for the four freedoms—freedom of religion and of speech, and freedom from want and from fear. Freedom from want means not only from want of food, clothing, shelter for all, but also freedom from the want of medical services for all who need them. Freedom from fear not only from fear of foreign aggression, but also from fear of poverty, sickness and helplessness. Through many centuries and in many countries this struggle for freedom has been going on and much progress has been made. The present world crisis is perhaps the greatest as it is certainly the most wide-spread of all the battles for freedom.

In the matter of freedom from the fear of many epidemics, such as smallpox, the black death, yellow fever, diphtheria, typhoid, etc., medical science has largely conquered helpless and irrational fear. To-day fears of cancer, poliomyelitis, heart disease are wide-spread, but when their causes are more fully and generally known irrational fears will be relieved, even if their prevention and cure have not been solved. For example, in the epidemic of infantile paralysis in 1916 many towns and villages established shot-gun quarantine against all transportation of persons under sixteen years of age. In the 1890's similar quarantines were set up against all persons coming from yellow fever districts. Medical science has in large part removed such irrational fears even if it has not established unfailing cures of these diseases or means of their prevention. We fear most those things which are mysterious, "the pestilence that walketh in darkness," the causes of which are unknown.

But the want and need of medical attention and skill on the part of the population in general is more important than their relief from fears. The enormous amount of preventable sickness and incapacity for useful work is one of the greatest if not the very greatest of all social problems. This problem must be attacked realistically. In addition to private practice, supplemented by public hospitals and clinics, there must be increased facilities for taking the results of medical science to those who need them most, and if this is not or can not be done by the age-old method of private practice it will necessarily be done by some system of public or socialized medicine. For universal medical service is a social necessity and can not be indefinitely postponed.

I congratulate you who are to-day admitted into the ranks of this honorable profession. May you bring to it the skill and resources of modern science and the altruism and idealism which have made medicine a humanitarian profession and not merely a business or trade.

AGRICULTURAL RESEARCH IN THE WAR AND AFTER. II

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When Knowledge is a Matter of Life or Death

So much for the fruits of past research and the answer to my second question—What is agricultural research doing now?

More than any other crisis we have ever met, this war has proved that possession of scientific knowledge is a matter of life or death. As has been pointed out, it is not an accident that we are suddenly able to increase agricultural production beyond all previous records just when it is vitally necessary; that our soldiers and civilians are adequately fed for the strain of war; that we can develop scores of new techniques and products to meet specific needs and turn out the products in huge quantities. We can do these things only because science was not caught napping but was "tooled up" and had a stockpile of scientific knowledge and experience, patiently accumulated through many years of research—and enough well-developed techniques and trained personnel organized to tackle new problems with an excellent chance of success.

Nor could such a stockpile of scientific knowledge and the necessary techniques and trained personnel be improvised over night. We would not have them if it had not been for the support given to research pertinent to agriculture in this country during the past years and decades. The war has proved that no wiser investment was ever made by the American public.

There is a lesson in this for the future. I hope no one will ever again be tempted to doubt the value of research to the point where public support is reduced, so that vigilance slackens and effort lags. For though I hope we shall never have another great war, I am also certain that if we do have one, our success will again depend in no small measure on how well equipped we are with knowledge developed in times of peace.

It is well recognized to-day that research of all kinds will have to be enlarged and accelerated in every nation that hopes either to retain or to advance its present standard of living. Science truly is one of the great frontiers of a much shrunken world, and

any nation that neglects the exploration and development of this frontier is almost certainly hazarding its future—its potential share in the fruits resulting from technological advances, if not its independent existence.

POOLING RESEARCH SUGGESTIONS

There will be a great need of research in the years ahead. If each one of us here were to sit down and try to think of all possible fields for really fruitful research in the post-war period, and then pooled the suggestions, we would come out with an impressive list. Among many things with which we shall certainly be vitally concerned are these:

(1) Improved nutrition for human beings will be one of the great objectives of the future. Home economists, biochemists, physiologists and animal nutritionists have been among the pioneers in human nutrition. It must be one of their responsibilities to expand their research and continue to provide authoritative information in this field.

(2) In the broad field of plant and animal production, there will be many problems. It would be valuable to build up a detailed, systematic world geography of soils, climatic conditions, varieties of plants and methods of plant and animal production. Much of our knowledge of the development and growth of plant and animal organisms has come from agricultural scientists; we shall be expected to advance on that front, particularly in the direction of still greater control by such methods as breeding and the use of substances that regulate growth and functions. In this connection, world exploration to obtain and then maintain plant and animal germ plasm for breeding purposes will be of decided importance. We are likely to have abundant supplies of cheap nitrogen after the war; our crop rotations and systems of farming will need to be reexamined in the light of the changed fertilizer situation. In any future additional irrigation and drainage projects that may be developed, research by engineers, soil scientists and economists should be carried on in advance so that the causes of past failures may be avoided. The increasingly close contact between countries will mean new problems of insect, parasite and disease control; how can we cope with them, and in particular adapt for civilian use the revolutionary new methods of combating insects that have been developed during the war? Research is needed leading to the development of new and improved immunizing agents for many specific animal diseases.

The nutritional quality of agricultural products will receive increasing attention. We must follow up the promising leads we now have for improving nutritional quality by the proper choice of climate, soil management, cultural practises and plant breeding. We must also continue to investigate means of conserving such quality once it has been obtained. Only about half of all the milk solids dairy farmers produce are used directly as food for human beings; how to make it possible to use more of these valuable products is a problem of world-wide interest. There are literally thousands of identified species and strains of micro-organisms, many of which might be utilized to make valuable new pharmaceuticals, foods and industrial products; would it not be worth while to make a systematic survey of the possibilities in this field, extending the work already started with certain yeasts as relatively cheap sources of protein?

