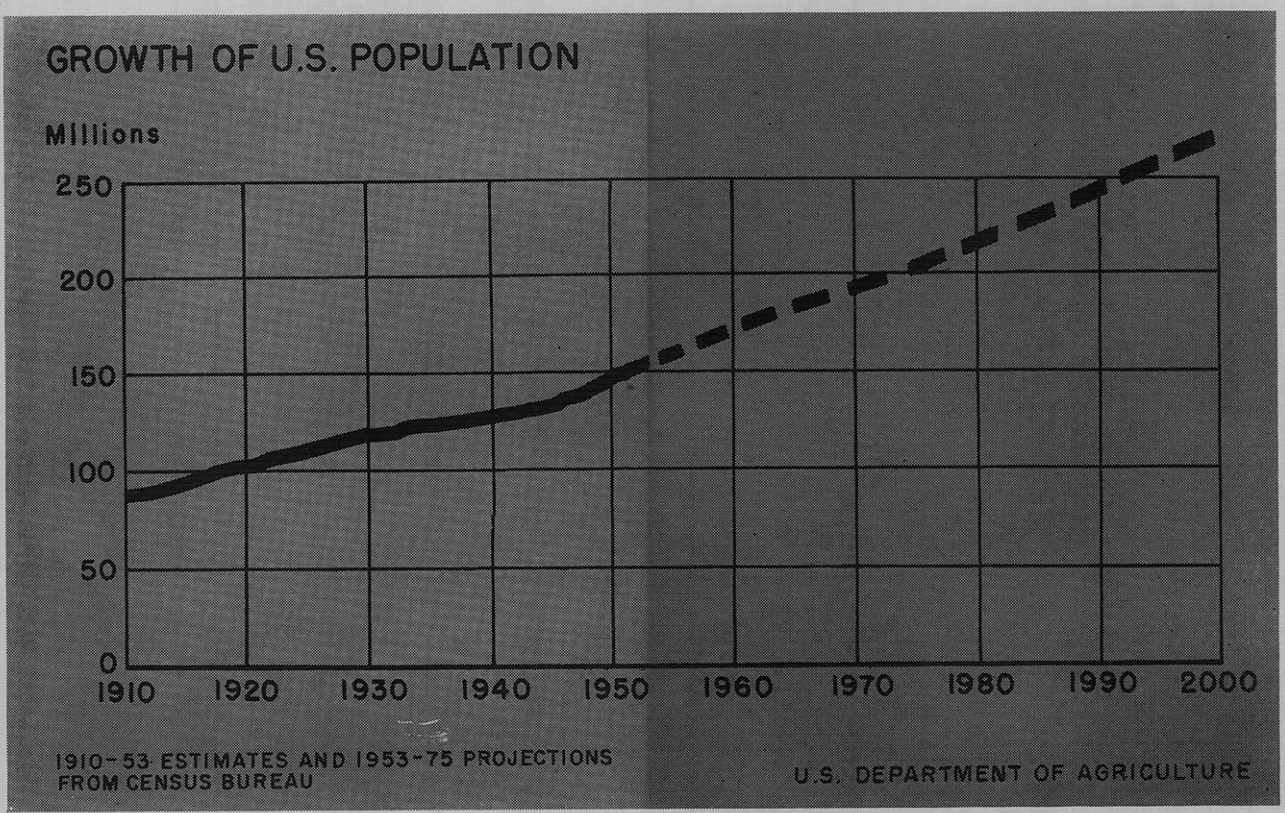
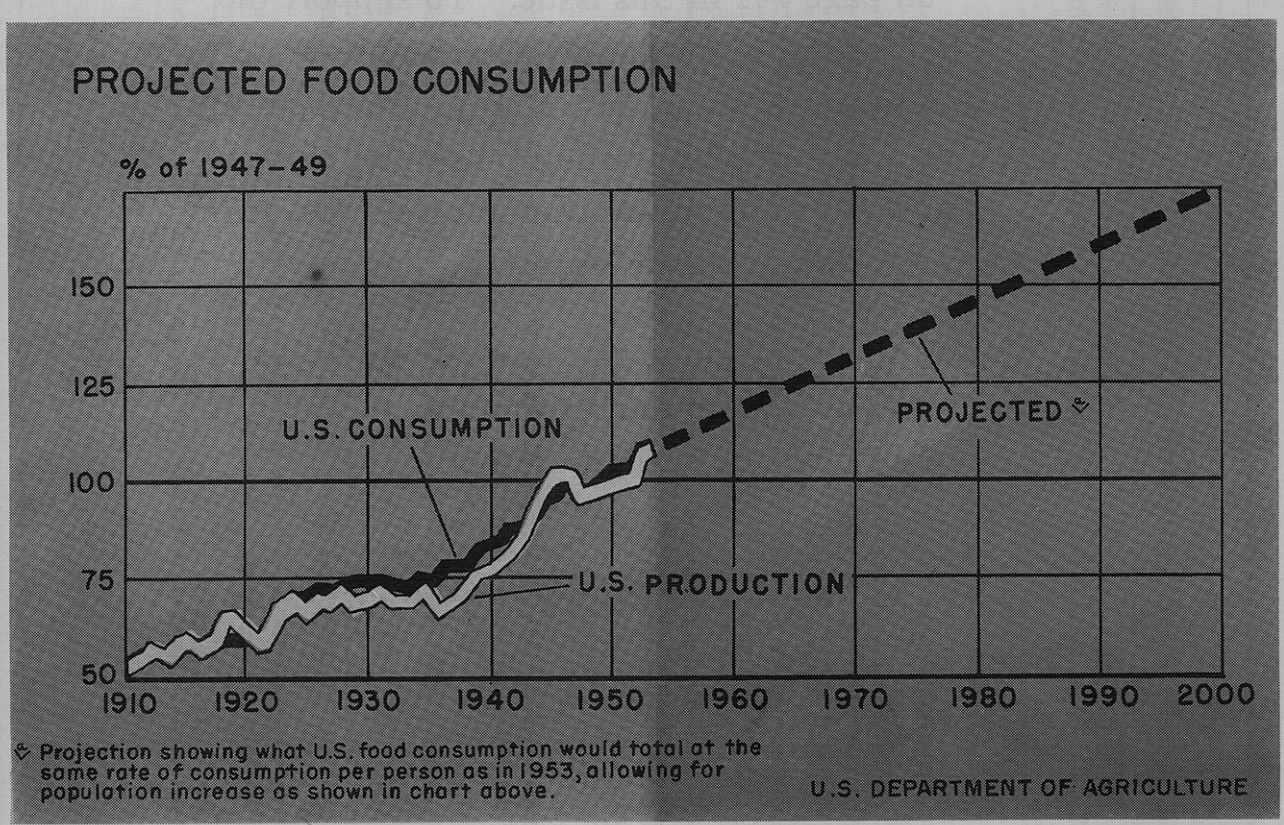


