week during the summer months after the first season.

Young palms should be wrapped with burlap during the first winter to protect them from killing frosts. The protection should be removed in the spring as soon as all danger from killing frosts has passed.

The varieties now being planted in southern Arizona are Awaydi, Deglet Noor, Halawi, Hayany, Iteena, Klachavi, Khalasa, Kustawi, Mactum, Zahili.

If the dates are set out correctly and properly cared for they can be grown almost as successful as can the more common fruit trees. The date is suitable to the warmer sections of Arizona, and, in time, should take its place among the leading commercial fruits of southern Arizona.

AGRICULTURAL ENGINEERING

Continued from Page 9

young man with an engineering bent and an attitude sympathetic to agriculture. O. W. Sjogren, chairman, department of agricultural engineering, Universtiy of Nebraska, and past president of the American Society of Agricultural Engineers, says, "As to the future of agricultural engineering, I cannot see anything but a bright future. If agriculture is going to rise from its present disparity as compared to manufacturing and the other industries of our country, it must make a greater application of engineering. Who is to do this best but the engineer who is familiar with agricultural methods? Agriculture must adopt the methods of other industries and increase the productive power per individual engaged in that industry. The only way that this can be accomplieshed most effectively is by a greater adoption of engineering methods. It is true that agriculture has developed by the aid of agronomists improving grain, by the animal husbandman improving breeds of various kinds of livestock, a greater study has been made of effective applications of fertilizers and in many other ways. All these agencies need equipment of the most efficient kind, which the engineer must design and, perhaps, in many cases, operate."