THE UNITED STATES DEPARTMENT OF AGRICULTURE*

ITS STRUCTURE AND FUNCTIONS

IN the first half century of our national life the Federal Government gave little practical aid to agriculture. John Adams as early as 1776 introduced in the Continental Congress two resolutions relating to agriculture. The first proposed the encouragement of the production of certain agricultural commodities, and the second recommended that the Colonies take early measures for erecting and establishing in every Colony a society for the improvement of agriculture. George Washington proposed Government aid to agriculture in his first annual message to Congress; but at that time he simply suggested that it should be encouraged in a general way along with commerce and manufactures. He had progressed far beyond that point by 1796, when, in his last annual message to Congress, he remarked that as nations advance in population the cultivation of the soil becomes more and more an object of public patronage. "Institutions for promoting it (agriculture) grow up, supported by the public purse; and to what object can it be dedicated with greater propriety?" Nothing came of these proposals.

LINCOLN SIGNED ACT IN 1862

The Act creating the Department was signed by President Lincoln on May 15, 1862, and in that year $64,000 was appropriated for agricultural purposes.

SCOPE OF THE ORGANIC ACT

The Act creating the Department of Agriculture directed it to acquire and diffuse useful information on subjects connected with agriculture in the most general and comprehensive sense.

THE PRESENT STRUCTURE

The United States Department of Agriculture is one of the 10 major executive departments of the Federal Government. Its affairs as a whole are supervised and controlled by the Secretary of Agriculture. He formulates and establishes its general policies. His extra-departmental functions include contacts with Congress, to secure necessary appropriations and to advise regarding pending agricultural legislation; contacts with other executive departments, to co-ordinate inter-departmental activities and to avoid duplication in work; and membership on numerous boards and commissions, such as the Executive Council, the Forest Reservation Commission, and the Migratory Bird Conservation Commission.

In his task of supervising the work of the Department, the Secretary is assisted by a general administrative staff, including an Assistant Secretary, four Directors of principal types of work and a Solicitor. The

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Assistant Secretary aids in the general supervision of the Department and acts for the Secretary in his absence. In the absence of both the Secretary and Assistant Secretary, the Chief of the Weather Bureau becomes the Acting Secretary of Agriculture.

FUNCTIONS OF THE DIRECTORS

Each of the four Directors supervises the work of the Department pertaining to his special sphere, and reports directly to the Secretary. There are Director of Scientific Work, the Director of Extension Work, the Director of Personnel and Business Administration, and the Director of Information. In many cases the responsibilities of the Directors are connected with many of the Department's bureaus and sometimes with them all. Their function, consequently, consists largely in co-ordinating the various activities so as to avoid duplications, to save time and money, and to forward a sound agricultural program. In addition to this general function, each of the directors has an organization under his immediate control. Thus the Chief of the Office of Experiment Stations reports to the Director of Scientific Work. The Director of Extension Work has under him the Office of Co-operative Extension Work, the Office of Motion Pictures and the Office of Exhibits. The Director of Personnel and Business Administration is in charge of the offices dealing with finance, personnel, salary classification, department organization, and general business operations. The Director of Information has immediate charge of the Office of Information, comprising the Division of Publications, the Press Service, and the Radio Service. The Solicitor, who is legal adviser to the Secretary, has a large staff of assistants.

SIX GENERAL CLASSES OF WORK

All the Department's ordinary activities — i.e., not including emergency adjustment work — may be divided roughly into six general classes: (1) research; (2) extension and information; (3) eradication or control of plant and animal diseases and pests; (4) service activities, such as weather and crop reporting, and forest and wild life refuge administration; (5) the administration of regulatory laws; and (6) road construction. These functions are closely inter-related and interdependent. Research, for example, is not complete in itself. Knowledge gained must be communicated to the public, used in eradicating plant and animal pests, and incorporated in regulatory-law administration. It is as essential a duty of the Department to promote the application of science as it is to increase scientific knowledge. These manifold duties though not the result of a preconceived plan, did not come about fortuitously. They developed from small beginnings in directions determined by agricultural and national wants and by the growth of science. The Department is not a mechanical creation but a living institution evolving structurally and functionally in a changing world.

RESEARCH

Research, of course, is fundamental in the Department's work. All interests today recognize that the Federal Government should promote agricultural science. It is a public, rather than a private, function because agricultural research does not ordinarily attract private enterprise. Individuals and corporations seldom have the public spirit, the scientific interest, or the financial resources to conduct agricultural research efficiently.

