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THE AGRICULTURAL REVOLUTION IN THE UNITED STATES—1860-1930[1]

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THE transformations through which the United States has been passing since 1860 are so varied, so far-reaching and so profoundly significant that the historian is justified in assigning to this period of our history a place of importance second to none of the many corresponding epochs of time in the preceding centuries. It is an era of great complexity; a challenge to the student of American development.

The importance of these changes was emphasized more than a generation ago by David A. Wells in his book on "Recent Economic Changes" published in 1889 in which appear these significant passages:

The economic changes that have occurred during the last quarter of a century—or during the present generation of living men—have unquestionably been more important and varied than during any former corresponding period of the world's history. It would seem, indeed, as if the world, during all the years since the inception of civilization, has been working up on the line of equipment for industrial effort—inventing and perfecting tools and machinery, building workshops and factories, and devising instrumentalities for the easy intercommunication of persons and thoughts, and the cheap exchange of products and services; that this equipment having at last been made ready, the work of using it has, for the first time in our day and generation, fairly begun; and also that every community, under prior or existing conditions of use and consumption, is becoming saturated, as it were, with its results. As an immediate consequence the world has never seen anything comparable to the results of the recent system of transportation by land and water; never experienced in so short a time such an expansion of all that pertains to what

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is called "business"; and has never before been able to accomplish so much in the way of production with a given amount of labor in a given time.

The problems which our advancing civilization is forcing upon the attention of society are, accordingly, of the utmost urgency and importance, and are already occupying the thoughts, in a greater or less degree, of every intelligent person in all civilized countries. But, in order that there may be intelligent and comprehensive discussion of the situation, and more especially that there may be wise remedial legislation for any economic or social evils that may exist, it is requisite that there should be a clear and full recognition of what has happened.

Frederick J. Turner, who has inaugurated and inspired most of the work in the economic interpretation of history which has been done in this country, observed recently that:

Few epochs in history have included such startling changes within a single generation as that between the eighties and the present. It is a hazardous task to attempt to portray the large outlines of a nation's changes and tendencies for the era of the present generation, especially an era of revolutionary changes in the material, political and social composition of a people. There have been generations of such stationary character that the historian's task in dealing with them is simple if not inspiring. But the very fact, that the generation which has passed . . . is one of such complexity and of such extraordinary change that it daunts the historian and almost forbids the attempt, is at the same time a challenge. For unless the American people turn at times from the rushing current of events to take observations, to look to the chart of their course, to measure their progress or decline, and survey its stages, they are not likely to comprehend the direction in which they are going, the meaning of the voyage, or the measures to pursue in the coming years. No one is wise enough, no one is far enough removed from the action, adequately to make this survey. The prepossessions and the prejudices, the survival of old conceptions, the complexity of the problems, are too great. It requires the base line which only coming generations can draw to measure the full meaning of these recent years and to reckon the things that should have been done and those that should have been undone.

Nevertheless a generation that does not attempt to consider its recent past is like the merchant who ignores his ledger, the mariner who takes no observations. However imperfect the results, it is necessary that the attitude of mind should be achieved. . . .

The dominant fact in American history during this period is the triple economic revolution which began its protean changes in England during the latter part of the eighteenth century and extended to the continent of Europe and the United States in the nineteenth century. Agriculture was transformed from a simple, pioneer and largely self-sufficing occupation into a modern business organized on a scientific, capitalistic and commercial basis; industry definitely underwent the change from hand labor in the home to machine production in the factory; and the local market was transformed into the world market. This threefold revolution in agriculture, industry and commerce is the key to the study of the recent history of the United States. While the antecedents of the economic revolution were already in evidence before 1860, it was the war between the states that hastened the tendencies and produced the changes that were destined to transform the economic and social structure of the nation and give rise to complex problems of reorganization and readjustment which to-day challenge the social sciences. With these observations in mind we may proceed to a consideration of the forces underlying the agricultural revolution in the United States.

I. The Passing of the Public Lands into Private Ownership

The entire continental land area of the United States, excluding Alaska, amounts to 1,903,290,880 acres. The public domain comprised three fourths of this area, or 1,442,200,320 acres; while the remaining one fourth, consisting of the original thirteen states and the states of Kentucky, Tennessee and Texas, embraces an area of 461,090,560 acres which did not come under the control of the federal government and so was never a part of the public domain. Of this vast domain, the federal government had by 1860 disposed of 394,088,712 acres, thus leaving for future disposition an area amounting to 1,048,111,608 acres, the greater portion of which was located in the public land states west of the Mississippi River. The rapid disposal of the public lands dates from 1862 with the passage of the homestead act, the land grant college act and the act providing for a grant of land for the first transcontinental railroad. Under the provisions of the homestead law, the government during the period ending with June 30, 1929, disposed of 232,259,180 acres of land—an area equal to six times the area of Iowa. The preemption act of 1841, the timber culture act of 1873, the desert land act of 1877 and the timber and stone act of 1878, together with the right granted under the homestead law, enabled any person to acquire the title to 1,120 acres of land. Large areas of timber and mineral lands were acquired under other laws. The utilization of inferior lands was made possible by the Carey Act of 1894, the reclamation act of 1902 and subsequent legislation. The huge grants of land to states and corporations for the construction of railroads, wagon roads and canals, and for the advancement of education also facilitated the disposal of the public domain. The

