The Response of Government to Agriculture

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An Account of the Origin and Development of the United States Department of Agriculture, on the Occasion of Its 75TH Anniversary

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Contents

Contents

Seventy-Five Years of Growth and Adaptation

THIS YEAR the United States Department of Agriculture celebrates its seventy-fifth anniversary.

It was on May 15, 1862, amid the turmoil of the Civil War, that President Lincoln signed the act creating the institution; in the same year he signed the Homestead Act and the Land-Grant College Act. Agriculture was at a crisis then, a crisis in which the principal need was more production. It is at a crisis now, though of a different kind. The modern difficulty, which still includes the need to increase the productivity of the farms, embraces also the job of finding scope for increasing productivity.

Hence the Department's work is moving in new directions and developing social research and action to match its purely technical studies. If we notice the influences that shaped the infant institution, we shall better understand the developments of its maturity; for the Department has not broken with the past or started jobs without historic roots. Its present duties are the lineal offspring of its former ones.

Agriculture's problems now turn more on *distribution* than on production. This term includes not merely the physical handling and movement of farm commodities from the country to the town, but the economic consequences of the operation. As everyone knows, science and technology have tremendously increased the farmer's productivity. In Dean Swift's phrase, it is easy to grow

two blades of grass where one grew before. Production per man engaged in agriculture has grown tremendously; and if in this country yields per acre have not increased proportionately, one reason is the expansion of farming into low-yield regions. It may never be possible to regard the problem of production as solved completely, but it is nearer solution than the problem of distribution. As we trace the historical development of Federal aid to agriculture, we find an inevitable growth of interest in the economic and social prerequisites of farm prosperity, as a necessary supplement to continued interest in the technique of production.

Conditions and problems, rather than the influence of supposedly dominant general ideas, explain the order in which the Department's various tasks originated. For a long time, in fact during the first half century of our national existence, the Federal Government did little for agriculture. Some historians have attributed this to the rise of individualism as an economic and political theory; but others have pointed out that public opinion in the United States before and after the Revolution was strongly mercantilist. It wished to replace British trade regulation with an American brand. Federal aid to agriculture lagged because the need was not urgent. When subsequently it became urgent and took form in insistent demands for Federal action to control live-stock and plant diseases, Congress provided for it promptly, although by that time mercantilism had waned and the laissez-faire doctrine had taken its place in the public mind.

After its formal creation in 1862, the Department sought mainly to increase farm production because there was a market for all that could be produced. Underlying the studies in agricultural chemistry, in entomology, in plant science, in animal husbandry, and in animal and plant pathology was a purpose to augment the volume, to increase the variety, to improve the quality, and to lower the cost of farm commodities. This purpose met the requirements of both producers and consumers. It animated the Department's work throughout, and established itself impregnably. Critics urged occasionally, especially when surpluses accumulated, that science should take a holiday; but that idea will not withstand analysis. Even in depressions low-cost production is better than high-cost production. For a long time

research in farm technology was both the foundation and the superstructure of the Department's work. Such work can never decline in importance or be superseded. Eventually, however, production studies ceased to be enough.

Specifically, the Department found itself compelled to deal with marketing as well, not only in research but in a regulatory capacity. By the end of the nineteenth century farm production had increased enormously in the United States and throughout the world. New countries with immense areas of fertile land were competing in the European market. Profitable farming required reductions in the costs of marketing and distribution and also a nicer adjustment of supply to demand. There was need for better crop and market information to guide production and to restrain improper speculation. Accordingly, the Department established first an Office of Markets and Rural Organization, then a Bureau of Markets and Crop Estimates, and eventually a Bureau of Agricultural Economics. It had become clear that the highest skill in production, if exerted blindly, could not make prosperous farmers or insure a stable and dependable supply of food and fibers.

Even that was not enough. It came to be evident finally that production and marketing should be treated not separately but together as the two halves of a single problem. This was a discovery of the farmers themselves. Farming has a natural momentum that causes surpluses to accumulate; and whenever that occurs, with its concomitant fall of prices, farmers seek relief spontaneously in two ways. (1) They attempt to regulate the marketing of their supplies, and to keep back part of their crops until prices recover. (2) If the pressure of their debts permits, they plan for smaller production. They find usually that mere storage makes matters worse, because it stimulates production as well as prices. Therefore they try, generally through cooperative associations, to adjust their marketing and their production together. After the World War they adopted this method extensively and asked Government help. Congress responded by enacting a series of measures which culminated in 1933 with the Agricultural Adjustment Act, which for the first time in our history brought production and marketing effectively together in an operating synthesis.

This seems remote from the original, exclusive interest in the mere technology of production; but the connection is direct and unbroken. As production power increases, marketing becomes more difficult. Efforts to solve the problem begin naturally with studies of supply and demand and with measures for simplifying the mechanics and reducing the costs of distribution. The next step is the simultaneous control of both production and marketing. Whether the Government aids in the control, as it did under the A. A. A., or the farmers accomplish it themselves, it concerns the Federal agricultural agency. After the United States Supreme Court threw out the production-control features of the Agricultural Adjustment Act, Congress passed a measure authorizing the Department to seek farm improvement through soil conservation and the shifting of acreage from soil-depleting to soil-conserving crops. This act likewise harmonized with main trends in the Department's research and with the trend of actual conditions in agriculture.

Agriculture has other great problems that concern the Department of Agriculture. Among them are the questions of land utilization and land tenure. Farmers cannot win prosperity merely by reducing the cost and adjusting the volume of their output, or even by conserving the soil as well. The use they make of the land is important, and also their financial and legal relation to it. Rapid gains in farm tenancy and declines in the equities of owner farmers cannot be checked simply by increasing the farm earnings. Much depends on what happens to the earnings, and this in turn depends partly on farm-tenure conditions. Therefore, along with its research in technology, marketing, crop adjustment, and soil conservation, the Department studies how to improve the relationship between the man and the land. This involves the relationship of agriculture to the whole national economy.

All these problems, which seem peculiar to the present, have their roots in the past. Probably they will require more of the Department than has ever been required of it before. This does not mean, however, that its fundamental principle will have to be changed. As this publication endeavors to show, that principle is simply response, through research and practical assistance, to the most general and most pressing needs of agriculture. The

Department is a part of the national economy. It may be likened to a central nervous system, with fibers running in all directions to carry messages and responses. In other words, it is not an independent entity, capable of moving in one direction while the society about it moves in another. Its life and its aims are those of agriculture and of the Nation.

In short, the Department is not the arbitrary creation of successive Federal administrations or a bureaucracy with an inherent tendency to self-aggrandizement, but an evolutionary product of the same forces that have molded our agriculture, our urban industry, and our social and political institutions. It is an organic part of the living social system, with which it develops in unbroken continuity. It has grown from small beginnings by slow degrees, in a series of responses to the pull of the environment. Expansion or change in its structure and functions is always the result of a summons from the outside, either a signal of distress or a new opportunity for service. Vital rather than mechanical in character, the institution can best be understood through a study of the relationships that have grown up between it and the society of which it is a necessary organ.

Naturally, however, it is difficult to tell the story briefly. The Department deals with all branches of agriculture and rural living, and with many urban interests and institutions. Its work embraces all the agricultural sciences; it concerns the health and welfare of the cities, as well as the life of the farms. Facilitating farm production is only the first of its tasks. In addition the Department keeps watch on supplies at home and abroad, standardizes and grades commodities, guards the food supply from spoilage and adulteration, finds uses for waste products, maps and defends the soils, protects the forests and wildlife, and supervises road construction. It studies land utilization and tenancy and problems relating to forests, floods, frosts, and storms. There is an important human side to the Department's work which finds expression in concern for the health and general well-being of the farm family.

Recently the Department has seen more clearly its responsibility for promoting intelligent consumption of agricultural products. Congress in establishing the agricultural experiment stations

provided for the study of the "composition and digestibility of the different kinds of food for domestic animals." Six years later the Secretary of Agriculture recommended that questions relating to "the use of an agricultural product as food for man should also be considered." President Cleveland in his message to Congress that year added emphasis to this recommendation. He said: "When we consider that fully one-half of all the money earned by the wage earners of the civilized world is expended by them for food, the importance and utility of such an investigation is apparent." Two acts of Congress have since broadened the scope of home-economics research. Now it includes textiles and other products of agriculture, as well as food, and also studies in family economics, the findings of which direct the way toward a richer, more satisfying life.

We cannot set a money value on what the Department does; the benefit is too complex and too widely diffused. Agricultural science merges with other science and nourishes the general culture of the world. The service activities of the Department likewise benefit society as a whole. Social values rarely admit of a cash accounting. Occasionally someone suggests that the worth of the Department should be measurable directly in farm income. That is a grotesque idea, twin to the notion that agricultural science should take a holiday whenever agricultural surpluses accumulate. Farm prosperity depends on many things besides the work of the Department, notably the state of urban industry and trade. There can be no question, however, that Federal work for agriculture pays a return on what it costs. For example, the Department has stamped out foot-and-mouth disease of cattle whenever it has appeared in the United States. Control of this disease costs immense sums in many countries every year. The late Sir Horace Plunkett, Ireland's great authority on agriculture, called the Department "perhaps the most popular and respected of the world's great administrative institutions." [1] If that is true, it is because the Department is worth what it costs and more.

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[1] PLUNKETT, SIR H. THE RURAL LIFE PROBLEM OF THE UNITED STATES; NOTES OF AN IRISH OBSERVER. 174 pp. New York. 1910, 1912, 1913.

Beginnings of Federal Agricultural Work

IT WAS Benjamin Franklin who planted the seed that eventually became the United States Department of Agriculture. He had no idea what would spring from it; nor for a long time had anyone else. Before the Revolution Franklin was in England as an agent of the Commonwealth of Pennsylvania. Although not primarily a farmer, he owned land and realized the importance of farming to the United States. He sent home silkworms, mulberry plants, and specimens of seeds and plants that he thought might do well here. After the Revolution American consuls abroad followed his example. Jefferson, as the first Secretary of State, took great interest in the introduction of plants and animals. It became the practice for the Patent Office, which was then in the State Department, to receive and distribute the foreign seeds and cuttings. As a result, the Patent Office, without neglecting its main function, developed also a kind of division of agriculture. In this way it became the progenitor of the existing institution.

In colonial times, and for a long time thereafter, the country held a limited idea of what the Government should do for agriculture. The early Presidents favored public aid to the country's basic industry; but Congress doubted the constitutionality of the proposal and did not adopt it. Farmers welcomed the introduction of desirable agricultural plants and animals without attach-

ing much value to agricultural science in general. Land was too abundant for them to trouble about getting high yields per acre or a large production of meat and milk for the feed consumed. They could not know that plant and livestock improvement, the eradication or control of plant and animal pests and diseases, the conservation of forests and of wildlife, weather forecasting, and the regulation of markets, would one day be necessary governmental functions.

In those days nearly every farm was also a factory. Farm families worked up their products into clothing, furniture, farm tools, harness, and other things for home use or consumption. Farming itself was only a part-time job; it had to be dovetailed with spinning, weaving, cabinetmaking, blacksmithing, and building. Almost everything the farm produced had to be subsequently handled on the farm in home handicrafts, and crop specialization was rare. Farmers probably did not think they should rely on the Government for advice about sowing and reaping any more than for advice on their countless other jobs. With 80 percent or more of the population living on farms, most farming was necessarily of a self-sufficing character. It was not then sufficiently specialized or sufficiently commercial to evoke organized scientific study by public agencies.

Only a small minority of the farmers could have used scientific knowledge had it been available. Most of them had more urgent preoccupations. They had to fight the Indians, to clear the land, to produce a sufficiently varied subsistence for their families, to build homes, barns, and roads, to cooperate with their neighbors in establishing and governing their local communities, and to be ready at any moment for military service. Even today farm life is more an art than a science. In Revolutionary times, with a continent not yet scratched even at the edge, scientific problems such as plant breeding, increasing the yields per acre, pest control, and soil conservation were secondary interests.

True, the country's leaders usually recognized the wisdom and propriety of public aid to agriculture. In 1773 John Adams introduced in the Continental Congress two resolutions relating to agriculture, the first proposing encouragement to the production of certain commodities and the second advocating the establish-

ment in every Colony of an agricultural society. George Washington proposed Government aid to agriculture in his first annual message to Congress. In his last annual message, in 1796, 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", he said, "grow up supported by the public purse; and to what object can it be dedicated with greater propriety?" President Washington advocated the establishment of a Federal board of agriculture, similar to one that had already been established in England, but nothing came of the proposal.

Apparently the farmers were not eager for it. American agriculture was then astonishingly primitive. Immediately after the Revolution there were no agricultural societies, no agricultural fairs, and no agricultural journals. Farmers used tools not unlike those of the ancient Greeks and Romans. They had wooden plows with iron points, wooden-toothed harrows, hoes, spades, sickles, and flails, and very little else in the way of agricultural implements. Even so, it was more difficult to clear than to till the soil. Cultivating the land after they had won it from the wilderness and the Indians seemed to the farmers a comparatively simple matter, which required neither elaborate tools nor a complicated science. Only the larger farmers, moreover, produced for the market; the vast majority were in domestic rather than commercial agriculture and felt no special need for technical knowledge.

Gradually, however, a different attitude developed. Agricultural plants imported from foreign countries seldom exactly suited American conditions, and had to be selected and adapted. Farmers came to recognize also that different crops may require different soils, that chemistry may be of assistance in farming, and that scientific methods existed for improving crops and combating plant pests and diseases. With the increase of population and the growth of cities, they began to specialize in production for the market. In the colonial period most American farmers were part-time or subsistence farmers; by the first decade of the nineteenth century an increasing number were attempting the much more difficult operation of production principally for sale. Agri-

cultural societies sprang up. One of them, the Berkshire (Mass.) Association for the Promotion of Agriculture and Manufacturing, bore witness to the new spirit by petitioning Congress in 1817 for a national board to help agriculture and manufacturing. Though Congress did not grant the petition, it formed an agricultural committee in the House in 1820, and 5 years later the Senate appointed a similar committee.

Soon afterward mass migration to the West began, and with it the age of machinery in agriculture. This important change took place in the 1830's or thereabouts. Manufacturing developed rapidly, and agriculture ceased to be predominantly self-sufficient. Knocking at the door was modern invention, with its revolutionary implications for all the world. Inventors produced the cotton gin, the iron plow, the cultivator, and the seed drill. Hussey and McCormick devised reapers; the thresher supplanted the flail; steamships began to ply the Atlantic, and railroads to penetrate the West. Europe, with its growing industrial population, demanded American grain in ever-mounting quantities. England repealed the corn laws.

As a result, American farmers relinquished many of their former jobs, and concentrated on the production of foods and fibers. Inevitably, as their calling became more mechanized and more commercial, they demanded more of science. Therefore Congress in 1839 took a memorable step; it appropriated $1,000 for collecting and distributing seeds, prosecuting agricultural investigations, and procuring agricultural statistics. It did so in response to repeated requests from the farmers, and the action laid the foundation for the present Department of Agriculture.

In making this appropriation Congress established, perhaps unwittingly, a fundamental principle. It recognized agricultural research as a public function. Federal interest in agriculture up to that time had been slight. Henry L. Ellsworth, the Commissioner of Patents, had begun in 1836 to import and distribute seeds, but he did so without official warrant. Congress had ignored various requests from agricultural societies for the systematic collection of crop statistics and had generally taken the position that special aid to agriculture was not a Federal responsibility. In 1839 it departed from that position. It authorized

Federal plant-introduction work, technical research into problems of crop production, and the gathering of economic information. These are basic Federal duties to this day. One of the first jobs undertaken with the appropriation was a study of the possibility of silk and tea production in the United States. Though the specific results were negative, the study set a precedent and established a principle; namely, that agricultural research is properly a public function.

Agricultural research then scarcely existed. Some of the colleges and a few individual scientists were doing a little; but funds were scanty and trained personnel almost unobtainable. Agricultural science, in fact, was rudimentary; and few suspected its potentialities. It is easy enough to recognize today that agricultural research is logically a public function. Ordinarily it does not attract private enterprise, though there are exceptions. Sir John Lawes, for example, developed important agricultural knowledge at the famous experiment farm at Rothamsted, England, without Government support or encouragement. As a rule, however, the expense and uncertainty involved are too much for private enterprise. Few individuals or even corporations have the scientific interest, the public spirit, the money, or the economic incentive to conduct agricultural research efficiently. Therefore public agencies must assume the responsibility.

Essentially, agricultural research is a public rather than a private function, because the benefit cannot be monopolized. Ultimately it goes to everyone. The first to apply its teachings may make a special profit for a time; but when the application becomes general, the advantage becomes general too. Agricultural research can seldom repay the expense to an individual or to a small number of individuals, though it may repay the expense many times over to society. It is a source of wealth which only public agencies can adequately develop. It is a job for the Government, because otherwise it would not be done, at any rate not on the necessary scale. The action taken in 1839 reflected this principle almost as if Congress had fully grasped the implications.

Note that economic investigation, or more specifically the collection of statistics, figured in the appropriation. Modern

agriculture needs economic information just as much as it needs technical knowledge; and the modern era was beginning. In 1800 Washington's farm was in the heart of the wheat country. As late as 1825 the wheat industry still centered in the East. By 1839 migration, railroad building, and invention had moved it into the Ohio Valley, and plunged agriculture into the money economy. Farmers had begun to exchange land freely in the market like other commodities, to depend on specialized cropping, to supply the foreign as well as the domestic market, and to involve themselves inextricably in the credit system. They had entered into a close relationship with urban industry, trade, and finance, and needed a constant and dependable supply of economic data. They had to look about them, if they wished to survive, and to understand their market as well as the means of supplying it. They got little enough economic information from the Government at first, but what they did get whetted their appetite.

Farmers woke up also to the value of production research. Some of the agricultural societies urged the agricultural division in the Patent Office to promote studies in chemistry, botany, and entomology, and to test the plants that it received from abroad. Farmers in the older settled regions began to worry about the loss of soil fertility. Far-sighted ones experimented with soil treatments, and with various plants on different soils. They corresponded with the Government's investigators. An early report of the Patent Office advocated the improvement of worn-out land by the use of peas and clover. As farm became joined to farm, insect perils arose. Native insects turned their attention to the farmers' crops, and one or two pests crept in from foreign countries. Farmers saw the connection between knowledge and results in farming. Sometimes they requested specific studies. As a result of one such request, the Treasury financed a project, which culminated in 1833 in the appearance of the first scientific publication ever issued by the Government of the United States. It was called "A Manual on the Cultivation of the Sugar Cane and the Fabrication and Refinement of Sugar." The scientifically minded were still a minority among the farmers, but their influence was growing.

Establishment of the Department

AS THE Federal agricultural services increased and improved, agitation developed among the farmers for a special agricultural department. Agricultural leaders in 1841 organized the Agricultural Society of the United States and sought through it to interest the Patent Office and Congress in proposals for additional Government aid to agriculture. This society lived only a year; but it started a movement that continued independently, with the result that 10 years later another national agricultural society sprang up with the same main purpose. The new organization was the United States Agricultural Society; its principal demand was the establishment of a Federal Department of Agriculture. Simultaneously there was a movement in some of the States for the establishment of State colleges of agriculture. Opinion in Government circles began to favor the idea of a Federal Department of Agriculture, and in 1858 the House Committee on Agriculture considered a bill to make it effective. President Lincoln lent his authority to the proposal in a message to Congress dated December 2, 1861.