We may distinguish between research for more or less well-defined practical objects, and fundamental research for the discovery of basic facts and principles. The first type may be undertaken to throw up a hurried defence against diseases and pests, to develop plant varieties or strains of livestock suited to particular conditions, or to find new uses for crop byproducts. Fundamental research is not always directed toward any clearly defined practical goal. It explores physical or biological phenomena, primarily to increase the sum of knowledge rather than to attain any specified tangible advantage. This does not mean that fundamental research is not practical. It is practical in the highest and most permanent sense. Time and again fundamental research has developed facts or principles of revolutionary practical importance.

PUTTING SCIENCE INTO PRACTICE

Service functions grow out of the Department's research. Knowledge gained by the study of animal diseases and parasites is the basis of control measures. Diagnosis of foot-and-mouth disease on its rare appearances in this country has led to its prompt and complete eradication. The same is true of the infectious poultry malady, European fowl pest, which appeared in the United States in 1924 and was eradicated in 1925. It made a second appearance in June 1929, but prompt diagnosis led to its speedy suppression. Research helps to eradicate or prevent bovine tuberculosis, tick fever, hog cholera, sheep and cattle scabies, diseases of animals on fur farms, and various other maladies. Several years ago the Department proved that anaplasmosis, a disease of cattle, exists in this country, and the knowledge led to experimental methods of control and treatment. A study of the so-called mosaic diseases of tobacco, tomatoes, cucumbers, potatoes, sugar beets, corn, wheat, sugarcane, and many other cultivated crops, including fruits, resulted in the development of resistant varieties and the establishment of these varieties in threatened areas.

ACCOMPLISHMENTS OF ENTOMOLOGY

The cotton bollweevil, one of the worst insect pests, has been brought under a large degree of control by thorough dusting of the cotton plants at appropriate times with powdered calcium arsenate. The discovery of the susceptibility of the insect to certain arsenical poisons gave cotton growers a means of decreasing its injury to the cotton crop even during the worst bollweevil years. The result is a net benefit averaging $15 an acre.

Curly top, a serious malady of the sugar beet, is attributed to a small leafhopper. This pest normally migrates from the desert into beet fields, carrying with it a virus which produces the malady of sugar beets. An entomologist trained also in ecology discovered the influences which result in the migration of the insect and the conditions under which migration is likely to take place. Hence the Department can inform growers, in time for the information to have a bearing on their sugar beet planting, whether an abundant or a light infestation of the pest that causes curly top is likely to occur during the coming season. Recently Department scientists developed a variety of sugar beet which is resistant to the curly top disease.

CORRELATING DISEASE KNOWLEDGE

That plants, like animals, are subject to disease has been known from the beginning of history. The Bible frequently refers to "blights and mildews" of plants and Aristotle, B.C. 300, speaks of the rust of wheat. It is only within the last hundred years that the fundamental discovery was made of the relation of fungi, bacteria, and other microscopic organisms to plant diseases. Pear-blight was the first bacterial disease of plants to be so recognized. Why the disease often developed almost at once on the whole bloom of the tree, however, was still a mystery. One morning, in the Department's grounds at Washington, a member of the Department saw a bee dive into a pear blossom. He caught the insect, removed certain adhering substances from its head and body, and looked at these substances through a microscope. He found the pear-blight organism. Thus was established the important fact that a bacterial plant disease can be carried from one plant to another through the agency of an insect, and the simultaneous development of pear-blight on many blossoms was explained.

This discovery was followed 2 years later by the discovery that splenetic or tick fever is transmitted by the cattle tick. The joint responsibility of bacteria and parasites in the causation of certain mysterious plant and animal diseases was revealed and a basis laid for effective control of such diseases. Through quarantine action in the Southern States cattle ticks were eradicated from large areas and cattle freed from a disease that had formerly caused heavy losses. Out 985 counties that were quarantined when systematic tick eradication began in 1906, only 89 still had to be kept in quarantine at the end of 1933. This is one of the most outstanding successes of regulatory action based on scientific discovery in the Department.

Benefits derived from the revelation that plant diseases may be transmitted by insects and other invertebrates have not been confined to agriculture. In the tick-fever investigation it was demonstrated that the actual cause of the disease is a micro-organism found in the blood of infected cattle, and that the cattle tick is the only means whereby the disease can be transmitted. This proof that a protozoan disease may be transmitted exclusively by an intermediate host or carrier led to the knowledge that yellow fever, malaria, typhus fever, African sleeping sickness, Rocky Mountain fever, nagana, and other diseases are similarly communicated. It made possible the control of yellow fever in the Panama Canal Zone. Many plant diseases, including sugarcane mosaic and sugar-beet curly top, are transmitted by insects.

TRIUMPHS IN PLANT BREEDING

Another branch of study in the Department that has had important practical consequences, including the enactment and enforcement of certain regulatory laws, is plant breeding. In the strict sense, plant breeding is a comparatively new development, though plant improvement has been going on since man first became interested in plants. Methodical plant breeding was unknown before the discovery that plants are male and female.