establishment of forest and Indian reserves further reduced the amount of public land available for private entry.

This legislation made possible the rapid alienation of the public lands. The report of the commissioner of the General Land Office shows that in spite of the liberal policy of the federal government the remaining area of public land, unappropriated and unreserved, amounted on June 30, 1929, to 190,031,722 acres, located for the most part in the mountain and Pacific Coast states. The greater portion of this area, however, will never be available for agricultural purposes.

The transfer of this vast heritage from public to private ownership was accompanied by a corresponding increase in the farming area of the country. The number of farms was increased from 2,044,077 in 1860 to 4,008,907 in 1880. In 1900 there were 5,737,372 farms in the United States. This number was further increased to 6,448,343 in 1920. The number of acres in farms was increased from 407,212,538 acres in 1860 to 536,081,835 acres in 1880. This was further increased to 838,591,774 acres in 1900 and 955,883,715 acres in 1920. The average number of acres in farms was reduced from 199.2 acres in 1860 to 133.8 acres in 1880, due largely to the breaking up of the plantation system and the operation of the homestead law. This was increased to 146.2 acres in 1900 and 148.2 acres in 1920 but reduced to 145 acres in 1925; while the average number of acres of improved land in farms was reduced from 79.8 in 1860 to 71 in 1880 and then increased to 72.2 in 1900 and 78 in 1920. That is to say, the average size of farms and the average amount of improved land in farms remained fairly constant throughout the period.

The passing of the public lands has been accompanied by significant changes which characterize American agriculture in the twentieth century. Among these changes may be mentioned: (1) the rapid rise of land values and the consequent transition from extensive to intensive farming; (2) the growth of tenancy; (3) the decline of the agricultural export trade; (4) the utilization of the inferior lands, and (5) the reorganization of rural life. The passing of the public lands has brought agriculture to the crossroads with modern industry. This is perhaps the most distinctive phase of the agricultural revolution in the United States.

II. The Rapid Growth of Population and Immigration

The population of the United States, excluding the non-contiguous possessions, numbered 31,443,321 in 1860 and 62,947,714 in 1890. By 1920, it passed the one hundred million mark, reaching the number of 105,710,620. That is to say, population was doubled in thirty years and increased by three and a half times in sixty years. Immigration supplied 28,749,245. Of this number 10,373,628 arrived in the period 1860 to 1890, and 18,373,617 in the period 1890 to 1920.

The great abundance of good land and the liberal policy of the federal government in providing free homesteads for the settler attracted great numbers of immigrants from the Atlantic seaboard states into the farming states of the West. Hither came also large groups of European immigrants experienced in Old World methods of farming which they adapted to the requirements of a new frontier environment. They were as a rule industrious and thrifty, becoming a substantial part of the farming population and loyal American citizens. An agricultural empire was founded in the Mississippi Valley. Meanwhile, the Pacific Coast states were settled and added to this great imperial domain.

The population has until recently continued to be predominately rural. According to the United States census of 1880, the rural population (including towns and villages with less than 2,500 inhabitants) numbered 35,383,345, or 70.5 per cent. of the entire population. This was a number greater than the total population of the United States in 1860. In 1910 the rural population numbered 49,348,883, which was 53.7 per cent. of the entire population. The United States census of 1920 is the first to show that the majority of the American people now live in towns and cities: 48.1 per cent. being classified as rural, while 51.9 are classified as urban—the latter excluding towns and villages of less than 2,500 inhabitants, which are classified as rural. In 1910, 33.2 per cent. of all persons engaged in gainful occupations were engaged in farming—a greater proportion than was engaged in any other occupation. In 1920 the proportion of persons over ten years of age thus employed declined to 26.3 per cent., while the proportion of persons engaged in manufacturing and mechanical industries was increased to 30.8 per cent. This is a fact of fundamental significance in marking the emergence of the United States into an agrarian-industrial state.