In this message Lincoln advocated the establishment of an agricultural bureau or department. He said:

> Agriculture, confessedly the largest interest of the Nation, has not a department or a bureau, but a clerkship only, assigned to it in the Government. I respectfully ask Congress

> to consider whether something more cannot be given with general advantage . . . While I make no suggestions as to details, I venture the opinion that an agricultural and statistical bureau might profitably be organized.

This message, along with the other influences favorable to the creation of a Department of Agriculture, bore speedy fruit. Congress revised the measure it had previously considered, and passed it in 1862 along with two other epoch-making agricultural laws, namely the Homestead Act and the Land-Grant College Act. The Department act was approved May 15, the Homestead Act May 20 and the Land Grant College Act July 2. The total appropriation for the new Department during its first year was $64,000.

After having declined for 70 years to create a Federal board, bureau, or department of agriculture, Congress acted during the Civil War. Previously the South had objected to the increase of Federal activities. The resignation of the southern Senators and Congressmen removed this obstacle. Another hindrance had been a belief that farmers did not want a department of agriculture. One Senator declared in the debate on the bill that he did not think "one in a hundred farmers of this country . . . has any idea of such a proposition, ever thought of it in his life, or ever will think of it (the Department) if we establish it." Through various societies, and particularly through the United States Agricultural Society, farmers showed that they did want representation for their industry in the Federal Government. Still more important in the final result, perhaps, was the Union's need of more production, particularly of fibers, for the Army; for the shortage of cotton was a serious handicap. Also, the Union wanted to build up an export trade for the purpose of obtaining European credit.

Not until 1889 did the Department become an executive branch of the Government under a cabinet officer. By that time the annual appropriation had increased to nearly $2,000,000. Congress had previously felt there might be danger in placing the Department under a political appointee. However, by 1889 the chiefs of the various divisions had shown themselves relatively free from political obligations, and the objection disappeared.

Up to that time the annual appropriations went largely for the purchase and distribution of seeds and plants. In 1884, however, Congress had created the Bureau of Animal Indusry, and in 1887 it had passed the Hatch Act to aid research at the agricultural experiment stations. These measures encouraged a more extensive Federal program for Agriculture. Congress began to appropriate money specifically for the investigation of crop production, plant and animal diseases, insect pests, reclamation, and certain economic problems.

After that the Department's duties and responsibilities increased rapidly. It became necessary to merge old units and to create new ones for research, service, and the administration of regulatory laws. In the Patent Office period, an agricultural commissioner and a few assistants did all the agricultural work sponsored by the Federal Government. As the work increased, the organization extended into all the States and into Alaska, Hawaii, Guam, Puerto Rico, and the Virgin Islands. The Department also stationed representatives in Europe, South America, and Asia.

Administration of regulatory laws became an important function of the Department. It now administers about 50 regulatory statutes. Among them are the animal quarantine laws, the Meat Inspection Act, the Virus Serum Toxin Act, the Packers and Stockyards Act, the 28-hour law, the Renovated Butter Act, the Plant Quarantine Act, the Food and Drugs Act, the Tea Importation Act, the Import Milk Act, the Naval Stores Act, the Caustic Poison Act, the Insecticide and Fungicide Act, the Steel Importation Act, the Migratory Bird Treaty Act, the Lacey Act (affecting wildlife), the Alaska game law, the Cotton Standards Act, the Grain Standards Act, the Federal Warehouse Act, the Cotton Futures Act, and the Commodity Exchange Act. Like its other activities the Department's regulatory work developed in response to long standing public needs and new conditions created by the progress of scientific knowledge and the growth of population and markets.

The first Secretary of Agriculture was Norman J. Colman, who had been the Commissioner of Agriculture in the Patent Office since 1885. Colman, however, served less than a month as

Secretary. Jeremiah M. Rusk, who followed him, held the position for 4 years [1889–93]. Succeeding secretaries were: J. Sterling Morton [1893–97]; James Wilson [1897–1913]; David F. Houston [1913–19]; E. T. Meredith [1919–21]; Henry C. Wallace [1921–24]; Howard M. Gore [1924–25]; William M. Jardine [1925–29]; Arthur M. Hyde [1929–33]; and Henry A. Wallace [1933–].

Plant Exploration and Adaptation

FEDERAL work for agriculture began long before the creation of the Department with plant introductions. That was the most urgent need. This country had few indigenous crops of agricultural value, and the settlers themselves imported plants on their own initiative. They welcomed the help of Federal representatives abroad, with their facilities for locating desirable plants. Without this help, or some efficient substitute, American agriculture could not have made much progress. It had to draw on foreign sources for all its field crops, except tobacco, corn, some types of beans, and a few lesser crops. Even the potato and the commercial types of tobacco originated below the southern boundary. The discoverers carried the potato first to Europe, and American farmers got it from Ireland.

Lacking funds and facilities for testing the plant introductions, the early commissioners of patents distributed the plant material to farmers. Subsequently Congress took over the distribution. In time the practice departed from the original purpose and included the distribution of common seeds as well as new introductions. Farmers, seedsmen, and Government officials protested against the waste and favoritism involved, but in one form or another the practice continued until 1923. Soon after the creation of the Department, however, the beginnings of a better system developed, in which an experimental testing and distribution

of new seeds and cuttings progressively replaced the indiscriminate and careless dissemination. The Department systematized the work. Its plant explorers sought valuable new plants in all parts of the world, and sent them home for scientific testing and propagation.

Entomologists and plant pathologists inspected all imported plants for signs of pests and diseases, fumigated them, and treated bulbs to kill nematodes. Frequently they grew the plants experimentally for a time, before distributing them, so as to make sure that no pests or diseases would be spread. The plants were tested to determine their merits under different conditions. When finally the selected progeny were distributed to commercial farmers, they could be reasonably sure that the plants harbored no diseases and pests and would be worth a trial. This method retained all the advantages of plant-introduction work, without the drawbacks that accumulated in the congressional seed-distribution period. Originally the motive was to increase the variety, to augment the quantity, and to improve the quality of our farm crops. Though the emphasis on quantity has now declined, the interest in variety and quality remains undiminished.

Some of the foreign-plant introductions proved extremely valuable. Acala cotton, with strains developed from it, came to be planted annually on several hundred thousand acres. American Egyptian cotton, bred from varieties introduced by the Department scientists from Egypt some 20 years ago, supplies the longest and best Egyptian cotton needed by American spinning mills and meets a growing demand by the manufacturers of high-duty automobile- and truck-tire casings. Cereal introductions created new farm enterprises. The first on a large scale was the introduction of durum wheat from Russia. Several varieties proved well adapted to regions of severe climates. Hard red winter wheats from Russia facilitated wheat growing under dry-land conditions.

Other outstanding plant introductions include Sixty Day oats; Dwarf hegari; Hairy Peruvian alfalfa; Sudan grass; the Washington Navel orange; the date palm; the Barouni olive; tung-oil trees; the pistache nut; the papaya; many varieties of vinifera grapes; Persian walnuts; the Meyer lemon; the avocado and

mango; the dasheen; the jujube; the Quetta nectarine; numerous varieties of soybeans; and a wide range of other field and vegetable crop varieties, fruits, and ornamental shrubs and trees.

Plant introductions led to plant-improvement work. Farmers saw the need, and took the first steps. The plants they got from abroad, either through their own efforts or through the Federal services, had to be selected and adapted to American conditions. Farmers tried also to improve native fruits and vegetables, some of which the Indians had learned to cultivate. The chronicler of Raleigh's expedition found grapes abundant in the vicinity of Cape Hatteras; and in 1610 Lord Delaware brought with him French vineyardists, who transplanted the native grapevines. William Wood in 1629 found the native cherry inferior, but had hopes that "English ordering would bring it to be an English cherry." William Penn in 1683 questioned whether it would be better to attempt the improvement of the native fruits, or to send for foreign stems and sets. He believed that things grew best where they grew naturally. The settlers, without ceasing to introduce exotic species, worked hard also to domesticate and improve the native fruits. Yet the American fruit industry has been built largely on fruits not native to this country. Apples, pears, peaches, plums, and oranges head a long list of fruits of foreign origin.

Up to about the middle of the nineteenth century, the plant-improvement work was slow and haphazard. The farmers had very little technical or scientific help. Moreover, once the major crops had become established, they felt no continuing incentive to improve them. They had crop losses from time to time, and normal yields were not particularly high. Land was cheap and plentiful, however, and production could easily be increased by expanding the area in cultivation. Even when the market expanded through the growth of industry at home and abroad, the farmers could satisfy it more easily by expanding their operations than by struggling to increase their yields per acre. When depressions occurred, as they did occasionally, and the prices of farm commodities and of farm land declined, the farmers had only to wait a little. After each crisis recovery came spontaneously, the surpluses disappeared, and the conditions called once more for

extensive rather than intensive agriculture. Individuals here and there made selections from wheat mixtures and natural hybrids, and important commercial varieties resulted. But it was not until after the creation of the Department and the State agricultural experiment stations that plant-improvement work began to be truly scientific.

By that time it had become evident that plant improvement, at any rate in the experimental stages, was a job for specialists. Isolated farmers could not sufficiently bring to bear upon the task the resources of all the agricultural sciences. It was necessary, not only to breed and select desirable varieties, but to test them under different conditions of soil and climate, and also to discover how they might be protected from diseases and pests. Single farmers lacked the means. Farmers could seldom grow crops and at the same time experiment with them scientifically. Plant scientists often have to grow poor crops deliberately, as well as good crops, for the purpose of making comparisons; commercial farmers generally cannot afford the time to grow what cannot be profitably sold. More and more, therefore, they turned over the job to this Department and to the State agricultural experiment stations.

Previously, plant diseases had been wholly mysterious. Federal investigators had studied them, to be sure, but with very inadequate results. In fact for 20 years after 1862 the Federal technical work had to be done with funds that seldom exceeded $5,000 a year. More substantial work was begun in 1885, when the Department obtained funds to establish a section of mycology. Even then, however, the greater part of the Department's annual appropriation, which never rose above half a million dollars annually, went for the collection of statistics and the distribution of seeds. In 1888 the Department obtained additional funds for the study of plant diseases and changed the name of the section of mycology to the section of plant pathology. Simultaneously with its christening, the infant science struggled to its feet and started to march along.

Subsequently the Department merged the division of plant pathology with four other divisions of plant science, and established the Bureau of Plant Industry. Research revealed some

of the basic laws of plant disease, developed methods for destroying fungi with chemical agents and spraying, and indicated rotation and tillage practices useful in preventing or controlling the ravages of diseases and pests. Investigators cooperated with farmers in experiments and demonstrations. In 1890, for example, more than 5,000 fruit growers were enrolled in farm tests to demonstrate the value and prove the use of the new copper remedies for black rot, mildew, anthracnose, and other plant diseases. Potato growers cooperated extensively with the Department in disease-control operations.

As a result, plant science struck deep roots both in the work of the Department and in practical agriculture. It established the possibility of breeding disease-resistant crops, investigated parasite and host relationships, and revealed some of the effects of soil and climate on the growth of plants. Pathologists found that bacteria may cause plant disease, and the discovery opened a new field of research and achievement. They demonstrated methods of preventing or controlling cereal and cotton diseases and of controlling some of the diseases of fruits and vegetables. They established the spraying of certain crops as a routine practice. Federal appropriations for the work increased, and the States contributed to it largely. Research in plant pathology came to embrace the virus diseases and the diseases that cannot be traced to any organism but which result from malnutrition or from unfavorable conditions of soil and climate. An investigator caught bees that had visited pear trees in the Department's grounds at Washington, examined the insects under a microscope, and found pear blight germs on their bodies. He proved that insects may spread plant diseases, and the discovery had important consequences.

Plant research in the Department also includes the study of methods for cultivating cereal, forage, fiber, sugar, tobacco, fruit, and vegetable crops; for determining the best conditions for storing and transporting fruits and vegetables; for determining the best rotations and tillage methods for crops grown in the dry-farming and irrigated regions, and for testing fertilizers and seeds. Another study has to do with quality in farm commodities. Its results have greatly influenced both the production and the

utilization of crops. Original work in the Department revealed certain of the effects of daylight on plant growth and disclosed other relations between light, temperature, and moisture, and the behavior of plants.

Breeding Better Plants and Animals

GRADUALLY the work with plants, along with similar studies in livestock breeding, came to center about genetics, or the laws of inheritance. Genetics ranks with chemistry as a powerful means of making agriculture more efficient and productive. Few studies are more complicated and abstruce; few yield less to purely random experimentation. Scientific men have interested themselves in the basic principles, and have abandoned many false doctrines and eliminated much guesswork. Experiments with organisms of no economic value, such as the pomace flies (*Drosophila*), have taught them much about inheritance, disease resistance, linkage groups, and hybrid vigor. They apply the knowledge to agriculturally important plants and animals. Since the rediscovery of Mendelism in 1900, progress has been very rapid.

It might be supposed, from its difficult and technical nature, that research in genetics results from the growth of science, rather than primarily from the demands or the experience of the farmers. Like other principal functions of the Department, however, experimentation in genetics began on the farms. Farmers themselves, and not the agricultural research institutions, were the pioneers. They began long ago to interest themselves in seed selection, and deliberately to preserve some of the natural hybrids that occurred in their fields.

Recorded farm experiments go back to colonial times. Sea island cotton reached the southeastern United States from the West Indies about 1785, and planters on the islands off the coast of South Carolina improved it by a rigid type of selection from the beginning. Seed selection by farmers was common in the early decades of the nineteenth century. General Harmon in 1830 selected Red May wheat from the white-kerneled May of English origin, and farmers grew the variety extensively in Virginia. In 1862 a farmer in Pennsylvania selected an important soft red winter wheat (Fultz) that was still grown on nearly 1,500,000 acres in 1929. Farmers were producing commercial varieties of wheat by hybridization, or selection from the progeny of artificial crosses, as early as 1870.

Mendel who first established definite laws of inheritance, died in 1884; years elapsed, however, before even scientists appreciated his discoveries. Farmers blazed a trail for the scientists long before the elements of genetics had been reduced to general laws. Mendel's work and subsequent discovery gave the study a tremendous impetus; but it inherited from the nineteenth century a substantial legacy. In short, genetics research in the Department and in the State agricultural institutions is no exception to the rule that agricultural work by public agencies is of external rather than of internal origin.

Probably no single factor in the research program in the Department is more important than the search for "superior germ plasm." This consists in the discovery and development of superior stock through applications of the art of breeding and the principles of genetics. Such superior material then becomes available for use by producers, as well as by the scientists and practical breeders, for further improvement. The isolation of strains having superior germ plasm is of tremendous value in efficient production. Superior germ plasm helps the farmer not only to produce more per unit but also to produce plants and animals of better quality and greater usefulness. In the plant field much has already been accomplished in this respect and although progress has been much slower and less spectacular in the animal field, many of the principles of inheritance are being applied in the development of new and superior strains.

By the use of three principal methods (introduction, selection, and hybridization) plant breeders have developed hundreds of new varieties which are high yielding, disease and insect resistant, of of high quality, and superior in many ways to the varieties previously used. New, superior varieties of wheat, such as Turkey, Marquis, Kanred, Ceres, Federation, Tenmarq, Ridit, and Oro, varieties of oats, such as Iogold, Albion (Iowa 103), and Markton, and varieties of barley, such as Hannchen, Trebi, and Gladron to mention only a few, are now cultivated on more than 40 millions of acres of cropland each year. Apples of higher color and quality and strawberries especially adapted to canning and freezing are now available. Melons resistant to wilt have been developed. Potatoes, such as the Katahdin, which is resistant to some of the baffling virus diseases, have been developed. Corn-canning methods have been revolutionized because of the work of the corn breeder.

Plant breeding is comparatively new. Early man improved his agricultural plants; but systematic progress in the art had to await the discovery, less than two centuries ago, that plants are male and female. That had been suspected previously, to be sure; in fact, the artificial pollination of female date palms dates back more than 2,000 years. Camerarius demonstrated the principle scientifically late in the seventeenth century and indicated that plants may be cross-bred like animals. Only within the last 30 or 40 years, however, have the plant breeders made substantial progress. They are advancing more rapidly now, though results necessarily come slowly because plant breeding must extend through many generations of the plants and the resulting varieties must be compared in different seasons and localities. Enough has been accomplished to create high hopes, but the solution of certain problems will inevitably take years.

It goes without saying that plant breeding should be stable and continuous. Conducted in this way, it improves the plant industries and makes important contributions to social and economic progress. In the Yearbooks for 1936 and 1937 the Department reported its achievements up to date. Together the two volumes recount hundreds of important developments in the breeding of cereals, trees, bush fruits, flowers, and forage grasses

and legumes, as well as in animal breeding. Plant varieties developed through breeding thrive where the varieties previously grown could not. Plant breeding has improved many crops in quality, in yield, in disease resistance, and in climatic adaptability. It has aided the potato and sugar-beet industries and restored the sugarcane industry of Louisiana following its virtual destruction by mosaic disease. It has pushed up the northern boundary of spring wheat and may do the same for winter wheat.

Among recent achievements are the development of the wilt-resistant Marglobe tomato, which saved the Florida industry from ruin; the development of strains of cantaloup that resist powdery mildew; the breeding of lettuce capable of resisting both brown blight and powdery mildew; the breeding of snap beans that resist the chief diseases of that crop; the breeding of cabbages resistant to yellows; the breeding of wilt-resistant sweet corn superior in canning value; and the development of superior varieties of fruits—notably strawberries, raspberries, blackberries, blueberries, and citrus fruits. Within the last 25 years investigations in the Department, in cooperation with the experiment stations, have revolutionized corn breeding and produced strains that in yield and quality far surpass any of the varieties previously grown.

First, the corn breeders demonstrated the inadequacy, or the great limitations, of the older corn-breeding methods. Then they experimented with selection during inbreeding and cross-breeding and with exact matings under definite control by hand-pollination between individual plants. These operations did not produce improved corn immediately. They provided the best possible true-breeding lines, however. These strains, though inferior to ordinary corn, had a supremely valuable characteristic in that they bred true for the characters they possessed.

The fixed material allowed the corn breeders to proceed with a certainty never possible before, and they tested the selfed lines in hybrid combinations. The hybrids that yielded most, had the soundest grain, the stiffest stalks, and the greatest resistance to drought, pests, and diseases were chosen for commercial crops. Only the first-hybrid combination, the seed from the direct crossing of different strains, had maximum value; it was necessary to

produce new hybrid seed corn annually. But the operation proved well worth while; for the hybrid selections yielded from 7 to 10 bushels per acre more than the best of the open-pollinated varieties.