This fact, though previously suspected, was not definitely established until less than 2 centuries ago. The greatest progress in plant breeding is a development of the last 20 or 30 years. Plant breeding in the Department of Agriculture has developed plant varieties that thrive where the varieties previously known could not, and has improved the quality, the yield, the disease resistance, and the climatic adaptability of many crops.

Among early triumphs in this field was the discovery of important facts about cotton wilt and about the nematode diseases of cowpeas and other leguminous crops. Through plant breeding the potato industry has been protected and the sugar industry of Puerto Rico and Louisiana reestablished. Plant breeding has pushed up the northern boundary of spring wheat and promises to do the same for winter wheat. The discovery that resistance to disease and to climatic conditions is a genetic character which may be bred into or bred out of plants constitutes the justification for such legislation as the Federal Seed Act. This law requires that all seed of alfalfa and red clover imported into the United States shall be artificially colored, so that the purchaser may know whether he is buying seed of domestic or foreign production.

PLANT IMPORTATIONS

Research and service activities are combined in the introduction of foreign plants, which has been a major function of the Department ever since it was created. As already noted, plant introduction long antedates the creation of the Department. It was practised by the early settlers, and was promoted after 1839 through the Patent Office. All our field crops, except tobacco and corn and a few lesser crops have been introduced from foreign countries. The original home of the potato is below our southern boundary. In the last 30 years or so plant-introduction work in the Department has been systematized and scientifically controlled, and its value much increased. Citrus fruits, durum wheat, alfalfa and Sudan grass, acala cotton, numerous important varieties of soybeans, Japanese plums, vinifera grapes, Persian walnuts, figs, and many other valuable crops have been introduced.

Highly trained plant explorers seek valuable new plants in all parts of the world. These plants, when received into the United States, are tested and cultivated to determine their importance to American Agriculture. Entomologists and pathologists carefully inspect each shipment for pests and signs of disease. All imported seeds are fumigated regardless of their origin, and many bulbs are treated with hot water to kill nematodes. Specimens from countries where especially dangerous pests or diseases occur are given additional treatment. Quarantine houses are maintained where the imported plants may be grown under observation, to disclose any condition not apparent on their arrival. In short, botanical and pathological studies go hand in hand with the propagation and establishment of the new varieties. Some idea of the scope of the Department's plant-introduction work is evident from the fact that the serial numbers given to the imported specimens now run above 100,000. The numbering system was started about 25 years ago.

SOME RECENT ACHIEVEMENTS

The stream of research accomplishments continues to flow. In a single year (1932) the Department reported dozens of achievements important as contributions to the country's economic welfare, as well as to the growth of science. It may be useful to mention just a few of these.

Investigators discovered that endemic typhus fever, a debilitating disease of man which had been increasing in the eastern and southern parts of the country, is transmitted by a mite that attacks the tropical rat. They found also that a small gnat caused pink eye or conjunctivitis, a serious scourge in many parts of the United States, especially among school children. The Department developed a curly top resistant variety of sugar beets which under curly top conditions produced on the average 4½ tons more beets per acre than did the commercial strains used locally. Sugarcane investigations indicated means of decreasing the deterioration of mill cane, of decreasing losses in the recovery of sugar, and of extending the length of the season during which cane may be milled in Louisiana.

In co-operative experiments at the California Experiment Station, early maturing hybrid selections of rice produced better yields than the principal early-maturing varieties, Colusa and Onsen, now grown commercially. The Department developed a new early wilt-resistant tomato named "Pritchard" that appears to rank with Marglobe in excellence and probable future importance. In recent years in the United States the annual injury to beans from seed-borne diseases has run as high as $4,000,000. In 1931 the Department demonstrated that the use in the Eastern States of seed from the Western States will greatly reduce seed-borne diseases. Strains of sweet corn resistant to bacterial wilt, a disease that caused severe damage in 1931, were produced in co-operative experiments with the Indiana State Experiment Station.

Two pedigreed varieties of fiber flax, developed by years of selection, proved superior when tried out in field tests in eastern Michigan in comparison with other fiber flax grown for seed and upholstering tow. A sudden and severe outbreak of downy mildew on hops in Oregon and Washington required the aid of Department scientists. Bordeaux mixture proved an effective control agent. Strains of tobacco resistant to black root rot were developed by the Department in co-operation with State Agencies.