The Next 50 Years i



ONE BIG REASON for the remarkable progress of American agriculture in the past half-century is the successful partnership of research and education in the land-grant colleges, the U. S. Department of Agriculture, and industry. Beneficial results of this partnership have touched the life of every man, woman, and child throughout the nation, city people as well as farmers. They have helped us to have a good life and a good living.

Fifty years ago we didn't even know whether the Plains could be farmed successfully. But the scientific groundwork was being laid for doing just that. Federal and state scientists were pioneering in the discoveries that have become so important to farming today. They were learning that insects can carry diseases to animals, plants, and humans. The principles of heredity discovered by Mendel were brought to light. Organized plant exploration to all parts of the world was only a few years old. Organized soil science was just an infant, although a lusty one. And the principles of systematic selection of plants for resistance to disease or weather were just beginning to be understood.

Productivity was increasing. A farm worker in 1904 was able to produce enough food and fiber for 7 persons. But further improvements were on the way.

By 1940, one farm worker could provide for 11 people—a 57% gain in labor efficiency in 36 years. Today, with many more and better machines, a sixfold increase in fertilizer use, numerous tailor-made crop varieties and livestock, and new research-developed weapons to fight insects, diseases, and weeds, one farm worker produces abundantly for about 18 persons. This is a gain of 63% in efficiency in 14 years.

These figures not only illustrate how much things have changed, but also how fast—especially in more recent years. Since the start of World War II, we have been producing at a record rate. It has become apparent that this new high level is the rule, and not the exception. Barring some great catastrophe, either natural or man-made, it should continue.