These figures show that there has been a rapid increase in the rural population since 1790 and in the urban population since about 1880; but that while the rural population has been increasing, the urban population has been growing at a more rapid rate. That is to say, the rural population has entered upon a period of rapid relative decline, which is another way of saying that the population of the United States is becoming urbanized. Many students and writers have tended to lament the movement of population from the country to the city; to view with

misgivings the desertion of the farms and the concentration of population in crowded tenements; to urge the importance of checking this "trek to the cities," and even to propose a "back-to-the-land" movement. These views are opposed by those who urge that science, invention and power-driven machinery have made possible the migration of population from the country to the city; that this movement is inevitable; that it is destined to continue at an accelerated rate; and that it is really a natural process which is best for the nation as a whole.

Among those who hold this view may be mentioned the editor of *The Birmingham News,* who in a recent editorial made these significant observations:

> The forthcoming census is expected to show a greatly reduced population in the provinces and vastly larger urban increases in the last decade; for while those who quit the rural regions are coming to the congested centers, the great majority of immigrants also are drawn to centers where population is greatest. And despite the fact that the depleted rural population continues to supply sufficient food for the nation—largely because of intensive production aided by labor-saving machinery—sociologists still deplore the migration from country to town. Precisely why social students grieve over this movement is never stated very clearly. What is clear is that the reason for it is largely economic. What is plain as a pikestaff is that the foods, the wool, the cotton, the livestock of the future will be produced scientifically by trained farmers. What the tender-minded sociologist sees is the gradual tendency of American living to become complex. He deplores that families are moving in from the spacious acres, the green and fertile fields, away from the open air, to become industrial slaves—burdens to the labor market already glutted. But that is not altogether a fair picture. The question is whether an unskilled farmer, unable to wrest a living from sterile soil—since he lacks capital to fertilize it and brains to develop it—is worse off in the industrial centers where he must endeavor to wrest a living from the streams of trade.
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> Doubtless this will be a puzzle for students to worry over for many years ahead. So long, however, as the trained farmers of the nation can produce sufficient bread, meat and textiles to provide the non-producing workers in the so-called "artificial industries," it must continue to be the paramount factor in that trek from the open spaces into towns where people rarely ever think of the processions of stars and suns. In times ahead when cities will become so greatly cluttered that the scientific farmers in the fields can not supply the demand for food, descendants of farmers who left the fields will go back.

Another view is expressed by Chester C. Maxey in his recently published book on "Urban Democracy." The writer observes that:

> The country is itself being urbanized. Automobiles, improved highways, telephones and radios are bringing the city to the country and the country to the city. A new chapter in country life is being written. The old distinctions between *rus* and *urbs* are gradually fading out. Agriculture is becoming a specialized industry, and the economic aspects of rural life are beginning to resemble those of the city. The truth is that city and country are alike caught in the same web of cosmic forces, and are doomed to share the same destiny. The outcome no man can foresee, but we know it will be shaped and determined by the ability of the human species to adapt itself to life in the great society which is being created by the urbanization of the modern world.

III. The Invention and Popularization of Improved Farm Implements and Machinery

"The year 1850 practically marks the close of the period in which the only farm implements and machinery other than the wagon, cart and cotton gin were those which for want of a better designation may be called implements of hand production. The old cast-iron plows were in use. Grass was mowed with a scythe, and grain was cut with the sickle or cradle and threshed with the flail." Although most of the epoch-making implements and machines which have revolutionized farming were invented and introduced into practical use before 1860, it was the Civil War decade that popularized these labor-saving devices. The withdrawal of hundreds of thousands of men from the farm to enlist in the army stimulated the use of such devices. The plow, the corn-planter, the two-horse cultivator, the mower, the reaper and the threshing machine rapidly overcame the conservatism of the farmer who, confronted with the alternative of losing his crops in the field for want of an adequate labor supply, now became convinced of the utility of these inventions when he saw it demonstrated, for example, that a reaper drawn by a team of horses and operated by one man could cut from ten to twelve acres of an ordinary stand of wheat in a day, whereas a man with a grain cradle could by laborious effort cut but an acre and a half to two acres of wheat in the same length of time.

Many notable mechanical improvements have been introduced and widely adopted since that time. The list is legion. The more recent introduction of power-driven machinery utilizing gas and electricity is a significant feature of this development. The question whether the horse or the tractor affords the most economical power for farm use is the subject of a lively controversy which must be decided by the farmers themselves with reference to their individual circumstances. The use of improved farm implements and machines has not only added greatly to the productivity of each unit of land and of labor but it has also made possible the intensive cultivation of a larger area of land. The topography of considerable areas of the

arable land of this country is comparatively level, which favors the use of farm machinery on a larger farm unit basis. The tendency of farmers to specialize in a few staple crops adds still further to the advantages of machinery, while the relatively large size of American farms makes the use of machinery economical. It is therefore apparent that while the size of farms varies, depending on the type of farming carried on, a farm "ought to be large enough to occupy the reasonable working time of the farmer and his family when they use the best and most efficient tools and machinery known to the farming world, with ample horse power, or some other form of power to drive that machinery." The tendency in the United States has been to reduce as much of the farm work as possible to mechanical process. This is one of the most significant aspects of the revolution in American agriculture.