The Department demonstrated that there is a marked difference in the vitamin content of hays. Cows fed for long periods on inferior roughage decline in general health, reproductive ability, and milk production. Investigators found that dairy barn temperatures affect milk yields; temperatures maintained between 45° and 60°F. gave the best results under northern winter conditions. Animal parasite studies conducted with the Oklahoma Station disclosed for the first time that three species of ticks can transmit anaplasmosis, an infectious febrile disease of cattle, from infected to susceptible animals. Investigations revealed that a species of round worm probably causes certain lesions in the livers of swine. Such lesions result in the condemnation of the livers at federally inspected slaughtering establishments.

Asparagine, a rare and expensive amino acid formerly obtainable only from Europe, can now be produced in this country as a result of biological investigations in this Department. Asparagine is valuable in investigations of bovine tuberculosis, the organisms of which make exceedingly good growth on culture media containing asparagine.

Discoveries by this Department have helped to place the United States well on the road to independence in fertilizer materials. So far as nitrogen is concerned, the monopoly is over; research in the Department fostered the production in the United States of cheap nitrogen from the air by a synthetic ammonia process. Though this country continues to import most of its potash, it has a substantial and growing potash industry, and American production promises shortly to be the controlling factor in domestic prices.

A new process has been developed and successfully tested whereby with the use of ammonia and carbon dioxide, potash and ammonium sulphate can be easily manufactured from polyhalite, the potash mineral recently found in large subterranean deposits in western Texas. If the results of the potash work of this Department were applied to the 1930 bill of $22,000,000 for fertilizer potash, this would represent a saving of $13,574,000.

Two new insecticides, deguelin and tephrosin, may prove valuable additions to the list of organic insecticides that can be used freely on vegetation without injuring it. Chemists discovered these insecticides in several tropical plants, derris root, cube root, and certain species of Tephrosia. Rotennone occurs in derris root, and in the cube plant. This valuable new insecticide was further developed by the Department's chemists. It is more toxic than pyrethrum to many insects. Various mechanical appliances developed by the Department's agricultural engineers helped to reduce farm costs of production. To combat the European corn borer, engineers devised a simple stalk shaver for cutting cornstalks flush with the ground. They developed experimental machines for applying fertilizers accurately at predetermined rates and in various positions with respect to the seed. Chemical and plant research had demonstrated the importance of this.

Two new fumigants for insects infesting grain and other agricultural products in storage were developed by the Bureau of Entomology and the Bureau of Chemistry and Soils. These fumigants are now widely used throughout the country for treating a great variety of products, including clothing and house furnishings. These new fumigants are the ethylene dichloride-carbon tetrachloride mixture and the ethylene oxide-carbon dioxide mixture. They are efficient, non-explosive and involve little or no risk to the operator.

Light plays an important rôle in the development of rancidity in foods. This was recently demonstrated by the Department in experiments that led to the granting of a public service patent to make the discovery available to the American public. The experiments showed that the portion of the spectrum lying between 4,900 and 5,600 Angstrom units, which imparts the color approximately chlorophyll green, prevents or delays rancidity. Temporary storage of some fruits and vegetables in atmosphere relatively high in carbon dioxide is an effective substitute for precooling, scientists discovered. This treatment holds rot organisms in check and delays the ripening process somewhat.

The Department showed how waste and costs may be reduced in handling and transporting fruits and vegetables. In orange shipments from California to eastern markets a new method permits safe shipment with only one reicing in transit instead of the 10 or 12 reicings required under the standard refrigeration previously used. With dilute nitric acid as the pulping agent, the Department developed a process for making high-grade cellulose from bagasse, the waste from sugarcane after the sugar has been extracted.

Work on lignin, a component of all agricultural wastes showed that several synthetic resins can be produced from it, as can eugenol, the essential constituent of oil of cloves, and vanilin, the flavoring constituent of vanilla. By processes developed in this Department, industrial chemists produced from agricultural wastes in 1932, more than 1,000,000 pounds of furfural. Some 5,000,000 pounds of oat hulls, which would otherwise have been wasted, were thus utilized.

Inulin, the principal constituent of chicory root, is thought to be the most suitable carbohydrate available for the diet of persons suffering from diabetes. Recently the Department devised a method of producing extremely pure inulin by a simple and cheap process, the most suitable source being chicory, now grown in limited quantities in the United States as a coffee substitute. Experiments at the Department's laboratory of fruit and vegetable chemistry at Los Angeles developed a new fruit product, frozen fruit pulp, which promises to afford a new and profitable outlet for fruit heretofore graded low and sold at a low price.

By a process recently developed in the Department, milk sugar can be removed from skim milk without affecting the casein. This process is particularly valuable to the icecream industry. Investigations developed means of preventing the crystallization of sugar from cane sirup and of controlling the flavour and color of cane sirup by the use of decolorizing carbon. This was an important step toward the more uniform production of high quality sirup.