Our economists, therefore, are now measuring our progress, not on the basis of what was normal before the war, but on what was the average production in 1947 to 1949.

The 1947–49 average was about one third greater than the average for the period of 1935–39. Many things have helped to bring about this new high level of production. Perhaps most significant were the increases in acre yields and in production per animal. These increases to a great extent resulted from improved practices and methods developed through agricultural research.

When thinking about agricultural research both in the present and for the future, the questions raised by surpluses must be considered. Answers must be given—and soon. Nevertheless, I'm also sure that surpluses—when viewed from a 50-year perspective—are a temporary problem. We know that emergencies or production hazards can quickly turn a surplus into a shortage. We can consider the present dilemma, then, in connection with our look ahead.

How Far May We Have to Go?

So—what about the next 50 years? It is easy to say that science has no more than made a beginning in advancing agriculture—and that enormous possibilities lie ahead. I feel, however, the big question is this:

Will our research advance agriculture in accordance with the needs?

Census Bureau projections show we may have 200 to 220 million people by 1975.

One actuarial study by the Social Security Administration indicates a population of 250 to 260 million by the year 2000.

Other projections may indicate a higher or smaller increase, but one thing they all show is this:

Under any set of reasonably normal conditions, our population will continue to increase, perhaps rapidly, as far ahead as we can see. This is the significant point we in agriculture must keep in mind.

Furthermore, dietary changes are bound to occur. Nutritionists say the diets of many millions of people in the United States can be greatly improved.

Then too, we are going to have more older people. At present, 1 out of every 12 persons in the United States is aged 65 or over. By 2000, it will probably be 1 in 8. Future nutritional needs will probably call for less of the high energy foods, and more protein, minerals, and vitamins.

It appears, then, that population growth and changing diets will require a sharp increase in total agricultural production. Projected population growth alone will require about a 60% increase. If we also improve our diets, total output will have to go up 75%.