Continuous research developed rust-resistant grains. For example, Ceres wheat, developed from a cross made in 1918, had a good record of yields, quality, and resistance to stem rust. Ceres was somewhat susceptible to rust but had ample resistance to avoid important damage for 10 years after it was distributed in the Dakotas and Minnesota, where the variety became widely grown. In 1935, however, abundant windblown rust spores from the South, along with unusually favorable conditions for rust development in the North, caused Ceres to rust heavily, and the yields were low. Meantime, the Department, in cooperation with the Minnesota Agricultural Experiment Station, had bred another variety. This variety, Thatcher, was more resistant than Ceres and withstood the rust.

Taken as a whole, the grasses are more important to mankind than any other group of plants. They include not merely the forage grasses, used for meadows, pastures, soiling crops, and range grazing, but also the food grasses, which include our great cereal-grain crops, the industrial grasses such as sugarcane, and the vastly important group known as bamboos. The bamboos alone furnish food, shelter, clothing, household furnishings, and a multitude of domestic supplies for nearly a quarter of a billion people in the Orient.

American agriculture is moving toward new frontiers where forage grasses will be even more important than they have been in the past. Accordingly, the Department is trying to develop forage grasses that will be useful as economic shock absorbers when overproduction of staple crops may dictate crop shifts. It seeks also to find grasses that will be valuable for soil conservation under different conditions as well as for their nutritive properties. It is making analyses of all the known native and introduced species of grasses in the United States.

In the case of the larger animals, livestock improvement involves such a long-time, expensive program that it is impractical to raise experimentally the large populations that are necessary for efficient progress. Nevertheless, the fundamental principles

of inheritance are essentially the same in the animal as in the plant kingdom. There is reason to believe that genetic factors concerned with disease resistance, growth, body size, performance, and fecundity can be obtained in relatively homozygous condition by application of the proper system of breeding and selection. Through introductions of the proper animal material and application of the correct breeding system, not only is it possible to concentrate important hereditary factors in strains of domestic livestock, but this is already being accomplished.

One outstanding achievement is the development of improved strains of cattle by practical cattle breeders in Texas. The Department has under way a similar program in which the Brahman and Aberdeen Angus breeds of cattle are being crossed for the purpose of combining certain desirable characteristics. Another experiment crosses the imported Africander cattle with the Aberdeen Angus. Dairy-cattle breeders in the Department are engaged in a significant longtime experiment in concentrating superior germ plasm that has already affected the practices of commercial breeders. The Department is experimenting with combinations of Southdown and Corriedale breeds of sheep for the purpose of producing more efficient and true-breeding strains of sheep for hothouse-lamb production. An important part of the improvement program with cattle, sheep, and swine consists of record-of-performance tests, in which efficiency of feed utilization and quality of animal products are evaluated.

In poultry, Department workers have demonstrated that first-year egg production is determined largely by four heritable characters—sexual maturity, rate of laying, absence of broodiness, and persistence of production. By the proper selection of breeding stock, based on the progeny test, it is possible to develop superior laying strains. For the past decade poultry breeders in several States have been carrying on record-of-performance work on their own premises, with the object of identifying superior sires and dams and perpetuating superior strains of laying stock. The various State rules and regulations governing the poultry record-of-performance work are standardized through an unofficial organization known as the United States Record-of-Performance Federation.

In the last third of a century scientific breeding with both plants and animals has become agriculturally indispensable. The production of strains of plants and animals relatively pure for efficient production of high quality ranks in importance with the conservation of the soil. The Department is well launched in genetics research. An interbureau committee is making an inventory of genetic accomplishments as a basis for further intensive study. It is cataloging for the use of scientists and farmers the superior strains of plant and animal breeding stock now available. As an indication of the possibilities in this field it may be mentioned that flocks of well-bred poultry produce more than 200 eggs per bird annually, as compared with an average of 82 eggs a year in farm and commercial flocks. In a survey of 4,000 dairy sires, representing the best dairy herds in the country, geneticists listed only 300, or less than 10 percent as excellent from the standpoint of transmitting high production.

Battles Against Livestock Diseases

SOME of the battles waged against the diseases of livestock have had a great influence on the development of the Department. Meat production increased tremendously in the United States after the Civil War, particularly on the western ranches. It reached a point that made an export outlet indispensable. Such an outlet was obtained, notably in Great Britain. This country's export trade mounted rapidly, both in live cattle and in dressed meats, until in 1878 the British discovered several cases of contagious pleuropneumonia in American beeves. Accordingly, by an order of the Privy Council dated February 6, 1879, the British Government decreed that all American cattle arriving at English ports should be slaughtered on the docks. Immediately the price of an American steer in the British market dropped about $10 below the price paid for a similar animal shipped from Canada. This was a heavy blow; for when the production of any commodity spills over normally into the export market, the price obtainable for the export proportion determines the price for the whole supply.

Contagious pleuropneumonia had entered the country at New York in 1843, in a cow bought from the captain of an English ship. Long prevalent in other countries, it had never been stamped out in any extensive infection. It is very insidious and destructive. From the infected animal the disease spread to many

herds in New York State and New Jersey. Another infection broke out in 1859 in Massachusetts; it had been brought there by four cows from the Netherlands. Port inspectors saw that the animals were sick, but the infection escaped, and within 4 years it had appeared in 20 towns in Massachusetts. Soon it developed in Connecticut, Delaware, Pennsylvania, Virginia, and the District of Columbia. Alarmed cattlemen demanded joint action by the States, but the States could not get together. It was necessary to invoke Federal action.

Congress had to pass laws to provide funds and to create an administrative organization; for it was a new type of emergency. William H. Hatch, of Missouri, introduced in 1884, a bill to establish the Bureau of Animal Industry. Public opinion had come to recognize that State action working at cross purposes and without concerted aim or uniformity would never be sufficient and that Federal action was indispensable. The new Bureau launched an energetic campaign. With the cooperation of State authorities, it eradicated the disease within 5 years, and the malady has never since gained a foothold in the United States. This victory encouraged the Bureau to pursue a similar course against other livestock diseases. It moved forward to notable victories against hog cholera, cattle fever, anthrax, and bovine tuberculosis. Through drastic, timely action it stamped out foot-and-mouth disease in several outbreaks. Its fundamental aim was the protection and development of the livestock industry.

One discovery in the treatment of livestock disease has been mentioned often, but it will bear repeating. Cattle fever entered the United States in colonial times from the West Indies and Mexico, and caused tremendous havoc during the greater part of the nineteenth century. Observers noted that southern cattle, though sometimes apparently immune themselves, left a trail of the disease when they were driven north. Farmers suspected the cattle tick, but scientists at first scouted the idea. Research by a trio of Department scientists (Smith, Kilborne, and Curtice) finally upheld the farmers' conclusion. These research workers proved, however, that the actual cause of tick fever in cattle was not the tick itself but a protozoan parasite that the tick harbored and implanted in its victim. Curtice placed young ticks on

northern cows, which then became sick with the cattle fever. Ten years later another investigator in the Department found the infective micro-organism in cattle fever ticks and their eggs.

These discoveries, besides leading to the control of cattle fever, brought great results in medicine. They were the first demonstration that a microbial disease can be transmitted *exclusively* through an intermediate host or carrier. Few discoveries in pathology have had a more extensive and beneficent application. Physicians learned from them how to control many dreaded diseases, including yellow fever, malaria, African sleeping sickness, Rocky Mountain spotted fever, and nagana. They fixed responsibility for the transmission of yellow fever on the mosquito. One result was the building of the Panama Canal with a comparatively small loss of life. The French had failed in that project owing largely to the presence of yellow fever in the Canal Zone.

More recent research, along with the application of veterinary science, has helped greatly to stabilize the livestock industry. Each year it becomes more secure from diseases, parasites, and other pests. Bovine tuberculosis has been practically eradicated from 44 of the 48 States, and vigorous campaigns are under way against Bang's disease, or infectious abortion. The area under Federal quarantine for the control of the cattle tick has been reduced to about one-twentieth of its original size. Control of hog cholera through the serum-virus treatment has become a routine procedure, and hog raisers who use it in combination with modern systems of swine sanitation have a dependable safeguard. Sheep raisers have means of controlling stomach worms, scab mites, and other parasites in their flocks. Biological products such as dips and disinfectants give the livestock industry additional protection. Pullorum disease, a major drawback in raising poultry, is being controlled. Knowledge of Mendelian inheritance guides the livestock breeder. Meantime, quarantine and inspection services prevent the introduction of livestock diseases from abroad, and Federal meat inspection insures the wholesomeness of the domestic meat supply.

Chemistry—
A Basic Agricultural Science

CHEMISTRY is the science which has contributed most to agriculture. But it is not the first subject to claim attention in a new agricultural society. The reason is obvious. Nature manages the chemical composition of the soil; nature maintains a biological laboratory which, if man does not ignorantly disturb it, will transform plant food into plants and imprison the radiant energy of the sun in carbohydrate and other material. In a new agricultural country farmers need not concern themselves immediately with problems of soil depletion, soil erosion, or loss of soil fertility. The first task is to utilize the bounty of nature in raising plants and animals. Interest in plant introductions and in plant improvement logically preceded interest in agricultural chemistry in the United States.

It was not long, however, before the chemical problems of agriculture demanded recognition. Worn-out land was a problem in the East before the West had been touched. The Patent Office employed an agricultural chemist within a few years after Congress had taken the initial step of appropriating $1,000 for agricultural investigations. One of the first agricultural reports of the Patent Office, as already mentioned, recommended the use of peas and clover as a remedy for soil depletion. This was the result of chemical analyses both of soils and of plants. In 1854 Congress increased the agricultural appropriation to $35,000, and

the agricultural commissioner began to coordinate studies in agricultural chemistry, botany, and entomology. Soon after the Department came into existence on an independent basis in 1862 it created a division of chemistry, with C. M. Wetherill as the first chief. The new division made its first report in 1862; the report dealt mainly with analyses of agricultural products. Interest in chemistry had been growing fast since 1840, when Liebig published his epoch-making work, Chemistry in Its Application to Agriculture and Physiology. Indeed, the farmers expected more from it than it could deliver.

Federal work for agriculture reflected farm needs and demands quite as directly 75 years ago as it does today; and it is evident from the place that chemistry held in the Department's early reports that farmers wanted chemical information. In 1869, for example, the Division of Chemistry published an analysis of soils and urged the establishment of an experimental garden for the study of problems in agricultural chemistry. In 1870 it reported on the alkali soils of the West from the standpoint of their physical properties, their chemical constitution, and their power to support vegetation. In 1871 it emphasized the value of sodium nitrate as a fertilizer. It showed that the soils of the bluegrass section of Kentucky renew their stock of phosphatic materials by the decomposition of limestone rocks. In 1873 it reported on the chemical composition of vines and of fertilizers. In 1885 it investigated the nitrogen nutrition of plants and the work of bacteria in supplying nitrogen to the soil.

Chemists in the Department began to realize about 1890 that the productivity of soils may not depend wholly on their chemical composition. They studied the physical properties also and indicated methods of tillage that would conserve moisture and prevent wind erosion. In 1896 the Department made a study of deep subsoiling to conserve moisture in dry seasons; in the following year it sketched the outlines of a system of soil classification. In 1898 it began a research project on the influence of soils on the heredity, flavoring, and fermentation of tobacco. By 1900 soil surveys had mapped 12 areas and laid the foundation for important subsequent developments. In view of the interest today in soil conservation it is worth noting that the early reports of the soil survey called

attention to soil erosion and emphasized the value of leguminous crops in maintaining soil fertility. Chemistry has made equally important contributions to other agricultural problems—the study of fertilizers, insecticides, nutrition, the function of trace elements in the plant and animal life, and the industrial utilization of farm crops and byproducts.

Potentially the agricultural applications of chemistry are boundless. Agriculture deals with the chemical composition and mutual chemical relations of soils, crops, and farm animals insofar as they concern the production of means of human subsistence and welfare. All agricultural problems have their chemical aspects. Soil chemistry of course is fundamental. Chemistry is important in studies of crop utilization, of processing, of storage, and of plant and animal nutrition. It takes approximately 1,000 calories of energy to produce an ounce of sugar from carbon dioxide and water, and yet plants produce many ounces. Scientists do not yet know how they perform this miracle nor how plants operate their factories without using enormous pressures, high temperatures, expensive chemicals, and elaborate equipment. This mystery shrouds the basic problem of all life on the earth. Chemistry is endeavoring to solve this biological problem; and when it does so man's power over nature will be enormously enhanced.

Meantime, however, exaggerated hopes and also exaggerated fears cluster about the possibilities of agricultural chemistry. Chemistry grew out of alchemy and to the layman still has a magical character. Optimists foresee great extensions of the agricultural market through the industrial utilization of farm wastes; alarmists predict that chemistry will synthesize foods in the factory and do the farmer out of his job. Therefore the subject exerts a peculiar fascination. Liebig's discoveries led farmers for a time to think that the productivity of the soil could be increased indefinitely at will; that it would be possible to suspend the law of diminishing returns. Successes in byproduct utilization engendered fantastic hopes. On the other hand, certain enthusiasts, fired by the achievements of chemistry in synthesizing a small number of organic compounds formerly obtained from plants, imagined that eventually man would not need to plow, sow, and reap.

Experience has discounted both the hopes and the fears. Chemistry has no power, at any rate as yet, either to expand the farmer's market indefinitely through the improved utilization of his products or to supplant him in the production of food and clothing. It can improve both the farmer's crops and the farmer's market, though perhaps at the expense of new intercommodity competition. Usually the balance is substantially on the favorable side, and collaboration between chemist and farmer will undoubtedly continue. Farmers, manufacturers, and consumers have a common interest in the result. But chemical discovery, like other aspects of technical progress, is not always an unmixed blessing. As it opens new possibilities, it creates a need for readjustments, and may even disturb the balance between town and country. It is necessary to prevent the unscrupulous exploitation of chemical discovery on false grounds, to correct the disadvantages that may accompany its benefits, and to harmonize it generally with the requirements of our complicated social system.

In response to the requests of both farmers and industrialists the Department has given great attention to the utilization of agricultural wastes. When the farmer grows 100 pounds of grain, he produces from 100 to 250 pounds of straw, stalks, or husks. He expends his own energy, and the fertility of the soil, as much in the production of these things as he does in the production of the grain. Farmers do not wholly waste these materials; they use them for feed or fertilizer. But the incentive to use them more profitably and directly is strong, and it has prompted a large amount of successful chemical experimentation. Cottonseed, for example, was once a nuisance. Chemistry has transformed it into an important source of wealth. Chemical science has likewise revolutionized the utilization of citrus culls and citrus byproducts and developed commercial methods of obtaining from them such things as lemon oil, orange oil, citrate of lime, citric acid, pectin, marmalade, and stock feeds. It has discovered how to convert Indian corn into starch, dextrine, commercial glucose, dextrose, and maize oil.

Another important field of agricultural chemistry involves the technical utilization of the main products, as well as the byproducts of the farm. There are chemical problems in the handling,

storing, and processing of grain, meats, fruits and vegetables, and dairy products. Chemistry is indispensable to the technologists interested in the manufacture of sugar, sirup, vinegar, butter, cheese, dried and canned fruits, and countless other agricultural products. It is important in meat packing, in the tanning of leather, in baking, in the prevention of food spoilage, in the production of alcoholic beverages, of candy, and of volatile oils, in the conversion of cereals and tubers into starch, and in the conversion of starch and sugars into alcohol or other liquid compounds that have fuel value. An important current project is the search for new industrial uses for soybeans.

There is an intimate relation, of course, between chemistry and economics. After the chemist has demonstrated that an industrial use for a farm product is possible, the economist must inquire into its commercial utility. Commercial research and cost accounting are necessary to get the best results. Files of this Department record scores of chemical discoveries and innovations which, though technically successful, remained for a time unutilized commercially because the first manufacturing costs were too high. Manufacturers can obtain straw and similar farm wastes, for example, only by paying more than they are worth to the farmer as feed or manure. That may be more than they can afford. Some years ago the Department developed a process involving the use of dilute nitric acid as the pulping agent for making high-grade cellulose from sugarcane bagasse. It could not be applied commercially until ways had been found to cheapen the technical details of the process. Fortunately, that was eventually done.

Other sciences are closely linked with chemistry in the study of agricultural problems. When the scientist studies the soil, he must draw on biology, mineralogy, and even meteorology as well as chemistry. Sciences cannot be kept in watertight compartments, for the specializations of science have no counterpart whatever in nature. Chemistry becomes part of agronomy, entomology, biology, and economics. It was possible 100 or even 50 years ago to organize agricultural research along the lines of the basic sciences. It is possible no longer. With the integration of scientific work in agriculture, we find chemists in all branches

of agricultural research. Chemists work with the specialists in entomology, in plant breeding, in animal and human nutrition, in solving the chemical problems that arise in these integrated fields of work. Together they can accomplish what no one group could do alone.

The Insect Peril

APPLIED entomology has grown large from a small beginning in the Department's work. It ranks today among the most useful and important branches of agricultural science. More than half of our worst crop pests are of foreign origin. Constant effort is necessary to hold them in check and to prevent new invasions. Crop yields would decline if the Department dropped the control operations.

Insect pests bothered the farmers very little before the Revolution. Farms were small and scattered then, communication with other countries was slow and infrequent, and the chances for accidental importation of insect pests was small. (Nevertheless, two great crop pests did get in—the codling moth and the hessian fly.) Most of the cultivated crops were new to the country, and native insects at first did not attack them.

Eventually, insects began to give trouble. Accordingly, the agricultural division in the Patent Office appointed an entomologist in 1853. One year later the New York State Legislature appointed the first State entomologist. After the creation of the Department in 1862, the Federal Entomological Service developed into an Entomological Division, and soon distinguished itself by a brilliant success against an orchard pest in California. This was the cottony cushion scale, which had been causing the citrus growers great alarm.

Federal entomologists introduced from Australia a parasite of the cottony cushion scale, a ladybird called *Vedalia* (*Novius*) *cardinalis*, which rapidly increased and stripped the citrus trees of their scale. Enthusiastic over the result, State entomologists bred colonies of the ladybird and distributed them throughout the State. In a short time the scale had been practically exterminated. This was the first large demonstration that an introduced pest may be destroyed by its natural enemies.

Congress passed the first important national legislation for entomological work in 1876, when it appropriated $18,000 for the investigation of the Rocky Mountain locust. Entomology received another stimulus with the passage of the Hatch Act in 1888, and the establishment of the State agricultural experiment stations. Before the end of the century four events gave it further impetus—the discovery of the gypsy moth and the brown-tail moth in Massachusetts; the entrance of the cotton boll weevil into Texas from Mexico; the finding of the San Jose scale in the East; and the demonstration that insects may carry diseases of man and animals.

These developments attracted wide attention to entomological research and insect-pest control. It became evident that the problem was essentially national, that pests could not be controlled adequately within State lines, and that to keep out new pests and eradicate or control old ones would necessitate Federal action. Accordingly, in 1912 Congress passed the Plant Quarantine Act, created a Federal Horticultural Board, and authorized various protective measures. Subsequently, the work was concentrated in the Bureau of Entomology and Plant Quarantine.

