THE PART THE AGRICULTURAL ENGINEER IS PLAYING IN THE FARM EQUIPMENT INDUSTRY

by

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I have been asked to talk, as a representative of the farm machinery industry on the part the agricultural engineer should have to be of maximum benefit to his employer. It was also indicated that you would be interested in knowing what the future prospects are for agricultural engineers in the farm machinery industry.

That last suggestion is a big order, in one way, because I do not have a dependable crystal ball. In another way, that is speaking in very broad general terms, it is very easy for, without fear of contradiction from anyone, I can say that the future prospects for well trained agricultural engineers in the farm equipment industry are very good indeed. I'll have more to say on this subject later on.

But now to get back to the first part of my assignment, I want to make it very clear that I cannot speak authoritatively for the entire industry, except as my own company and my own personal experience in the industry are typical—and I think they are. Therefore, instead of talking in generalities, I will talk specifically about the part agricultural engineers are playing in my company and what type of training and qualities are most desired and looked for by our people who are hiring and working with agricultural engineers—especially the younger engineers who are just getting started in business.

One of the greatest contributions any engineer, or for that matter any person, can make to his employer is creativity. In a recent talk to a group of Industrial Engineers, Mr. William A. Hewitt, President of Deere & Company, has this to say:

"By way of a preface to my remarks this morning I think it would be appropriate for me to acknowledge the fundamental importance of creative thinking in all fields of human endeavor—science, the arts, philosophy, government, and so on. But today I will devote the time allotted to me to speaking of the importance of creative individuals in only one field — business and industry. It is difficult for one in my position to overemphasize the importance of creative individuals in a business organization because both individuals and companies either go ahead or they slide backwards in direct proportion to the amount of creative thinking, or lack of it, that they exercise. It is impossible for either to stand still. Individuals and companies both must make innovations in order to succeed. If either one simply repeats the application of techniques learned in previous situations and under past conditions he or his company soon will run out of gas and be left at the side of the road. . . . Creativity in business and industry is essential for survival in our competitive society."

Because of our present day competitive society, there is a greatly increased demand for new and better farm equipment and for improvements in products now on the market — it therefore follows that there is an increased demand for engineers of all kinds to create, test, produce, and sell present day farm equipment which is much more complicated than it was even 10 years ago — and infinitely more complicated than it was when I started out in the farm machinery business 30 years ago.

It is a matter of record that at the turn of the century, industry in general had about one engineer to about every 400 production workers—while today that ratio is somewhere around one to fifty. Those are the figures for the U.S. and I assume they would be about the same for Canada—at least the trend will be in the same direction, I am sure. Under the impact of intensified automation and research this ratio will gradually be smaller. I understand that in some industries today the ratio is now one to five, and in our Chemical Plant in Oklahoma where we produce synthetic nitrogen for fertilizer and other uses, the ratia is about 1 to 3 or 4. I have no idea what the figures might be for the farm machinery industry, or more importantly, for the broad field of agriculture as a whole, but if we did have such figures I am sure they would point out the great need for agricultural engineers and the great opportunity that lies ahead for well trained, capable agricultural engineering students.

Now, as I said a moment ago, instead of dealing in generalities I will tell you specifically what agricultural engineers are doing in my company and what type of training and qualifications we think are important. I believe what we are doing and what we are looking for is fairly typical of the industry—at least as far as the larger companies are concerned. This will then be a "Case Study", so to speak, and I hope you will pardon my using my own Company, as the subject. I am not doing so in a boastful manner at all, for, as I said, I think what we are doing is merely typical of what many companies are doing today. There are some slight differences in organization, etc., but basically what we are all trying to accomplish is the same. In this way I believe I can best cover the subject assigned to me, "The Part the Agricultural Engineer is Playing In the Farm Equipment Industry."

First, I think I should clarify one point about my subject. That is that agricultural engineers are playing an important part in many segments of our industry. For example, agricultural engineers are, of course, in industry supplying equipment and service for farm buildings, rural electrification, soil and water conservation. However, my discussion will be limited to the farm machinery industry with which I am most familiar.