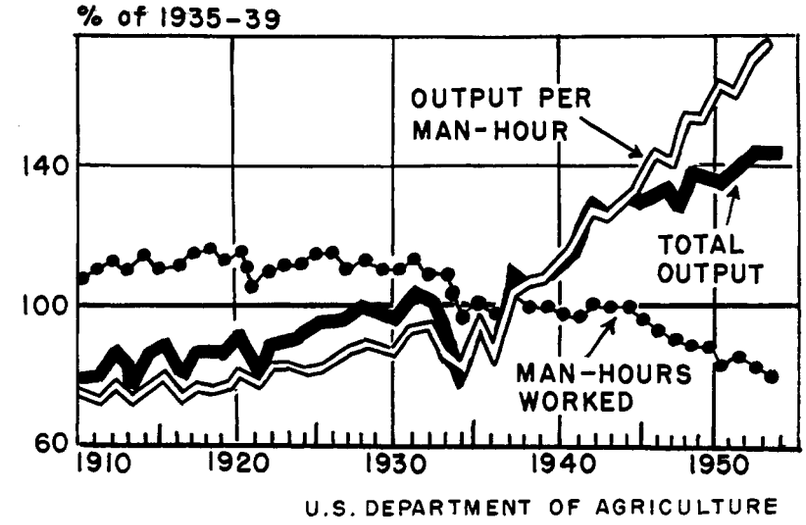
The Responsibility of Research

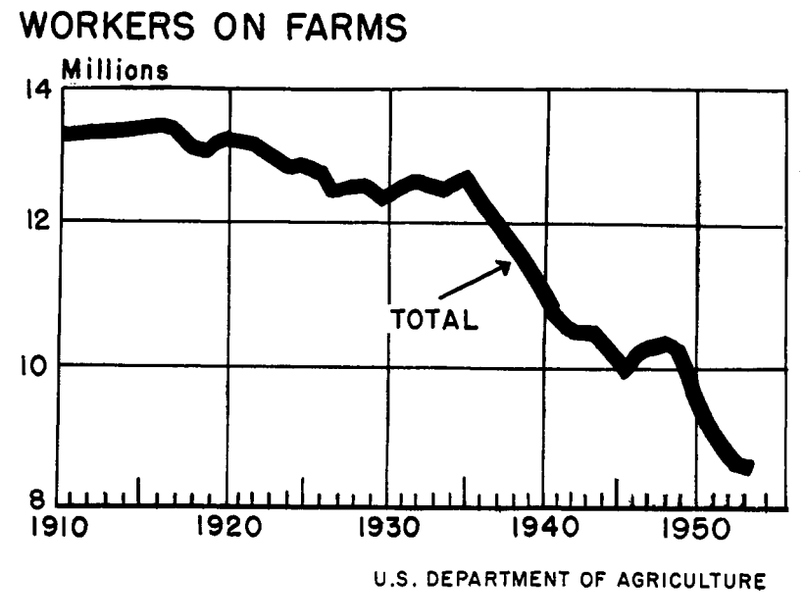
The first responsibility of agriculture, and with it, of agricultural research, is to provide enough for everybody. I have no fear that the people of the United States in 1975, in 2000, or in any other year within the foreseeable future, will be going hungry. We have the resources, including land, to prevent that.

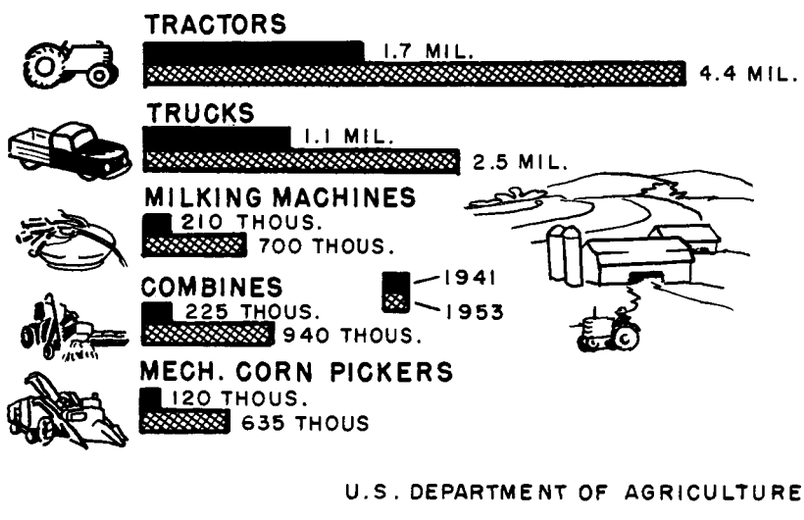
AGRICULTURAL PROGRESS

BYRON T. SHAW, Administrator, Agricultural Research Service, U. S. Department of Agriculture

Progress in agriculture during the past 50 years has been remarkable. But the possibilities for improvement now in view and a host of unanswered questions under attack by research suggest that the next half-century will be equally remarkable—or more so







If necessary, we can do many things, including lowering the quality of our diets, without having to eat algae, or some other artificial substitute for accustomed foods, as some people fear. Actually, the demands upon our agriculture would have to be heavier than any in prospect before they could force us to a subsistence diet.

But there is a second responsibility of agriculture. And here is where the real test comes for research. This test comes after the basic needs of food and fiber are met. It is this: can research ensure that the food and fiber will be forthcoming at decreasing cost, with minimum strain upon our resources of land, manpower, and capital, and in accordance with the nutritional needs of the people? In the final analysis, it is how efficiently we use our productive resources in both agriculture and industry that determines whether or not we continue to raise our standards of living.

We can put it this way. The past 50 years brought tremendous increases in agricultural output. This must be continued. But the next 50 years must also bring tremendous increases in agricultural efficiency.

Increased efficiency is needed in all phases of agriculture—in marketing and using farm products as well as in producing them. This means, then, that over the long run marketing practices, farming techniques, and shifts in land use will have to be in accord with the changing needs of consumers.

Means of Acceleration

How can research help? How can it accelerate our agricultural advance? I believe the most important clues to production gains lie in the areas of current difficulties on which scientists now are working, or should be working.

Recent departmental studies show that despite all the gains we've made, farmers still lose $13 billion a year because of insects, diseases, parasites, weeds, inadequate harvesting, mechanical damage, weather, and similar hazards.

If by some magic this $13 billion loss had been eliminated, last year's farm production would have required 120 million fewer acres.