Most of our serious introduced pests entered the country before the passage of the Plant Quarantine Act of 1912. One very serious pest, the Mediterranean fruitfly, became established in Florida a few years ago, but prompt action eradicated it. Long-continued effort has eradicated other pests. For example, the pink bollworm has been eradicated from Louisiana, parts of Texas, Georgia and Florida, after a long battle. Federal cooperation with State agencies provides important protection. The cooperative work includes Japanese beetle control, white-pine blister rust control, pink bollworm control, phony peach eradication, barberry eradi-

cation, grasshopper control, and eradication work against the Dutch elm disease.

Quarantines are indispensable, more so today than ever. Aircraft travel involves peculiar dangers. For example, when the *Graf Zeppelin* arrived on her second trip in 1929, plant quarantine inspectors found 20 species of insects in the plant material on board, 6 of them not known to occur in this country. Each year the quarantine officials inspect several thousand airplanes from foreign countries and intercept quantities of prohibited plant material. They often intercept injurious insects, particularly the fruitflies and the pink bollworm.

The research work is done in the Department's laboratories and in the National Museum in Washington, D. C.; in a new laboratory group at the National Agricultural Research Center at Beltsville, Md.; and at 92 stations in 34 States. Also, the Bureau of Entomology and Plant Quarantine has a number of foreign parasite laboratories. Its work develops new insecticides, introduces and determines the value of parasitic insects, aids the plant scientists in developing plant varieties capable of resisting insect damage, discovers new species of insects, reveals the life cycles of insect pests, and develops various methods of insect control.

Growth of Forest Care

FOREST care as a Federal job has developed gradually in response to growing national wants. It goes back to colonial times. As early as 1615 the Crown reserved trees in this country to provide timber for the Royal Navy, and marked them with England's broad arrow made by three blows of an ax. First applied in Virginia, the symbol irritated the colonists nearly as much as did the tax on tea. When they formed a government of their own, however, the colonists likewise earmarked timber and timberlands.

Congress appropriated $200,000 in 1799 for the purchase of timberland for American naval needs. It recognized forest protection as a Federal function in 1822 and ordered the naval brig *Spark* to prevent the cutting of timber on public lands in Florida and Louisiana. Subsequently Congress provided for the planting of trees, for the Federal administration of public timberlands, and for the prevention of "timber trespass." Forest conservation lapsed after the substitution of iron and steel for oak in warships. However, the early steps were precedents of great national importance.

Federal interest in forest problems grew slowly in the first half of the nineteenth century. In 1845 the agricultural division of the Patent Office directed the growing of locust trees as a crop. References to forest culture became more and more frequent in

agricultural discussions. Several of the States promoted tree growing. Finally in 1876, by a rider attached to the agricultural appropriation act of that year, Congress authorized a Federal commission to study how timber growing might be encouraged and the existing forests protected. Not long afterward it provided for organized forestry work by the Department of Agriculture, and in 1881 it established the Division of Forestry.

Nevertheless, practical forestry continued to lag. Foresters in the Government service did what they could to inculcate better forest management, but at first without notable results. This was the land-disposal period of our national history. Legislation practically forced the Nation's forest lands into State, corporate, or individual ownership, in the belief that such a course would best promote the general welfare. Instead it fostered ruthless waste and totally neglected the possibility of growing timber as a crop. Forest research revealed truths that influenced public opinion only very slowly, and for a long time the destruction of our forest heritage seemed destined to continue unabated.

But the research was fruitful. It showed the need of forest protection, indicated various methods, emphasized the commercial advantage, and acquainted the public with the benefit from a national point of view. It laid a basis for forest policies on both public and private forest lands. When the problem came up in Congress the Division of Forestry had ready a mass of data that aroused public opinion strongly and crystallized it in favor of a program of forest reform. As a result, Congress in 1891 authorized the President to set aside forest reserves from the public domain.

This was the beginning of our national-forest system. There was urgent need for more orderly use of our renewable forest resources and for the application of forest science on a wider front. Subsequently, in 1905, Congress consolidated all Federal forest work in one department, and brought into existence the Forest Service.

By that time nearly four-fifths of our commercially valuable timberland had passed from Federal control. Heavy carrying charges had accumulated on it, and these, plus a desire for quick profits, dictated a policy of rapid forest exploitation. Reckless

lumbering destroyed forest empires, left a trail of ghost towns and rural slums, and exposed the hillsides to accelerated erosion. This was the situation with which the new Forest Service had to deal.

Meanwhile the foresters had shown that forests can be conserved and used at the same time. They had demonstrated this particularly in the national forests of the West, through practices in the sharpest contrast with those prevalent on private forest lands. Federal forestry, besides protecting and producing timber as a sustained or continuing resource, helped to retard the water run-off and to reduce the height and severity of floods. It proved that forests, whether in public or in private ownership, may be handled so as to promote public and private interests together.

As a result, Congress in 1911 passed the Weeks law. This was a really epochal enactment. It revived a policy that had been in abeyance since 1799, the policy of Federal purchase and administration of forest lands. Armed with the Weeks law, the Forest Service began to protect watersheds east of the Mississippi. Previously it had not been able to function vigorously in this region where no public domain had been reserved as national forests. Congress amended the law in 1924 to authorize cooperation with the States and with private owners in forest protection. The amended law did not attempt to regulate private forest operations, but simply recognized a wide common interest in all forest plans and offered aid to private forest owners in combating fires and planting trees.

Through a decentralized organization, which keeps in close touch with local needs in all parts of the country, the Forest Service now administers a national-forest system that embraces parts of every major mountain range and forest area in the United States and extends into 37 States and 2 Territories. It conducts a multiple-use system of management in the national forests, which makes it possible for these areas to furnish a livelihood in whole or in part for many people and at the same time to provide recreation for more than 20,000,000 visitors to the forests annually. Many people regard forestry largely as a means of securing an adequate supply of timber. That is only one of its important objects. Forestry has other ends as well, notably the conserva-

tion of soil and of water. Fortunately, the same methods that save the trees promote the other objects too, and no conflict arises. Forest management on a sustained-yield basis serves a national interest.

Social as well as economic considerations vest forestry with a public interest. Living in or near the national forests alone are more than three-quarters of a million people partly or wholly dependent on these forests. Forest industries create local markets for farm products, provide work off the farm, increase community advantages, and lighten the burden of taxes. Forest recreation and wildlife afford sources of income. Forests should be protected and improved not only to insure the Nation a continuous and adequate supply of forest products but to furnish employment and build stable communities. Moreover, their indirect value as a source of income is enormous. The forests help to protect growing crops, to control erosion and stream flow, and to conserve water for city needs and for power, irrigation, and navigation.

Administration of the national forests by the Department serves to conserve a tremendously valuable national resource. But, important as conservation is, this is more than just a conservation job. The Department's central task is putting land to its proper use, and in that task forestry is an indispensable tool. In such programs as those for sustained-yield management, for the development of farm forestry, and for regulating grazing within the forests, the Department is administering agricultural activities of the greatest importance. The checkerboard pattern of private and public forest lands tends to emphasize the importance of these purely agricultural phases of forest-land management.

Prior to 1911 national forests had been set aside only from the western public domain. In that year the Federal acquisition of eastern forest lands began; yet until 1933 purchases never exceeded 550,000 acres a year. The total area approved for purchase was only 4,727,680 acres in the first 22 years of the program. In 1933 Congress authorized an accelerated program, and the area acquired in the 3-year period ended June 30, 1936, exceeded 11,400,000 acres. The acquisitions in the last fiscal year aggregated 2,998,060 acres. Besides adding to the system of federally

owned and managed national forests this accelerated program assured county governments of future revenue from lands that might otherwise have become tax-delinquent. Also, it harmonized with other aspects of the national agricultural policy.

Dependence on State Cooperation

FEDERAL aid to the States for agricultural research and service began with the creation of the Department. As noted, Congress passed the Land-Grant College Act in the same year, and there began the close relationship between the United States Department of Agriculture and the State colleges of agriculture which has existed ever since. In 1887 Congress passed the Hatch Act, which authorized appropriations for the support of State agricultural experiment stations. Subsequently, it supplemented the Hatch Act with three other measures—the Adams Act of 1906, the Purnell Act of 1925, and the Bankhead-Jones Act of 1935.

The Department has advisory relations with the experiment stations in matters of organization and administration, personnel, equipment, and the choice, formulation, and coordination of research projects. Agricultural extension likewise involves Federal cooperation with the States. Three measures provide the foundation—the Smith-Lever Act of 1914, the Capper-Ketcham Act of 1928, and the Bankhead-Jones Act, which combines research with educational objectives.

Extension work seeks to promote better farming and better rural living principally through the demonstration method. It aids farmers to learn by doing, as well as by lectures and reading. Each State has an extension director, and nearly every county in

the United States has a county agricultural agent. Nearly a third of the counties have home demonstration agents. In both farm- and home-demonstration work, the farm people themselves decide what shall be done; they meet for that purpose regularly. Extension work has proved that agriculture becomes more profitable, rural conditions improve, and rural life grows richer as the farmers try out ways and means suggested by research, experience, and discussion. In Washington the Extension Service maintains three divisions—the Division of Cooperative Extension Work, the Division of Motion Pictures, and the Division of Exhibits.

Agricultural extension now touches every phase of farming and farm living. Originally it dealt chiefly with the technique of production. In the South, for example, the first concern was to meet conditions brought about by the spread of the cotton boll weevil. In the Northern and Central States problems were less uniform; but even there production was practically the sole phase of farming that the Extension Service emphasized for some time. Always, however, it sought answers to the questions, What are the difficulties met with in farming, and what can be done to remove them? What are the values in farm family living, and how can it be made more satisfying? Until after the World War, these problems generally centered about production. After the war, they came to include problems of marketing, farm debt, crop adjustment, soil care, and better use of available resources for family living. Extension workers now treat technical and economic questions as interrelated. Federal extension workers cooperate in everything they do with the State agricultural colleges. This Department supervises the administration of funds that Congress appropriates to each of the States for scientific research and for extension work.

Home economics extension has its roots in the desire to improve rural living. Production and preservation of the home food supply offered the beginning of a nutrition program that contributed to family health. This derived considerable impetus during the World War from the demand for food production and preservation. The homemaker was also helped through "home demonstrations" to meet problems in clothing, house furnishing, and family eco-

nomics. The work has grown rapidly and has been adjusted to the changing needs of farm homes in different sections. There is increasing emphasis on child care and training, on recreation, and on family and community relationships. Extension has stimulated the development of community organizations through which the farm family takes its place in the social and economic life of the country as a whole.

In 4–H Clubs rural youth demonstrate various farm and home activities such as the growing of corn, potatoes, home gardening, the raising of dairy cattle and other livestock, forestry work, food preparation and preservation, the selection and care of clothing, and home improvements. Through their activities in these groups leadership has been developed which is already making itself felt in rural community life.

After the Department has discovered ways to improve plants and livestock, to eradicate agricultural pests, or to lessen the cost of marketing and distribution, it must communicate the results to the farmers and to the general public. This involves close cooperation with State agencies. The Department distributes more than 25,000,000 copies of its publications annually and issues press releases, special articles, and radio talks as well. It answers millions of letters. The information thus presented must be combined for practical application in what might be termed a balanced diet. Farmers cannot apply technical or economic knowledge in fragments. There is no place in farming for soil facts by themselves or for isolated particulars about biology, chemistry, and entomology. Findings from all these sciences must be synthesized and coordinated for practical application. Investigators must keep in touch with one another and pool their results. This calls especially for collaboration between research workers and extension workers.

Moreover, the utilization of agricultural science requires a partnership between the scientist and the farmer. Neither the scientist by himself nor the farmer by himself can fit together the various parts of agricultural science for practical application. Obviously the scientist cannot give detailed instructions suited to all farms and all conditions. He can combine the results of different studies only in very general recommendations. He can

meet the farmer halfway, but the farmer must do his part, which consists in the collection and sifting of technical and economic facts for his own particular purposes. Science alone can never indicate precisely what the individual farmer should do; nor can the farmer's blind groping, which is far too slow and costly. Scientist and farmer together, with the aid of controlled experimentation, can make theory and practice march abreast. To facilitate this cooperation is one of the Department's major responsibilities.

This it does primarily through extension and information services. Extension work, official publications, radio and press releases, and other means of communication make constantly available to the farmer a "balanced diet" of scientific information. Federal and State extension workers help one another in seeing the problems of the farm as a whole and in proposing cropping and marketing practices that usefully combine various branches of agricultural knowledge. Federal workers keep in close touch with the agricultural colleges, with the State experiment stations, with county agents, and with farmers' organizations. There is Federal cooperation with the States in research, in educational work, in the administration of certain regulatory laws, such as those involving animal and plant quarantines, and in a long list of practical services for farmers and homemakers. Research and extension work go hand in hand, and both involve the closest possible cooperation between Federal and State agencies.

Federal and State agencies work together in numerous research projects that deal with farm technique, land use, rural life, crop adjustment, farm management, and home economics. There are hundreds of formal cooperative agreements and many instances of informal cooperation. The Bankhead-Jones Act of 1935 provides for Federal-State cooperation in fundamental research for the discovery of basic laws and principles, and also for the establishment of regional laboratories. Three such laboratories have already been set up, one for research in vegetable breeding, one for soybean research, and one for the study of grass breeding and pasture improvement. Two bureaus of this Department and 12 State experiment stations participated in establishing the soybean laboratory. Several States shared in establishing the other two. The country's

tremendous area, the diversity of its climate and its soils, and the technological advances of recent years put increasing emphasis on the value of Federal-State cooperation.

In fact most of the Department's work involves cooperation with the States. Both Federal and State laws provide for it. Each year in appropriating money for the Department, Congress specifically directs it to coordinate its work with that of the State agricultural agencies; and, on the other hand, the funds that the States appropriate for agricultural work and extension have to be coordinated with Federal expenditures. Thus the two great systems of agricultural investigation work in close harmony and make a concerted attack on problems that need to be attacked from many angles simultaneously. Important developments in agricultural science have resulted from this Federal and State cooperation. Both the Federal and State agencies devote funds to the same general objects and must coordinate their activities to avoid waste and duplication of effort.

Federal and State cooperation is the basis of our highway system. Forty years ago the Department set up a small organization known as the Office of Road Inquiry, to learn, so that it might teach, how to build, maintain, and administer roads. Roads had then chiefly to carry horse-drawn traffic, and, judged by modern standards, not much of that. Nevertheless, road building demanded scientific and technical knowledge. Accordingly the Office of Road Inquiry conducted road tests and road-building experiments and made reports on road construction and maintenance. It built short "object-lesson" roads in many counties. Local road builders profited by the experience thus gained.

The rise of the automobile and the resulting demand for more and better highways presented new tasks to the Office of Road Inquiry. It became the Bureau of Public Roads. In 1916 Congress undertook to assist the States by passing the Federal Aid Road Act. The new Bureau supervised the construction of Federal-aid roads, a task for which its long study of road conditions throughout the country had fitted it efficiently. In the tremendous subsequent expansion of highways the Bureau played an important part.

The great system of highways which now leads to all parts of the country involves organization, management, and engineering to a degree hitherto unknown in road work. Only a few States had well-organized highway departments when the Federal Aid Road Act was passed. Many were entirely unprepared for extensive road building. The Bureau helped the States to formulate highway laws, to organize highway departments, and to prepare specifications and standards suitable for main highways. It set up testing laboratories and tested much of the material used, as only a few States had facilities for such work. It developed a program of cooperation with the States in highway research, construction, and administration.

This policy speeded the improvement of a correlated Nationwide system of main roads, caused main-highway construction to be centered in efficient highway departments, maintained adequate standards of construction, and pooled available road knowledge for the benefit of all the States. Congress in 1921 amended the Federal Aid Road Act in an important respect. It provided for the expenditure of Federal-aid money on a connected system of main highways not exceeding 7 percent of the total mileage in any State. The step had far-reaching effects. It prevented the dissipation of funds on short sections of disconnected roads and led to the creation of a road system that now reaches all parts of the country. Planning and coordination by Federal and State officials under the Federal Aid Road Act made this possible.

In the last few years Federal and Federal-aid road construction have employed thousands who would otherwise have been jobless. Moreover, the benefit has extended far beyond the number employed directly in this work. It has included perhaps twice as many persons engaged in producing and transporting materials, machinery, and supplies. At the height of the 1934 season road construction with regular Federal-aid road funds and funds provided for emergency relief resulted in the direct or indirect employment of 800,000 men.

Guarding the Food and Drug Supply

MANY governments have enacted laws to prevent the adulteration of foods and medicines. The ancient Athenians and the Romans forbade the adulteration of wine and certain foods. As early as the thirteenth century the English enforced laws to check the adulteration of staples such as bread and butter. On June 30, 1906, President Theodore Roosevelt signed the Food and Drugs Act, a national law which controls interstate and foreign traffic in adulterated or misbranded foods or drugs.

This measure, commonly called the "pure food law", was the result of persistent and strenuous agitation. Consumers had come to realize that the sale of adulterated foods and drugs was general and definitely harmful to their health and economic welfare. Briefly, the purpose of the law is to prevent the sale of worthless, injurious, adulterated, or misbranded foods and drugs; in short, to safeguard the public health. A secondary aim is to prevent manufacturers from practicing economic cheats. It is enforced by the Department through the Food and Drug Administration.

Before the passage of the Federal Food and Drugs Act, many manufacturers of foods preserved, colored, and flavored their goods artificially. Poisonous dyes were used in some products, such as highly tinted candies. Some of the dyes were objectionable for other reasons. Milk and meat were "embalmed" with

formaldehyde. Some manufacturers utilized both sound and decayed tomatoes in making tomato catchup, which they preserved with a generous quantity of benzoate of soda.

The food law discourages the use of any artificial preservative or color and makes illegal the use of harmful ones. Only two of the many chemical preservatives, which were used indiscriminately before the Federal law was enacted now have any general use, and these must be declared on the label. The two that have survived and are now occasionally employed are benzoate of soda and sulphur dioxide. Extensive research has not established so far that these preservatives, as used, render foods detrimental to human health. Artificial flavors are frequently used in beverages and in a number of food products, but these, too, must be declared. The pure-food law permits the use of certain harmless artificial colors in commercially packed foods, but requires that these also be declared.

Mixtures, even imitations, are not always inferior to the pure article. Some people like a chicory-coffee mixture, or a cereal-coffee mixture, as well as pure coffee. Others find that an imitation flavor made with the coal-tar derivatives, coumarin and vanillin, for some uses, pleases them as well as genuine vanilla extract. To assure the buyer of the protection and satisfaction that come from knowing exactly what he is getting, the food law requires that mixtures and imitations be clearly labeled. It also requires that when a food is labeled with a statement showing the country of origin, the declaration be truthful. When the buyer wants a can of Norwegian sardines, he can be assured that the name, "Norwegian", printed on the label truthfully tells where the fish came from.

An amendment to the food law gives authority to the Secretary of Agriculture to establish standards for canned foods other than canned meat and milk and further authorizes him to designate a form of label statement which will definitely tell the purchaser that goods which fail to meet the standards actually are substandard. That legend is "Below U. S. Standard—Good Food, Not High Grade", for substandard fruits and vegetables. The legend does not signify that the goods are inedible; if they were unwholesome or adulterated, they would violate the law. But

the presence of these words on a label indicates that the goods do not possess the aesthetic or palatable qualities of foods not so labeled.