IV. The Extension and Development of Transportation Facilities

The history of the United States from the beginning of colonization is in a very real sense the history of the development of transportation and communication. Prior to 1850, the principal avenues for the disposal of farm products were the two great waterways of the country: (1) the Mississippi River with its navigable tributaries, and (2) the Great Lakes with their eastern connections, the Erie Canal and the Hudson River and the Welland Canal and the St. Lawrence River. The early railroads in the Middle West were regarded as tributaries of the waterways; but the rapid extension and improvement of railway facilities after 1850 was destined to effect profound changes in both agriculture and industry and to revolutionize the whole course of internal trade. In 1860 there were 30,626 miles of railroad in operation, distributed equally among the three great sections of the country: the East, the South and the West. The rate of construction was checked somewhat during the war between the states, but immediately after the war the entire country was seized with a mania for railroads. In 1870 there were 52,922 miles in operation. This was further expanded to 93,922 miles in 1880 and 166,654 miles in 1890, finally reaching 198,904 miles at the close of the century. Railway expansion continued, amounting in 1910 to 249,992 miles and in 1916 to 254,251 miles. Since that date there has been a continuous annual decrease of railway mileage, which in 1927 amounted to 249,131 miles. The country was spanned with a network of railroads. Chicago became the greatest railway center in the world, with St. Louis as a keen competitor for first place. Five transcontinental railroads were constructed, thus bringing the Pacific Coast states into direct economic relationships with the Mississippi Valley and the Atlantic seaboard states.

No less important than the rapid growth of mileage were the great improvements which accompanied the development of rail transportation. Reference should be made especially to the reduction of grades and curves, improved drainage and ballasting, better bridges, the introduction of steel rails, the increase in the capacity of freight cars and in the drawing power of locomotives, the adoption of uniform gauges, the establishment of belts of standard time, the development of terminal facilities, including side tracks, warehouses and terminal elevators, and scientific rate-making.

These improvements, supplemented by the advantages afforded by rapid transit and reduced risks, tended to increase the value of railroads as commercial highways which by the middle of the seventies had become effective competitors of the waterways in the transportation of farm products. The introduction of the iron steamship on the ocean after 1860 and the formation of combinations between railroad and steamship lines, which made possible the shipment of products on through bills of lading from interior points to the markets of Europe, further increased the importance of the railroads as carriers of farm products. These developments were further accompanied by improvements in the facilities for communication which served to bring all sections of the country and the nations of western Europe into more interdependent relationships. Of these, the telegraph was the most important agency for the rapid dissemination of information without which the organization and management of the modern commercial system would have been impossible. The improvement of the postal system, the growth of newspapers and trade journals, the invention and extension of the telephone system, the organization of produce exchanges and the modern system of banking and rural credit facilities also performed incalculable services in transforming agriculture from the self-sufficing into the commercial stage.

The extension and development of transportation facilities, rapid though it has been, has not kept pace with the surplus production of farm and factory. The inadequacy of the present system for the handling of this surplus, combined with high freight rates, has led to the urgent demand since Roosevelt's administration for the improvement of our great inland waterway system. This includes two great projects of importance to the Middle West: the restoration of the upper Mississippi River to its former importance as a carrier of bulky products such as grain and lumber and also coal and machinery; and the development of the Great Lakes-St. Lawrence waterway. These

projects are opposed by the commercial interests of the East, which foresee in the construction of this route and the consequent development of great seaports in the American Mediterranean the destruction of a monopoly of the western traffic in grain and livestock products which it has held since the completion of the Erie Canal.

The twentieth century marks the beginning of a new epoch in the history of transportation. The new heralds of progress are the automobile and the airplane. In 1900 there were 8,000 automobiles in the United States. Had any one then predicted a million automobiles within a generation he would have been ridiculed for his child-like fancy; but in how short a time would his prophecy have been redeemed? There are now 25,000,000 automobiles in the country: one to every four of the population! What a great influence this fact has had on the good roads movement and on rural civilization! There are now about 8,000 commercial airplanes in use in the United States, which is equal to the number of automobiles in 1900. Aviation is indeed on the threshold of a new era of remarkable development. The Curtiss Airport Corporation has definitely inaugurated a program of constructing twenty-five or thirty airports in this country and the island possessions, each airport costing from $2,500,000 to $3,000,000. Who can doubt the tremendous possibilities of commercial aviation and its importance as a factor in reconstructing rural life?