No one expects this to be done, of course. One hundred per cent efficiency cannot be achieved. But taking an optimistic attitude, let's assume that, given time and the proper research effort, it would be possible to eliminate perhaps one half the current losses. To the extent that research accomplishes this in the years ahead, it will in effect "reclaim" agricultural lands for our use. And, we would have a good head start toward meeting our needs.

Reduction of losses is not the only way open to us. Other means may be more timely or more economical. We must at

all times try to develop all the things that can help. Boosting crop yields through better use of fertilizers may, in some instances, be a more economical route. New developments in livestock feeding, such as in the use of antibiotics, may be the answer in other instances. Many things that will affect our lives and our agriculture during the next 50 years probably are already discovered. It is our job to develop them.

It is unlikely that the early scientists who put Mendel's law of heredity to the test in plant breeding could predict the discovery of male sterile plants in various species. Nevertheless, this development has come about. It already has opened a great future for such crops as hybrid sugar beets, onions, and grain sorghums. Almost certainly we will use this new knowledge in research to great advantage for many other crops.

Also, we have had some success in redesigning animals as well as plants better to adapt them to environment, or to meet changing consumer demands. The meat-type hog is a case in point. In a few years most farmers probably will be raising the meat-type hogs, because that's where the markets lie. And what we've learned in developing these hogs can be expected to help us in breeding some of the back and belly fat from beef cattle without losing the marbling that makes prime cuts of meat.

There are many more things ahead, because beef cattle breeding now is only about the same stage that corn breeding had reached 30 years ago.

There's every chance that the problem of dwarfism will eventually be licked. Cattle that can gain 3 or 4 pounds a day and can do it cheaply, may revolutionize stock raising. We already have bred "3-pound-a-day" steers in our test lots, and we know that we can get these gains within the type and kind of beef cattle that the breeders and the market prefer.

It is reasonable to believe that if we put sufficient effort into research we will, in the next 20 years, make as much gain in egg and poultry meat production as we did in the past 20 years. The time may come when every farm flock will be producing 240 or 250 eggs per hen a year.

In increasing our production of eggs, milk, and meat in the past, we've depended heavily on the selection and mating of a superior specimen to another superior specimen. This has been very successful. The things we are learning about hybrid vigor open up still further possibilities. Our research in the next generation needs to find and apply the scientific principles that will enable us to predict the outcome of the mating with certainty. Instead of one fine animal and an assortment of culls, farmers of the future will be getting a good one every time.

Disease Resistance

Consider the matter of breeding disease resistance into plants. Three new wheat varieties are well on the way to general release. They will make it possible for farmers in the Northern Great Plains to grow wheat in spite of stem rust race 15B. That's something for the immediate future. Looking farther ahead, there's no reason, on the basis of preliminary research, why we can't breed crop varieties that will resist several, or many, diseases, insects, nematodes, and weather hazards, too. We already have certain tobaccos, for example, which are resistant to five of their worst diseases. We have wheat varieties that combine resistance to leaf rust, loose smut, and Hessian fly. Small grain breeders are crossing wheat and rye in an effort to get into wheat the resistance of rye to cold.