The Food and Drugs Act likewise protects buyers of drug products, and here, again, the purchaser is protected by reading labels. It requires that no manufacturer label his drug preparations with false and fraudulent claims as to their curative or remedial value nor with misleading statements as to composition or strength.

Nevertheless, the act has sharp limitations, and the Department has long advocated stronger legislation. In 1933 a new food and drugs bill was introduced in the Senate and considered by the Senate Committee on Commerce Hearings resulted in modifications of the bill. The following year the committee favorably reported a revised draft. This contained most of the provisions advocated by the Department and would have controlled the traffic in foods and drugs more effectively than does the existing law. Also, it would have regulated the cosmetics trade, and the advertising of foods, drugs, and cosmetics. Curative devices and contraptions of various kinds, and products like the so-called reducing agents would have been brought under control. The measure would have strengthened the existing provisions as to labels, which should tell not only the truth but enough of the truth to be a real protection to the buyer. However, the bill did not come up for passage during that Congress Though other bills have since been introduced, two of which passed the Senate and another the House, none has been enacted into law, and the whole question is still under consideration.

The Weather Services

IN RESPONSE to a general and persistent demand this Government has done quite a bit about the *weather*. What Mark Twain said is no longer true; that people merely talk about the weather. No one knows how to make it rain or shine, and this feat may never in any degree be within human power. But there are other ways to get practical results from meteorological knowledge. One is through weather forecasting, which for short periods has been brought to a remarkable degree of accuracy. Weather forecasting, the main function of the Weather Bureau, along with numerous related services such as flood warnings, warnings of forest-fire hazards, and hurricane warnings, plays a vital role in agriculture, commerce, and navigation both on the water and in the air. Every year the demand increases for the Weather Bureau's services.

The Weather Bureau came into existence as a branch of the Signal Service of the War Department in 1870, under the provisions of a joint resolution of Congress. This resolution authorized the Secretary of War to take meteorological observations at military stations, and to give notice by telegraph and marine signals of the approach and force of storms. Intended originally for the benefit primarily of navigation on the seacoast and the Great Lakes, the service was soon extended to cover the interior and particularly the great rivers of the central valleys. Agriculture

and industry recognized its benefits and sought to share in them. Congress finally decided that the Weather Bureau would function better under civilian control, and transferred it in 1891 to the Department of Agriculture.

Long agitation had preceded the establishment of regular weather services. It had been difficult to persuade Congress that forecasts of the weather were practicable in the United States, and that organized, systematic effort to furnish storm warnings would pay. Yet the undertaking proved its worth at once. Warnings of storms and hurricanes, of hot and cold waves, of heavy snows, and of frost saved the country millions of dollars. Land transportation as well as navigation benefited. Railroad companies came to depend on the flood, snow, and frost forecasts; engineers and builders took the weather forecasts into their reckoning; farmers studied the weather reports, instead of the skies, in trying to guard against weather hazards; horticulturists obeyed frost warnings and heated their orchards; forest-fire fighters learned in advance of probable danger areas; cities looked to the Weather Bureau for word as to probable flood stages. When aviation developed, navigation by air made a heavy call on the Bureau's services. Suspension of the weather service now, even for a few days, would disrupt the Nation's life.

It is nothing new for people to be weather conscious. Primitive man thinks more about the weather than civilized man; country people think more about it than city people. The new thing is that meteorological science today enables the weather-conscious person to guide his actions intelligently with regard to the weather. Meteorological knowledge, like other sorts, is a means of power. Most city people know the Weather Bureau chiefly through the medium of its daily weather forecasts. They may use them only in minor ways, if they contemplate a trip to the woods or the seashore, feel anxious about their gardens, or suspect the automobile needs antifreeze solution.

The farmer, the rancher, the fruit grower, the truck driver, the bus company, the railroad company, the aviation company, the shipper of perishables, the construction engineer with a big concrete job in mind, and other handlers of animate and inanimate things have a more direct and vital interest in weather news.

They may want to know whether to go ahead at once with some operation, or to wait a day or two. About 95 percent of the time the Weather Bureau can tell them. In flood or storm conditions, even the stay-at-home develops a vital interest in the weather news.

Naturally, the Bureau keeps close watch on weather conditions as they affect agriculture. Every morning observations are made at some 400 places in the grain and cotton areas and telegraphed to collecting centers where bulletins containing the reports are prepared and released within 3 hours. There is also a weekly weather report for each State, and for the country as a whole. This indicates, week by week, the effect of the weather on crop growth and farming operations.

Fruit and truck growers, especially on the west coast and in Florida and Texas, benefit from the Bureau's horticultural protection service, which makes temperature surveys to determine the liability of different localities to frost, issues frost warnings, investigates frost-protection methods, and advises growers about heating requirements. Advance warnings of dangerous temperatures have saved enough fruit in one night to pay the cost of the horticultural protection service for many years. Specialists study the thermal relations of different localities in their districts, and in danger periods make a definite forecast of the lowest temperature expected during the ensuing night. Specially arranged communications notify the growers.

Flood warnings are indispensable to all river cities, river industries, and farm enterprises in regions subject to inundation. Accordingly, the Weather Bureau maintains a special river and flood service with headquarters in Washington, and forecast centers at 66 advantageous river points. As a basis for the issuance of flood warnings, the flood forecasters obtain measurements of the precipitation in the various drainage basins and observations of the height of the water on river gages. This information comes to them by telephone or telegraph from about 900 substations. The flood-forecasting service functioned efficiently during the record-breaking floods that occurred in the Ohio and lower Mississippi Valleys in January and February of 1937. Daily river-stage forecasts and flood warnings received wide dis-

tribution, and proved remarkably accurate. They helped in fighting the floods and in planning relief activities. The warnings saved many lives and millions of dollars worth of property.

Warnings of hurricanes, of cold waves, and of heavy snows and frosts protect life and property. The Weather Bureau displays storm warnings at about 325 points along the Atlantic, Pacific, and Gulf coasts and on the shores of the Great Lakes. On one occasion warnings of an approaching hurricane kept from venturing to sea vessels worth, with their cargoes, more than $30,000,000. In the 5 months of greatest hurricane danger each year the Bureau maintains a 24-hour hurricane service along the Florida and Gulf coasts, and distributes warnings by radio.

Cold-wave warnings are invaluable to railroads, cattlemen, shippers of perishables, florists, and many other groups. Transportation companies, both rail and highway, depend greatly on the Bureau's snowfall reports, which are valuable too in safeguarding livestock and protecting human life. Interests that serve the winter-sports trade watch the snow reports; no snow, no business. In forest-fire prevention the Weather Bureau aids with a special fire-weather forecasting service, which guides the foresters in deploying their forces.

In 1926 Congress passed the Air Commerce Act, and a material expansion followed in the activities of the Weather Bureau. To aid air navigation the Bureau maintains 782 stations of various types, from which it issues aviation-weather reports for the protection of air traffic over approximately 33,000 miles of airways in the United States, Hawaii, and Alaska. At 52 of these stations it maintains a 24-hour service. More than 200 of the stations have teletype or radio-communication facilities, and issue reports hourly or oftener. Some 370 stations furnish observations for specific flights, or when sudden changes in the weather necessitate special reports. Still another group of stations telegraph reports every 6 hours in the airway weather network.

In making its daily forecasts the Weather Bureau takes simultaneous observations of local weather conditions, at 7:30 a. m. and 7:30 p. m. seventy-fifth meridian time, at 372 stations scattered throughout the country and Alaska. Supplementary

reports come from Canada, Mexico, Central America, and the West Indies, and from ships at sea. Analyzed and charted in Washington and other forecast centers, the data enable experts to forecast the weather conditions that may be expected to prevail for the next 36 to 48 hours. The forecasts are ready for distribution within 2 hours after the recording of the observations. Telegraphed from the forecast centers to distributing points, and then distributed by telegraph, telephone, radio, and mail, and by the press, the reports influence innumerable decisions daily in all branches of our economic life. Rural mail delivery and rural telephone lines carry the reports to farmers who might otherwise not get them quickly enough. More than 400 commercial radio stations broadcast the forecasts on regular schedules. Naval radio stations broadcast daily weather bulletins for ships and for foreign meteorological services, and bulletins for the benefit of aviation and commercial interests.

Farmers have been looking for years for long range weather service, but very little progress has yet been made along this line. Observations now going forward in the north, concerning the development and movement of cold waves, may improve the accuracy and extend the range of cold wave predictions. Improvements in the technique of air-mass analysis may throw light on the problem. There is a possibility that the study of past reports of the Weather Bureau, which go back for 50 and in some cases for 100 years, will provide a key to long-range forecasting. Studies indicate that the records may contain some clues to the laws of the weather. Long-range weather forecasting is a subject that has received and is now receiving careful attention and study by the Weather Bureau, but thus far no basis has been discovered whereby reliable weather forecasts for long periods in advance can be made. But more data about the weather, and a wider geographical coverage, may reveal principles that cannot now be glimpsed.

There is a demand for detailed knowledge of the climate of the United States, and of our insular possessions. This has led to an interesting and important feature of the Bureau's activities—the Climatological Service. Data collected by thousands of cooperating observers, as well as by the Bureau's own field personnel,

form the basis of a complete climatology of the country, which the Bureau publishes in monthly and annual bulletins. Investigations that increase our understanding of meteorological phenomena have practical applications, and fundamental research in meteorology is amply worth while. The Weather Bureau endeavors constantly to apply the results of its theoretical investigations, in all branches of its work from forecasting to cooperation with other Government agencies in the control of erosion, the prevention of floods and forest fires, and the improvement of our land-use system.

Economic Information

TECHNICAL progress, which helps farmers to grow more per acre and to get more meat and milk from their livestock for each pound of feed consumed, comes into conflict occasionally with the necessity to balance supply with demand. Production runs ahead of consumption. American farmers, with power machinery, produce from two to five times as much as do farm workers in the older countries of Europe. Farm technology has an obvious relation to farm prices. Increased efficiency, with its resulting increased output per farm worker, may require a reduction, either in the agricultural acreage or the agricultural personnel. Farmers recognized the situation long ago. They besought the Government to study the economics as well as the technology of farming. Sometimes they declared technology had done enough and should pause to let economics catch up.

But what would happen were farmers to abandon science, or to use it with deliberately decreased efficiency, in the hope of causing prices to rise through scarcity? They would still have to plow, sow, and reap; but since they would use poor machinery, poor seed, and poor methods, their expenses would rise out of all proportion to any resulting rise of prices. Pests and diseases would ravage their crops; the land would deteriorate. Science is the friend of the farmer, rarely his enemy; but it is true that he needs economic science as well as physical and biological science.

Efficiency in the old sense of the word is not enough. Farmers cannot make profits merely by improving their plants and livestock and by fighting diseases and pests. They must also strive to reduce the costs of distribution, and to adjust their output to the effective demand.

Farmers demanded crop statistics in the Patent Office period of the Federal agricultural services. Oliver Ellsworth, the Commissioner of Patents, declared in 1839, that farmers could not afford to leave the collection of crop statistics in the hands of private individuals, and he assigned a clerk to collect them from voluntary correspondents. That was the origin of Federal crop reporting. Today more than 400,000 voluntary crop reporters scattered over the country assist the Department in collecting crop statistics. The early Commissioners of Patents did not content themselves merely with the collection of such figures as they could obtain. They recognized the importance of interpreting the data, and of persuading farmers to use them as a guide in their planting and livestock breeding. By a natural process, crop reporting became the basis of numerous related economic services, notably the supervision of the principal commodity markets. But that came later.

Grain merchants, speculators, and investors formerly spent large sums to obtain figures for themselves. Private crop reporting developed for a time more rapidly than the Federal system and put the farmers at a disadvantage. Frequently the Government reports were less accurate, less comprehensive, and less prompt than those obtained by private individuals and corporations. Farmers therefore lost most of their tilts with middlemen and speculators. Lacking data on markets and prices, they played in the dark, with the cards against them. Moreover the early Government reports contained no news about foreign crops and markets; that was a grave shortcoming. Commercial interests had good sources of information overseas; agriculture had practically none. Not until after the Civil War did the Government bestir itself to remedy the defect.

Then it sent the chief agricultural statistician to Europe to study the possibility of beginning an interchange of statistical information with the chief importing countries. This visit

resulted in some progress. Soon afterward the Government reorganized and expanded the crop-reporting system and laid a foundation that eventually supported varied and extensive economic services, in which the regular gathering of crop and market data both foreign and domestic came to be combined with numerous related services such as commodity grading and standardization, inspection of farm commodities at shipping and receiving points, price analysis, seed verification, and "outlook reporting." Farm-management studies were a further development. They related general economic information to the needs of particular localities and particular farms. Thus the Federal Government, besides helping the farmer to discover how his various crops might best be grown, endeavored also to assist him in deciding what to grow and how much. It sought, in other words, to help him establish a better balance among his different crop enterprises, and to adjust his production as a whole to the requirements of the market.

Government officials, and perhaps also the farmers, expected too much from the statistical work at first. Agricultural Commissioner Newton in 1863 declared that statistics formed—

> the key which is to unlock the hidden treasure of maturing nature, or the chart which is to reveal to the husbandman and merchant the great laws of demand and supply—of tillage and barter—thus enabling both to work out a safe and healthy prosperity.[1]

Members of the Department saw in statistics a means of enabling farmers to adjust their operations both to the laws of nature and to the conditions of the market place. Jacob R. Dodge, the Department's chief statistician, said in an article in 1882 that statistics would permit the farmer—

> to make operative the controlling influences of soil, climate, and circumstances, and would serve as an agent for adapting the most efficient methods to the raising of the most efficient crops in the most efficient climates at the most profitable times.[2]

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[1] Newton, I. REPORT OF THE COMMISSIONER OF AGRICULTURE FOR THE YEAR 1863. pp. 1–17. Washington, 1863. See p. 15.

[2] Cory, R. H., Jr. THE UNITED STATES DEPARTMENT OF AGRICULTURE, A HISTORY. (Unpublished.)

Dodge believed farmers could determine from statistics whether, for example, it would be profitable to raise wheat, what kind of wheat would produce the best crops, what time was most profitable for planting, and whether machine methods, initially expensive, would pay in the end.

Crop reporting and other statistical work in the Department have been carried to a high degree of efficiency since Dodge's time. Thousands of farmers and a large force of Federal and State statisticians cooperate in collecting the data. Numerous elaborate methods, each a check upon the other, determine the acreage. Meteorologists, entomologists, and plant pathologists confer during the growing season to estimate the probable crop damage from pests and diseases. The personal element in crop reporting is a small factor, and production prospects can be indicated reliably months before the harvest. Besides gathering the crop news, the Department distributes it widely, through the press, by leased telegraph, and by radio. Its market-news service provides information regularly, at more than 50 principal market centers, on the supply, the demand, and the prices for all the leading farm products. The market reports have become standard for agricultural trading. They have reduced the speculative element in the agricultural markets, and have moderated the tendency of farmers to swing from one extreme to the other in production. But the statistical work, and the related services, have not fulfilled the early hopes.

These services should not be undervalued. Economic information helps the farmer to adjust his acreage and his livestock breeding intelligently, to join with other farmers in concerted action to stabilize production, and to counteract improper or ignorant speculation in the commodity markets. Combined with price analyses, and with outlook reporting, such information indicates the tangible and measurable elements in the supply-and-demand situation, among which production is the most important, and aids the farmer to cope with them efficiently. Facts about crops and markets, accompanied by skilled interpretations and by useful information concerning the general price level, the state of business and employment, and intercommodity competition, are indispensable to the operation of a modern farm. Yet by

themselves they do not smooth out the production cycles, eliminate undue spreads between farm and city prices, or prevent the agricultural depressions that result from the periodical collapse of consumer buying power. A thermometer cannot by itself cure the fever.

Farmers still rush in and out of different crop enterprises erratically. True, they base their planting more on price prospects, as distinguished from past prices, than they formerly did; but the net effect is small. Individual farm adjustments give almost no protection against the farm-production swings. For one thing, the individual farmer cannot look far enough ahead. Crop and market news gives him a forecast for only a few months, or at most a year. Effective crop adjustment requires concerted action over considerable periods. Moreover, agriculture has marketing problems too, and also difficulties connected with the land-tenure system, and with the land-use malpractices that sprang up in the pioneer epoch. All these problems, along with the still greater one of readjusting American agriculture to a profoundly changed world situation, make new demands on the Federal economic services.

Marketing—A Federal Problem

SYSTEMATIC Federal work in marketing began in 1913, when Congress authorized the creation of an Office of Markets in the Department. Agitation over marketing had been keen for a decade or more. Farmers joined with city dwellers in complaining about the spreads between farm and city prices. Both groups believed that transportation companies, storage concerns, and distributors exacted unfair margins and that the great commodity exchanges did not function in the public interest. Economic studies did not endorse this view entirely; but they showed the need for and the possibility of improvement. Economists urged uniformity in grain standards, regulation of the livestock markets, and the extension of grading to more commodities. They demonstrated that the technique, as well as the machinery of marketing, could be improved.

The Office of Markets subsequently became the Bureau of Markets. In 1921 it underwent another transformation, when the Department merged it with the Bureau of Crop Estimates and the Office of Farm Management in a new unit thereafter known as the Bureau of Agricultural Economics. It launched a many-sided attack upon the economic problems of the farmer, with fact finding and fact interpretation as the basis. Congress charged the Bureau with the administration of the Cotton Standards Act, the Grain Standards Act, the Cotton Futures Act, the Federal

Warehouse Act, the Perishable Agricultural Commodities Act, and other important marketing legislation.

Marketing research and regulation produced benefits far transcending the mere prevention of abuses. Research indicated means of marketing reform; regulation achieved it to a considerable extent. Besides checking improper trade practices, the regulatory laws provided fixed commodity standards, good throughout the country and even in international trade, and greatly facilitated agricultural trading. Buyers and sellers found themselves speaking a common trade language; producers had more incentive to attempt better quality production; and the spread of knowledge about supply and prices kept the fluctuations of the markets within a narrower range. Consumers benefited equally with producers and distributors. Federal grading gave them tests of quality on which they could rely. This whole development came in less than 25 years.

Along with the standardization and inspection work, the Department developed a market-news service that soon became indispensable. It took in all the important farm products and provided timely and usable data about commodity shipments, market receipts, stocks in storage, imports and exports, prices, the quality and condition of market offerings, and prospective trends of demand and supply. Growers found it a basis for action with regard to many of their problems both of production and marketing. Besides facilitating and equalizing the distribution of crops, the service discouraged fictitious and misleading reports, enabled producers both individually and through their cooperative associations to deal with buyers more advantageously, and furnished a guide to crop planting and livestock breeding. It promoted orderly marketing, reduced the losses that attend blind shipments, particularly of perishables, placed the sellers more nearly on an equality with the buyers, and facilitated better crop adjustments.