V. The Migration of Industries from the Farm to the Factory

The distinguishing feature of farm life in the pioneer period was its economic self-sufficiency. There was no market for farm products; consequently no goods could be purchased from the outside. Each farm was "an economic microcosm," producing for itself practically everything that it consumed: food, clothing, furniture, linens, soap, candles and a great variety of minor articles essential to the farmer and his family. The transfer of these industries from the farm to the factory is the most significant aspect of the transition from self-sufficient to commercial agriculture. It is an interlocking feature of both the agricultural and industrial revolutions. This is emphasized by the fact that the farms furnish approximately three fourths of the raw materials of industry, while fully one half of the products sold by the farmer are purchased by our manufacturing plants. The transformation of farm products by industrial processes into goods ready for the consumer is therefore the basic fact in the transition from pioneer self-sufficiency to commercial agriculture and industry.

The migration of industries from the farm to the factory since 1860 is characterized by the evolution of technical processes of manufacturing, increased market demands due to the growth of population, the addition of many new products and the utilization of by-products, new methods of marketing, improved methods of factory organization and management, concentration of manufacturing into large establishments and the localization of industries at advantageous points. These forces made possible increasing specialization which characterizes the transition from self-sufficient to commercial agriculture.

The industries that have been transferred from the farm to the factory may be classified into three groups: (1) food products; (2) textiles and clothing, including boots and shoes; and (3) tobacco and a number of minor products. The food industries include slaughtering and meat packing, flour milling, the manufacturing of dairy products, the canning of fruits and vegetables, the preparation of poultry and its products and the production of preserves and pickles. Many new industries have been added, such as the manufacture of beet sugar and the production of bread, pastries and confections. The list of package products includes a considerable number of animal and vegetable products. In 1860 flour and grist mills ranked first among the manufacturing industries in valuation of products, which amounted to $248,580,000. In 1919 slaughtering and meat packing ranked first with a total output valued at $4,246,290,000, while iron and steel ranked second in products, valued at $2,828,902,000, and automobiles ranked third with a valuation of $2,387,903,000. The products of all food industries were valued at $12,438,891,000, which was 20 per cent. of the total value of manufactured products in the United States.

The transfer of the textile and clothing and the boot and shoe industries from the farm to the factory has been studied chiefly from the standpoint of the development of manufacturing in the United States, but it deserves the attention of students of the history of American agriculture. It has been estimated that the household production of textiles in 1820 constituted more than two thirds of the entire product. The age of homespun gave way to the factory system by the operation of the same forces that took the food industries out of the home and placed them in the factory. In 1919 the total value of manufactures of textiles and their products amounted to $9,216,103,000.

The significance of the transfer of these industries from the farm to the factory can hardly be exaggerated. It is "the best evidence of the extent and rapidity of the transition from self-sufficient to commercial agriculture."

VI. The Expansion of Domestic and Foreign Markets

These forces made possible a territorial division of labor which enabled each section to devote itself more exclusively to the production of those commodities for which it was best adapted: the East to manufacfacturing and commerce; the South to the raising of cotton, cane and tobacco, and the West to the production of grain and live stock. That is to say, there were created three great economically interdependent sections bound together by reciprocal trading interests. The East became the home market for the surplus products of the West and the South, taking grain and flour and meat for its rapidly growing urban population and raw materials for its factories and offering in return the products of its factories.

The volume of production, however, exceeded the demands of the home market, thus giving rise to an annual product far in excess of the needs of the country, but for which there fortunately existed a growing demand abroad. The development and expansion of the facilities for the transportation and handling of bulky products and the reduction of freight rates transformed the local into the world market, the effect of which was twofold: first, it stimulated the production of food in the great agricultural regions which now had access to the markets of the world; and, second, it subjected the agricultural systems of the western European countries to a severe strain of competition which compelled large numbers of the rural population to abandon farming. As a result, they either migrated to the industrial centers to enlist in the army of wage-earners or emigrated to the New World, the greater proportion of them settling in the United States, which furnished unequaled opportunities for the making of an independent living. The countries of Europe thus became the natural market for the breadstuffs and live-stock products and the cotton and tobacco which entered into the export trade of the United States. The most important market for these commodities was Great Britain, which after the repeal of the Corn Laws in 1846 was transformed from an agricultural into an industrial nation largely dependent on foreign nations for an adequate supply of foodstuffs and raw materials. The nations of continental Europe were second in order of dependence, while the non-European countries of South America, the West Indies, Canada, China, Australia and South Africa came next. These countries all furnished markets that absorbed the surplus agricultural products which the United States had available for export. Meanwhile Russia, India, Australia, Canada and Argentina became strong competitors of the United States for this trade.