Our industry uses mechanical engineers, electrical engineers, chemical engineers, civil engineers and industrial engineers in its plant maintenance and production operations. However, the agricultural engineer, while sometimes difficult to distinguish from other engineers, should be particularly well qualified to determine requirements for farm machinery and to develop, design and test this machinery. In other words, he should be well fitted for serving the farm machinery industry as a research or product engineer.

The manufacture of farm equipment by John Deere is carried on in twelve individual factories, one of which is located at Welland, Ontario. Each factory is responsible for specific lines of equipment and has its own Product Engineering Department. I previously mentioned that present day farm equipment is infinitely more complex and this has necessitated expansion in both engineering staff and facilities. While this applies to farm equipment in general, it is particularly true of tractors, and it is for this reason that John Deere recently cre-

ated a new Research & Engineering Center at Waterloo, Iowa, to serve our two tractor factories. We are very proud of this new facility. Here is a picture of it showing the durability and "torture" test track, and mud bath and dynamometer drawbar test track and the acreage surrounding the center which is also used for field testing work under actual farming conditions. This Research & Engineering Center was built in 1955 and 1956 at a cost of over two million dollars. It is located on a 600 acre farm five miles from our Waterloo, Iowa tractor factory. Approximately 450 people employed in tractor research design and development work. A substantial number of this total personnel are engineers and one third of those are agricultural engineers. It takes all kinds of people and skills to properly man an engineering center of this kind and I think it interesting that one third of the engineers, by plan or design — not by happenstance—are agricultural engineers.

In addition to the Product Engineering Departments of each factory, and the Research and Engineering Center at Waterloo, Deere & Company maintains a rather small Product Research Department and a Product Development Department at its general headquarters in Moline.

The personnel of the Product Research Department have collectively many years of experience in design, sales and service, field testing of new equipment and in following research in agriculture in public service and other agencies.

The Product Research Department is a staff organization of the General Company which serves both the management of the General Company and the various Deere factories. They supplement the activities of the various factories but do not lessen the responsibility of the factory manager for the acceptance of his product line.

The chief responsibilities of the Product Research group are:

1. Provide unbiased judgment of field performance of currently manufactured equipment from the standpoint of function, reliability, cost and convenience.

2. Determine requirements for new types of equipment or modifications in current equipment to accommodate changes in farm practices.

The sources of information as to farmer acceptance of equipment and to future requirements are:

1. Sales people and dealers — they are quick to report shortcomings in current equipment and to notice demands for new types of equipment as those demands develop.

2. Farmers' mail indicates new requirements.

3. Technical meetings of various agricultural research groups.

4. Close contacts with agricultural research agencies, including visits with farmers and extensive travel through farming areas.

In addition to the Product Research Department of Deere & Company, we have a Product Development Department which operates very closely with the Product Research Department and also with the Product Engineering Departments of the various Deere factories, but independent of these factories. The personnel of the Product Development Department includes research and development engineers with facilities available for designing and building proto-type machines. The work of this department is confined generally to research and development on equipment for which, at the time, very little demand exists but which may show considerable possibilities for the future. After research studies have indicated the desirability of new equipment or changes in current equipment to carry out some new farm practice, this Development Department can alter present equipment or design and construct new equipment and test it for its functional and economic value. If the equipment shows promise, it is turned over to the Product Engineering Department of a factory where it is carefully designed, field tested and released for production.

The Product Development Department is intended to supply a place where a certain amount of research and development can be carried on away from the almost unavoidable production pressure found in factory Product Engineering Departments.

Regardless of the assistance given in research and development by the Product Research and the Product Development Departments of Deere & Company, the responsibility for the greater part of research and development, the final production design and field testing remains with the Product Engineering Department of the factory which manufactures the machine. The Product Engineering must create the final design and supply working drawings covering all details of the design in order that the factory production department can fabricate and assemble all parts into the complete machine.

The designer must keep the final cost of the machine in line with its economic value to the prospective farmer purchaser. Farmers buy equipment that will either make them a profit and/or make their work easier.