This program of orderly marketing has been extended to retail markets, and the Department has developed standards for grades of agricultural products. Such standards help the producer to distribute and the consumer to buy more effectively. In response to a growing demand from consumers for grade-labeling of goods,

the Department has in the last few years studied the use values of agricultural products for home consumption. Out of these studies have come buying guides for a number of items of family living. Also the Department tries to give consumers a better understanding of prices and a broader economic background.

Continuity of the National Agricultural Policy

THERE is an impression that the United States never had a truly national agricultural policy until quite recent times. On the contrary, it has had one from the beginning. Originally, to be sure, the policy was somewhat negative; it consisted chiefly in the removal of restraints on land settlement and efforts to democratize the land laws. Congress in 1820 reduced the minimum purchase of public land to 160 acres and established a uniform low price; in addition, with the object of discouraging speculation, it insisted on cash payments. Subsequent laws permitted buyers to purchase public land in tracts as small as 80 acres. Eventually 40 acres became the familiar unit in land selection and purchase. This, of course, was before the era of the homestead laws. The land policy, coupled with plant-introduction work, the beginnings of crop reporting, and agricultural research, summed up the national agricultural policy of the first half of the nineteenth century.

Afterward the policy became more positive. In the period of westward migration, of rapid land settlement, and of eager cultivation, the Government sought—

> to fill the States with homes, to build up communities, and to lessen the chances of social and civil disorder by giving the ownership of the soil in small tracts to the occupants thereof.

That was the object, as a Federal commission stated it, of the

Homestead Act, which Congress enacted in the same year in which it created the Department and the land-grant colleges. These laws, combined with railroad building, mechanical invention, and a keen overseas demand for foodstuffs, brought about our agricultural empire, and scientific research aided farmers in developing it rapidly. As Federal and State research indicated improved methods, the education and extension work carried on by the land-grant colleges brought science and practice in agriculture more closely together.

Two factors were basic in our agricultural expansion during the nineteenth century: (1) The existence of a virgin continent awaiting settlement and cultivation, and (2) a rough division of labor between the Old World and the New. Europe was the workshop; the United States was the bread basket. These two factors in combination placed a tremendous emphasis on production. Farmers could generally sell at satisfactory prices all that they produced. They could specialize with safety in the production of cereals, fibers, and meats, because the market was virtually insatiable. Farmers had their troubles from time to time; they had to contend occasionally with temporary overproduction, with low prices, with falling land values, with mounting debts, and with the other familiar conditions of economic depression. Recovery always came spontaneously, however, and allowed them to plunge once more into strenuous production without check or limit. Agricultural science spurred them on.

Economic crises occurred in 1819, 1837, 1857, 1873, and 1893, each time with disastrous effects upon agriculture. These difficulties, however, seemed to result from general conditions, rather than from disabilities or grievances peculiar to agriculture. The crises tended to follow excessive land speculation, overinvestment in railroads and mining, and reckless banking. Depression in the 1880's led to the organization of farmers' alliances, and in the 1890's to populism, which met defeat at the polls in 1896. The Grange movement led to Federal regulation of railroads. Farmers lodged complaints against the marketing system and began to organize cooperative associations. Since, however, their market continued to expand, the emphasis upon

production in the national agricultural policy met no serious challenge, and the natural recuperative power of the economic system, coupled with some regulation of railroads and of the great commodity markets, delayed exploration along other paths.

Eventually production overshot the demand, at first sporadically and then with growing persistence. Farmers came to see that production science alone was not enough and that under certain conditions technical efficiency may defeat itself or may benefit principally middlemen and consumers. They noted a growing spread between prices at the farm and prices at city retail stores. They suffered also from wide swings in the volume of their production, which tended to go through regular cycles of expansion and contraction. From 1870 to 1898 our agricultural exports, particularly in cereals, livestock products, cotton, and tobacco, increased tremendously. Thereafter a decline began in the foreign demand and continued until the World War. Growth of the market at home afforded only partial compensation because the powers of production were increasing still more rapidly. Therefore it became imperative to couple research in the technique of production with studies to improve the marketing system and to keep production more nearly in line with the demand.

Agricultural policy draws its inspiration, not from the accidents of politics, but from fundamental economic changes. Among the forces that shape it today two are paramount; (1) the closing of the frontier, with the resulting pressure of population on resources, accompanied by soil wastage and actual soil destruction and, (2) the world-wide growth of economic regulation, not only in trade but in production. Governments are assuming greater responsibilities for the regulation of commerce, both domestic and international. Another regulatory influence results from the growth of industrial trusts and combinations. Into an economic pattern of that sort, a purely competitive, wholly individualistic agriculture does not fit. Together, the disappearance of the frontier and the rise of economic controls of one kind or another in urban industry seem destined to exert more and more influence, which will express itself in agricultural legislation and policy no matter what political party may be

in power. Recent developments in the agricultural program and in the research and service program of the Department, are responses to an altered economic situation and betoken a profound readjustment to permanently changed conditions.

Technical change has been rapid in agriculture during the last 20 years. Tractors have replaced horses and mules; improved harvesting machinery has come into wide use; the size of the average farm has increased; more productive plants have been used; livestock has produced more milk and meat for each unit of feed consumed; and farm management has become considerably more efficient. American farmers have not lacked in vigor and resourcefulness in these trying times. They have maintained their productivity beyond the requirements of the market, and through technical progress have created new economic problems.

Accelerated mechanization has released from 30,000,000 to 40,000,000 acres formerly required to feed horses and mules. Motortrucks and automobiles have increased tremendously the power available for farm-commodity transportation. The use of stationary gas engines and of electricity on farms has increased. As a result, farming has expanded in regions suited only to specialized cropping systems, such as the Great Plains, and has become more involved in one-crop production for uncertain markets. Specialized cotton and wheat growing have jumped ahead.

Symptomatic are the eastward sweep of the combine harvester, which began its career west of the Rocky Mountains, and power farming in cotton production. The combine is well established east of the Mississippi River. Power units facilitate cotton growing in western Texas and Oklahoma. One man in those States, with mechanical aid, can care for as much as 75 to 100 acres of cotton up to the time of picking. In the old South the usual area handled per man is only 10 to 20 acres of cotton, and a similar acreage of feed crops. This technical revolution, which tremendously increases the farmer's productivity, has coincided with a tendency for the agricultural market to decline.

The war drew the United States back into heavy production for export, while saddling the importing countries with debts and political troubles that reduced their buying power. Tem-

porarily it created shortages of commodities both agricultural and industrial; but agriculture and industry overestimated the shortages and soon replaced them with surpluses. Tariffs excluded foreign goods which this country might have received in payment for its agricultural exports. Loans furnished our foreign customers an undependable means of payment which eventually failed. The crisis of 1929 developed largely as a consequence of these inconsistencies, though monetary difficulties in many countries played a part therein. As their buying power declined, foreign countries adopted trade restrictions which added to our export difficulties and brought world trade under governmental control to an extent unprecedented in modern times. As a result the demand for the products of the farm dropped catastrophically, while the production remained virtually unchanged.

The depression of 1929–33 caused a tremendous disparity between the prices of farm commodities and the prices of the goods and services that farmers usually buy. Farm-commodity prices had dropped by early 1933 to a point 50 percent below the pre-war level; in 1928 they had averaged nearly 50 percent above. Prices paid by farmers for commodities dropped down to, but not below, the pre-war level. Thus farm commodities had only half their pre-war unit-purchasing power. Gross farm income from the production of 1932 was less than half that of 1929, whereas fixed charges, including taxes and interest, were not materially lower. Mortgage interest and taxes in the same year took almost 25 percent of the gross farm income. After paying the expenses of production, interest, rent, and taxes, the average farmer had only about $230 left. Agriculture was very sick, and the troubles from which it suffered threatened also the entire community. Ruinously low farm earnings tended to separate farm operation from farm ownership and to degrade farmers into virtual serfdom. The collapse of farm prices caused a heavy loss in farm valuations, in which farmers' equities were destroyed.

Congress provided means for dealing with this problem in an act (Public, No. 10, 73d Cong., approved May 12, 1933) which sought to raise the incomes of farmers by two principal means: (1) By getting their cooperation in necessary crop adjustments

calculated to bring supply into a better balance with demand; and (2) by authorizing the Secretary of Agriculture to enter into marketing agreements with producers, processors, and distributors of agricultural products, so that competitive wastes might be eliminated, trade practices improved, surpluses moved into markets for consumption, and producers' prices raised. The Government offered compensatory payments to the producers of leading crops in return for agreements to curtail their acreage or their production for the market.

This was an emergency program. From a long-time standpoint it had certain disadvantages. It took out of production both the efficient and the inefficient areas and carried no insurance against the bringing of new lands into cultivation under the stimulation of better prices. But it lifted agriculture from the pit of the depression. The marketing agreements proved extremely useful. They involved more than the simple term "agreement" may imply. Producers, processors, and handlers of farm products entered into arrangements for affecting the commodity markets either by regulating the movement of products into consumption or by eliminating part of the supply from commercial channels.

Congress intended the Agricultural Adjustment Act to benefit our economy as a whole and to invigorate urban industry as well as agriculture, and that object it accomplished. Consumer buying power rose with farm incomes, and in 1936 the average employed wage earner could buy more food with his wages than he could at the peak of urban prosperity in 1929. Agricultural recovery stimulated industrial recovery and employment. But 1936 saw the end of the production-adjustment phase of the program, as a result of a decision of the United States Supreme Court in the Hoosac Mills case.[1] Congress at once attempted to offset the effects of this decision by enacting the Soil Conservation and Domestic Allotment Act. Through this act, the operation of which is described in subsequent pages, agriculture continued to seek progress toward parity income and toward a good rural-urban balance. In the new act, however, soil conservation, which had been a byproduct of the Agricultural Adjustment Act, became a major objective.

[1] *United States* v. *Butler*, 297 U. S. 1.

Toward Higher Standards of Living

WHAT levels of living is agriculture making possible for the Nation's farm families? To answer this question, the Department inquires how much of the farm family's income is spent for living, and what kind of a living this money buys. It compares the levels of living of farm families in different parts of the country with the levels attained by various groups of city families. Such information helps in formulating policies of land utilization. How well the land can support a farm family is one of the criteria for determining whether or not it should be classed as submarginal for agricultural purposes.

The farm cost-of-living index indicates whether changes in the amount the farmer must pay for maintaining his family keep pace with changes in the prices he receives for his goods. This index is based upon studies of the kinds and quantities of goods bought by farm families. Such investigations serve many other purposes. They indicate the relative burdensomeness of certain taxes that farm families pay, point the way toward better farm-family housing, and show how a wise balance may be effected between money expenditures and the farm production of goods for family use.

The participation of the farm family in community activities, the broadening of social contacts through organizations (both

rural and those in which farm and nonfarm groups mingle), and the improvement of community facilities serving the farm family, all are concerns of the Department.

Because of the relation of food to health, the Department specially emphasizes the study of family diets. A recent survey showed that diets of farm families are somewhat better than those of city families at a corresponding level of living. For many years the Department has encouraged a program for the wise production of food for farm-family use because of its ultimate effect on health. Appreciation of the possible uses of all resources of the farm home helps to enrich family living, not only in material but also in intangible values.

The research projects on family living are along many lines, and the associated educational program takes many forms. Extension activities have been mentioned. Not only through field workers but also through popular bulletins, through the press, and by radio, do the findings of home economics research and other scientific research reach the farm family. Suggestions for the improvement of nutrition, of housekeeping, of money management, and of other aspects of family living find their way from the Department into millions of American homes.

In times of stress, as during the years of the economic depression, or in a flood or drought emergency, individuals and agencies turn to agricultural research for an answer to their problems. Special studies may be set up in the Department. Emergency publications on subsistence homesteads, low-cost adequate diets, first aid for flooded homes, and many other subjects have been prepared from the fund of information thus accumulated.

Recently the Department has had a more direct contact with farm-rehabilitation work through the Resettlement Administration now merged with the Farm Security Administration. When depression, drought, dust storms, and floods added seriously to the other causes of rural poverty in the United States, the Resettlement Administration enlisted the aid of science in combating the evil. Soil specialists, agronomists, home economists, farm-management experts, and other technicians attempted by exact methods to discover the roots of the trouble.

The depression forced more than 1,000,000 farm families on

relief. Natural calamities, especially droughts and floods, added to the number. The specific causes of distress were manifold. They included the general economic situation, the action of the weather, the nature of the land the families occupied, and their own health, efficiency, and means.

In rare cases their relocation was necessary. In such cases, families were not moved great distances. Usually they were relocated in the same county; never were they moved to another State. In most cases financial assistance and guidance in farm and home management restored them to relative independence. This type of assistance is known as "rehabilitation in place." Those families remained on the same land. Farm families that had relied precariously on one-crop systems frequently discovered and developed other possibilities. Benefit resulted also from better controlled expenditure.

Farm-management specialists in the Department worked out plans whereby deserving farmers who were in need of help could again become self-supporting. These plans included loans for the purchase of seed, equipment, and livestock. Applicants for loans had to have access to suitable land and had to possess certain character qualifications. Sometimes, pending the development of satisfactory rehabilitation plans, the Department made subsistence grants.

Farm plans worked out under the direction of the county supervisors of rural rehabilitation indicated the crops best suited to the land. They reduced cash-crop specialization and provided for the planting of foodstuffs and feed for livestock. This method furnished both an assured food supply and some cash income. Also, the plans provided for soil conservation.

Simultaneously, home-management experts aided farm families in budgeting their expenditure. They endeavored first to insure an adequate food supply the year round and then to increase the supply of other necessary goods and services. With expert guidance farm families planted vegetable gardens, raised cows and chickens, and canned fruit and vegetables.

In health investigations the Department demonstrated that malnutrition, pellagra, malaria, hookworm, and other remediable ailments are often important causes of economic distress. In

cooperation with other Federal agencies it helped to alleviate these ills. It carried on important housing activities, cooperated with creditors of farmers in facilitating the adjustment of farm debts, and combined this work with a granting of new credits for specific purposes. In 1936, for example, it made supervised loans on a 5-percent basis to nearly 300,000 farm families, and aided an additional 520,000 farm families by grants and emergency feed loans in drought areas.

Employing the services of trained soil specialists and agronomists, the land-use and land-development program of the Department is selecting and removing from cultivation large areas of land unsuited to farming. It selects these lands in cooperation with other Government agencies. In developing them for nonfarm purposes it follows strictly scientific methods. Farm families who sell their holdings in these areas frequently relocate on other properties with the assistance of the Farm Security Administration. Naturally the Department does not move farm families about arbitrarily but simply helps in moving families that desire to be moved.

In the fiscal year ended June 30, 1936, the Department obtained options on 9,500,000 acres of poor land in 207 projects. Most of this land will be diverted to nonagricultural uses. Some of it will be developed by the Forest Service, some by the National Park Service for recreational purposes, and some by the Bureau of Biological Survey for wildlife conservation. The Indian Service is sponsoring 31 of the projects to provide more land for Indians. For resettlement purposes the Department now has the management of over 100 projects calling for the building of homes for about 13,000 families.

Conserving Soil and Water

CRITICAL agricultural problems may result from physical as well as economic causes—specifically, from soil erosion or soil deterioration. Bad soil conditions, besides diminishing the incomes of farmers, may reduce the Nation's standard of living. Permanent farm prosperity requires both the adjustment of agricultural production and the conservation of soil productivity; for our soil resources are not inexhaustible and current land-use practices deplete them seriously.

Pioneers had land and water to waste; their descendants have not. Government soil experts found in 1934 that 200,000,000 acres of our cropland have already been impoverished by erosion, in some cases ruined for further agricultural use, and that an additional, larger area is subject to erosion and should be protected. In one way or another erosion removes some 3,000,000,000 tons of soil annually from our fields. Wind and water are the agents. Erosion by water is the more serious evil, but wind erosion has been important in drought areas. Floods and dust storms have apprised the whole country of the danger.

Following the invalidation of the production-control features of the Agricultural Adjustment Act, Congress enacted a measure to conserve the soil, and at the same time to improve the crop balance and the farm income. This was the Soil Conservation and Domestic Allotment Act, the administra-

tion of which became a major responsibility of the Department. Essentially, the act has three main objects: (1) Conservation of the soil; (2) promotion of the economic use of land; and (3) the restoration of parity income to farmers. It rests on the principle that long-time planning to increase farm incomes should be linked with efforts to protect the physical body of the soil. This promotes the interests of consumers equally with those of producers because, while regulating the volume, it reduces the costs of farm production. Soil conservation was an important byproduct of the earlier A. A. A. programs, which promoted a considerable diversion of acreage from soil-depleting crops such as corn, wheat, cotton, and tobacco, to soil-conserving crops like legumes and grasses. The new law made soil conservation the main product, with a certain amount of crop adjustment in view as an incidental result.

Using the administrative machinery that it had developed for the earlier program, the Department invited farmers to cooperate under the new law in soil-conservation plans worked out by Federal and State agricultural officials and county committees. Each State appointed a conservation committee that included three to five farmers, and each county appointed a county committee. Federal and State extension officials directed the educational work. They pointed out that conservation is not an end in itself but a means—ultimately, in fact a means of production—and that it includes economic as well as physical objectives. Essentially, the object is not necessarily to prevent all depletion whatsoever of natural resources but rather to establish a proper balance between soil spending and soil saving.

Farmers responded as fully as they had done to the crop-adjustment programs of the 3 preceding years. The cooperation was about the same in the areas where corn, cotton, wheat, and tobacco are the major crops and greater in areas of general and mixed farming such as New England, Wisconsin, and California. The program was more flexible and better regionalized than the earlier commodity programs, and it considered each farm as a unit. Therefore it had a very wide appeal.

Action under the Soil Conservation and Domestic Allotment Act moves in the right direction but cannot do all that is neces-

sary for the defense of the soil. There is need for intensive local operations, as well as for a national approach to the problem. Research, demonstration, and operations of an intensive or regional character are the special tasks of the Soil Conservation Service, which was established in 1933 in the Department of the Interior and transferred 2 years later to the Department of Agriculture.

Soil losses from the floods of the last few years and soil blowing in the Great Plains have brought home to farmers generally, and to other interested groups, the fact that the soil problem has distinct local and regional peculiarities the treatment of which requires methods appropriate to each locality and each region. In the Corn Belt overcropping is a serious cause of soil erosion. In the Great Plains overgrazing and overplowing are main soil hazards. In certain regions the cultivation of steep slopes and the setting of brush fires should be controlled. Some localities need engineering works such as terracing, check dams, ditches, and ponds. Elsewhere the problem may be principally one of reclothing denuded slopes with vegetation. Everywhere the soil problem has local peculiarities which preclude exclusive reliance on blanket methods.

Soil conservation, though largely, is not exclusively a farm problem. Conditions in our great river basins have been altered profoundly by lumbering and grazing. Water from improperly handled or denuded lands rushes into the streams carrying millions of tons of soil; and many land uses, or rather misuses, contribute to soil erosion. Effective soil conservation depends mainly on the willing and informed cooperation of several million farmers. Nevertheless, the best results require also the cooperation of other land occupiers, including graziers, forest operators, and public agencies, Federal, State, and local. Accordingly, besides working with the farmers, the Soil Conservation Service endeavors to interest land occupiers generally in the defense of the soil.