The principal items entering into agricultural export trade of the United States during the period under review were grain and flour, live-stock products, cotton and tobacco. The rapid expansion in the volume of these exports during the latter part of the nineteenth century was followed by a marked decline during a period of approximately fifteen years preceding the outbreak of the World War. Grain and flour and live-stock products declined at a precipitous rate, while cotton and tobacco continued at a fairly steady rate. The forces contributing to the sharp reduction in grain and meat exports were: (1) the tariff policies of France and Germany; (2) the competition of Argentina, Canada and Russia; and (3) the growth of the home market. These forces are of a permanent character, thus pointing to the day when the United States will cease to be a food-exporting nation.

The present agricultural situation in the United States is due in no small measure to the fact that Europe during the last decade has been unable to absorb its normal share of our exportable surplus. This condition will probably not be remedied until European nations have recovered their prewar purchasing power and world markets have again become stabilized. Domestic legislation may provide temporary relief; but it will not solve the problem. The farmer is dependent on foreign markets for the disposal of 60 per cent. of his cotton, 20 per cent. of his wheat and 15 per cent. of his pork and lard. He is dependent on Europe for the absorption of 80 per cent. of his whole exportable surplus. But the reduced purchasing power of Europe is a factor of more or less permanence. Moreover, Europe has been going back to the farm, with the result that it is to-day really less dependent on American food products than in the prewar period. But let us suppose that the European countries recover their former purchasing power. The United States has come to the end of the free land epoch and entered the period of high-priced land and high cost of production while Canada, Australia, New Zealand, South Africa, Argentina and Russia, with low-priced land and low cost of production, have become competitors of the United States in the markets of the world for the disposal of their surplus food products. The advantages lie with the new countries.

The present insecurity of the farmer in the foreign market of the world is therefore more or less permanent. There is but one alternative which offers any hope of escape from this condition. This alternative is the reorganization of American agriculture to meet the demand of a rapidly expanding home market. This means that the time has come when less attention should be given to the production of the great world

agricultural staples such as wheat, pork and cotton and more attention to the production of perishable and semi-perishable commodities—dairy products, vegetables, fruits and the like. But even so, it will be some time before we cease to be a food- and cotton-exporting nation, for the reorganization of agriculture along the lines suggested can not be effected in less than a generation for reasons which are inherent in the nature of the farming business.

VII. The Establishment of Agencies for the Promotion of Scientific Knowledge Relating to Agriculture

Interest in scientific farming dates back to the beginning of the national period of our history, but this interest was shared by but a comparatively small number of progressive farmers. The great mass of the rural population followed the rule of tradition, custom and superstition which prevailed throughout the pioneer period. The reluctance to apply scientific principles to the practice of farming is explained by the fact that it was easier and more economical to acquire and cultivate new land than to institute intensive methods on the older land. Moreover, the farmers generally possessed a very meager knowledge respecting the proper treatment of soils and plant life, even the most intelligent farmers, including the scientists themselves, knowing very little about such matters. Then, too, the great majority of farmers were averse to new ideas and methods which they regarded as "book farming" and therefore as impracticable. This attitude is due largely to the fact that the farmers of the pioneer period, accustomed to a life of isolation and separation from their fellowmen, were naturally independent and extremely individualistic, relying on their own initiative and taking pride in following their own peculiar methods of farming, when it would have been easier and less expensive for them to seek and follow the advice and experience of others.

The rapid disposal of the public domain after 1862 soon brought the nation to the end of the free land era when rising land values made it necessary for the farmer to change from extensive to intensive methods; and the transformation of agriculture from the pioneer into the commercial stage brought the farmer into closer relations with the business world. The new conditions thus created broadened the farmer's outlook and awakened him to a realization of his educational needs and opportunities. This period also witnessed the rise of a new generation of farmers who were ready to abandon primitive methods of farming and adopt scientific methods as soon as their utility was demonstrated. Agriculture, thus liberated from the fetters of custom and tradition, was prepared to enter upon a new era of development. This led to the creation of agencies for the promotion of scientific knowledge relating to agriculture. The limits of this paper will permit only a brief consideration of these agencies in the education of the farmer along scientific and practical lines.