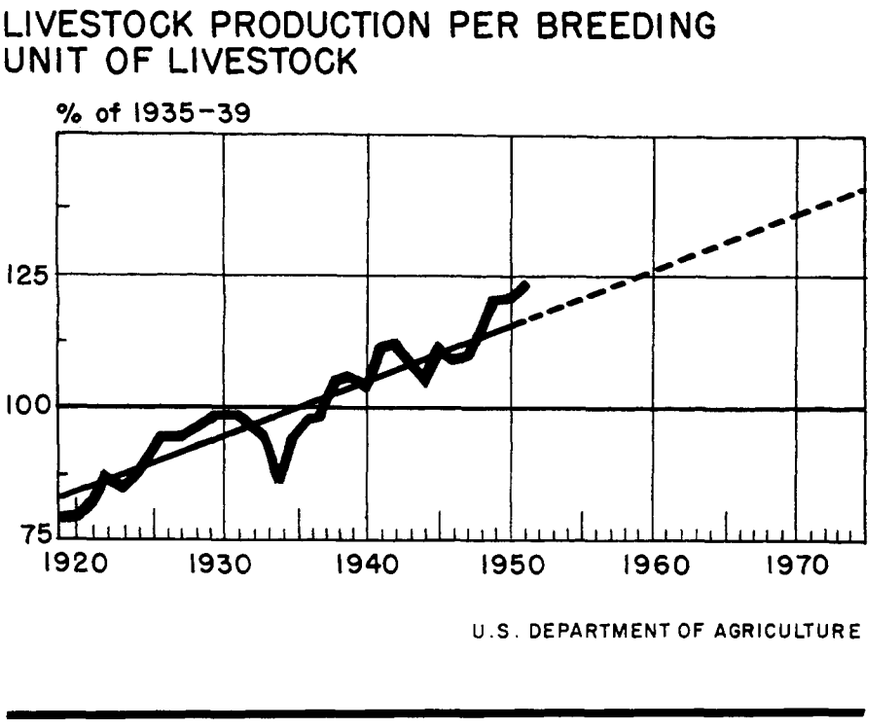
There's no reason why disease resistance can't be bred into animals, too. We have already done it to some extent with poultry. We have strains that resist fowl paralysis, pullorum disease, and typhoid. If we can develop cows and pigs that can resist some of the plagues of today, we will help take some of the risk out of livestock farming. Farmers will feel more secure, more certain, and our supply of these products will be more readily assured. With demands bound to increase, this can be a real guarantee of both adequate food supplies and profitable farming.

We can establish new crops in an area. For example, we already have the techniques and some of the material to provide the Missouri Basin with small fruits of the quality now produced only in balmy climates. A number of new varieties with marked winter hardiness have been developed.

But present varieties are only a beginning. Plant breeders have studied the potential germ plasm enough to see that it holds great possibilities.

They already have strawberry plants that withstand temperatures as low as 18° F. when they are in full flower. They are working to combine this remarkable hardiness with other good qualities—high yields and luscious flavor. Their goal is to provide plants that not only produce excellent berries, but require less care. A high degree of winter hardiness, for instance, would eliminate the need for mulching.

Grapes too are a possibility. It looks now as though we have the means of combining extreme winter hardiness with good size. This is a new technique that involves a chemical—colchicine—once used to treat gout. It is now being



Byron T. Shaw, administrator of the Agricultural Research Service since 1951, worked his way up from soils specialist in the USDA, through assistant administrator and deputy administrator. He grew up on farms in Utah and Idaho. His Ph.D. came from Ohio State, which he served as associate professor of soils until he went to USDA. His scientific specialty is in soil physics, the influence of cropping systems on soil productivity, soil management, and irrigation investigations.

used very efficiently to produce new grape varieties with unusually large fruit. Those now in the making are adapted to existing grape areas. But I believe the technique can also be used to develop varieties suitable for the Plains. And while it will probably take a longer time, I believe the fruit breeders will one day also provide apples, peaches, plums, and pears that do well there also. Made-to-order, completely engineered crops are going to be more common in the future.

Advances in Soil Science

Agriculturally speaking, our soils are very young. We know that in some cases they have been greatly improved under farming. In others, they have been greatly damaged. What we are doing about our soils now can have a big bearing on whether our agriculture will continue strong, or start the downward trial that many civilizations followed in the past.

With x-ray and chemical analyses, soil surveys and mapping, electronic microscopes, and radioactive isotopes, soils research men are slowly building up the knowledge we need so much. We are finding many things we never knew before about fertilizers, lime, manure, and crop residues; about erosion control; about drainage and irrigation; about the minor elements and their effect on plants and animals. With the electronic microscope we can now study tiny soil fractions to learn what organic matter is, how it is formed, and how it functions in the life of the soil. With radioactive phosphorous and other materials, we are finding out how nutrients are absorbed and transferred to various parts of the plant.

The time is coming, perhaps soon, when farmers will be able to determine in advance the management needs and prospects for crop production of any combination of soils, crops, and climate.

That includes water. The more we increase acre yields, the more it is likely that water, not land, will become our most serious limiting factor—in humid areas as well as in dry.