In some areas all the land, nonagricultural as well as agricultural, should be brought into conservation programs. This has become plain from the floods and dust storms of recent years. There is need for erosion control throughout whole land-

use regions; it does not suffice to check erosion on isolated tracts. Neglect on a few hill farms may ruin a valley lower down and cause much other damage as well. Wind erosion dissipates fertile soil in dust storms. Erosion by water carries the dust into streams, covers bottom lands, chokes dams and reservoirs, and damages roads, railways, irrigation works, power plants, and public water supplies. Through research, demonstrations, and practical control operations the Department's Soil Conservation Service, with the cooperation of other Government agencies, both Federal and State, and of farmers, makes detailed surveys, studies the erosion conditions of entire land-use regions, and promotes the adoption of correct cropping, tillage, and engineering practices.

The Soil Conservation Service cooperates in research with other Federal agencies and with the State agricultural experiment stations, and carries on demonstration projects and additional work relating to erosion control. Its methods are intensive. After making detailed surveys and studying the erosion conditions of entire land-use regions, it seeks the cooperation of farmers in appropriate erosion-control practices. The studies include topographic and contour mapping, erosion surveys, soil analyses, observations of land-use practices, and the testing of different expedients. In short, the Soil Conservation Service tests various methods of erosion control, provides demonstrations of effective methods, and actually prevents erosion on the particular lands involved. All available methods, such as correct cropping and rotations, tillage and engineering practices, moisture conservation, and pasture and forest development, find practical, combined application in this work.

On the demonstration projects, which have been established in nearly all the States, the Soil Conservation Service usually begins by marking off a naturally bounded tract of about 25,000 acres. It has three very much larger projects in the Southwest and one in Wyoming, but these are not typical. Next follow various soil and farm-management studies and analyses of cropping systems and farming conditions. The results thus obtained become the basis for a soil-conservation plan for the whole area. The Soil Conservation Service gives effect to it by two principal means:

(1) It reaches an understanding with any public agencies that may be concerned; and (2), it enters into 5-year erosion-control agreements with private landowners. Each agreement contains a plan for land use and appropriate practices, specifies what shall be done by the Soil Conservation Service and what shall be done by the farmer, and obligates the operator or owner of the land to maintain for the 5-year period any physical improvements that may be constructed and also to follow an agreed program of cropping and tillage. Besides carrying on this work the Soil Conservation Service encourages the formation of soil-conservation associations, more than 400 of which have been organized already.

Other bureaus of the Department have important responsibilities for the protection of the soil, notably the Forest Service, the Bureau of Biological Survey, and the Bureau of Agricultural Engineering. The Forest Service conducts a closely related Nation-wide program of better land utilization, in which it cooperates with the States and with private timber owners and operators in fire prevention and related forestry work. Trees put a roof over the soil and cover it with a protecting carpet. Management of the national-forest system, which includes more than 170,000,000 acres in 32 States and 2 Territories, is a mainstay in the defense of the soil. The extension of good forest care to State-owned and privately owned forest land is equally important, and the Forest Service has a special mandate to promote that end. Agricultural engineering for the protection of the soil includes terracing, strip cropping, contour furrowing on slopes, and the construction of small dams and other installations for regulating the water flow. The Bureau of Agricultural Engineering investigates this whole subject intensively.

It is bad economy to deforest the mountains, to cultivate steep slopes, to cultivate even moderate slopes without precaution against erosion, to plow up grasslands unsuited to farming, and to overgraze the range without giving the natural vegetation a chance to recuperate. All these practices destroy the soil. They cut into a capital which man can never replace. True, they afford certain persons a living, and often much more. Greed as

well as want may be improvident. Wealthy lumber companies, ranching corporations, and dry-farming concerns mine the soil quite as disastrously as do poverty farmers. They enrich themselves, but the community suffers. There is a clash between the interests of the individual and the interests of society.

In a proprietary economy individuals will not voluntarily forego their interests for the sake of the community. They cannot afford to do so. Competition inhibits such action. Exploitative land use continues inevitably, therefore, until the community as a whole senses the danger and organizes protective machinery. Essentially the problem is a social one. Conservation requires a fair distribution of the costs and benefits. It requires a bargain between society and the individual, a bargain that will give the individual an immediate interest in the preservation of the soil values for the future.

This is why the Department takes a hand. Farmers cannot do enough on their own initiative; they cannot put conservation before everything else. In fact, under highly competitive conditions, they cannot give it the attention it deserves. Farmers who overemphasize conservation do so at their peril. Long before the results become apparent they may find themselves bankrupt and supplanted by others with a better sense of proportion. Economic use of the land gives first place to production properly adjusted to the market. Accordingly, the Department steps in to do for the farmers what they cannot do for themselves in the care of the soil. It helps them to reconcile the demands of immediate production with the longer time interest in the conservation of resources.

Natural and economic conditions, and also legislation, make the Department partly responsible for flood control, as well as for the control of soil erosion. Indeed the two jobs go together. Whatever conserves the soil conserves also the water that falls upon it and reduces the run-off into river channels. In flood control the immediate defenses are the great engineering works of the War Department, and these may always be more important than anything that can be done on the land. Land treatment cannot furnish a substitute for flood-water fortifications down the river, but it can provide a multitude of reinforcements on the

land where the floods begin. Congress recognized the principle specifically in the Omnibus Flood Control Act of 1936, which for the first time in the history of the country authorized a coordinated land and water program for flood control.

This measure, after asserting that flood control on navigable waters or their tributaries is a proper Federal activity in cooperation with the States and their political subdivisions, declares that flood control requires not only the improvement of rivers and other waterways but also the treatment of the lands that shed the water. It vests responsibility for the improvement of rivers and waterways with the War Department, and responsibility for investigations and measures for run-off and water-flow retardation, and for the prevention of soil erosion on watersheds with the Department of Agriculture, except as may be otherwise provided.

In a populous country with a well-developed industry and agriculture, flood control requires a combination of forces, among the more important of which are engineering and agricultural science, public awareness of the problem, funds for dealing with it, means for the reconciliation of public with private interests in land use, and public institutions capable of mobilizing all concerned in large-scale programs. These factors must be present in the correct proportions, or little can be done. They do not come together of themselves, but develop independently, in unequal degrees, at rates varying with social and economic pressures. This country has ample physical power, both for floodwater fortifications such as dams, levees, and spillways, and for land treatment to retard the run-off from the slopes; but it lacks facilities for dealing with the human and economic problems involved. Land treatment for flood control must recognize the economic as well as the physical imperatives and besides contributing to water and soil control, must benefit those who do it. It is necessary to develop Federal, State, and local cooperation.

This can be promoted by the Omnibus Flood Control Act of 1936, and also by the Soil Conservation and Domestic Allotment Act of 1935. Under the Flood Control Act, the Department is preparing to study each watershed listed therein as a distinct problem and to hold public hearings on flood-control projects. These hearings will bring out the views of farmers, forest

operators, wildlife conservationists, livestock men, and other groups concerned with agriculture and soil conservation. After the hearings have been completed and detailed surveys made, further steps will await action by Congress. The Soil Conservation and Domestic Allotment Act authorizes the Secretary of Agriculture, as a condition to the extension of benefits under the act to lands in any State, to require the enactment of State laws providing suitably for the prevention of soil erosion. Such State legislation will be of great importance in flood control since, erosion control and flood control through land treatment may be promoted by the same means.

The Man and the Land

AGRICULTURE'S basic problem is the relationship of the man to the land. Once we thought we had this problem solved. Actually we were allowing it to become formidable. Economists and historians agree that our early land policy, in many respects, was seriously wrong.

It ignored important regional differences; it failed to promote the conservation of timber, soil, and water; it gave occupants an absolute right to use or abuse the land at will; and it allowed immense areas to come into the possession of speculators. It accomplished only in part its basic purpose, which was to establish the family-farm system throughout the country. Along with the family-farm system, it caused to grow up land-use patterns which tended to defeat the original intention.

After giving away some 270,000,000 acres in homesteads and selling or granting millions of acres more to individuals, railroads, and States, the Nation woke up to the fact that vast areas of forest and pasture had been devastated, that farming had extended into regions not suited to farming, that farm families throughout large portions of the country had failed to achieve a decent standard of living, and that the ownership and operation of the land tended to grow apart.

In the nineteenth century the Federal Government gave away more than one-quarter of the available farm land. In the fourth

decade of the twentieth century more than 42 percent of the farm families were tenants, and more than 900,000 farm families were trying to exist on gross incomes of less than $400 a year. Resources that had been considered limitless proved insufficient. The dream of a land of family-owned farms had vanished. Erosion by wind and water, following droughts and floods, drove home the bitter truth that the Nation had wasted its land, and created conditions that threatened further irreparable damage.

In our period of the open frontier when land was plentiful and population sparse, the path to farm ownership was easy, and the dominant factor of the land-tenure system was owner operation. No one had to work long for another, either as laborer or tenant, if he cared to set up in farming for himself. There was good land to be had free, or at a very low price. But as the country filled up and the good free or cheap land disappeared, newcomers had to apply for land to those who had preceded them. They had to become tenants or to buy farms on terms which entitled the former owners to a large share of the earnings for a long time. Eventually, even these expedients became difficult or hazardous. More people wanted to rent land than could get it, and would-be purchasers had to assume heavy fixed charges. Suddenly we discovered that we had a large army of landless farm people for whose welfare and security we had made little or no provision.

This problem has two main aspects: (1) The relationship between land use and the public good; and (2) the relationship of individuals to one another in the tenure system and in community organization. Submarginal farming, overgrazing, overcropping, forest devastation, and other destructive practices cause tremendous soil erosion and flood damage. To stop or lessen the destruction it will be necessary to modify the right of the individual to abuse the land. Probably that cannot be done without at the same time modifying tenure conditions; for tenancy may be more destructive than the weather, and both land use and tenure depend on social attitudes. Existing tenure conditions impoverish both the land and the people. They foster tenancy, debt, and speculation, and deprive millions of all incentive to defend the soil. The Nation and the individual farmer have a common interest in seeking a remedy. Federal responsibility for

agricultural welfare cannot stop with efforts to improve the technique of production, or to devise better methods of marketing. Much has been accomplished along these lines already, without safeguarding either the land or the farmer.

In an approach to the solution of this problem, Congress passed the Bankhead-Jones Farm Tenant Act (Public No. 210, approved July 22, 1937). It was the culmination of efforts continued during three sessions to provide a national program for helping tenant farmers to get farms of their own. Three titles of the act establish tenancy, rural-rehabilitation, and submarginal-land-purchase programs, and a fourth deals with its administration. It puts large new responsibilities on the Department of Agriculture.

In title I the measure authorizes and directs the Secretary of Agriculture to conduct a farm-tenancy program and for that purpose authorizes appropriations in the amounts of $10,000,000 for the year 1937–38, $25,000,000 for the following year, and $50,000,000 for each year thereafter. With this money the Secretary may make loans to farm tenants for the purchase of individual farms. Local county committees will select the applications. Loans may be equal to the full value of the farms and may run for a 40-year period at 3-percent interest.

Originally the bill had proposed to provide for the purchase of land by the Government and its resale to farm tenants. There is a provision in the act as it now stands that the Secretary shall not be legally obligated to relinquish his interest in any farm purchased under the program for a period of 5 years from the date on which the loan is made. Furthermore, the Secretary may supervise farming operations on the purchased farm throughout the life of the loan.

The second title provides for a rural-rehabilitation program of loans and guidance similar to the one now being conducted by the Department. There is no appropriation for this rehabilitation, but the President may allot, out of appropriations made for relief or work relief, any amounts which he may determine to be necessary. Rural-rehabilitation loans bear interest at 3 percent per annum and may not be made for more than 5 years. At maturity, however, the loans may be renewed.

Retirement from agriculture of land submarginal for farming is only one among several purposes of title III. This title directs the Secretary to develop a general program of land conservation and efficient land utilization. Land not primarily suited to agriculture may be acquired by the Government and devoted to uses for which it is better adapted, such as forestry, wildlife conservation, or recreation. For all its purposes the act authorizes an appropriation of $10,000,000 for the fiscal year 1938 and $20,000,000 for each of the 2 succeeding fiscal years.

Needless to say this program cannot lift all our tenant farmers to the ownership status. Two out of every five farmers in the United States are tenants today, as compared with only one in four in 1880. Farm tenancy increased at the rate of 33,465 farms a year during the period 1880 to 1935. Assuming that this represents a normal rate of increase and assuming that on an average an investment of $4,000 would suffice to supply each of these tenants with land, buildings, and equipment necessary to make him economically independent, the Federal Government would have to appropriate $133,860,000 a year merely to take care of the annual increase in tenancy. There would be no reduction whatever in the number of tenant farms already in operation. Nevertheless the new program, modest though it is, will make a start in lifting worthy tenants up the tenure ladder and at the same time will promote better farming and better care of the soil. As the experiment proceeds, it should be possible to extend and improve it.

More than anything else agriculture requires a consistent land-use program that can deal effectively both with land in farms and with land not in farms. Federal legislation since 1933 has dealt vigorously with land in farms through crop adjustments and soil conservation. Such action, however, is not enough. Congress has recognized the fact and provided also for additional forest-land buying, for new recreation areas, for wildlife conservation, for the regulation of grazing in the public domain, for rural resettlement, and for the withdrawal of poor lands from farming. The Flood Control Act of 1936 provides for action on all the land throughout entire watersheds. Nevertheless there remains a lag between land-use practices that the Government

can control or influence and those that remain subject exclusively or nearly so to the play of commercial competition.

Land economists in the Department have striven to resolve this conflict. It is complex and difficult. In 1934, for example, the economists recommended a program for the Federal purchase of about 75,000,000 acres of submarginal farm land, including more than 20,000,000 acres then in crops. This program depends greatly for its success on what happens to other lands that cannot be profitably farmed. Federal land buying cannot embrace all the submarginal land. Yet there is no permanent advantage in checking submarginal farming in one area, only to have it crop up in another. Manifestly, Federal efforts to discourage submarginal farming need certain supports, among them a keener public realization of the uses to which different kinds of land should be put and relief from the economic pressure that forces people onto submarginal land.

Here we enter a labyrinth of diverse yet related problems. What is submarginal land? It depends on the intended uses, on the efficiency of the production technique, on the state of the market, and on the degree of unemployment prevailing. Whether land should be kept in farming or withdrawn from it is an economic and legal problem as well as a problem in farm production. Poor farming on poor land may be a byproduct of poor farming on good land. When the better situated farmers oversupply their market, they are farming poorly; and as a result the men on the poor land have to follow suit. Whatever they do adds a little to the surplus and much to their own distress. Theirs is not an isolated problem; it is a part of the agricultural problem as a whole.

Federal funds are available for soil conservation; for the increased acquisition of forest lands; for the retirement of areas submarginal for farming; for the restoration to wildlife of areas suited best to it; for research and cooperation with farmers and with State agencies in soil improvement; for the better control of grazing; and for the coordination of irrigation farming with other phases of land use. But to be successful, all the programs must harmonize. Resettlement must not clash with the retirement of poor land. Efforts to prevent soil erosion must not

stimulate unwise land settlement. Public and private land policy must synchronize. Good land utilization requires a combination of agronomy, engineering, economics, cooperative crop adjustment, scientific grazing and forestry, and public land acquisition; still more important, it requires an integration of public with private land use through entire land-use regions.

As the scope of governmental land policy increases, its relation with private policy becomes more intimate. There will be remote as well as immediate consequences. Everything depends on a cordial collaboration between public and private interests. Without the support and approval of land operators, the governmental policy can accomplish little. This is a transition period in which we seem to be moving from a purely laissez-faire land economy to one of foresight and cooperative control. Research must show the way, public opinion must accept it, and democratic processes must determine how it may be followed.

This Department is cooperating in land research with State and local agencies, especially in the study of types of farming, taxation problems, and zoning.

In many of the most important aspects of land utilization it can exercise as yet only a limited influence. Federal regulations may control grazing in the national forests and on the public domain, but forest devastation, settlement on poor land unsuited to enduring agriculture, overgrazing on private lands, and the unwise plowing up of range land for cultivation are only partly within the scope of Federal policy. To reconcile public with private interests in land utilization and to coordinate Federal with State and local activities is the next great problem in land utilization.

As a preliminary step, the Department classifies land for particular objectives. It describes the surface, position, soil, climate, vegetation, and other physical characteristics of particular areas and indicates their bearing on the natural land uses. Next, it studies the relationship between these physical characteristics and the available economic and social opportunities. This work has an important bearing on the equalization of taxes; on the guidance of land settlement; on the development of community services; on the efficient allocation of land among

cropping, grazing, forestry, mining, and recreation; and on the public planning of long-time utilization projects.

Economic and social aspects of the land-use problem must be studied, along with the physical aspects. Migration trends, rural poverty, improper farming systems, harmful tenure relationships, property rights in land, mortgage debt, and land taxation are just a few of the subjects that need investigation. Proposed remedies will require careful analyses. Such proposals range from minor changes in landlord-tenure contracts to the extensive exercise of regulatory power on private land. Along with the regulated use of publicly owned land in the public domain, in the national forests, and on State-owned land, many States have taken the first steps toward private land-use regulation through rural zoning, cooperative grazing associations, and soil-conservation-district laws. Essentially, the task is to synchronize land use with economic opportunity and to economize both land and human energy.

The Central Paradox

TAKEN one by one, the economic problems of agriculture yield to analysis more or less readily, though the solution remains difficult. There is no particular mystery, for example, about the origin of surpluses, about the disparities that develop between farm and nonfarm prices, about the increase of tenancy, or about the conditions that promote accelerated erosion.

But taken together these problems make a total that is greater than the sum of the parts and merges with the central problem of the modern economy, which is the existence, side by side, of want and potential plenty. No one seems to know the answer. Monetary theorists, Neo-Malthusians, social reformers, and revolutionists, offer conflicting interpretations, which the older schools at least agree in rejecting.

Agriculture, though it is a principal source of food and clothing, feels the paradox cruelly. Those who work at it and produce abundance, find themselves going without, particularly when they have been exceptionally successful in getting nature to give up her treasure. American farmers grow enough for the country and something for export even in drought years; in years of normal weather they produce surpluses. The result is not plenty on the farms, in contrast to an insufficiency elsewhere. On the contrary, the farmers go short, and other people satisfy their wants at a very low cost.

When farming is too productive, farm families go hungry—literally. In this age of specialization, farm products must usually be exchanged before they can satisfy the farm family's wants; when the goods are too plentiful, the exchange brings little in return. Wealth and poverty have rubbed elbows from time immemorial; but the contemporary phase of the conflict is novel. It is the sheer inability of wealth, under certain circumstances, to do those who have produced it any good.

This problem is so obscure and difficult that little can be said about it here. One point, however, we may note. Many persons attribute the difficulty to a disparity or lag between science on the one hand and social organization on the other. Science, they believe, has provided the means of plenty, and it remains for politics or sociology or something not usually called science, to show how the scientific victory may be applied. But such is not the case. Science cannot be truly said to have provided the means of plenty when it has solved merely the technical problems involved. Science includes economic and social, as well as physical problems; its sphere embraces man as well as nature. Not merely production but distribution and exchange and numerous social questions fall within its scope.