The Federal Government first took an active interest in the promotion of agriculture in 1839, when, on the recommendation of the commissioner of patents, an appropriation of $1,000 was made for the "collection of agricultural statistics, investigations for promoting agriculture and rural economy, and the procurement of cuttings and seeds for gratuitous distribution among the farmers." The work was gradually developed by the Patent Office, through its agricultural division, until 1862, when the Department of Agriculture was established. The functions of this department as defined by law were "to acquire and diffuse among the people of the United States useful information on subjects connected with agriculture in the most general and comprehensive sense of that word, and to acquire, propagate, and distribute among the people new and valuable seeds and plants."

This department grew slowly at first, owing to inadequate moral and financial support; but as the need for a scientific knowledge relating to agriculture developed, the functions of this department were gradually expanded. By 1889 it had finally achieved sufficient dignity to be raised to the rank of a cabinet office. Thereafter the work of the department was rapidly developed until it became the leading government agency of its kind in the world for the promotion of scientific research relating to all lines of agricultural development, including plant and animal life, crop production, insect pests, trade and commerce, irrigation, statistics, quarantine and road-making—almost everything, indeed, affecting the interests of those engaged in the raising and marketing of agricultural products. In 1927 the total expenditures of the department amounted to $153,049,018.

The U. S. Department of Agriculture is supplemented by the state departments, most of which have been established since 1860. The functions of these may be defined in general terms as follows: the collection, publication and distribution of crop statistics; the holding of state and district fairs; the conducting of farmers' institutes; the enforcement of laws relating to live stock and human foods; the control of insect pests and fungus diseases in orchards, nurseries and vineyards; the enforcement of quarantine laws against animal diseases; the operation of experimental farms; the distribution of seeds and plants, and the preparation and publication of annual reports, journals and bulletins.

The same year in which the U. S. Department of Agriculture was established marks also the passage

of the land-grant college act, providing for the establishment of colleges of agriculture and mechanic arts. According to the provisions of this law, each state received 30,000 acres of public land for each representative and senator to whom the state was entitled in Congress under the apportionment of 1860. The interest on the money derived from the sale of this land was to be appropriated for "the endowment, support, and maintenance of at least one college where the leading object shall be, without excluding other scientific and classical studies, and including military tactics, to teach such branches of learning as are related to agriculture and the mechanic arts, in such manner as the legislatures of the states may respectively prescribe, in order to promote the liberal and practical education of the industrial classes in the several pursuits and professions of life."

The land-grant act of 1862 was the most important specific enactment ever made for the promotion of scientific knowledge relating to agriculture in the United States. It gave a great stimulus to the movement, already inaugurated before 1860, for the establishment of state-supported institutions of learning devoted to "the liberal and practical education of the industrial classes." Many states accepted the conditions of the grant soon after the passage of the act. There are now sixty-nine institutions in the United States receiving the benefits of this grant.

The land-grant colleges underwent a period of slow development during the first twenty-five years of their existence. It was a period of organization and of discussion as to what the character of these institutions should be in order to fulfil the purpose of the act and to meet the needs of "the industrial classes" in the respective states. Courses in the study of the sciences were yet to be developed, teachers in these subjects were to be trained and the system of elective studies was to be organized, while graduate courses of instruction and research remained to be developed later. It was therefore impossible to develop technical courses in agriculture until the sciences were placed on a sound basis with adequate equipment and well-trained teachers in charge of these courses. The most important functions of the land-grant colleges during this period were, therefore, first, the establishment and perfection of instruction in the natural sciences; and, second, the development of technical courses suited to the needs of farmers and mechanics. At the same time, they gave instruction in a variety of general subjects, thus developing a broader view of what constitutes a liberal education. Finally, they rendered a valuable service in preparing teachers and scientists who later rose to eminence in the work of technical instruction as well as in scientific and practical investigations.

The natural outgrowth of this development was the experiment station. The first regularly organized experiment station in the United States was established by the state of Connecticut in 1875. Other states followed until by 1887 there were seventeen stations in operation in fourteen states. In that year, Congress passed the Hatch Act providing for the establishment and maintenance of experiment stations as departments of the land-grant colleges in all the states and territories. The experiment station thus became an integral part of the agricultural college, while its work has formed the basis of all instruction relating to the science of agriculture. In addition to this, it has performed a valuable service in the publication and dissemination of bulletins on a variety of subjects of great interest and importance to the farmer.

By 1890, the land-grant colleges were beginning to achieve a place of influence and prestige among the better colleges and universities of the country. Since that year these institutions have undergone a rapid growth and development along three clearly defined lines: first, teaching; second, research and experimental work, and, third, extension work. The development of this threefold function has made the land-grant college, in cooperation with the U. S. Department of Agriculture, an important factor in the transformation of farming from a pioneer occupation into a modern business organized on a scientific basis.