In order that equipment costs be kept as low as possible the designing engineer must have intimate knowledge of design of both mechanisms and structures, and be familiar with materials and methods of fabrication. He must design toward the ultimate in performance, mechanical reliability, ease of maintenance and safety. A first hand knowledge of farming operations and the conditions under which the machine must perform are of great value to the design engineer.

In the field testing of a machine during its design and development, the engineer must be capable of interpreting its performance and recognize possible deficiencies in function and structure. It often requires a great deal of ingenuity, perseverance and enthusiasm to overcome even minor troubles. The wise engineer is willing to accept from any source suggestions or aids which hold promise of overcoming difficulties.

The Product Engineer's responsibilitys does not end when his machine is manufactured and in the hands of farmer customers. Even though the machine has been extensively field tested before being offered for sale, it is not unusual for farmers to find certain conditions where problems arise. The product engineer must recognize these problems and provide new or redesigned parts to overcome the field difficulty as quickly as possible.

My preceding remarks about the work of the Agricultural Engineer in my company indicate, I believe, many of the qualifications which we think are most important. In general an engineering college graduate (or a man who has acquired equivalent education through self study and possibly correspondence) is well grounded in science, mathmatics and engineering fundamentals. In addition to this engineering training whether acquired formally or informally, there are many more qualifications which are desirable. One of the most important of these is the ability to work and associate with other people — his supervisors, co-workers and farmer users of his equipment.

Another rather vital qualification is the ability to communicate effectively with other people. This will include oral and written reports which to be most effective, reflect training in orderly thinking, grammar and composition.

Another means of communication which is all important to the design engineer involves the drafting board. Many young engineers seem to dread the thought of working at a drafting

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The continued use of the barrel as a field container is anticipated by authorities in Maine. Some changes in storage design have been recommended in order to facilitate handling. A storage incorporating these recommendations was constructed at Florenceville, N. B. two years ago and has been found to be most efficient.

Potato Storage Design

Future potato storage design will be influenced by the harvesting and handling method that is adopted. It is anticipated that the multiple floor track side storage will be replaced by single storey warehouse type building. It would appear that construction of new on the farm potato storages will decline. This trend will be accelerated by improved trucking facilities, the desire to make regular shipments throughout the winter months when below freezing weather makes transportation of potatoes in unheated trucks risky and more rigid requirements as to grading facilities.

Potato storage design becomes more complicated as the size increases. At the present time most trackside storages in New Brunswick and Maine are of multiple storey design with potatoes being stored in the basement and one or more above grade floors. This requires the use of hoists and the barrels frequently have to be rolled a considerable distance before dumping into bins. A similar time and labor consuming operation is necessary when potatoes are removed from storage. The newly designed Maine barrel storage provides for gravity movement with potatoes being moved only a short distance horizontally.

We are presently promoting single storey above ground trackside storages with potatoes being placed in bins with a bin loader or piler. The first storage of this type was constructed in 1957 and two more will be constructed during the summer. They offer storage facilities at a cost of approximately $1.00 per barrel of capacity and since potatoes are conveyed rather than dropped into storage, mechanical injury is greatly reduced.

Potato Storage Ventilation

There is a considerable lack of sound basic information on potato storage ventilation. It is true that authorities generally agree that temperatures of 38° F. and relative humidi ties of 85% are the most suitable for the storage of table potatoes. There is, however, considerable disagreement as to air movement within the storage and through the stacked potatoes. These recommendations vary all the way from shell circulation with no movement through the potatoes to movement of 1 c.f.m. per 50 lbs. of potatoes through the pile. There seems to be some evidence that under certain conditions it will be necessary to vary air flows. As far as I have been able to ascertain the only research work on this problem was instituted at the Aroostook Farm, of the Maine Experimental Station two years ago when a system was installed that provided a means of controlling air delivery to different bins within the storage. Definite results are not yet available but their first year's work showed that shrinkage was at a minimum at no air flow and at high air flows—3 - 4 c.f.m. per barrel with medium air flows of 1 to 2 c.f.m. resulting in the highest shrinkage.