Such problems are as truly scientific as the more exact problems of mathematics, chemistry, astronomy, and physics. Specialists in these fields commonly deny the name of science to economics, psychology, and politics. This is a mistake. It springs from the idea that science deals only with what can be measured. No study becomes exact, quantitative, or measurable all at once; it begins with observation, experiment, and reason. Measurement comes later. Certain problems in economics and sociology are so vital that if we do not solve them, all the rest of our science may disappear; but economics and sociology are not yet exact sciences. Further progress in the physical sciences awaits progress in the social sciences. There must be more cross-fertilization of technical with social research, or both will come to a halt. Science must enter fields that it has not yet staked out.

The problem of coexistent want and plenty, which is utterly different today from what it was before the industrial revolution, is a central example of the need for a new combination of the physi-

cal and the social sciences. It becomes more and more urgent. Each advance in the technology of production enhances the difficulties of distribution and shows that one path cannot run ahead of the other indefinitely. It is time to pause, to take stock, and to see whether technology and social organization cannot somehow be harmonized. Science has done wonders in production; but unless it achieves corresponding victories in the economic and social sphere, it will find itself in a blind alley. Its technical successes will be misapplied or forgotten, and society will revert to more primitive forms. Already we get a hint of the possibility in a retrograde tendency in agriculture. Even in the United States the difficulties of distribution are producing less commercial and technically less efficient types of farming.

The Final Aim

WHATEVER the Government does for agriculture or with agriculture presupposes a goal. This goal may be defined in terms of balance. Agricultural prosperity requires a working balance between agriculture and industry which will carry both branches of production toward abundance. This looks simple; it is really complex. No one can object in principle, as the diplomats say, to the idea that we ought to have a working balance between agriculture and industry. Balance, however, is only another name for adjustment, without which nothing can live.

When we say that agriculture can prosper only in a balanced relationship with what is external to it and conclude that a good balance for agriculture will naturally be a good balance also for nonagricultural business, everyone agrees. But in trying to particularize the form and character of the desired good working balance we encounter difficulties.

The relationship between agriculture and industry is extremely complicated. It involves more than the simple opposition of buyers and sellers; more, in other words, than the perennial conflict over relative prices. Some city dwellers may imagine that the best state of agriculture is the one that supplies farm products at the lowest prices. Short-sighted farmers complain of high city wages. They suppose that lower wages would mean

cheaper farm machinery, cheaper automobiles, cheaper clothing, and cheaper furnishings.

That is by no means sure. But suppose it were true. How would the farmers benefit if the wage earners had to restrict their diet? Agriculture requires a harmonious relationship with industry, rather than merely a flow of cheap industrial commodities.

What is a good working balance between the two great branches of production? In the first years of the A. A. A. experiment farmers thought of it in terms of relative prices. They knew that farm prices were far below the expenses of production; they suspected that industrial prices were too high. But reflection disposed of this concept as too crude. It would have been possible, the farmers realized, to correct the disparity between farm and nonfarm prices by cutting farm production drastically. To have imposed an agricultural scarcity equal to the industrial scarcity that already existed would, however, have penalized both farmers and city workers without giving either group what they really wanted, which was more real income. It would have started a contest in competitive scarcity in which all the contestants would have lost.

Farm and nonfarm prices need to be in an equitable relationship; but it makes an enormous difference at what level of production the balance comes about. In farm prosperity the volume as well as the price of production is important. Agriculture must meet the needs of consumers at fair prices; otherwise its market will disappear, and consumers may look abroad for cheaper products. Similarly, industry must satisfy agriculture at fair prices.

One essential in a good rural-urban balance is an increase in the farm share of the national income, which since 1929 has been demonstrably too low. But we cannot specify the percentage. Suppose farmers were to force up their prices exorbitantly through scarcity until farm income became an abnormally high proportion of the national income? Whether they could hold it there would depend on many things, notably on industrial conditions.

Unemployment in the cities would thrust capital and labor into farming; consumers would demand lower agricultural tariffs; and the farm income would decline. On the other hand, with

industry booming and jobs abundant, the farm income would make a smaller relative gain even if the absolute amount increased. Economic forces tend to establish the farm share of the national income at different levels under different conditions.

What conditions will allow the farm proportion to be increased without preventing a good rural-urban relationship? They may be described briefly. Before agriculture can get and keep an increased share, the national income must be increased.

This is only another way of saying that the national production must be increased in both fields and factories; because production is income. As the total increases the share going to agriculture may rise without cutting into the amounts available to industry and labor. This may happen indeed with industry and labor receiving more than previously. Amicably to divide an increase in the national income on principles consistent with social justice is a totally different thing from quarreling over a decrease produced through competitive scarcity. Agriculture can win and keep an adequate share of the national income only when the country advances toward balanced increasing production.

This proposition has important practical applications. It defines the essence of the good rural-urban relationship. Agriculture cannot win prosperity for itself or keep an increased share of the national income if town and country engage in contests to force up prices through scarcity.

This does not mean that progress toward a balanced abundance always requires the same rate of increase in agricultural as it does in industrial production. The capacity of the human stomach is limited. Much depends, moreover, on the starting point. In 1933 agricultural production was nearly as large as it had been in 1929; whereas industrial production was down something like 50 percent. Industry had arrears to make up before the two great partners in production could begin again on an even footing. Agriculture had abundant justification for marking time while industry caught up.

But for the long pull both farm and factory production should be increased, so that consumers may be well supplied with all sorts of products and so that the disparity between the farm and the nonfarm income may be corrected without causing hardship to

anyone. Excessive limitations on production work against a satisfactory rural-urban balance.

Such limitations may eliminate surpluses of goods, but they create surpluses of labor and also of capital. They change the form rather than the essence of the surplus. In a balanced abundance surpluses would not exist except temporarily. In general, everything would be consumed on terms agreeable to both producer and consumer. The good rural-urban balance requires an approach to parity income for the farmers through increasing activity in both town and country, with their respective rates of increase varying with changing market trends. It requires, also, an approach to agricultural security through such measures as crop insurance and an ever-normal granary.

To obtain this beneficial rural-urban balance is the Department's main end, to which all that it does should contribute. Its responsibilities cannot be restricted to farm interests, but must embrace the general welfare. The Department has been called the farmer's branch of the Government. Actually it is much more than that. Research and service to find new and better ways of producing crops and livestock, and to aid farmers in planning their production and marketing, benefit the community. Otherwise, they would not benefit even the farmers.

Country and town are partners; each needs the other both as a market and as a source of supplies. Therefore, attempts by the Department to promote agricultural interests exclusively, without regard to other legitimate interests, would fail. Much of the Department's work and much of the money it spends go to advance the health, prosperity, and happiness of the general public, in which term are included the farmers. The Department works for all; it is a service agency for the Nation.

Superficially, the interests of farmers and nonfarmers may sometimes clash. Some urban interests prosper directly with the production of agriculture. Transportation companies, elevator concerns, ginners, exporters, and other handlers get more immediate profit from big crops than from small, whereas the farmers often do not. Actually, middlemen, farmers, and the general public profit most in the long run from stable supplies and prices. But there are often temporary conflicts, which should not be ignored.

These conflicts are not irreconcilable or even serious. Neither industry nor agriculture can benefit in the long run by underpaying the other. Therefore the Department tries to discover ways to compose the conflicting interests. Conditions oblige it to deal with social and economic maladjustments and to work for economic justice for agriculture. This is not antagonistic to nonfarm interests. On the contrary, the Department seeks to bring the different economic groups together in closer union and more efficient cooperation, so that the general welfare may continually be served.

Appendix—
An Agricultural Chronology

1776—John Adams introduces resolutions in Continental Congress to encourage agriculture.

1796—George Washington in his last annual message makes an appeal for a national board of agriculture.

1820—House of Representatives appoints agricultural committee.

1825—Senate appoints agricultural committee.

1839—Congress appropriates $1,000 to collect and distribute seeds, conduct agricultural investigations, and collect agricultural statistics. Patent Office assumes the work.

1862—Organic Act (May 15, R. S. sec. 520) establishes the Department of Agriculture for the purpose of acquiring and diffusing among the people of the United States information relating to agriculture.

1862—First Homestead Act (May 20, Chap. 75, 12 Stat. 392).

1862—First Morrill Act (July 2) donates land for colleges of agricultural and mechanic arts.

1884—Act of May 29 (23 Stat. 31) designed to prevent the spread of contagious diseases among cattle. It establishes the Bureau of Animal Industry.

1887—Agricultural Experiment Stations Act (Mar. 2, 24 Stat. 440) authorizes the establishment, under the direction of the land-grant colleges for which provision was made by the act of July 2, 1862 (12 Stat. 503), of experiment stations to conduct experiments relating to agricultural subjects.

1889—Act of February 9 (25 Stat. 659) makes the Department of Agriculture an executive department.

1890—Second Morrill Act (Aug. 30) provides for the further endowment of land-grant colleges.

1890—The Weather Service Act (Oct. 1, 26 Stat. 653) establishes the Weather Bureau in the Department of Agriculture to forecast the weather, issue storm warnings, etc.

1891—National-forest system begins. Congress authorizes the President to set aside forest reserves from the public domain.

1905—Act of February 1 (33 Stat. 628) places under the jurisdiction of the Secretary of Agriculture the protection of the national forests.

1905—Animal Quarantine Act (Mar. 3, 43 Stat. 1264) prevents the spread of the diseases of livestock by regulating their interstate movement from areas affected with contagious diseases.

1905—Act of March 3 (33 Stat. 1269) prohibits the interstate transportation of enumerated insect pests.

1906—Food and Drugs Act (June 30, 34 Stat. 768) prohibits the shipment in interstate commerce of articles of food and drug that are adulterated or misbranded as those words are defined in the act and authorizes seizure of the goods and criminal prosecution of the shipper.

1907—Meat Inspection Act (Mar. 4, 34 Stat. 1260) authorizes inspection of slaughtering or packing establishments of meats moving in interstate or foreign commerce and the destruction of condemned meats.

1908—Inspection of Dairy Products for Export Act (May 23, 35 Stat. 254) provides for the inspection and certification as to purity and quality of dairy products intended for export and the marketing, stamping, and labeling of such products.

1910—Insecticides Act (Apr. 26, 36 Stat. 331) prohibits the transportation or selling in interstate commerce of adulterated or misbranded insecticides and fungicides and provides for the seizure of adulterated or misbranded insecticides and fungicides.

1911—Weeks Act (Mar. 1 36 Stat. 961) authorizes States to enter into compacts for the conservation of forests and water supplies, and sets up the National Forest Reservation Commission to pass upon recommendations of the Secretary for the purchase of lands necessary to the regulation of the flow of navigable streams.

1912—Plant Quarantine Act (Aug. 20, 37 Stat. 315) regulates the importation and interstate movement of plants, plant products, and other commodities to prevent the introduction into and the spread within the United States of injurious plant diseases and pests.

1912—Federal Seed Act (Aug. 24, 37 Stat. 506), as amended, prohibits the importation into the United States of seeds which are adulterated or unfit for planting purposes and regulates the transportation in interstate commerce of adulterated or misbranded seeds and provides for criminal prosecutions of any person knowingly violating the provisions of the act.

1914—Agricultural Extension Act of May 8 (38 Stat. 372), authorizes cooperative work with the land-grant colleges in giving instruction in agriculture and home economics to persons not attending said colleges.

1916—Grain Standards Act (Aug. 11, 39 Stat. 482) provides for uniformity in the grading of grain by authorizing the Secretary of Agriculture to establish standards of quality and condition of grain.

1916—United States Cotton Futures Act (Aug. 11, 39 Stat. 476) lays a tax of 2 cents on each pound of cotton involved in any contract of sale of cotton for future delivery upon exchange unless certain types of contracts are used.

1916—Warehouse Act (Aug. 11, 39 Stat. 486) provides for the licensing by the Secretary of Agriculture of warehouses in which agricultural commodities are stored for shipment in interstate commerce.

1918—Migratory Bird Treaty Act (July 3, 40 Stat. 755) prohibits the hunting of migratory birds and their shipment except under such regulations as the Secretary of Agriculture may issue.

1921—Packers and Stockyards Act (Aug. 15, 42 Stat. 159) regulates the business practices of packers in interstate commerce and of stockyard owners or operators and the commission merchants and others operating on yards posted by the Secretary of Agriculture in compliance with the act. It prohibits unfair, unjustly discriminatory, and deceptive practices and devices.

1921—Federal Highway Act (Nov. 9, 42 Stat. 212), as amended, authorizes the Secretary of Agriculture to have payments made to the States by the Secretary of the Treasury on a specified basis for the construction of highways.

1922—Commodity Exchange Act, known as the Grain Futures Act, (42 Stat. 998), until amended June 15, 1936, regulates the exchanges, commission merchants, and brokers who deal in future contracts covering wheat, cotton, rice, corn, oats, barley, rye, flax, seed grain, sorghums, mill feeds, butter, eggs, and potatoes. It provides for the elimination of certain practices such as manipulation of the market, corners and squeezes, and making of false reports. Commission merchants and floor brokers are required to register with the Secretary of Agriculture.

1923—Naval Stores Act (Mar. 3, 42 Stat. 1435) provides for the promulgation by the Secretary of Agriculture of official standards for resin and turpentine and requires that all resin and turpentine shipped in interstate commerce shall be sold under or by reference to such standards.

1923—Cotton Standards Act (Mar. 4, 42 Stat. 1517) provides for the establishment of standards of quality of cotton and forbids the use of other than official standards in transactions in interstate commerce and in the publication of prices or quotations determined in or in connection with such transactions and authorizes an inspection service.

1927—Import Milk Act (Feb. 15, 44 Stat. 1101) is designed to prevent the importation into the United States of milk and cream that do not comply with the health requirements specifically designated therein.

1927—Produce Agency Act (Mar. 3, 44 Stat. 1355) makes it a criminal offense for any person receiving fruits, vegetables, melons, dairy or poultry products, or perishable farm products in interstate commerce for or on behalf of another to fail truly and correctly to account therefor, or to make false reports or statements relating to the handling or disposition of the same.

1929—Migratory Bird Conservation Act (Feb. 18, 45 Stat. 1222), as amended, establishes the Migratory Bird Conservation Commission on which the Secretary of Agriculture serves as chairman and which may acquire lands recommended by him as necessary for the conservation of migratory game birds.

1930—Foreign Agricultural Service Act (June 5, 46 Stat. 497) authorizes the establishment of the foreign agricultural service for the purpose of acquiring information regarding quality, competition, and demand for agricultural products, and the production, marketing, and distribution of such products in foreign countries.

1930—Perishable Agricultural Commodities Act (June 10, 46 Star. 531), as amended, requires the licensing of commission merchants, dealers, and brokers handling fresh fruits and vegetables in interstate commerce, and enumerates certain kinds of unfair conduct which it declares unlawful. The Secretary of Agriculture is authorized to award reparation for damages resulting from violation of the act.

1933—Agricultural Adjustment Act (May 12, 48 Stat. 31), several times amended, to establish and maintain such balance between the production and consumption of agricultural commodities and such marketing conditions therefor as would reestablish prices to farmers at a level that would give agricultural commodities a purchasing power with respect to articles that farmers buy equivalent to the purchasing power of agricultural commodities in the base period (August 1909–July 1914, except August 1919–July 1929 for tobacco and potatoes).

1934—Sugar Act (Jones-Costigan Act), (May 9, 48 Stat. 670), enacted as amendment to the Agricultural Adjustment Act and later amended, provides for making benefit payments to producers of sugar, a tax on the processing of sugar, and quota allotments to restrict the amount of sugar imported as well as the amount moving in interstate commerce.

1935—Soil Erosion Act (Apr. 27, 49 Stat. 163) establishes the Soil Conservation Service in order to prevent soil erosion and thereby preserve natural resources, control floods, maintain the navigability of rivers and harbors, and carry out other public purposes. The Service is authorized to conduct investigations and research, carry out preventive measures either on Federal lands or by cooperative agreements with agencies and persons controlling other lands, and contribute services, equipment, money, or materials in connection with such operations.

1935—Act of June 29 (49 Stat. 436) authorizes the Secretary of Agriculture to conduct research into basic laws and principles of agriculture. It also provides for the development of extension work.

1935—Section 32 of the act to amend the Agricultural Adjustment Act, and for other purposes (approved Aug. 24, 49 Stat. 750), authorizes the Secretary of Agriculture to make payments for the purpose of encouraging the exportation and the domestic consumption of agricultural commodities and products

thereof and, in order to reestablish farmers' purchasing power, to make payments in connection with the normal production of any agricultural commodity for domestic consumption.

1936—Soil Conservation and Domestic Allotment Act (Feb. 29, 49 Stat. 1148), stresses as its objective, in addition to those present in the Soil Erosion Act, the preservation and improvement of soil fertility and the promotion of the economic use and conservation of lands, by the encouragement of soil-conserving and soil-rebuilding practices rather than the growing of soil-depleting commercial crops. By the terms and the act, appropriations may be made available to the States upon their passing an approved State plan which will carry out the objectives of the act. Pending the enactment of State legislation, the statute permits payments to individual agricultural producers.

1936—Flood Control Act of June 22 (49 Stat. 1570) authorizes the Secretary of Agriculture to conduct investigations of watersheds and measures for run-off and water-flow retardation.

Organization of the United States Department of Agriculture

Secretary of Agriculture	Henry A. Wallace.
Under Secretary	M. L. Wilson.
Assistant Secretary	Harry L. Brown.
Director of Extension Work	C. W. Warburton.
Director of Finance	W. A. Jump.
Director of Information	M. S. Eisenhower.
Director of Personnel	W. W. Stockberger.
Director of Research	James T. Jardine.
Solicitor	Mastin G. White.
Agricultural Adjustment Administration	H. R. Tolley, *Administrator*.
Bureau of Agricultural Economics	A. G. Black, *Chief*.
Bureau of Agricultural Engineering	S. H. McCrory, *Chief*.
Bureau of Animal Industry	John R. Mohler, *Chief*.
Bureau of Biological Survey	Ira N. Gabrielson, *Chief*.
Bureau of Chemistry and Soils	Henry G. Knight, *Chief*.
Commodity Exchange Administration	J. W. T. Duvel, *Chief*.
Bureau of Dairy Industry	O. E. Reed, *Chief*.
Bureau of Entomology and Plant Quarantine	Lee A. Strong, *Chief*.
Office of Experiment Stations	James T. Jardine, *Chief*.
Farm Security Administration	W. W. Alexander, *Administrator*.
Food and Drug Administration	Walter G. Campbell, *Chief*.
Forest Service	Ferdinand A. Silcox, *Chief*.
Bureau of Home Economics	Louise Stanley, *Chief*.
Library	Claribel R. Barnett, *Librarian*.
Bureau of Plant Industry	Frederick D. Richey, *Chief*.
Bureau of Public Roads	Thomas H. MacDonald, *Chief*.
Soil Conservation Service	H. H. Bennett, *Chief*.
Weather Bureau	Willis R. Gregg, *Chief*.

16572°—37