(3) Research in engineering and electrical and mechanical problems will be needed more than ever for such things as the perfection of home freezers, further improvements in refrigerated transportation, developing the possibilities in air transport of agricultural products, the use of the newer building materials for farm structures and improvements in the functional adaptation of farm buildings. Might it not be possible to develop complete sets of labor-saving machinery at reasonable prices for farms of different sizes and types? Although entirely an engineering problem, much will need to be done to develop dehydration, quick-freezing and canning of foods to meet the changed needs and conditions of the post-war world. And as home economists know, we have not yet reached the limit in developing labor-saving devices for the home.

(4) Many of the problems mentioned have both immediate and long-time aspects. In addition, there are many that will be urgent as soon as the war stops and that should be solved as far as possible before that time. For example, how can we best adapt for agricultural use certain equipment that will no longer be needed for military purposes? How can we best use training camp areas —land, buildings and other improvements—for agricultural and rural industries, and especially for aiding and training returning soldiers?

(5) Hundreds of millions of tons of crop residues are produced annually on the farms of this country. We should have a more vigorous research program to exploit this tremendous resource more intelligently for soil improvement, feed and such industrial products as building materials, fuel and chemicals. Some of the products developed might be made right on the farms while others could be the basis for local industries.

(6) Last, but surely not least, we need to think seriously about much more basic research in several fields of science. I need only to point out that our knowledge of such substances as starch, proteins, lignin, hemicellulose, enzymes, hormones and vitamins is still hardly more than rudimentary.

Have agricultural scientists expanded their field to the extent that the results of their research and their contacts with other fields justify? After all, if we find out how to produce excellent plant and animal products, should we not be interested in determining how to keep them excellent and in merchandising them properly until they are consumed by either rural or urban people? Are not the problems, incomes and activities of all people who use the products of the land of considerable importance to those concerned with production? Production, utilization and all that lies between are of one piece and we have not done our full duty until an integration has been effected. Past records of performance have demonstrated

clearly that both personnel and vision for such a task are available.

The list of suggestions just made is by no means exhaustive, but it does represent pressing and important lines of work. It would take careful thought, critical judgment and evaluation by many people of experience to determine what we need to do first and most after the war. Wartime developments and the prospective needs of farmers and consumers must be continuously weighed and considered. Thinking along that line is being done in connection with cooperative efforts at post-war planning, but as much attention must be given to the natural sciences as to economics.

Post-war planning in the social sciences is, of course, very important. Many urgent problems demand attention, such as those involving desirable adjustments in land tenure, cooperative institutions, shifts of population, improvement in marketing methods and various rural social institutions. The urgency of these problems, however, serves to emphasize the need for the closest possible integration of planning and research in all the sciences, natural and social alike, and a careful avoidance of too great compartmentalizing, or departmentalizing, of the planning and the implementing of the plans. There is also need for careful thinking and planning with respect to methods of extending the results of research to industry as well as to agriculture, particularly as they pertain to the utilization of farm products.

New Opportunities and Responsibilities

Agricultural research after the war can no longer be concerned with the needs of the United States alone; it must relate our needs to world conditions. This will be true whether or not there is close post-war collaboration among many countries. It will be doubly true if any such plans for cooperation are put into effect as those discussed at the United Nations Conference on Food and Agriculture held at Hot Springs earlier this year. The delegates at Hot Springs paid a great deal of attention to agricultural science. If a permanent organization results from the conference, as now seems likely, agricultural science must be given critical attention in its work.

I am not going to discuss the work of the Hot Springs conference except to point out briefly the bearing it may have on the development of agricultural research in the future. The essence of the recommendations made at Hot Springs is this:

Agricultural science has reached the point where we can say with some certainty that, given the right conditions, the world can produce enough food to eliminate starvation and raise populations to a considerably higher level of nutrition. At the same time, nutritional science has reached the point where we know what people need, not only to escape deficiency diseases but to bring about very great improvements in the physical conditions of masses of people in every country. What is needed to achieve these results—which are included in the broad objective of freedom from want—is closer integration of various aspects of agriculture and nutrition; the adoption by nations of food production and distribution policies aimed at getting adequate food to all their people; and collaboration among nations to achieve cooperative planning, expanded trade, and so on.

The Hot Springs recommendations envisage a gradual expanding of agricultural production all over the world, and this in turn would involve a gradual modernization of production methods, some reorientation of agriculture to produce enough of the foods needed, better distribution of agricultural products and comprehensive plans and studies to achieve better nutrition.

It would not be possible to do any of these things, and especially to expand, modernize and reorient production, without constant use of agricultural science. Knowledge of improved production, processing and storage methods, and assistance in adopting them, would have to become much more widespread, especially in certain countries. Research would be needed to solve scores of problems that would arise in every country and region. There would be a greater need than ever for scientists of high ability and capacity in various fields to serve in agriculture, where they would have opportunity and freedom to carry on research of the utmost significance to human welfare and would also be needed as consulting experts in the case of broad economic and social policies.

In other words, we are certain to have a world in which agricultural science will play an even more positive and dynamic part than it has in the past; and if recommendations such as those made at Hot Springs are carried out, even very gradually, by a permanent international organization, agricultural science will be consciously used, on a scale never before attempted, to help bring about world-wide freedom from want—and more lasting peace.

That will be both an immense responsibility and an immense opportunity to serve individual nations and mankind as a whole. Are we ready to accept such an opportunity? I believe we are. Agricultural science has done much to shape the world we live in. It is playing an important part in the solution of our present problems. It is ready, able and eager to make the greatest possible contribution in the post-war world.