This information is absolutely essential if we are to design potato storage ventilation systems.

We have had a modulating type recirculation system in use for the past three years. Air is discharged into underfloor ducts with slatted covers at the rate of ½ c.f.m. per barrel. This storage is used for storing seed and excellent results have been obtained. The controls are set to hold a temperature of 38° F. and it is able to do this so that over a six weeks period in the winter of 1956-57 when outside temperature varied from −15° to +50°, inside temperature varied less than the 2° calibrations on the recording thermometer. Relative humidities varied between 80 and 85 percent.

The development of new uses for potatoes particularly by the chip and quick frozen french fries industries have presented new storage problems. Ideal temperatures for the storage of potatoes for these purposes appear to be 50° or higher. Work done by the frozen food industries appear to indicate that at these high temperatures best results are obtained with humidities kept as low as possible preferably 50%-60%. With constant temperatures and low humidities dormancy has been maintained until April. The use of sprout inhibitors is becoming common for this type of storage.

The dsign of storage presents many problems for the Agricultural Engineer. Provided with the necessary basic information new designs will emerge that combine long life and efficiency.

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board but the engineering drawing is the means of communication between the design engineers and the production department which must fabricate the desired item. The ability to create designs on the drafting board and to interpret drawings made by others is essential for the design engineer. I know of nothing more satisfying than to see a product develop before ones very eyes and the remuneration should, and I believe will, be as rewarding to the competent as any other field of engineering.

A general knowledge of agriculture and of farming operations is of great benefit to the designer of farm machinery. A graduate agricultural engineer obtains a good grounding in the agricultural sciences in school and in many cases has been raised on a farm. A survey of the Product Engineering Departments in eight Deere & Company plants in 1955 showed that 62% of these engineers were either raised on farms or had farming experience before entering their present engineering activities.

There are, of course, other possibilities for agricultural engineers in the farm machinery industry. My remarks so far have chiefly covered the research and product engineer in our Industry, since most of our agricultural engineers are in that type of work, but there are other important and rewarding opportunities.

For those engineers who are interested in factory production operations, there are many opportunities where their training can be put to good use.

Another opportunity which is almost wide-open and for which agricultural engineering training is extremely valuable is that of sales work. As farming operations get larger, more competitive and more complex, the technical training of a salesman becomes of more value. The Company salesman, farm equipment dealer or retail salesman who has technical information on crops, soils, agricultural chemicals, crop drying, fertilizing and the many other farm practices of today has a great advantage over a less informed sales person.

In summary, I have attempted to indicate the type of work the Agricultural Engineer is doing in our own company. As I said at the begining, I believe this is rather typical of the entire farm machinery industry. In pointing out the activities of the engineers, the qualifications for this

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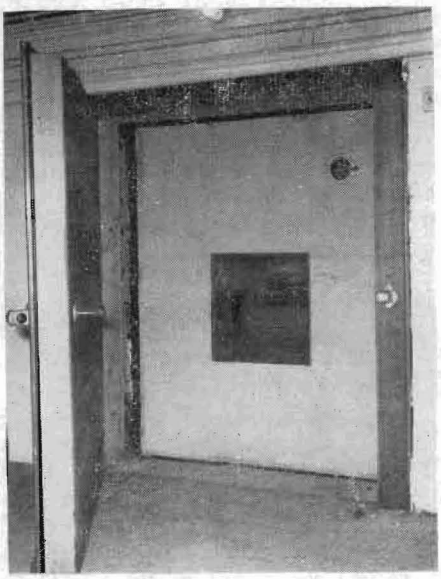
an easy operation.

Several materials have been tried for use as lining for controlled atmosphere storage rooms but were found to have joint leaks even though impervious to gas through the material itself.

The door leading to the chamber consists of a large steel door set into angles and then tightly sealed around the edges by caulking compound. A glass about 2 feet square is installed in the upper central portion of the door for observation purposes while in some storages an additional port about 4 inches in diameter is installed so that oxygen can be supplied to the room when necessary. This door is very heavy and even though moved only when the storage is loaded and unloaded is too cumbersome to be practical. A reinforced plastic door has been used on some cold storage rooms and may well replace the heavy steel door just described.