Irrigation experts estimate the efficiency of most farmers in using irrigation water is probably 35 to 55%. Yet there is no valid reason why 80% efficiency or better cannot be obtained. Research is now giving us some clues on how this can be done. Good fertilizer practice and good irrigation go hand in hand, for example, in producing better crops. In experiments in Arizona, heavy fertilization and frequent light irrigations produced almost twice as much hay to the acre as when low rates of fertilization and normal irrigation were used. The proper combination of practices increased the efficiency of water almost 100%.

There's no doubt that we are going to learn how to use fertilizer more effectively in areas with 10 to 20 inches of rain.

Labor Saving

The time spent in caring for livestock—or doing chores—still requires more than a third of all farm labor. That amounts to about 6.5 billion hours of work a year. If farm workers were on a 40-hour week like workers in factories, they would spend almost 16 weeks a year, each, doing chores. That should be reduced.

Milking machines, barn cleaners, and silo unloaders are examples of work reducers. Automatic grinder-mixers for feed are here. Bulk handling of milk has speeded the job and made work easier.

Air-conditioned barns and livestock shelters may sound fanciful today, but they may be common in the future. We are just beginning to find out how big an effect temperature and humidity have in livestock production.

The heat pump can both raise and lower temperature. The possibilities are numerous. One that occurs to me is a pump to warm dairy wash water while cooling the milk.

Multipurpose equipment and high-speed field operations are here. Further refinements can be expected. In many cases machines, in one trip over the field, will plant, fertilize, and spray to control weeds, all at the same time. Research should solve many of the soils and plant problems that prevent full mechanization of crops such as cotton and sugar beets.

Considering other possibilities, we may find that certain weeds can be controlled effectively—and inexpensively—by beneficial insects introduced for that purpose. For example, scientists have imported an insect that lives only on Klamath weed—a serious pest of our western range lands. It won't eat anything else. Under its attack, the weed has been controlled on nearly half a million acres.

Pig hatcheries on a large scale may not be too far away. They will come as research solves two basic questions: (1) a fully adequate substitute for sow's milk to carry young pigs through the first week or two of life, and (2) reduction of the danger of disease losses inherent in such a system. Pig hatcheries offer the same advantages chick hatcheries do: more uniform marketing and more orderly production.

A brand new piece of research shows one possibility for increasing farm productivity: by spraying live virus vaccine into an enclosed area, scientists have been able to immunize, at one time, large numbers of chickens as well as small fur bearing animals. This will become even more important as we increase the number of vaccines to protect livestock.

In short, no matter in what direction we look, the prospects are that, with proper attention to agricultural research, farm life in the future not only will be more efficient, but less back-breaking and more pleasant.

Increasing Complexity

Farming is becoming more complex every year. It already involves large capital investment—in many cases exceeding the per worker investment of industry—and cash costs are heavy. Mistakes in management have far greater consequences to individual farmers than in the past. Mistakes multiplied spell upheavals affecting the whole nation. Along with technical know-how, therefore, farmers more than ever need reliable information to help them answer the questions of farm management which, almost invariably, revolve around this one: "Will it pay?"

I believe research, whether conducted by states, by the federal government, or by industry, will have to devote more and more attention to question of farm management and production economics.

In addition to farm management and production research, other types have specific value for farmers. Knowledge produced by science can help cushion the impact of periodic surplus supplies, just as it has helped in the past to increase farm production. We already have good powdered citrus fruit juices, powdered tomato juice, and tasty powdered eggs. We're making progress in finding how to make good powdered whole milk. It well may be that a stable whole milk concentrate or powder will do for the dairy farmer what frozen concentrates have done for the orange grower. Research such as this, which is transforming perishable foods into storable form, is bound to be useful in adjusting marketing to demand more readily.

Research—if given the proper chance—can be our most powerful tool in building a better agriculture. But it isn't only a question of finding out if something will or will not work. Let us remember that the pursuit of practical results from applied research is not the whole of agricultural research. Pursuit of fundamental principles is just as important. The environment which encourages such pursuit is one of our most valuable assets.

Even so, progress won't be automatic. We can't sit back and trust that things will take care of themselves. We need to look ahead in our research and direct our energies toward the opportunities as well as the responsibilities. Agricultural research has demonstrated during the past 50 years a growing capacity to help solve every kind of farm problem.

There every reason to believe, therefore, that if we move ahead in research as we should, our agriculture can be made ready for whatever the next 50 years may demand.