The rise and growth of farmers' organizations should also be mentioned as one of the important agencies for the diffusion of knowledge relating to the practice of farming. The revolution in agriculture gave rise to complex problems of production, distribution and exchange which were of fundamental interest and importance to the farmers. As agriculture became more interwoven with the fabric of our national economy, these problems became more and more acute. It was therefore natural that the farmers should follow the example of other economic groups and organize for the promotion of their interests. This period, consequently, witnessed the formation of many organizations which may be divided into two general groups: first, those serving some special end or industry, as, for example, the cooperative creamery associations and the farmers' elevator companies; and second, those which sought to unite the farmers as a class, among which organizations may be mentioned the Granger, Greenback, Farmers' Alliance, Populist and Farm Bureau movements. These various organizations—local, state and national—performed a great service in the education of the American farmer. They aided in breaking down the barriers which had heretofore separated the farmers from their

fellowmen, developed in the farming population a feeling of class consciousness, taught valuable lessons in cooperation and became an important agency for the dissemination of the new ideas and methods in farming which were being advanced by the agricultural colleges and experiment stations.

Of inestimable importance, finally, as an agency for the promotion of scientific knowledge relating to agriculture was the agricultural press. It would be difficult, indeed, to estimate the influence of the agricultural press on the development of scientific farming in the United States. From the beginning it has dealt with an infinite variety of subjects; it has been one of the most efficient agencies for the popularization of the results of scientific experiments conducted by the agricultural colleges and experiment stations, and it has accorded much space in its advertising columns to ways and methods of improving the practice of farming.

The significant aspects of the agricultural revolution in the United States may now be stated: (1) the passing of the public lands into private ownership; (2) the rapid growth of population and immigration; (3) the invention and popularization of improved farm implements and machinery; (4) the extension and development of transportation and communication; (5) the migration of industries from the farm to the factory; (6) the expansion of domestic and foreign markets; and (7) the establishment of agencies for the promotion of scientific knowledge relating to agriculture, among which may be mentioned, especially, the federal and state departments of agriculture, the agricultural colleges and experiment stations, including rural extension work, the farmers' organizations, with their economic, social, educational and political functions, and the farm press. These forces transformed farming from a pioneer and largely self-sufficing occupation into a modern business organized on a scientific, capitalistic and commercial basis. Farming became inextricably bound up with the business world. It had become indeed the warp, with industry as the woof, of our national economy. These new developments and relationships gave rise to many problems which to-day confront the nation and which require for their solution a thorough scientific knowledge of farming and a sound, far-sighted and well-balanced statesmanship.

The agricultural situation in the United States during the last decade has produced a large volume of discussion of the farm problem. "In considering this discussion," observes Dr. C. L. Holmes, "one is struck by the fact that almost all of it has been from the point of view of the immediate situation, and (that) but little has been said of the long-time aspects of the problem." Dr. Holmes then proceeds to state the long-time aspect of the problem in the following terms:

> An analysis of the present agricultural situation, and causes which have operated and are still operating to bring it about, seems to justify the conclusions: first, that the present depressed condition of our agriculture is due primarily to certain more or less permanent results of the World War, first, in the direction of expanding our agricultural output and, second, of impairing our foreign market for agricultural products and of redirecting the currents and changing the content of our international trade; second, that the recovery of our agricultural industry depends upon the adjustment of our agricultural production, both qualitatively and quantitatively, to the domestic market; and third, that the result of these necessary adjustments will be the beginning of a new era in American farming, representing as profound a change as that which came with the shift from self-sufficing to commercial agriculture.

Dr. Holmes adds, however, that this "does not point to a policy of inactivity and indifference. The emergency truly is great enough to demand the best thought and effort of our agricultural leadership. Probably no previous period has presented so great a need as the present for the best effort of educators, legislators and the leaders of the farmers' movement toward making general an intelligent view of the real nature of the situation, toward making as easy as possible the adjustment to the new alignment of forces, and toward developing unity of purpose and concerted action on the part of the agricultural class. There was never so great a need, and probably never so great an opportunity, for the development of a comprehensive and far-reaching agricultural policy."

OBITUARY

MEMORIALS

THE unveiling of a bronze memorial tablet of Dr. William Royal Stokes in the municipal building, Baltimore, took place on November 26. Dr. C. Hampson Jones, commissioner of health, presented the tablet and addresses were made by Dr. William H. Welch, professor of the history of medicine in the Johns Hopkins School of Medicine, and Dr. Hugh S. Cumming, surgeon-general, U. S. Public Health Service. The tablet bears the relief portrait of Dr. Stokes and underneath the inscription: "To the memory of an able physician and bacteriologist. A lover of art, music and poetry, who died a martyr to the cause of science, contracting psittacosis (parrot fever) in line of duty."