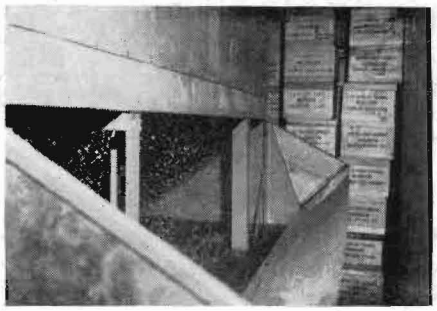
In order to insulate the door section from the chamber a conventional refrigerator door is installed on the outside.



A sealed door with an observation window is important.

The framing and exterior construction is very similar to standard practices but some practical ideas have been incorporated in recent storages which enhance the appearance of the buildings, and provides functional features.

The use of open web beam or bar joists have enabled storage construction with long post free spans and gives freedom of movement within the storage compartments as well as in the central work alley at the center



A caustic soda bath picks up excess carbon dioxide from the air.

of the building.

The bar joists allow an additional function by providing passage of air over the ceiling insulation which decreases heat transfer to some degree. One storage operation has applied corrugated asbestos cement board to the exterior wall, leaving the corrugations open at the bottom so air may be carried over the walls across the ceiling and thence through roof ventilators to provide, in effect, jacket cooling by natural air currents. The asbestos cement board also provides fire-proofing qualities necessary for buildings of this type.

A timber sill is bolted to the top of the concrete foundation and is covered by a metal protective sheet which forms a drip cap over the concrete. This protection is advised to prevent excessive moisture affecting the timber sill and also discourages infestation by insects and penetration by rodents.

A similar metal flashing may be placed at the plate for the same reasons as that at the sill and it provides a pleasing appearance to the structure.

Since the operation of controlled atmosphere storages in this country is comparatively new it can be expected to increase rapidly within the next few years and even plants now in use will have to increase their capacity. It is, therefore, expedient to choose a site carefully to take care of expansion. One storey structures are probably easier to manage and buildings should be designed for flexibility with this in mind. Always locate the building on a well drained site and accessible to highways and railways with adequate electric power facilities.

While the interior mechanical equipment may be a problem for specialists it is certainly the duty of the Agricultural Engineer designing in this field to have sufficient knowledge of the refrigeration capacities and the capabilities of labour saving equipment to advise on proper layout.

The refrigeration unit is usually designed for 32 deg. F. during the loading period but need only hold the C.A. chamber at 38 deg. F. after the room is sealed. Only the evaporator and the blower is installed within the room with sufficient duct length to provide complete circulation of the cool air.

It should be explained in conclusion that apples controlled in storages so described do not *improve* in quality but *maintain* the quality reached at loading time. It is, therefore, necessary that apples of good quality be stored and care taken to prevent damage during loading. In this way the life of the apple may be extended to control market prices at a reasonable operating profit.

This type of storage may well be the answer to problems of many growers in the fruit belts of Canada and it is indeed a stirring challenge to Agricultural Engineers to participate more actively in designing structures of this type to keep alive an important industry in our fast growing nation.

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type of work are in many cases quite apparent.

I have also attempted to list briefly some of the qualifications we believe most desirable for the engineer in our industry. Aside from a training in agriculture, a knowledge of farm operations and a desire to improve the production facilities of agriculture, the desirable qualifications will not differ much from any other occupation or career. Such qualifications as judgment, honesty, integrity, loyalty, proper attitude, and diligence are essentials of any calling.

In closing, let me leave this thought with you. The retired chairman of our Board of Directors, who is now 86 years of age, had a standard statement that he always used when called upon to close almost any type of company gathering. It was very brief. He would always conclude, "Deere's best years are ahead". I'd like to paraphrase that and say to you, "The best years of agricultural Engineers and Engineering in both the United States and Canada are ahead of us".